



Functional  
Safety  
Type  
Approved

www.tuv.com  
ID 060000000



## Operating and assembly instructions

**Absolute encoder with  
PROFINET IO interface and PROFIsafe protocol**

**AMPN 41 in construction types B5 (flange) and B35 (flange and foot)  
AMPNH 41 (hollow shaft design)**

**Functional safety according to EN 61508: SIL CL3 and EN ISO 13849: PL e**

**Read the operating and assembly instructions prior to  
assembly, starting installation and handling!  
Keep for future reference!**

Translation of the original operating and assembly instructions



## Manufacturer / Publisher

Johannes Hübner  
Fabrik elektrischer Maschinen GmbH  
Siemensstr. 7  
35394 Giessen / Germany

Phone: +49 641 7969 0  
Fax: +49 641 73645  
Internet: [www.huebner-giessen.com](http://www.huebner-giessen.com)  
E-mail: [info@huebner-giessen.com](mailto:info@huebner-giessen.com)

## Document information

Release date/Rev. date: 2022-11-07  
Document / Rev. No.: AMPN(H)41\_MANUAL-en\_R12  
File name: AMPN(H)41\_MANUAL-en\_R12.pdf  
Author: F. Sitt, J. Klingelhöfer, Me. Engels, F. Eberz  
Order no.: ID 78882

## Trademarks

**PROFIBUS™**, **PROFINET™** and **PROFIsafe™**, as well as the relevant logos, are registered trademarks of PROFIBUS Nutzerorganisation e.V. (PNO), **SIMATIC** is a registered trademark of SIEMENS AG and **Loctite®** is a registered trademark of Henkel AG & Co. KG, Düsseldorf. Brand names and product names are trademarks or registered trademarks of their respective owner. Protected trademarks bearing a ™ or ® symbol are not always depicted as such in the manual. However, the statutory rights of the respective owners remain unaffected.

Johannes Hübner Fabrik elektrischer Maschinen GmbH is listed by Underwriters Laboratories. UL certificates can be requested from us.

An overview of our UL devices can be found at the following link:

<https://iq.ulprospector.com/info>

**UL File Number: E351535**

**UL model No. ASYH 40 Z-XXXX**

## Copyright

It is strictly forbidden to reproduce this publication or parts of this publication in any form or by any means without the prior written permission of Johannes Hübner Fabrik elektrischer Maschinen GmbH. Content information, text, drawings, graphics, and other representations are protected by copyright and are subject to commercial property rights. Duplications of any kind that are not combined with use of the machine are prohibited without manufacturer's written consent. Actions to the contrary make damage compensation mandatory.

**Copyright© Johannes Hübner Fabrik elektrischer Maschinen GmbH**

## Change reservation

The manual has been drawn up with the utmost care and attention. Nevertheless, we cannot exclude the possibility of errors in form and content.

**All rights, subject to errors and changes due to technical improvements reserved.**

## Font styles

*Italic* or **bold** font styles are used for the title of a document or are used for highlighting.

*Courier-New* font displays text, which is visible on the screen and software/software menu selections.

## Contents

<b>Revision Index</b> .....	<b>8</b>
<b>1 General Information</b> .....	<b>9</b>
1.1 Applicability.....	9
1.2 General functional description .....	9
1.2.1 Main Features.....	10
1.2.2 Principle of the safety function.....	10
<b>2 Basic safety instructions</b> .....	<b>11</b>
2.1 Explanation of symbols and notes .....	11
2.2 General risks when using the product.....	12
2.3 Intended use .....	12
2.4 Non-intended use.....	12
2.5 Safety functions of the fail-safe processing unit .....	13
2.5.1 Mandatory safety checks / measures .....	13
2.6 Warranty and liability.....	14
2.7 Declaration of conformity.....	14
2.8 Organizational measures .....	14
2.9 Personnel selection and qualification; basic obligations .....	14
2.10 Safety information .....	15
<b>3 Transport, packaging and storage</b> .....	<b>16</b>
3.1 Safety instructions for transport.....	16
3.2 Incomings goods inspection .....	16
3.3 Packaging / disposal .....	16
3.4 Storage of packages (devices) .....	16
<b>4 Assembly</b> .....	<b>17</b>
4.1 Safety instructions and requirements.....	17
4.2 Technical notes.....	18
4.3 Required tools.....	18
4.4 Mounting preparations .....	18
4.5 Mounting of AMPN 41, construction type B5 (flange).....	19
4.6 Mounting of AMPN 41, construction type B35 (flange and foot) .....	20
4.7 Mounting of AMPNH 41, (hollow shaft type) .....	21
4.8 Dismantling of AMPH 41 .....	22
<b>5 Installation / Preparation for Commissioning</b> .....	<b>23</b>
5.1 Basic rules .....	23
5.2 PROFINET IO transfer technology, cable specification .....	24
5.3 Connection .....	25
5.3.1 Supply voltage .....	25
5.3.2 PROFINET .....	26
5.3.3 Incremental interface .....	26
5.3.4 PROFIsafe Destination address "F_Dest_Add" .....	27
5.4 Incremental interface.....	27
5.4.1 Signal characteristics .....	28
5.4.2 Option HTI-Level, 13...27 V DC .....	29
<b>6 Commissioning</b> .....	<b>30</b>
6.1 PROFINET IO.....	30
6.1.1 Device classes.....	30
6.1.2 Device description file (XML).....	31

6.1.3 Device identification .....	31
6.1.4 Distribution of IP addresses .....	31
6.2 PROFINET IO System boot .....	32
6.3 Bus status display .....	32
6.4 Configuration .....	34
6.4.1 Safety-oriented data, module "AMPN(H)41 I/O safety" .....	34
6.4.1.1 Input data .....	35
6.4.1.1.1 Cams .....	35
6.4.1.1.2 Status .....	35
6.4.1.1.3 Speed .....	35
6.4.1.1.4 Multi-Turn / Single-Turn .....	36
6.4.1.1.5 Safe status .....	36
6.4.1.2 Output data .....	38
6.4.1.2.1 Control1 .....	38
6.4.1.2.2 Control2 .....	38
6.4.1.2.3 Preset Multi-Turn / Single-Turn .....	38
6.4.1.2.4 Safe-Control .....	39
6.4.2 Not safety-oriented Process data, module "AMPN(H)41 I/O" .....	40
6.4.2.1 Input data .....	41
6.4.2.1.1 Cams .....	41
6.4.2.1.2 Speed .....	41
6.4.2.1.3 Multi-Turn / Single-Turn .....	41
6.5 Parameterization .....	42
6.5.1 F-Parameters (F_Par) .....	42
6.5.1.1 F_Check_iPar .....	42
6.5.1.2 F_SIL .....	42
6.5.1.3 F_CRC_Length .....	43
6.5.1.4 F_Block_ID .....	43
6.5.1.5 F_Par_Version .....	43
6.5.1.6 F_Source_Add / F_Dest_Add .....	43
6.5.1.7 F_WD_Time .....	43
6.5.1.8 F_iPar_CRC .....	43
6.5.1.9 F_Par_CRC .....	43
6.5.2 iParameters (F_iPar) .....	44
6.5.2.1 Integration Time Safe .....	44
6.5.2.2 Integration Time Unsafe .....	44
6.5.2.3 Windows Increments .....	44
6.5.2.4 Idleness Tolerance Preset .....	44
6.5.2.5 Direction .....	45
<b>7 Parameter Definition / CRC Calculation .....</b>	<b>45</b>
7.1 iParameters .....	45
7.1.1 CRC calculation across the iParameters .....	46
7.2 F-Parameters .....	47
7.2.1 Non-settable F-Parameters .....	47
7.2.2 Settable F-Parameters .....	48
<b>8 Safety Program Creation – Configuration Example .....</b>	<b>48</b>
8.1 Prerequisites .....	49
8.2 Hardware configuration .....	50
8.2.1 Defining the properties of the hardware configuration .....	55
8.3 Parameterization .....	62
8.3.1 Setting the iParameters .....	62
8.3.2 Setting the F-Parameters .....	63

8.4	Creating the missing (F-)blocks .....	65
8.4.1	Program structure .....	65
8.4.2	F-Runtime Group .....	65
8.4.3	Generating the Object Blocks (OBs).....	66
8.4.4	Generating the functions (F-FCs) .....	67
8.4.5	Programming the F-Blocks .....	68
8.5	Generating the safety program .....	70
8.6	Loading the safety program .....	71
8.7	Testing the safety program.....	71
<b>9</b>	<b>Access to the safety-oriented data channel .....</b>	<b>71</b>
9.1	Output of passivated data (substitute values) in case of error .....	72
9.2	F-Periphery-DB.....	72
9.2.1	Measuring system F-Periphery-DB "DB1638" – Overview of variables.....	73
9.2.1.1	PASS_ON.....	73
9.2.1.2	ACK_NEC.....	73
9.2.1.3	ACK_REI .....	74
9.2.1.4	IPAR_EN .....	74
9.2.1.5	PASS_OUT/QBAD/QBAD_I_xx/QBAD_O_xx.....	74
9.2.1.6	ACK_REQ .....	74
9.2.1.7	IPAR_OK .....	75
9.2.1.8	DIAG.....	75
9.3	Access to variables of the F-Periphery-DB .....	75
9.4	Passivation and Operator acknowledgment of the measuring system .....	76
9.4.1	After start-up of the F-System .....	76
9.4.2	After communication errors .....	76
<b>10</b>	<b>Preset Adjustment Function .....</b>	<b>77</b>
10.1	Procedure .....	78
<b>11</b>	<b>Troubleshooting and Diagnosis Options .....</b>	<b>79</b>
11.1	Optical Displays .....	79
11.1.1	Device Status, LED1 Bicolor .....	79
11.1.2	Bus Status, LED2.....	80
11.1.3	Link Status, PORT1:LED3; PORT2:LED5 .....	80
11.2	PROFINET IO Diagnostic.....	80
11.2.1	Diagnostic alarm .....	80
11.2.2	Diagnostic about Record Data.....	81
11.3	Data status.....	81
11.4	Return of Submodule Alarm .....	81
11.5	Information & Maintenance.....	82
11.5.1	I&M0, 0xAFF0.....	82
<b>12</b>	<b>Replacing the measuring system .....</b>	<b>82</b>
<b>13</b>	<b>Checklist .....</b>	<b>83</b>
<b>14</b>	<b>Technical data .....</b>	<b>84</b>
14.1	Safety .....	84
14.2	Electrical characteristics .....	84
14.2.1	General.....	84
14.2.2	Device-specific.....	85
14.3	Environmental conditions .....	86
14.4	Mechanical characteristics .....	86
14.4.1	AMPN 41 .....	86

14.4.2 AMPNH 41 .....	87
<b>15 Maintenance .....</b>	<b>88</b>
<b>16 Appendix.....</b>	<b>89</b>
16.1 References.....	89
16.2 Abbreviations and terms used.....	90
16.3 TÜV certificate.....	92
16.4 PROFINET IO certificate .....	93
16.5 PROFIsafe certificate .....	94
16.6 UKCA certificate.....	95
16.7 Accessories.....	96
16.8 Dimension drawings .....	97
16.8.1 AMPN 41, construction type B5 (flange) .....	97
16.8.2 AMPN 41, construction type B35 (flange and foot).....	98
16.8.3 AMPNH 41 (hollow shaft design) .....	99
16.8.4 AMPNH 41 with adapter shaft ADA HFA (external centering).....	100
16.8.5 AMPNH 41 with adapter shaft ADA HG (screw-in type).....	101
16.9 Type plate .....	102
16.10 Type code .....	103

## Revision Index

Revision	Description of Changes	Date	Releaser
0	First release	2013-12-13	F. Sitt
1	Rework of chapter 4	2014-01-09	J. Klingelh.
2	Degree of protection IP 54 added	2014-02-27	Me. Engels
3	Rework of chapter 7-9 (Safety Program Creation – Configuration Example added) Certificates added Dimension drawing HM 13 M 106327 → HM 13 M 106327a Mounting instructions added Accessories added	2014-09-24	J. Klingelh.
4	Chapter 15 Maintenance added	2014-11-14	J. Klingelh.
5	Incremental interface optional with HTL-Level	2015-09-28	F. Eberz
6	EC-Declaration of Conformity updated	2016-06-09	F. Eberz
7	PNO-Certificates inserted	2017-09-08	F. Eberz
8	New logo inserted, current version of EC Type-Examination Certificate inserted, nameplate with new logo inserted.	2018-12-05	F. Eberz
9	Table 14.2.2 updated	2019-03-28	F. Eberz
10	Current version of PROFINET certificate and PROFIsafe certificate inserted	2020-04-02	F. Eberz
11	UL notes added, chap. 1.3 Applied guidelines and standards removed, current version of PROFINET certificate and PROFIsafe certificate added	2021-06-21	F. Eberz
	Current version of EC Type-Examination Certificate inserted	2021-09-01	F. Eberz
12	UKCA marking inserted, chap. 2.7 Declarations of conformity inserted. QR code shown on type plate. UKCA certificate page added.	2022-11-07	F. Eberz
	UK Type-Examination Certificate added. Page 95.	2023-01-09	F. Eberz

## 1 General Information

These operating and assembly instructions provide important instructions for working with the device. They must be carefully read prior to starting all tasks, and the instructions contained herein must be followed.

In addition, applicable local regulations for the prevention of industrial accidents and general safety regulations must be complied with.

The operating and assembly instruction contains the following topics:

- General functional description
- Basic safety instructions with declaration of the intended use
- Characteristics
- Assembly
- Installation/Commissioning
- Parameterization
- Error causes and remedies

The operating and assembly instruction is supplementary to other documentation, such as product data sheets, dimensional drawings, brochures, etc.

The scope of delivery includes the absolute encoder AMPN(H) 41, the operating and assembly instruction and the Software and Support CD.

The operating and assembly instruction may be requested separately.

### 1.1 Applicability

These operating and assembly instruction applies exclusively for the following measuring system series with **PROFINET IO** interface and **PROFIsafe** profile:

- AMPN 41
- AMPNH 41

The products are labelled with affixed nameplates and are components of a system.

The following documentation therefore also applies:

- operator's operating instructions specific to the system,
- and this operating and assembly instruction

### 1.2 General functional description

The AMPN(H) 41 rotary measuring system is a safe and absolute Multi-Turn position measuring system with PROFINET IO interface and PROFIsafe protocol.

The measuring system has primarily been designed for use in systems that require safe position detection.

The safety measuring system consists of a **redundant, two-channel system**, in which **optical** and **magnetic scanning units** are arranged on a drive shaft, designed as a hollow shaft or solid shaft.

## 1.2.1 Main Features

- PROFINET IO interface with PROFIsafe protocol, for transfer of a safe position and speed
- Quick process data channel via PROFINET IO, not safety-oriented
- Additional incremental interface, not safety-oriented
- Two-channel scanning system, for generation of safe measured data through internal channel comparison
  - Channel 1, master system:  
optical Single-Turn scanning via code disk with transmitted light and magnetic Multi-Turn scanning
  - Channel 2, inspection system:  
magnetic Single and Multi-Turn scanning
- A common drive shaft

Due to its technology the optical system possesses greater accuracy; therefore it is used as master system. The data of the master system are unevaluated in the non-safety-oriented process data channel with normal PROFINET IO protocol, but are made available with a short cycle time.

The magnetic scanning system serves for the internal safety check. The "safe data" obtained through two-channel data comparison are packed into the PROFIsafe protocol and also transmitted to the control via the PROFINET IO.

The incremental interface is derived from the master system and is not evaluated in relation to safety.

## 1.2.2 Principle of the safety function

System safety results when:

- Each of the two scanning channels is largely fail-safe thanks to individual diagnostic measures.
- The measuring system internally compares the positions detected by both channels in two channels, also determines the speed in two channels and transfers the safe data to the PROFINET IO in the PROFIsafe protocol.
- In the event of a failed channel comparison or other errors detected through internal diagnostic mechanisms, the measuring system switches the PROFIsafe channel into error state.
- The measuring system initialization and execution of the preset adjustment function are appropriately verified.
- The control additionally checks whether the obtained position data lie in the position window expected by the control. Unexpected position data are e.g. position jumps, tracking error deviations and incorrect direction of travel.
- When errors are detected the control introduces appropriate safety measures defined by the system manufacturer.
- The system manufacturer ensures, through correct mounting of the measuring system, that the measuring system is always driven by the axis for measurement and is not overloaded.
- The system manufacturer performs a verified test during commissioning and in the event of any parameter modification.

## 2 Basic safety instructions

### 2.1 Explanation of symbols and notes

Warnings are indicated by symbols in these operating and assembly instructions. The warnings are introduced by signal words that express the scope of the hazard.

The warnings must be strictly heeded; you must act prudently to prevent accidents, personal injury, and property damage.



#### **DANGER!**

Means that death or serious injury will occur if the required precautions are not met.



#### **WARNING!**

Means that death or serious injury can occur if the required precautions are not met.



#### **CAUTION!**

Means that minor injuries can occur if the required precautions are not met.



#### **NOTICE!**

Indicates a possibly dangerous situation that can result in material damage if it is not avoided.



#### **NOTES!**

Indicates important information or features and application tips for the product used.



#### **NOTES!**

Means that appropriate ESD-protective measures are to be considered according to EN 61340-5-1 supplementary sheet 1.



#### **NOTES!**

Do not use a hammer or similar tool when installing the device due to the risk of damage occurring to the bearings or coupling!

## 2.2 General risks when using the product

The product, hereinafter referred to as **the measuring system**, is manufactured according to state-of-the-art technology and accepted safety rules. **Nevertheless, non-intended use can pose a danger to life and limb of the user or third parties, or lead to impairment of the measuring system or other property!**

Only use the measuring system in perfect technical condition, and only for its intended use, paying attention to safety and dangers, and in compliance with the **operating and assembly instructions!** Faults which could threaten safety should be eliminated without delay!

## 2.3 Intended use

The safety measuring system can be used for the detection of angular movement and processing of measured data for a downstream safety host (F-Host) in systems in which the **goal of "Protection of travel"** must be safely achieved. The complete processing chain of the safety function must then satisfy the requirements of the applied safety standard.

The safety measuring system must only be used in safety applications in conjunction with a control certified according to the applied safety standard.

The system manufacturer must check that the characteristics of the measuring system satisfy his application-specific safety requirements. The responsibility or decision regarding the use of the measuring system lies with the system manufacturer.

**For UL and CSA:** For the use in NFPA 79 applications only.

### Intended use also includes:

- observing all instructions in this operating and assembly instructions,
- observing the nameplate and any prohibition or instruction symbols on the measuring system,
- observing the operating instructions from the machine/system manufacturer,
- operating the measuring system within the limit values specified in the technical data,
- ensuring that the fail-safe processing unit (F-Host) fulfils all required safety functions,
- observing and using the checklist in the Appendix,
- safe mounting (form-closed) of the measuring system to the driving axis.

## 2.4 Non-intended use



### WARNING! NOTICE!

***Danger of death, physical injury and damage to property in case of non-intended use of the measuring system!***

The following areas of use are especially forbidden:

- in environments where there is an explosive atmosphere
- for medical purposes
- fastening transport or lifting tackle to the device, for example a crane hook to lift a motor
- fastening packaging components to the device, for example ratchet straps, tarpaulins etc.
- using the device as a step, for example by people to climb onto a motor

## 2.5 Safety functions of the fail-safe processing unit

The **F-Host**, to which the measuring system is connected, must perform the following safety checks.



### NOTES!

To enable the correct measures to be taken in the case of an error, the following applies:

If no safe position can be output due to an error detected by the measuring system, the PROFIsafe data channel is automatically put into fail-safe status. In this status so-called "passivated data" are output via PROFIsafe.

**Note chapter 9.1 "Output of passivated data (substitute values) in case of error" on page 72.**

Passivated data from the viewpoint of the measuring system are:

- PROFIsafe data channel: all are set to 0
- PROFIsafe status: error bit 2<sup>1</sup> Device\_Fault is set
- PROFIsafe-CRC: valid

**Upon receipt of passivated data, the F-Host must put the system into a safe state. It is only possible to leave this error state by eliminating the error and then switching the supply voltage off and on again!**

The process data channel addressable via PROFINET IO is not necessarily affected by this. If the internal diagnosis in the master channel does not detect an error, the process data are still output. However, these data are not safe for the purposes of a safety standard.

### 2.5.1 Mandatory safety checks / measures

Measures for commissioning, changes	F-Host error reaction
Application-dependent parameterization and definition of the necessary <i>iParameters</i> , <b>note chapter 7.1 "iParameter" on page 45.</b>	–
In the event of parameter changes, check that the measure is executed as desired.	STOP
Check by F-Host	F-Host error reaction
Cyclical consistency check of the current safety-oriented data from the AMPN(H) 41 I/O safety-module in relation to the previous data.	STOP
Travel curve calculation and monitoring by means of cyclical data from the AMPN(H) 41 I/O safety-module.	STOP
Monitoring of cyclical data from the AMPN(H) 41 I/O safety-module, and the process data from the AMPN(H) 41 I/O-module.	Receipt of passivated data → STOP
Timeout: Monitoring of the measuring system - response time. For checking e.g. cable breakage, power failure etc.	STOP

## 2.6 Warranty and liability

In principle the "General Terms and Conditions" of Johannes Hübner - Fabrik elektrischer Maschinen GmbH apply. These are available to the operator with the Order Confirmation or when the contract is concluded at the latest. Warranty and liability claims in the case of personal injury or damage to property are excluded if they result from one or more of the following causes:

- Non-intended use of the measuring system
- Improper assembly, installation, start-up and programming of the measuring system
- Work carried out incorrectly on the measuring system
- Operation of the measuring system with technical defects
- Mechanical or electrical modifications to the measuring systems undertaken autonomously
- Repairs carried out autonomously
- Third party interference and Acts of God
- Non-observance of these operating and assembly instructions
- Opening of the measuring system
- Deployment of non-qualified personnel

## 2.7 Declaration of conformity

The device is tested in accordance with the following directives:

2006/42/EG, 2014/30/EU and 2011/65/EU (EU)  
S.I. 2008/1597, S.I. 2016/1091 and S.I. 2012/3032 (UK).

## 2.8 Organizational measures

- The operating and assembly instructions must always be kept ready-to-hand at the place of use of the measuring system.
- In addition to the operating and assembly instructions, generally valid legal and other binding regulations on accident prevention and environmental protection must be observed and communicated.
- The respective applicable national, local and system-specific provisions and requirements must be observed and communicated.
- The operator is obliged to inform personnel on special operating features and requirements.
- Prior to commencing work, personnel working with the measuring system must have read and understood the **chapter 2 "Basic safety instructions" on page 11**.
- The nameplate and any prohibition or instruction symbols applied on the measuring system must always be maintained in a legible state.
- Do not undertake any mechanical or electrical modifications to the measuring system, except for those expressly described in this operating and assembly instructions.
- Repairs may only be undertaken by the manufacturer or a center or person authorized by the manufacturer.

## 2.9 Personnel selection and qualification; basic obligations

- All work on the measuring system must only be carried out by qualified personnel. Qualified personnel includes persons, who, through their training, experience and instruction, as well as their knowledge of the relevant standards, provisions, accident prevention regulations and operating conditions, have been authorized by the persons responsible for the system to carry out the required work and are able to recognize and avoid potential hazards. They are capable of identifying and avoiding potential hazards.
- The definition of "qualified personnel" also includes an understanding of the standards VDE 0105-100 and IEC 364 (source: e.g. Beuth Verlag GmbH, VDE-Verlag GmbH).
- The responsibility for assembly, installation, commissioning and operation must be clearly defined. The obligation exists to provide supervision for trainee personnel.

## 2.10 Safety information



### WARNING! NOTICE! NOTES!

#### ***Destruction, damage and malfunction of the measuring system!***

- Only carry out wiring work or opening and closing of electrical connections with the system de-energized.
- Do not undertake any welding work if the measuring system is already wired or switched on.
- Falling below or exceeding the permissible operating temperature limit values must be prevented through an appropriate heating/cooling measure at the place of installation.
- The measuring system must be installed so that no direct moisture can affect the measuring system.
- Suitable aeration/ventilation and heating/cooling measures must be provided at the place of installation to prevent the temperature falling below the dew point (condensation).
- If an overvoltage of >36 V DC is inadvertently applied the measuring system must be inspected in the factory of Johannes Hübner - Fabrik elektrischer Maschinen GmbH, with specification of the reasons or circumstances.
- Potential hazards resulting from interactions with other systems and equipment which are or will be installed in the vicinity must be checked. The user is responsible for taking appropriate measures.
- The power supply must be protected with a fuse suitable for the supply lead cross-section.
- Cables used must be suitable for the temperature range.
- A defective measuring system must not be operated.
- Make sure that the installation environment is protected from aggressive media (acids etc.).
- Avoid shocks (e.g. hammer blows) to the shaft during installation.
- Opening the measuring system is forbidden.
- Make sure that the access to the address switches and LEDs is locked after the settings with the screw plug. Tighten firmly!
- The type plate specifies the technical characteristics of the measuring system. If the type plate is no longer legible or if the type plate is completely missing, the measuring system must not be operated.
- In case of storage as well as in the operation of the measuring system unused connecting plugs have to be provided either with a mating connector or with a protective cap. The IP protection class is to be selected according to the requirements.



### NOTES!

#### ***The measuring system contains components and assemblies susceptible to electrical discharge, which can be destroyed if incorrectly handled.***

- Touching the measuring system connection contacts with the fingers must be avoided or the relevant ESD protective measures must be applied.



### NOTES!

#### ***Disposal***

- If disposal has to be undertaken after the lifespan of the device, the respective applicable country-specific regulations are to be observed.

## 3 Transport, packaging and storage



### NOTES!

#### Shipping information

- Do not drop the device or subject it to heavy impacts!  
The device contains an optical system.
- Use only the original packaging.  
Inappropriate packaging material may cause damage to the unit in transit.
- Storage temperature: -30 °C...+60 °C
- Store in a dry place.

### 3.1 Safety instructions for transport



### NOTICE!

***Material damage caused by improper transport!***

**Observe the symbols and information on the packaging:**

- Do not throw – risk of breakage
- Keep dry
- Do not expose to heat above 40°C or direct sunlight.

### 3.2 Incomings goods inspection

Check delivery immediately upon receipt for completeness and possible transport damage. Inform the forwarder directly on receipt of the goods about existing transport damages (prepare pictures for evidence).

### 3.3 Packaging / disposal

The packaging is not taken back and must be disposed of in accordance with the respective statutory regulations and local guidelines.

### 3.4 Storage of packages (devices)



#### Keep dry

Keep packages dry and free from dust; protect from moisture



#### Protect against heat

Protect packages from heat above 40° C and direct sunlight

If you intend to store the device for a longer period of time (> 6 months) we recommend you use protective packaging (with desiccant).



### NOTES!

Turn the shaft of the device every 6 month to prevent the bearing grease solidifying!

## 4 Assembly

### 4.1 Safety instructions and requirements



#### **WARNING!**

**At assembly, dismantling and other work to the device the basic safety instructions contained in chapter 2 must be observed.**

The assembly and dismantling of the measuring system must only be carried out by qualified personnel!



#### **DANGER! NOTICE!**

***Danger of death, serious physical injury and/or damage to property due to deactivation of safety functions, caused by an unstable shaft drive!***

- The system manufacturer must implement suitable design measures, so that the drive of the measuring system is ensured at all times through the shaft and mounting of the measuring system (fault exclusion). The specifications of DIN EN 61800-5-2:2008 "Adjustable speed electrical power drive systems, Safety requirements - Functional, Table D.16 – Motion and position sensors" must be observed.
- In general, the requirements and acceptance conditions for the complete system must be taken into account for mounting.
- The measuring system must be inspected on a regular basis (see below). Inspections must be recorded in a log book.

**As the installation situation is application-dependent, the following notes are not exhaustive.**

- All fastening screws must be secured against unintentional loosening. All screwed connections must be inspected once a year.
- In case of applications with low operating temperatures, increased values for the start-up torque result. This fact is to be considered when the assembling and wave drive is performed.
- After approx. 16 000 - 20 000 hours of operation or higher levels of continuous load:  
Check deep groove ball bearings for noise, running smoothly. Bearings must be replaced by the manufacturer only.

#### **AMPN 41 (solid shaft type):**

- A suitable coupling with positive connection must be used for the application.
- Inspect the coupling for damage and ensure it is free of play once a year.
- The coupling manufacturer's information and installation requirements must be observed.

#### **In particular, you must ensure that:**

- the coupling is suitable for the specified speed and the potential parallel, angular and axial offset,
- installation is on a grease-free shaft,
- the coupling and the measuring system are not radially and axially loaded,
- the clamping screws are tightened with the torque defined by the coupling manufacturer and are secured against unintentional loosening, so that the coupling cannot slip on the drive shaft or on the measuring system shaft.



## DANGER! NOTICE!

*Danger of death, serious physical injury and/or damage to property due to deactivation of safety functions, caused by an unstable shaft drive!*



### AMPNH 41 (hollow shaft type):

- The measuring system must be installed on a grease-free shaft by means of form-closure, using a parallel key / groove combination.
- Axial slipping of the measuring system on the drive shaft must be prevented through fixing by means of the axial tensioning disc.
- The torque bracket must be inspected once a year: check link heads can move freely. You must be able to move the link rod manually. If it proves difficult to move, lightly oil the link rod heads or apply lubricant spray.

## 4.2 Technical notes



## NOTES!

Do not use a hammer or similar tool when installing the device due to the risk of damage occurring to the bearings or coupling!

### Ambient temperature

The max. permissible ambient temperature depends on the speed and degree of protection of the device and the place of installation.

### Degree of protection

The device complies with the specified degree of protection (see chapter 14.3 “Environmental conditions” on page 86) only with screwed-on mating connectors or blind plugs!

### Deep groove ball bearings

Absolute encoders AMP(H) 41 are fitted with maintenance-free, greased "for-life" deep groove bearings. Bearings must be changed by the manufacturer only.

**Opening the encoder renders the guarantee null and void.**

### Screw retention

All fastening screws must be secured against unintentional loosening. We recommend using Loctite® 243 thread locker (medium strength).

## 4.3 Required tools

- Spanners: 10 mm, 13 mm, 14 mm, 24 mm, Allen key: 5 mm
- Flat-blade screwdriver, assembly grease, Loctite® 243 (medium strength thread locker)

## 4.4 Mounting preparations

- Ensure all accessories are available.



## NOTES!

Fastening screws and earth cable are not included in the scope of delivery.

- Preparing the place of attachment: Clean the (motor) shaft, centering, bolting surfaces and fastening threads; check for damage. Repair any damage!

#### 4.5 Mounting of AMPN 41, construction type B5 (flange)

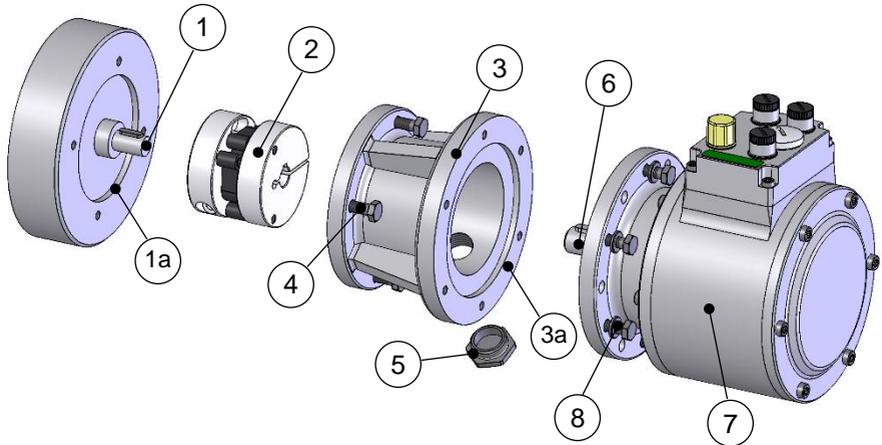


Fig. 1: AMPN 41, construction type B5 (mounting example)



#### **DANGER! NOTICE!**

***Danger of death, serious physical injury and/or damage to property due to deactivation of safety functions, caused by an unstable mounting!***

It is the responsibility of the user to ensure the screwed connections used to secure the encoder are properly dimensioned and that the mounting process is carried out in accordance with best practices.

Ensure the centering is implemented to tolerance  $\varnothing 85\ H7\ (0 / +0.035)$ .

1. Fit coupling (2) onto (motor) shaft (1).
2. Secure the coupling hub on the (motor) shaft (1) using the clamping screw.
3. Lightly grease the (motor) centering (1a).
4. Fasten the intermediate flange (3) to the motor using the fastening screws (4).
5. Lightly grease the intermediate flange centering (3a).
6. Fit the encoder (7) into both the centering (3a) and coupling hub (2) at the same time.
7. **Secure the encoder (7) to the intermediate flange (3) using at least 4 M6 screws (8) of the property class 8.8 and washers to ISO 7090 - 6 - 200 HV distributed evenly around the circumference!**
8. Secure the coupling hub (2) on the encoder shaft using the clamping screw.
9. Screw in the sealing plug (5) to seal the access bore to the coupling.

## 4.6 Mounting of AMPN 41, construction type B35 (flange and foot)

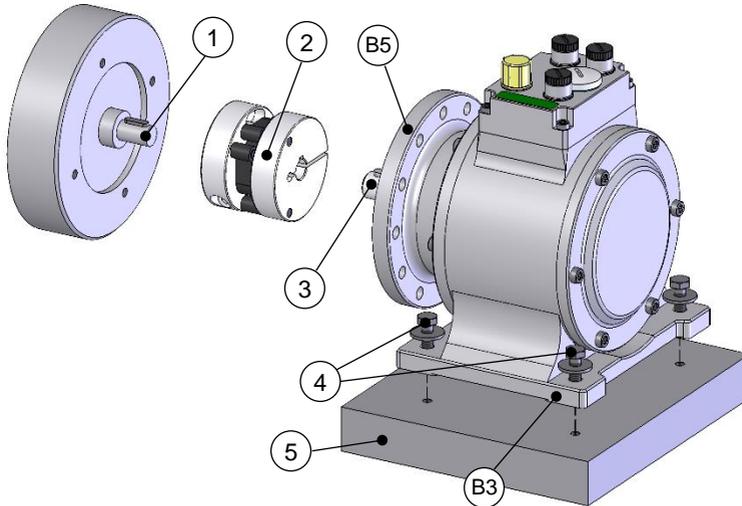


Fig. 2: AMPN 41, construction type B35 (mounting example)



### **DANGER! NOTICE!**

***Danger of death, serious physical injury and/or damage to property due to deactivation of safety functions, caused by an unstable mounting!***

It is the responsibility of the user to ensure the screwed connections used to secure the encoder are properly dimensioned and that the mounting process is carried out in accordance with best practices.

Ensure the housing foot is mounted on a plane, dry, meaning free from oil, mounting surface.

If shock loads > 30 g arise in the application, we recommend using screws of the property class 10.9 as well as friction-enhancing shims in the parting line, see **Chapter 16.7 "Accessories"**.

1. Fit coupling (2) onto (motor) shaft (1).
2. Secure the coupling hub on the (motor) shaft (1) using the clamping screw.
3. Align the encoder shaft (3) to the (motor) shaft (1) and insert into the coupling hub (2).  
Angle misalignment and parallel displacement between the (motor) shaft and the encoder shaft are mounting errors and should be kept as small as possible.  
Mounting errors cause radial forces to act on the encoder shaft, reduce the service life of the bearings and the coupling and degrade the quality of the signals (harmonic content).
4. **Secure the encoder foot (B3) to the bracket (5) using 4 hexagon head screws M6 (4) and the 4 supplied washers Ø18/6.4 x 1.6!**
5. Secure the coupling hub on the encoder shaft using the clamping screw.

## 4.7 Mounting of AMPNH 41, (hollow shaft type)

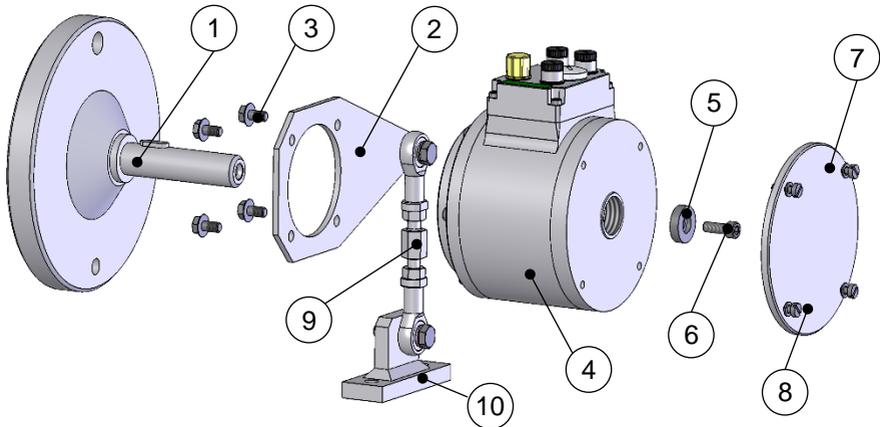


Fig. 3: AMPNH 41 (mounting example)

1. Mount the adapter shaft (1) and align using a dial gauge.



### NOTES!

The maximum radial run-out of the adapter shaft is 0.05 mm.

If necessary, use the ball thrust adjustment screws to align the adapter shaft. Secure ball thrust screws with Loctite® 243. Remove unused ball thrust screws or secure with Loctite® 243. Max. tightening torque for M12 approx. 25 Nm, for M16 approx. 35 Nm. Use parallel keys to DIN 6885.

**Observe the installation instructions supplied with the adapter shaft when installing!**

2. Secure the torque bracket (2) to the hollow shaft encoder (4) using the 4 supplied Tensilock screws (3)! Tightening torque: 16 Nm.



### NOTES!

When fitting the device, it is possible to align the torque bracket in four different directions.

3. Mount the hollow shaft device (4) to the adapter shaft (1).



### NOTES!

The hollow shaft device must slide easily onto the adapter shaft. Never use excessive force; otherwise the bearings may be damaged. If necessary, use emery cloth or a file to rework the adapter shaft and the feather key. Do not allow the device to hit hard against the collar of the shaft.

4. **Secure the hollow-shaft device with the aid of the supplied axial tensioning disc (5) and the hexagon socket head cap screw (6) (property class: 8.8)!  
Tightening torque: 5.4 Nm.**



## NOTES!

The axial tensioning disc is supplied with several hexagon head socket cap screws of different lengths. To select the suitable hexagon head socket cap screw, see the dimensioning drawing **HM 13 M 104960 on page 99**.

The hexagon head socket cap screws are coated with a microencapsulated adhesive as locking agent.

5. Fit the cover (7) and secure with 4 screws (8) to seal the hollow-shaft encoder.  
6. Fastening the torque bracket:

### Fastening without base plate:

Secure the link rod head of the link rod (9) to a fixed point (for example on the motor housing).

### Fastening with base plate:

Secure the base plate (10) to a fixed point with two hexagon head screws (for example on the motor housing or the foundations).



## NOTES!

Once fitted the link rod must rotate easily around the link rod heads! Failure to observe this point may result in damage to the bearings!

The perfect angle from the torque bracket (2) to the link rod (9) should be 90°. The link heads are maintenance free. However, ensure they remain free from soiling and paint!

## 4.8 Dismantling of AMPH 41



## WARNING!

**At assembly, dismantling and other work to the device the basic safety instructions contained in chapter 2 must be observed.**

**The assembly and dismantling of the measuring system must only be carried out by qualified personnel!**



## NOTES!

To dismantle the hollow-shaft encoder, use the draw-off-tool D-53663-1a (available as an accessory) if you are unable to remove the device manually from the adapter shaft, after having removed the axial tensioning disc!



Draw-off-tool D-53663-1a

Using the draw-off-tool, which is screwed into the withdrawal thread M25x0.75 of the hollow shaft, allows you to remove the hollow-shaft encoder from the adapter shaft without risking damage to the bearings.

## 5 Installation / Preparation for Commissioning

### 5.1 Basic rules



#### **WARNING!**

##### ***Deactivation of the safety function through conducted interference sources!***

- All nodes of the safety-relevant communication must be certified according to IEC 61010 or must have a corresponding EC conformity declaration.
- All PROFIsafe devices used on the bus must have a PROFINET and a PROFIsafe - certificate.
- All safety devices must also have a certificate from a "Notified Body" (e.g. TÜV, BIA, HSE, INRS, UL, etc.).
- The 24V power supplies used must not cut out in the event of a fault in the energy supply (safe under single fault conditions) and must fulfil SELV/PELV.
- Only cables and connectors which are provided with a PROFINET manufacturer's declaration are to be used.
- The shielding effect of cables must also be guaranteed after installation (bending radii/tensile strength!) and after connector changes. In cases of doubt, use more flexible cables with a higher current carrying capacity.
- Only use M12 connectors for connecting the measuring system, which guarantee good contact between the cable shield and connector housing. The cable shield must be connected to the connector housing over a large area.
- A 5-wire cable with a PE-conductor isolated from the N-conductor (so-called TN network) must be used for the drive/motor cabling. This will largely prevent equipotential bonding currents and the development of interference.
- A shielded and stranded data cable must be used to ensure high electromagnetic interference stability of the system. The shielding should be connected with low resistance to protective ground using large shield clips at **both ends**. The shielding should be grounded **in the switch cabinet only** if the machine ground is heavily contaminated with interference towards the switch cabinet ground.
- Equipotential bonding measures must be provided for the complete processing chain of the system.
- Power and signal cables must be laid separately. During installation, observe the applicable national safety and installation regulations for data and power cables.
- Observe the manufacturer's instructions for the installation of converters and for shielding power cables between frequency converter and motor.
- Ensure adequate dimensioning of the energy supply.

Upon completion of installation, a visual inspection with report should be carried out. Wherever possible, the quality of the network should be verified using a suitable bus analysis tool: no duplicate IP-addresses, no reflections, no telegram repetitions etc.



## NOTES!

To ensure safe and fault-free operation, the

- PROFINET Design Guideline, PNO Order no.: 8.062,
- PROFINET Assembly Guideline, PNO Order no.: 8.072,
- PROFINET Commissioning Guideline, PNO Order no.: 8.082,
- PROFIsafe "Environmental Requirements", PNO Bestell-Nr.: 2.232,
- And the reference Standards and PNO Documents contained in it must be observed!

***In particular the EMC directive in its valid version must be observed!***

## 5.2 PROFINET IO transfer technology, cable specification

The safety-related PROFIsafe communication as well as the PROFINET communication is transferred about the same network

PROFINET supports linear, tree or star structures. The bus or linear structure used in the field buses is thus also available for Ethernet. This is particularly practical for system wiring, as a combination of line and stubs is possible. Because the measuring system already has an integrated switch, the line topology can be realized in a simple manner.

Use only cables and connectors which are provided with a PROFINET manufacturer's declaration. The cable type A/B/C, the mechanical and chemical properties as well as the type of the PROFINET cable have to be defined according to the automation task. The cables are designed for bit rates of up to 100 Mbit/s. The transmission speed is automatically detected by the measuring system and does not have to be set by means of switches.

Addressing by switches as in the case of the PROFIBUS-DP is also not necessary, this is done automatically using the addressing options of the PROFINET-Controller, however the PROFIsafe destination address "F\_Dest\_Add" must be adjusted, **note chapter 5.3.4 "PROFIsafe Destination address "F\_Dest\_Add", page 27.**

The cable length including patch cables in case of copper wiring between two subscribers may amount max. 100 m. This transmission link has been defined as *PROFINET end-to-end link*. Within an end-to-end link the number of detachable links is limited up to six connector pairs (male connector/female connector). If more than six connector pairs are required, make sure that the attenuation values for the entire link are observed (channel class-D values).



## NOTES!

In case of IRT communication the topology is projected in a connection table. Thereby you must pay attention on a right connection of the ports 1 and 2. With RT communication this is not the case, it can be cabled freely.

### 5.3 Connection



#### NOTICE!

***Destruction, damage and malfunction of the measuring system in case of infiltration of damp!***

- In case of storage as well as in the operation of the measuring system unused connecting plugs have to be provided either with a mating connector or with a protective cap. The IP protection class is to be selected according to the requirements.
- Protective cap with O-ring: In case of re-close of the protective cap the existence and the correct seat of the O-ring have to be checked.
- Corresponding protective caps **see chapter 16.7 “Accessories“ on page 96.**

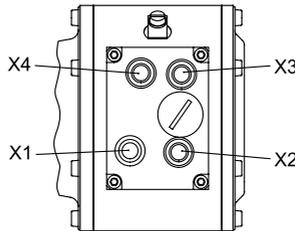


Fig. 4: Connector assignment

#### 5.3.1 Supply voltage



#### NOTES for UL and CSA!

Do only use copper cables



#### NOTICE!

***Danger of unnoticed damage to the internal electronics, due to unacceptable overvoltages!***

If an overvoltage of >36 V DC is inadvertently applied, the measuring system must be checked in the factory. The measuring system is permanently switched off for safety reasons, if the overvoltage is applied for more than 200 ms.

- The measuring system must be shut down immediately.
- When sending the measuring system to the factory, the reasons and circumstances relating to the overvoltage must be specified.
- The power supply used must meet the requirements of SELV/PELV (IEC 60364-4-41:2005).

X1	Signal	Description	Pin, M12x1, 4 pole
1	+ 24 V DC (13...27 V DC)	Supply voltage	
2	N.C.	-	
3	0 V	GND	
4	N.C.	-	

Cable specification: min. 0.5 mm<sup>2</sup>, shielded

## 5.3.2 PROFINET

X2	Signal	Description	Socket, M12x1, 4 pole
1	TxD+, Transmission Data +	PORT 2	D-coded 
2	RxD+, Receive Data +		
3	TxD-, Transmission Data -		
4	RxD-, Receive Data -		

X3	Signal	Description	Socket, M12x1, 4 pole
1	TxD+, Transmission Data +	PORT 1	D-coded 
2	RxD+, Receive Data +		
3	TxD-, Transmission Data -		
4	RxD-, Receive Data -		

## 5.3.3 Incremental interface

X4	Signal	Description	Socket, M12x1, 5 pole
<sup>1)</sup> 1	Channel B +	5 V, differential / 13...27 V DC	A-coded 
<sup>1)</sup> 2	Channel B -	5 V, differential / 13...27 V DC	
<sup>1)</sup> 3	Channel A +	5 V, differential / 13...27 V DC	
<sup>1)</sup> 4	Channel A -	5 V, differential / 13...27 V DC	
5	0 V, GND	Data reference potential	

Cable specification: min. 0.25 mm<sup>2</sup>, shielded

To guarantee the signal quality and minimization of possible environmental influences it is recommended urgently to use a shielded twisted pair cable.

<sup>1)</sup> TTL/HTL – Level variant see type plate

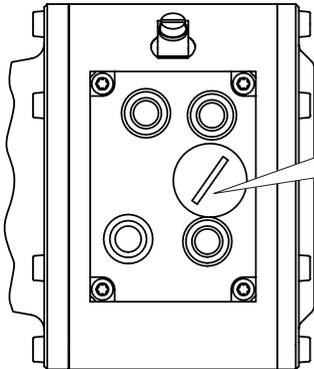
## 5.3.4 PROFIsafe Destination address “F\_Dest\_Add”



### WARNING! NOTICE!

***Destruction, damage and malfunction of the measuring system in case of infiltration of foreign substances and damp!***

The access to the address switches has to be locked after the settings with the screw plug. Tighten firmly!



The PROFIsafe destination address corresponds to the F-parameter `F_Dest_Add` and defines an unique source address within a PROFIsafe cluster.

Valid addresses: 1...99, **also see chapter 6.5.1.6 “F\_Source\_Add / F\_Dest\_Add” on page 43.**

## 5.4 Incremental interface

In addition to the PROFINET IO interface for output of the absolute position, the measuring system also has an incremental interface.



### WARNING!

***This additional interface is not evaluated in relation to safety and must not be used for safety-oriented purposes!***

- The measuring system checks the outputs of this interface for the feed-in of external voltages. In the event of voltages > 5.7 V, the measuring system is switched off for safety reasons. In this state the measuring system behaves as if it were not connected.
- The interface is generally used as position feedback for motor control applications.



### NOTICE!

***Danger of damage to subsequent electronics due to overvoltages caused by a missing ground reference point!***

If the ground reference point is completely missing, e.g. 0 V of the power supply not connected, voltages equal to the supply voltage can occur at the outputs of this interface.

- It must be guaranteed that a ground reference point is present at all times,
- or corresponding protective measures by the system operator must be provided for subsequent electronics

## 5.4.1 Signal characteristics

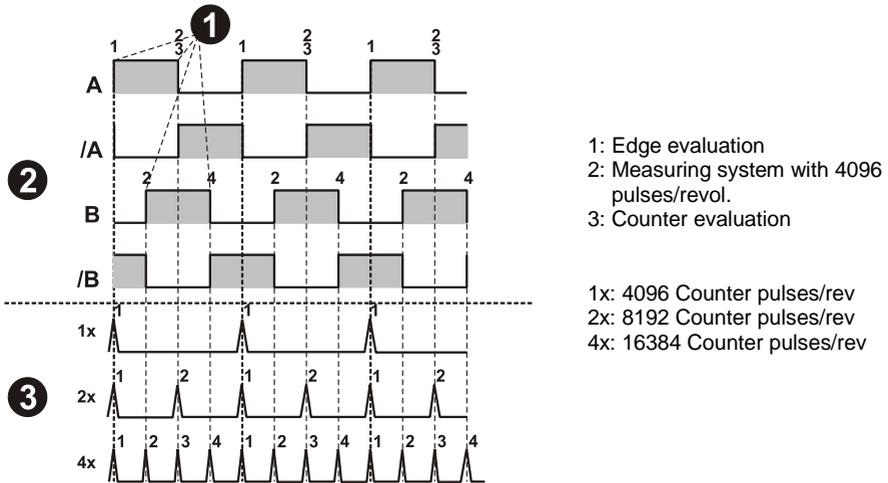


Fig. 5: Counter evaluation, incremental interface

### 5.4.2 Option HTI-Level, 13...27 V DC

Optionally the incremental interface is available also with HTL levels. For technical reasons, the user must consider the following boundary conditions at this variant: Ambient temperature, cable length, cable capacitance, supply voltage and output frequency.

In this case the maximum reachable output frequencies about the incremental interface are a function of the cable capacitance, the supply voltage and the ambient temperature. Therefore, the use of this interface is reasonable only if the interface characteristics meet the technical requirements.

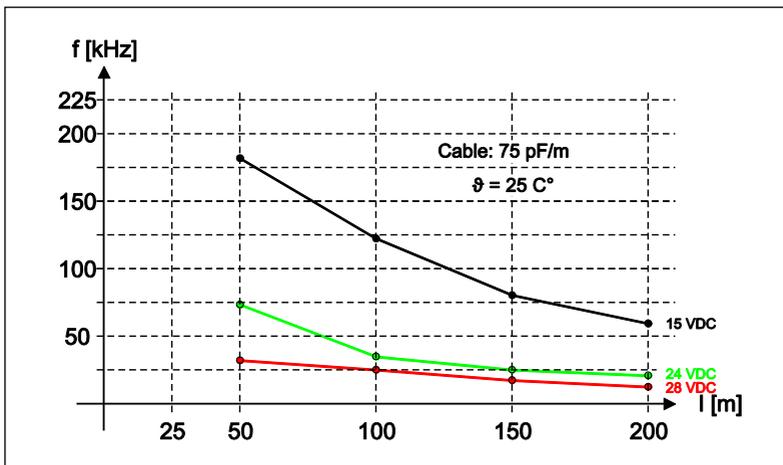
From the view of the measuring system, the transmission cable represents a capacitive load which must be reloaded with each impulse. In dependence of the cable capacitance, the load quantity necessary for it varies very strongly. Exactly this reloading of the cable capacitances is responsible for the high dissipation and heat, which result thereby in the measuring system.

Example: Cable with 75 pF/m, cable length = 100 m, half limiting frequency related to the rated voltage of 24 V DC: It results a twice as high current consumption of the measuring system. By the arising heat the measuring system may be only operated with approx. 80% of the given working temperature.

The following diagram shows the different dependences with respect to three different supply voltages.

Fixed items are

- Capacity of the cable: 75 pF/m
- Ambient temperature: 25 °C



**Fig. 6: Cable length / Limiting frequencies**

Other cable parameters, frequencies and ambient temperatures as well as bearing heat and temperature increase over the shaft and flange, can produce a considerably worse result in the practice.

Therefore, the fault-free function of the incremental interface with the application-dependent parameters has to be checked prior to the productive operation.

## 6 Commissioning

### 6.1 PROFINET IO

Important information for the commissioning can be found in the PROFINET Guideline:

**PROFINET Commissioning Guideline, Order No.: 8.082**

These and further information on PROFINET or PROFIsafe is available from the offices of the PROFIBUS User Organization:

#### **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)

Tel.: + 49 721 96 58 590

Fax: + 49 721 96 58 589

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

#### 6.1.1 Device classes

In a PROFINET IO - system the following device classes are differentiated:

- **IO-Controller**

For example a PLC, this controls the connected IO-Device.

- **IO-Device**

Decentralized arranged field device (measuring system), which is assigned to one or several IO-Controllers and transmits, additionally to the process and configuration data, also alarms.

- **IO-Supervisor** (Engineering Station)

A programming device or an Industrial PC, which has also access to all process- and parameter data additionally to an IO-Controller.

## 6.1.2 Device description file (XML)

The GSDML file and the corresponding bitmap file are components of the measuring system: "**GSDML-V2.3-HU-024A-AMPN(H)41-current date.xml**".

The files are on the Software and Support CD, order no. ID 21771. It is included in the package supplied.

## 6.1.3 Device identification

Each PROFINET IO-Device possesses device identification. It consists of a firm identification, the Vendor-ID, and a manufacturer-specific part, the Device-ID. The Vendor-ID is assigned by the PNO. For Johannes Hübner - Fabrik elektrischer Maschinen GmbH the Vendor-ID contains the value **0x024A**, the Device-ID has the value **0x03E8**. When the system boots up, the projected device identification is examined. In this way, errors in the project engineering can be recognized.

## 6.1.4 Distribution of IP addresses

Parameter	Default value	Description
MAC-Address	–	By default in the delivery state the measuring system has saved his <i>MAC-Address</i> which is printed on the connection hood of the device, e.g. "00:03:12:04:00:60". The MAC-Address is not changeable.
Device type	AMPN(H)41	The name for the device type is "AMPN(H)41" and is allocated by JHG. The Device type is not changeable
Device name	–	Before an IO-Device can be controlled by an IO-Controller, it must have a <i>Device name</i> , because the IP-Address is assigned directly to the Device name. If necessary when the system boots up the IO-Controller distributes the IP-addresses to the IO-Devices according to their device names. This procedure has the advantage that names can be handled more simply than complex IP-Addresses. Assigning a device name for a concrete IO-Device is to compare with the adjusting of the PROFIBUS address in case of a DP-slave.  In the delivery state as well as after a system boot up the measuring system has not saved a device name. Only after assignment of a device name with the engineering tool the measuring system for an IO-Controller is addressable, e. g. for the transmission of the project engineering data (e.g. the IP-Address) when the system boots up or for the user data exchange in the cyclic operation.  The name assignment is executed by the engineering tool before the beginning of operation. In case of PROFINET IO-Field devices the standard DCP-Protocol is used.
IP-Address	0.0.0.0	In the delivery state as well as after a system boot up the measuring system has not saved an IP-Address. Default value: "0.0.0.0"
Subnet mask	0.0.0.0	In the delivery state as well as after a system boot up the measuring system has not saved a Subnet mask. Default value: "0.0.0.0"

## Proceeding at the distribution of Device names and Addresses in case of an IO-Device

- Define Device name, IP-Address and Subnet mask. Depending on configuration this process can be executed also automatically by the IO-Controller.
- Device name is assigned to an IO-Device (MAC-Address)
  - Transmit Device name to the device
- Load projection into the IO-Controller
- When the system boots up the IO-Controller distributes the IP-Addresses to the Device names. The distribution of the IP-address also can be switched off; in this case the existing IP-Address in the IO-Device is used.

## 6.2 PROFINET IO System boot

With a successful system boot the IO-Devices start automatically with the data transmission. In case of PROFINET IO a communication relation always follows the provider consumer model. With cyclical transmission of the measuring value, the IO-Device corresponds to the provider of the data, the IO-Controller (e.g. a PLC) corresponds to the consumer. The transferred data always contains a status (good or bad).

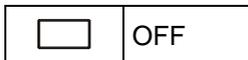
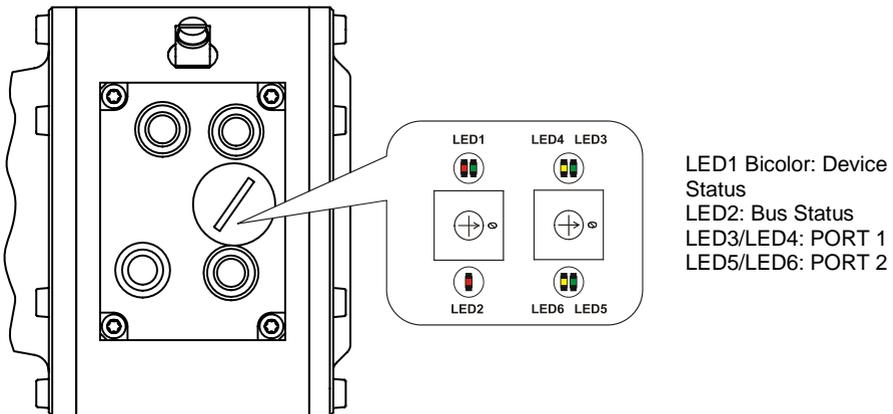
## 6.3 Bus status display



### WARNING! NOTICE!

***Destruction, damage and malfunction of the measuring system in case of infiltration of foreign substances and damp!***

The access to the LEDs has to be locked after the settings with the screw plug. Tighten firmly!



**Device Status, LED1 Bicolor**

	<b>green</b>
	No supply voltage, hardware error
	Operational
	Operator acknowledgment required, 3x 5 Hz
	<b>red</b>
	System or safety relevant error

**Bus Status, LED2**

	<b>red</b>
	No error
	Parameter - or F-Parameter error; 0.5 Hz
	No link to the IO-Controller

**PORT 1; LED3 = Link, LED4 = Data Activity**

	LED3, green	Ethernet connection established
	LED4, yellow	Data transfer TxD/RxD

**PORT 2; LED5= Link, LED6 = Data Activity**

	LED5, green	Ethernet connection established
	LED6, yellow	Data transferTxD/RxD

For appropriate measures in case of error, **see chapter 11 “Troubleshooting and Diagnosis Options” on page 79.**

## 6.4 Configuration

The following definition applies:

**Data flow for input data:** F-Device → F-Host

**Data flow for output data:** F-Host → F-Device

### 6.4.1 Safety-oriented data, module “AMPN(H)41 I/O safety”

#### Structure of the input data

Byte	Bit	Input data	
X+0	$2^8-2^{15}$	Cams	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, Multi-Turn, 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	$2^0-2^7$		

#### Structure of the output data

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	$2^0-2^7$		

## 6.4.1.1 Input data

### 6.4.1.1.1 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 overflow</b> The bit is set if the speed value is outside the range of $-32768...+32767$ .
$2^1...2^{15}$	reserved

### 6.4.1.1.2 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> The bit is set if the F-Host triggers a preset request. When the preset has been executed, the bit is automatically reset. <b>Also see chapter 10 “Preset Adjustment Function” on page 77.</b>
$2^1...2^{14}$	Reserved
$2^{15}$	<b>Error</b> The bit is set if a preset request could not be executed due to excessive speed. The current speed must be in the range of the speed set under <code>Preset Standstill Tolerance</code> . The bit is reset after the host has cleared the variable associated to the control bit $2^0$ <code>iPar EN</code> , <b>also see chapter 10 “Preset Adjustment Function” on page 77.</b>

### 6.4.1.1.3 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 two's complement value with preceding sign.

Setting the direction of rotation = **forward**

- Looking at the flange connection, turn the shaft clockwise:  
→ positive speed output

Setting the direction of rotation = **backward**

- Looking at the flange connection, turn the shaft clockwise:  
→ negative speed output

If the measured speed exceeds the display range of  $-32768 \dots +32767$ , this results in an overflow, which is reported in the cams register via bit  $2^0$ . At the time of the overflow the speed stops at the respective +/- maximum value, until the speed is once again in the display range. In this case the message in the cams register is also cleared.

The speed is specified in increments per Integration Time Safe.

### 6.4.1.1.4 Multi-Turn / Single-Turn

	Multi-Turn, Integer16		Single-Turn, Integer16	
Byte	X+6	X+7	X+8	X+9
Bit	15 – 8	7 – 0	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$	$2^{15} - 2^8$	$2^7 - 2^0$

The number of revolutions is noted in the Multi-Turn register, and the current Single-Turn position is noted in steps in the Single-Turn register. Together with the measuring system resolution, max. number of steps per revolution according to type plate, the actual position can then be calculated:

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

Steps per revolution: **8192 ± 13 Bit**

Number of revolutions: **0...32767 ± 15 Bit**

The output position does not have a preceding sign.

### 6.4.1.1.5 Safe status

#### Unsigned8

Byte	X+10
Bit	7 – 0
Data	$2^7 - 2^0$

Bit	Description
$2^0$	<b>iPar_OK:</b> New iParameter values have been assigned to the F-Device. The bit is set when a preset request has been successfully completed via the F-Host (iPar_EN bit), <b>see chapter 10 “Preset Adjustment Function“ on page 77.</b>
$2^1$	<b>Device_Fault:</b> Error in F-Device or F-Module The bit is set if the value set for the Window increments under the iParameters has been exceeded and/or the internally calculated PROFIsafe telegram is defective. The measuring system is then put into fail-safe status and outputs its passivated data. It is only possible to leave this status by eliminating the error and turning the supply voltage OFF/ON.

Bit	Description
2 <sup>2</sup>	<p><b>CE_CRC:</b> Checksum error in communication The bit is set if the F-Device detects an F-Communication error, such as e.g. an incorrect consecutive number (detected via a CRC2 error in V2 mode) or if the data integrity has been violated (CRC error). The F-Host must then count all defective messages within a defined time period T and assume a configured safe status in the event of exceeding the maximum permissible defective messages.</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 parameterization sequence. The measuring system reports a parameter error via the PROFINET standard diagnosis and does not start up.</p>
2 <sup>3</sup>	<p><b>WD_timeout:</b> Watchdog-Timeout during communication The bit is set if the set watchdog time F_WD_Time in the F-Parameters is exceeded. A valid current safety telegram must arrive from the F-Host within this time, otherwise the measuring system will be set to fail-safe status and output its passivated data. It is only possible to leave this status by eliminating the error and turning the supply voltage OFF/ON. <b>Also see chapter 6.5.1.7 “F_WD_Time“ on page 43.</b></p>
2 <sup>4</sup>	<p><b>FV_activated:</b> Fail-safe values activated The bit is set when the measuring system is in fail-safe status and output its passivated data.</p>
2 <sup>5</sup>	<p><b>Toggle_d:</b> Toggle bit The toggle bit is device-based and causes the incrementation of the virtual consecutive number in the F-Host. The toggle bit is used to synchronize the counters in the measuring system/F-Host for generation of the virtual consecutive number.</p>
2 <sup>6</sup>	<p><b>cons_nr_R:</b> Virtual consecutive number has been reset The counter is reset if the F-Host detects an F-Communicator error (CE_CRC).</p>
2 <sup>7</sup>	Reserved

## NOTES!



Safe status can only be indirectly accessed from the safety program with the aid of variables, **see chapter 9 “Access to the safety-oriented data channel” on page 71**. A detailed description of the status bits can be taken from the PNO document "PROFIsafe – Profile for Safety Technology on PROFIBUS DP and PROFINET IO“, Order No.: 3.192b.

## 6.4.1.2 Output data

### 6.4.1.2.1 Control1

#### 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>Preset_Request</b> The bit serves to control the preset adjustment function. When this function is executed, the measuring system is set to the position value stored in the <code>Preset Multi-Turn / Preset Single-Turn</code> registers. A precise sequence must be observed in order to execute the function, see chapter 10 “Preset Adjustment Function” on page 77.
$2^1...2^{15}$	reserved

### 6.4.1.2.2 Control2

Reserved.

### 6.4.1.2.3 Preset Multi-Turn / Single-Turn

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

The desired preset value must be in the range of 0 to 268 435 455 (28 bit). Together with the measuring system resolution, max. number of steps per revolution according to type plate (8192), the corresponding values for `Preset Multi-Turn / Preset Single-Turn` can then be calculated:

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

The integer part from this division gives the number of revolutions and must be entered in the `Preset Multi-Turn` register.

$\text{Single-Turn-Position} = \text{desired preset value} - (\text{steps per revolution} * \text{no. of revolutions})$
---

The result of this calculation is entered in the `Preset Single-Turn` register.

The preset value is set as new position when the preset adjustment function is executed, see chapter 10 “Preset Adjustment Function” on page 77.

## 6.4.1.2.4 Safe-Control

### Unsigned8

Byte	X+8
Bit	7 – 0
Data	$2^7 - 2^0$

Bit	Description
2 <sup>0</sup>	<b>iPar_EN:</b> iParameter assignment unlocked The bit must be set indirectly via a variable of the F-Host in order to be able to execute the preset adjustment function, <b>see chapter 10 “Preset Adjustment Function” on page 77.</b>
2 <sup>1</sup>	<b>OA_Req:</b> Operator acknowledgment required The bit is set by the F-Host driver after detection and elimination of an error in the safety-oriented communication. The bit is also set if the measuring system/F-Host could not be synchronously integrated into the bus operation at start-up of the F-System. An operator acknowledgment is displayed via the green LED (3x with 5 Hz) in relation to the measuring system. In this case an operator acknowledgment of the function blocks contained in the safety program must be performed. In this way the counters contained in the F-Host and F-Device for the virtual consecutive numbers are synchronized. The measuring system is then reset from safe status, output of passivated data, to normal status, output of cyclical data.
2 <sup>2</sup>	<b>R_cons_nr:</b> Resetting of the counter for the virtual consecutive no. The bit is set when the F-Host detects an F-Communicator error, either via the status byte or itself.
2 <sup>3</sup>	Reserved
2 <sup>4</sup>	<b>activate_FV:</b> Activate fail-safe values The bit is set inside the device via the firmware if the measuring system can no longer output fail-safe data due to a device error, errors in the safety-oriented communication or at start-up of the F-system. The measuring system outputs its passivated data instead.
2 <sup>5</sup>	<b>Toggle_h:</b> Toggle bit The toggle bit is host-based and causes the incrementation of the virtual consecutive numbers in the F-Device. The toggle bit is used to synchronize the counters in the measuring system/F-Host for generation of the virtual consecutive number.
2 <sup>6</sup> -2 <sup>7</sup>	Reserved

### NOTES!



The Safe-Control register can only be indirectly accessed from the safety program with the aid of variables, **see chapter 9 “Access to the safety-oriented data channel” on page 71.**

A detailed description of the control bits can be taken from the PNO document "PROFIsafe – Profile for Safety Technology on PROFIBUS DP and PROFINET IO", Order No.: 3.192b.

## 6.4.2 Not safety-oriented Process data, module “AMPN(H)41 I/O”

### Structure of the input data

Byte	Bit	Input data	
X+0	$2^8-2^{15}$	Cams	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, Multi-Turn, 15 Bit	Integer16
X+5	$2^0-2^7$		
X+6	$2^8-2^{15}$	Actual value, Single-Turn, 13 Bit	Integer16
X+7	$2^0-2^7$		

### 6.4.2.1 Input data

#### 6.4.2.1.1 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 overflow</b> The bit is set if the speed value is outside the range of $-32768...+32767$ .
$2^1...2^{15}$	reserved

#### 6.4.2.1.2 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 two's complement value with preceding sign.

Setting the direction of rotation = **forward**

- Looking at the flange connection, turn the shaft clockwise:  
→ positive speed output

Setting the direction of rotation = **backward**

- Looking at the flange connection, turn the shaft clockwise:  
→ negative speed output

If the measured speed exceeds the display range of  $-32768...+32767$ , this results in an overflow, which is reported in the cams register via bit  $2^0$ . At the time of the overflow the speed stops at the respective +/- maximum value, until the speed is once again in the display range. In this case the message in the cams register is also cleared.

The speed is specified in increments per Integration Time Unsafe.

#### 6.4.2.1.3 Multi-Turn / Single-Turn

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

The number of revolutions is noted in the Multi-Turn register, and the current Single-Turn position is noted in steps in the Single-Turn register. Together with the measuring system resolution, max. number of steps per revolution according to type plate, the actual position can then be calculated. The output position does not have a preceding sign.

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

Steps per revolution:           **8192    ± 13 Bit**

Number of revolution:       **0...32767 ± 15 Bit**

## 6.5 Parameterization

Normally the configuration program provides an input box for the IO-Controller with which the user can enter parameter data or select from a list. The structure of the input box is stored in the device master file.



### **DANGER! NOTICE!**

*Danger of death, serious physical injury and/or damage to property due to malfunction, caused by incorrect parameterization!*

The system manufacturer must ensure correct functioning by carrying out a protected test run during commissioning and after each parameter change.

### 6.5.1 F-Parameters (F\_Par)

The F-Parameters supported by the measuring system are listed below.

Byte order = Big Endian

Byte	Parameter	Type	Description	Page
X+0	–	Bit	Bit 0 = 0: not used	–
	F_Check_iPar	Bit	Bit 1 = 0: No check	42
	F_SIL	Bit range	Bit 3-2 00: SIL1 01: SIL2 10: SIL3 [default] 11: noSIL	42
	F_CRC_Length	Bit range	Bit 5-4 00: 3-Byte-CRC	43
X+1	F_Block_ID	Bit range	Bit 5-3 001: 1	43
	F_Par_Version	Bit range	Bit 7-6 01: V2-Mode	43
X+2	F_Source_Add	Unsigned16	Source address, default = 1, range: 1-65534	43
X+4	F_Dest_Add	Unsigned16	Destination address, default = 1, range: 1-99	43
X+6	F_WD_Time	Unsigned16	Watchdog time, default = 125, Range: 125-10000	43
X+8	F_iPar_CRC	Unsigned32	CRC of iParameters, default = 1132081116, Range: 0-4294967295	43
X+12	F_Par_CRC	Unsigned16	CRC of F-Parameters, default = 17033, Range 0-65535	43

#### 6.5.1.1 F\_Check\_iPar

The parameter is set to "NoCheck" and cannot be changed. This means the check sum value is not evaluated about the iParameters.

#### 6.5.1.2 F\_SIL

F\_SIL specifies the SIL which the user expects from the respective F-Device. This is compared with the locally saved manufacturer's specification. The measuring system supports the safety classes no SIL and SIL1 to SIL3, SIL3 = standard value.

### 6.5.1.3 F\_CRC\_Length

The measuring system supports the CRC length of 3 bytes. This value is predefined and cannot be changed.

### 6.5.1.4 F\_Block\_ID

As the measuring system supports device-specific safety parameters such as e.g. "Integration Time Safe", this parameter is preconfigured with the value "1 = generate F\_iPar\_CRC" and cannot be changed.

### 6.5.1.5 F\_Par\_Version

The parameter identifies the PROFIsafe version "V2-Mode" implemented in the measuring system. This value is predefined and cannot be changed.

### 6.5.1.6 F\_Source\_Add / F\_Dest\_Add

The parameter `F_Source_Add` defines a unique source address within a PROFIsafe cluster. The parameter `F_Dest_Add` defines a unique destination address within a PROFIsafe cluster. The PROFIsafe destination address must correspond to the address set by the address switches implemented in the measuring system, **also see chapter 5.3.4 "PROFIsafe Destination address "F\_Dest\_Add" on page 27.**

Valid addresses: 1...99.

Standard value `F_Source_Add` = 1, standard value `F_Dest_Add` = 1,  
`F_Source_Add` ≠ `F_Dest_Add`.

### 6.5.1.7 F\_WD\_Time

This parameter defines the monitoring time [ms] in the measuring system. A valid current safety telegram must arrive from the F-Host within this time, otherwise the measuring system will be set to safe status.

The predefined value is 125 ms.

The watchdog time must generally be set at a level where telegram runtimes are tolerated by the communication, but it must also allow quick execution of the error reaction function in case of error.

### 6.5.1.8 F\_iPar\_CRC

This parameter represents the checksum value (CRC3), which is calculated from all iParameters of the device-specific part of the measuring system and ensures safe transmission of the iParameters. The calculation occurs in a program called "JHG\_iParameter" provided by Johannes Hübner Gießen. The checksum value calculated there must then be manually entered in the F-Host engineering tool, **also see chapter 7 "Parameter Definition / CRC Calculation" on page 45.**

### 6.5.1.9 F\_Par\_CRC

This parameter represents the checksum value (CRC1), which is calculated from all F-Parameters of the measuring system and ensures safe transmission of the F-Parameters. The calculation occurs externally in the F-Host engineering tool and must then be entered here under this parameter, or is generated automatically.

## 6.5.2 iParameters (F\_iPar)

Application-dependent device characteristics are defined with the iParameters. A CRC calculation is necessary for safe transmission of the iParameters, **see chapter 7.1 "iParameters" on page 45.**

The iParameters supported by the measuring system are listed below.

**Byte order = Big Endian**

Byte	Parameter	Type	Description	Page
X+0	Integration Time Safe	Unsigned16	Default = 2, range: 1-10	44
X+2	Integration Time Unsafe	Unsigned16	Default = 20, range: 1-100	44
X+4	Windows Increments	Unsigned16	Default = 1000, range: 50-4000	44
X+6	Idleness Tolerance Preset	Unsigned8	Default = 1, range1-5	44
X+7	Direction	Bit	0: Backward 1: Forward [default]	45

### 6.5.2.1 Integration Time Safe

This parameter is used to calculate the safe speed, which is output via the cyclical data of the AMPN(H)41 I/O safety module. High integration times enable high-resolution measurements at low speeds. Low integration times show speed changes more quickly and are suitable for high speeds and high dynamics. The time basis is predefined to 50 ms. 50...500 ms can thus be set using the value range of 1...10. Standard value = 100 ms.

### 6.5.2.2 Integration Time Unsafe

This parameter is used to calculate the unsafe speed, which is output via the process data of the AMPN(H)41 I/O module. High integration times enable high-resolution measurements at low speeds. Low integration times show speed changes more quickly and are suitable for high speeds and high dynamics. The time basis is predefined to 5 ms. 5...500 ms can thus be set using the value range of 1...100. Standard value = 100 ms.

### 6.5.2.3 Windows Increments

This parameter defines the maximum permissible position deviation in increments of the master / slave scanning units integrated into the measuring system. The permissible tolerance window is basically dependent on the maximum speed occurring in the system and must first be determined by the system operator. Higher speeds require a larger tolerance window. The value range extends from 50...4000 increments. Standard value = 1000 increments.

**The larger the window increments, the larger the angle until an error will be recognized.**

### 6.5.2.4 Idleness Tolerance Preset

This parameter defines the maximum permissible speed in increments per `Integration Time Safe` for performance of the preset function. The permissible speed is dependent on the bus behavior and the system speed, and must be determined by the system operator first. The value range extends from 1 increment per `Integration Time Safe` to 5 increments per `Integration Time Safe`. That means that the shaft of the measuring system must be nearly at rest, so that the preset function can be executed.

Standard value = 1 increment per standard value `Integration Time Safe`.

## 6.5.2.5 Direction

This parameter defines the current counting direction of the position value looking at the flange connection, turning the shaft clockwise.

- Forward** = Counting direction increasing
- Backward** = Counting direction decreasing
- Standard value** = **Forward**

## 7 Parameter Definition / CRC Calculation

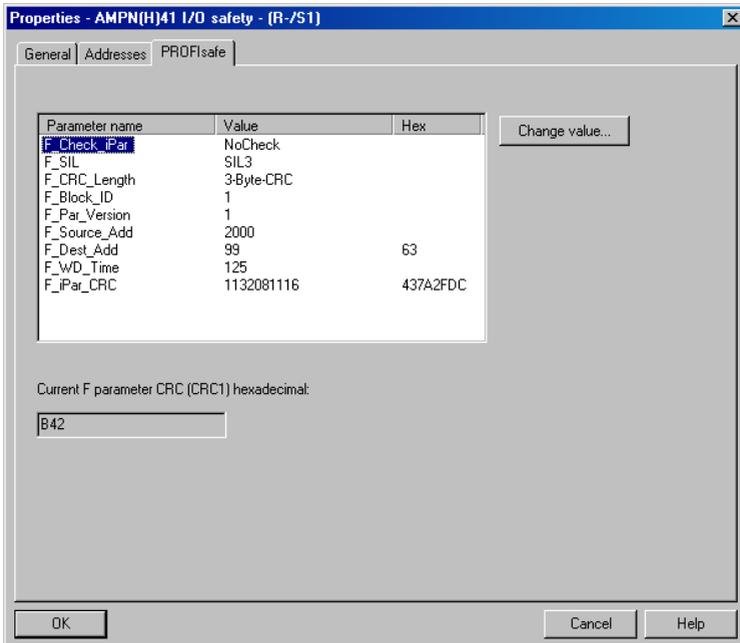
It is best to define the known parameters before configuration in the F-Host, so that they can be taken into account during configuration.

The procedure, in conjunction with the SIEMENS configuration software SIMATIC Manager and the optional package S7 Distributed Safety, is described below.

The JHG\_iParameter software, required for the CRC calculation, is a constituent of the Software and Support CD, order no. ID 21771, **also see chapter 16.7 “Accessories” on page 96.**

### 7.1 iParameters

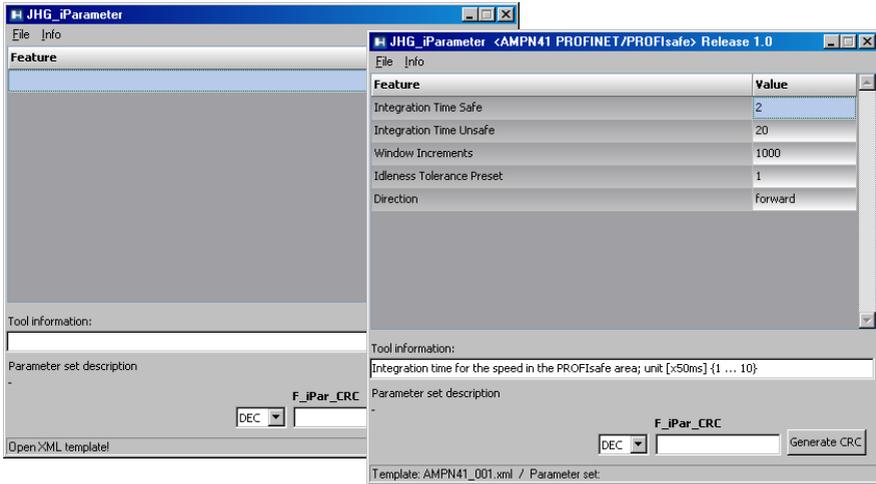
The iParameters are preconfigured with meaningful values in the default setting and should only be changed if expressly required by the automation task. A CRC calculation is necessary for safe transmission of the individually set iParameters. This must be performed when changing the predefined iParameters via the JHG program "JHG\_iParameter". The calculated checksum corresponds to the F-Parameter F\_iPar\_CRC. This must be entered in the field with the same name in the Properties - AMPN(H) 41 I/O safety window when configuring the measuring system with the hardware configurator, **also see chapter 8.3.1 “Setting the iParameters” on page 62.**



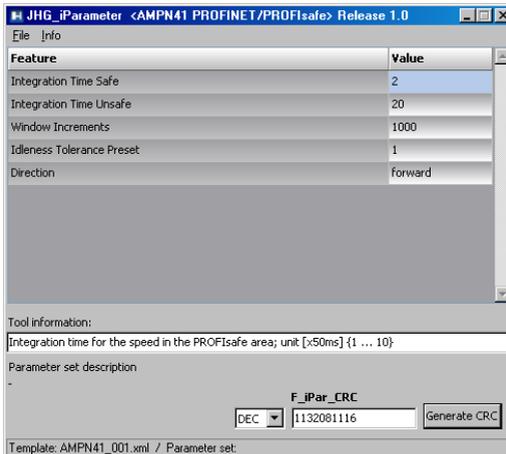
## 7.1.1 CRC calculation across the iParameters

The predefined standard values are used for the following example of a CRC calculation. These can be loaded in the `JHG_iParameter` program using an XML template file. If different values are required, the standard values can be overwritten by double-clicking on the relevant entry. The modified parameters can be saved as a complete parameter set or opened again as a template.

- Install `JHG_iParameter` by means of the setup file "JHG\_iParameter\_setup.exe".
- Start `JHG_iParameter` by means of the start file "JHG\_iParameter.exe", then open the template file provided with the measuring system with the menu `File` → `Open XML template` (as example here: `AMPN41_001.xml`).



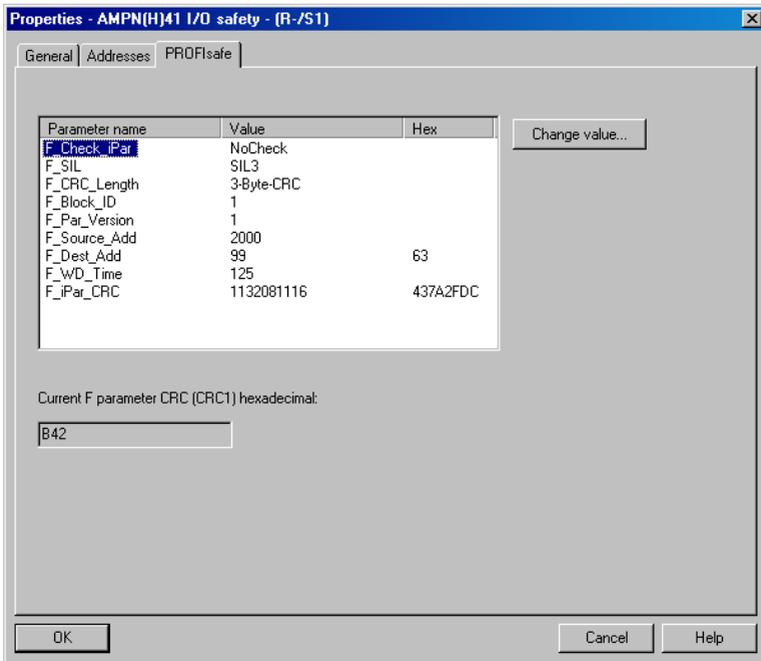
Modify the relevant parameters if necessary, then click on the `Generate CRC` switch for the `F_iPar_CRC` calculation. The result is shown in the field `F_iPar_CRC` alternatively as decimal or Hex value.



Each parameter change requires a new `F_iPar_CRC` calculation, which must then be taken into account in the projection. If a safety program is already present, it must be re-generated. For further information on the use of `JHG_iParameter`, refer to the help file with the menu **Info** → **Help**.

## 7.2 F-Parameters

The F-Parameters are already preconfigured with meaningful values in the default setting and should only be changed if expressly required by the automation task. A CRC which is automatically calculated by the `SIMATIC Manager` is necessary for safe transmission of the individually set F-Parameters. This checksum corresponds to the F-Parameter `F_Par_CRC`, which is displayed as a hexadecimal value in the `Properties - AMPN(H)41 I/O safety` window under the heading `Current F parameter CRC (CRC1)` when configuring the measuring system with the hardware configurator. The value `B42` entered in the example below is valid for the default setting shown here, **also see chapter 8.3.2 “Setting the F-Parameters” on page 63.**



### 7.2.1 Non-settable F-Parameters

The F-Parameters specified below are either managed by the measuring system or by the F-Host, and therefore cannot be manually changed:

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

## 7.2.2 Settable F-Parameters

It is assumed that the following parameters are configured with their standard values:

- F\_SIL: SIL3
- F\_Dest\_Add: 513 (address switches)
- F\_WD\_Time: 125
- F\_iPar\_CRC: 1132081116 (calculation by means of JHG tool JHG\_iParameter)

Each parameter change gives a new F\_Par\_CRC value, which is displayed as shown above. If a safety program is already present, it must be re-generated.

## 8 Safety Program Creation – Configuration Example

This chapter describes the procedure for creating the safety program using the SIEMENS SIMATIC Manager configuration software and the S7 Distributed Safety optional package.

The safety program is created with the FBD/LAD Editor in STEP 7. The fail-safe FBs and FCs are programmed in the F-FBD or F-LAD programming language, while the fail-safe DBs are created in the F-DB programming language. The Distributed Safety F-Library supplied by SIEMENS provides the user with fail-safe application modules, which can be used in the safety program.

When generating the safety program, safety checks are performed automatically and additional fail-safe blocks are integrated for error detection and error reaction. This ensures that failures and errors are detected and corresponding reactions are triggered, which keep the F-System in safe status or put it into a safe status.

A standard user program can run in the F-CPU in addition to the safety program. The co-existence of standard and safety program in the F-CPU is possible, as the safety-oriented data of the safety program are protected against undesirable influence by data of the standard user program.

Data exchange between safety and standard user program in the F-CPU is possible by means of flags and through access to the process image of the inputs and outputs.

### Access protection

Access to the F-System S7 Distributed Safety is protected by two passwords, the password for the F-CPU and the password for the safety program. A differentiation is made between offline and online password for the safety program:

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

## 8.1 Prerequisites



### WARNING!

***Danger of deactivation of the fail-safe function through incorrect configuration of the safety program!***

- The safety program must be created in conjunction with the system documentation provided by SIEMENS for the software and hardware.
- Extensive documentation on "Configuring and Programming" a safe control is provided by SIEMENS in its manual ***S7 Distributed Safety - Configuring and Programming***, document order number: ***A5E00109537-04***. This documentation is a constituent of the optional package *S7 Distributed Safety*.
- The following descriptions relate to the pure procedure and do not take account of the instructions from the SIEMENS manual. It is therefore essential to observe and comply with the information and instructions provided in the SIEMENS manual, particularly the safety instructions and warnings.
- The configuration shown should be taken as an example. The user is required to check and adapt the usability of the configuration for his own application. This also includes the selection of suitable safety-oriented hardware components and the necessary software prerequisites.

#### Software components used for the *S7 Distributed Safety* configuration example:

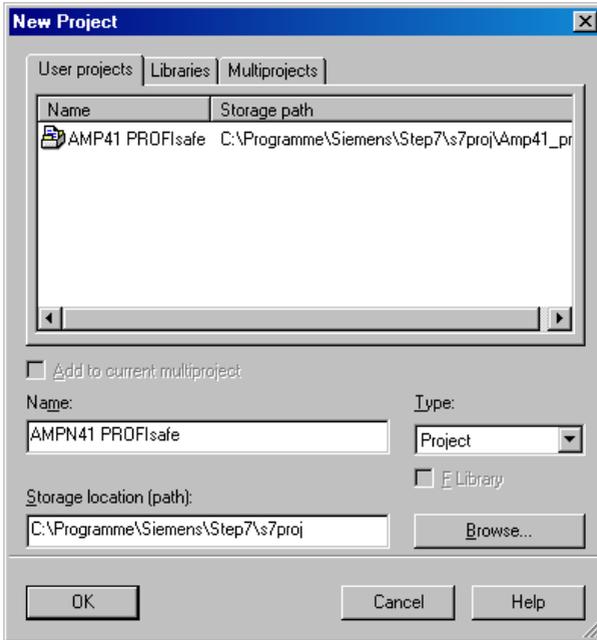
- STEP 7 V5.5 + SP2
- *S7 Distributed Safety* Programming V5.4 + SP5
- *S7 F ConfigurationPack* V5.5 + SP9

#### Hardware components in the SIMATIC 300 series used for the *S7 Distributed Safety* configuration example:

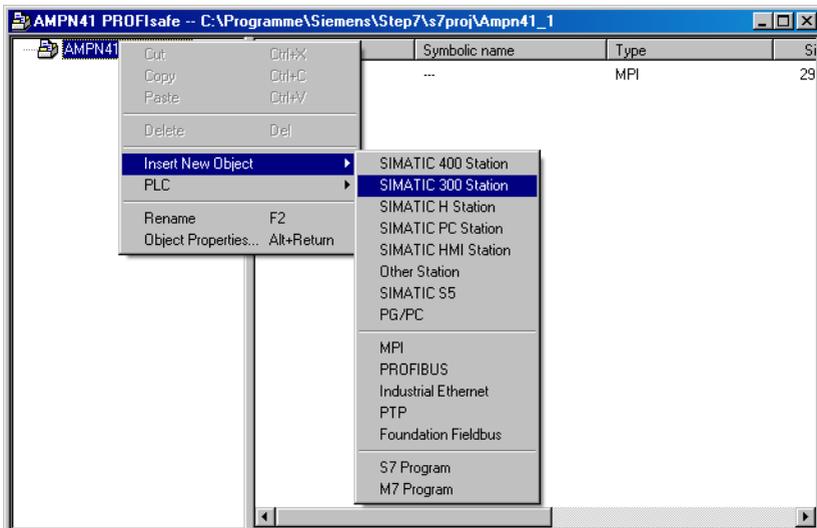
- Rail
- Power supply "PS307 2A" (307-1BA00-0AA0)
- F-CPU unit "CPU317F-2 PN/DP" (317-2FK13-0AB0)
- Digital output module "SM 326F DO 10xDC24V/2A" (326-2BF01-0AB0), is not actively used in the following safety program and is intended for customer-specific outputs, e.g. to show the variable states of the F-Periphery-Block: PASS\_OUT, QBAD, ACK\_REQ, IPAR\_OK etc.
- Digital input module "SM 326F DI 24xDC24V" (326-1BK01-0AB0), is used for the operator acknowledgment.

## 8.2 Hardware configuration

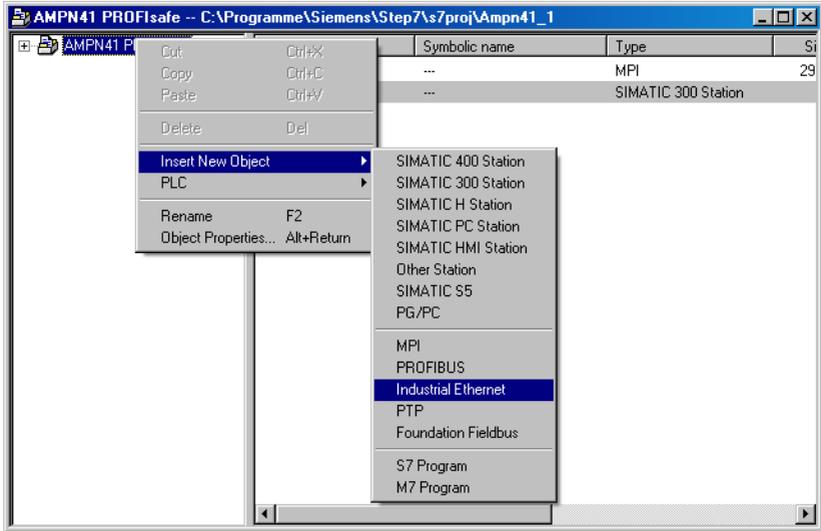
→ Start SIMATIC Manager and create a new project.



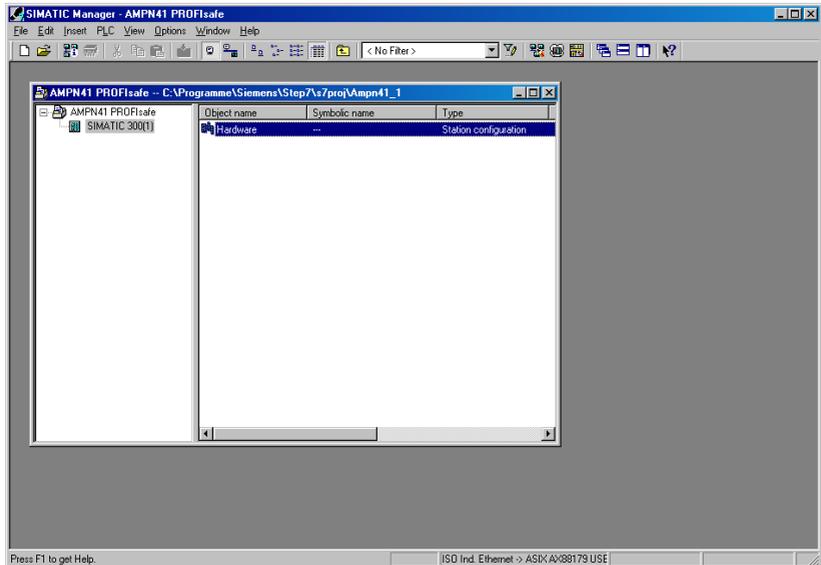
→ Using the right mouse button, insert the SIMATIC 300 Station as a new object in the project window.



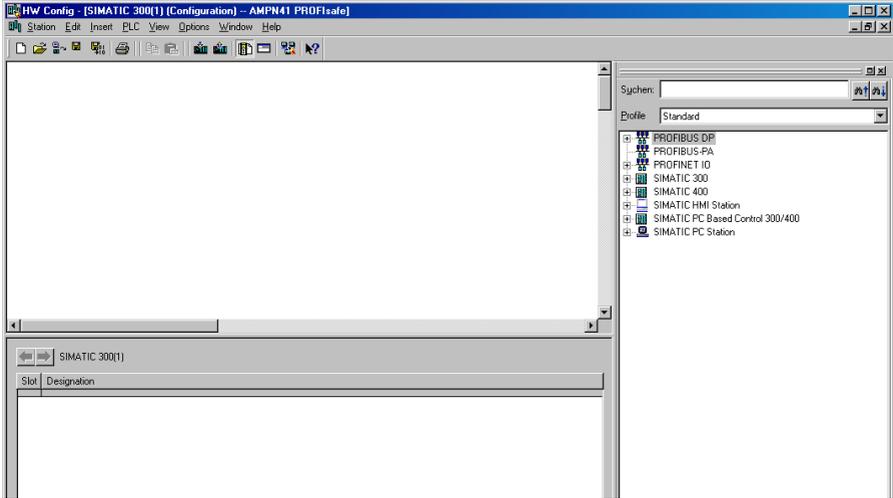
→ Insert an Industrial Ethernet for PROFINET as a new object in the same way.



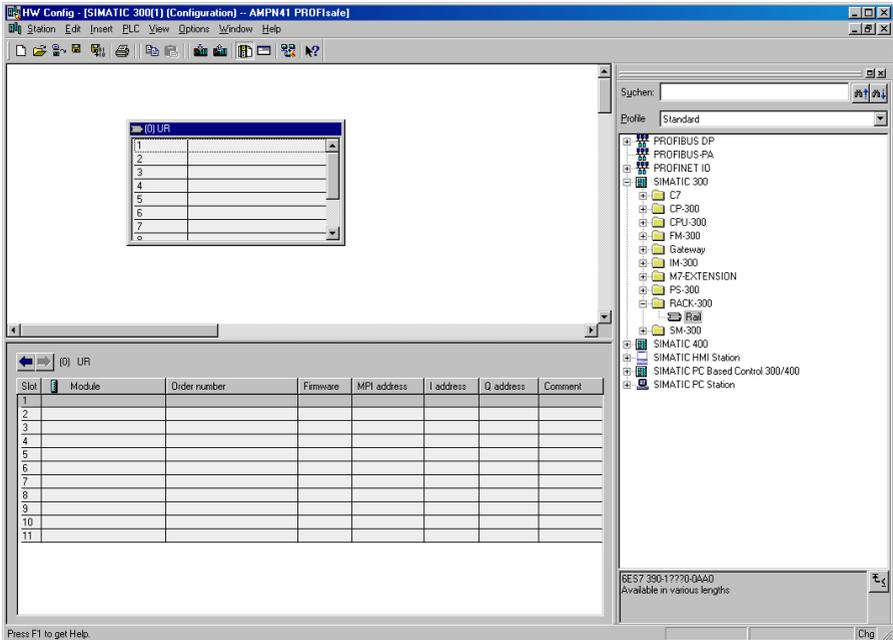
→ Double-click on Hardware to start the hardware configurator HW Config.



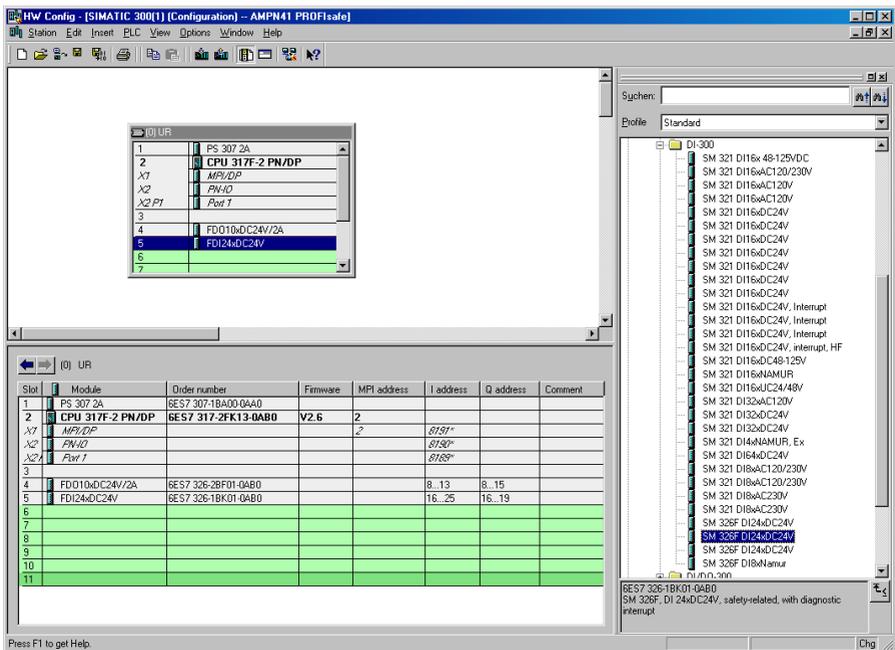
- If the hardware catalog is not shown on the right, it can be displayed with the View → Catalog menu.



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



- Drag the power supply PS 307 2A in the catalog to position 1 of the rack with SIMATIC 300 → PS-300 → PS 307 2A.
- Drag CPU 317F-2 PN/DP in the catalog to position 2 of the rack with SIMATIC 300 → CPU-300 → CPU 317F-2 PN/DP → 6ES7 317-2FK13-0AB0 → V2.6. Also specify the characteristics of the Ethernet interface here if necessary.
- Drag digital output module SM 326F DO 10xDC24V/2A in the catalog to position 4 of the rack with SIMATIC 300 → SM-300 → DO-300 → SM 326F DO 10xDC24V/2A (6ES7 326-2BF01-0AB0).
- Drag digital input module SM 326F DI 24xDC24V in the catalog to position 5 of the rack with SIMATIC 300 → SM-300 → DI-300 → SM 326F DI 24xDC24V (6ES7 326-1BK01-0AB0).



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

- The GSDML file belonging to the measuring system must be installed in the next step. This is copied with the belonging bitmap file into the installation directory of the SIMATIC Manager. You should note that the directory structure can vary.

→ Install GSDML file in the stored directory with menu Options → Install GSD File...

The measuring system now appears in the catalog as a new item:

PROFINET IO → Additional Field Devices → Encoders → HUEBNER  
AMPN (H) 41 → AMPN (H) 41.

The screenshot shows the SIMATIC Manager HW Config interface for a SIMATIC 300 station. The main window displays a rack configuration with the following modules:

- Slot 1: PS 307 2A
- Slot 2: CPU 317F-2 PN/DP
- Slot X1: MPI/DP
- Slot X2: PN-ID
- Slot X2 P1: Port 1
- Slot 3: (Empty)
- Slot 4: FD010dC24V/2A
- Slot 5: FD124dC24V
- Slot 6: (Empty)
- Slot 7: (Empty)
- Slot 8: (Empty)
- Slot 9: (Empty)
- Slot 10: (Empty)
- Slot 11: (Empty)

The right-hand pane shows the component catalog with the following tree structure:

- Standard
- PROFIBUS DP
- PROFIBUS-PA
- PROFINET IO
- Additional Field Devices
  - Encoders
    - Huebner AMPN(H)41
      - AMPN(H)41
- Gateway
- HMI
- I/O
- Network Components
- Sensors
- Switching devices
- SIMATIC 300
- SIMATIC 400
- SIMATIC HMI Station
- SIMATIC PC Based Control 300/400
- SIMATIC PC Station

At the bottom right, the selected AMPN(H)41 encoder is detailed:

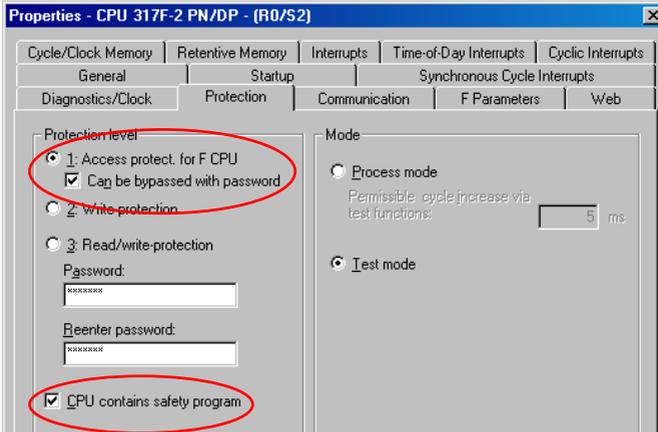
- AMPN(H)41
- Huebner/Giessen
- Safe/Unsafe: Multium (15 Bit), Singleturn (13 Bit), Velocity (15 Bit / signed)

The bottom status bar indicates: Press F1 to get Help.

## 8.2.1 Defining the properties of the hardware configuration

The object properties of the individual hardware components are defined by clicking with the right mouse button on the relevant position in the rack or slot:

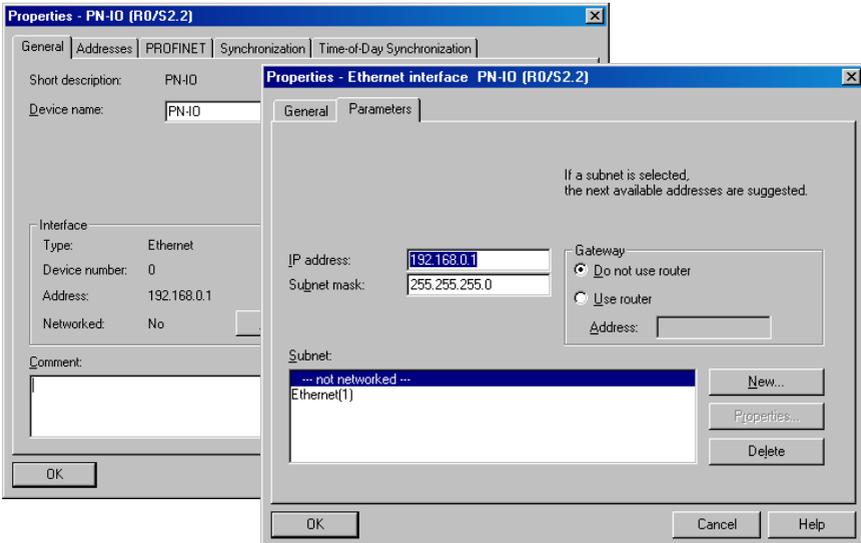
→ For the CPU, Protection level 1 and a Password must be configured in the Protection register. The Mode field is not relevant for safety mode.



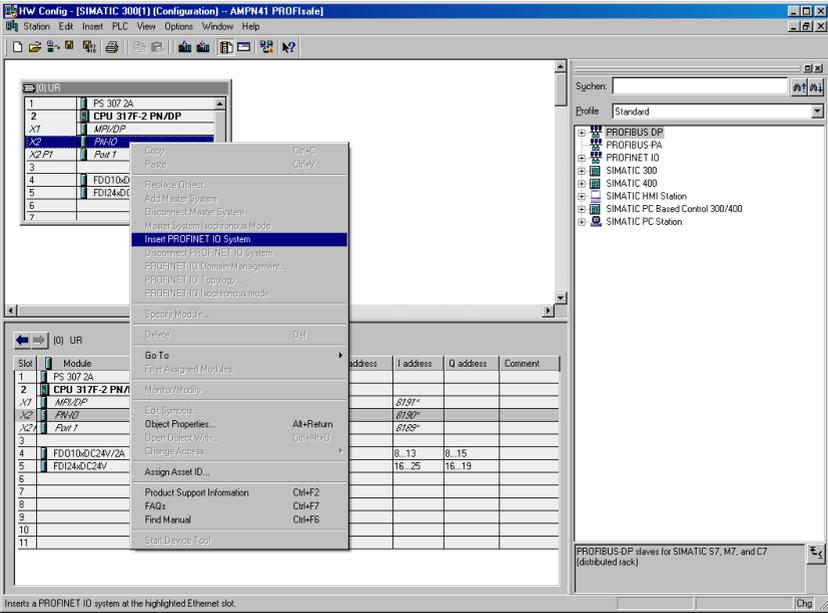
→ For the CPU, in the sub-item PN-IO, General → register, select Ethernet type in the Interface field.

→ In the Properties window of Ethernet interface PN-IO the Ethernet properties of the control system (SPS) must be filled in:

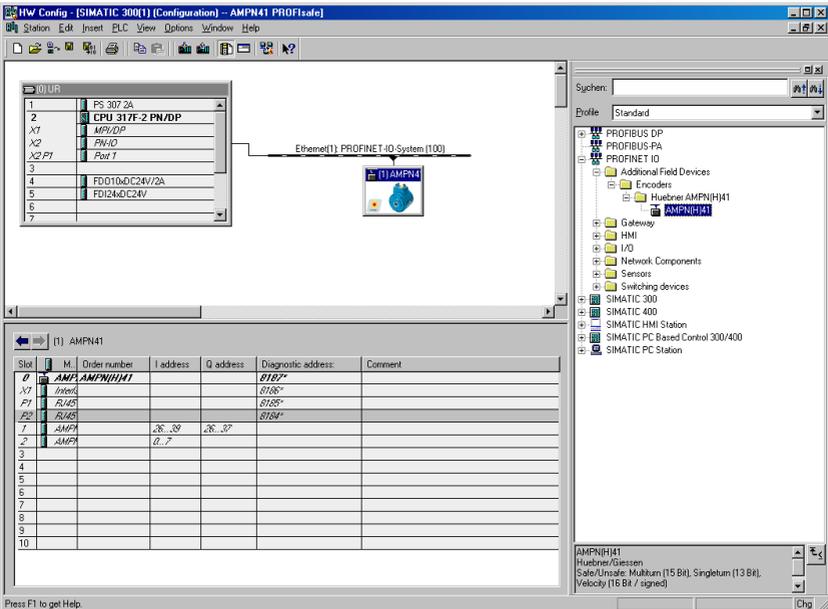
- IP address of SPS
- Subnet mask of SPS
- Subnet: Ethernet



→ Add PROFINET IO system: Right mouse button click on “PN-IO” and then select “Insert PROFINET IO System”.



→ Connect the AMPN (H) 41 measuring system from the catalog to the PROFINET IO system, to the bus line now available, using Drag&Drop.



- With connection of the measuring system to the master system, in the Properties window, in the General register, you can now configure the desired Device name and mark the checkbox "Assign IP address via IO controller".

**Properties - AMPN41** [X]

General

Short description: AMPN41  
Safe/Unsafe: Multiturn (15 Bit), Singleturn (13 Bit), Velocity (16 Bit / signed)

Order No./ firmware: AMPN(H)41 / V1.06  
Family: Huebner AMPN(H)41

Device name: AMPN41

GSD file: GSDML-V2.3-HU-024A-AMPN(H)41-20130418.xml  
Change Release Number...

Node in PROFINET IO System

Device number: 1 | PROFINET-IO-System (100)

IP address: 192.168.0.2 | Ethernet...

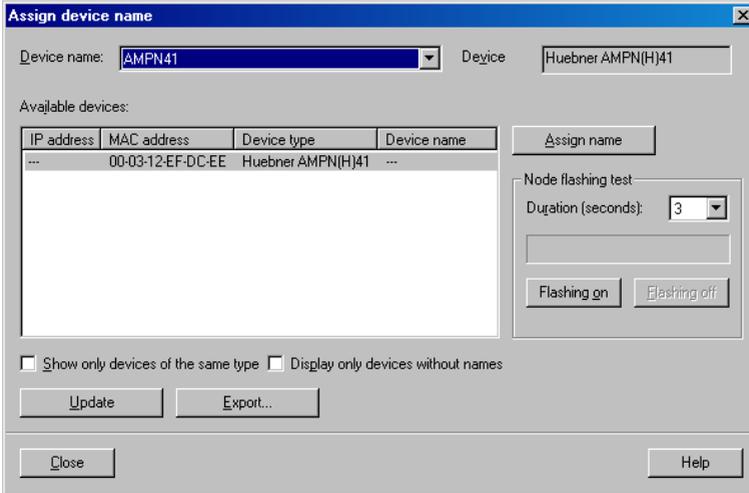
Assign IP address via IO controller

Comment:

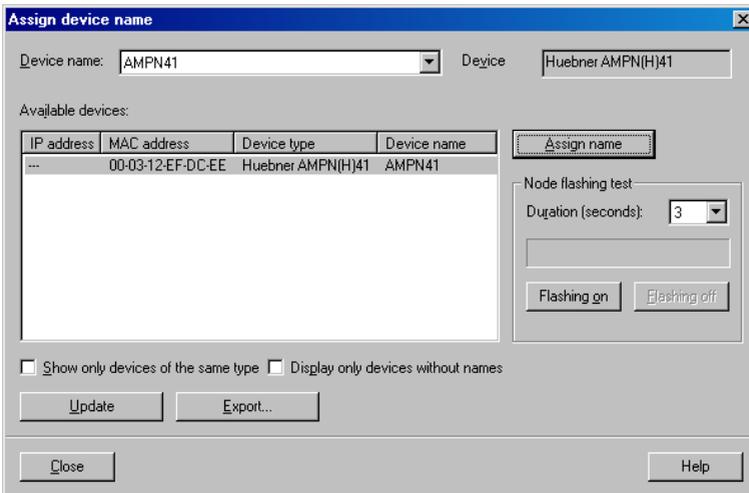
OK Cancel Help

→ Set the device name by DCP:

- Open the menu “PLC → Ethernet → Assign device name” in the “HW Config” window.
- The supplied measuring system that is connected to the network should be visible in the list after pressing the “Update” button.



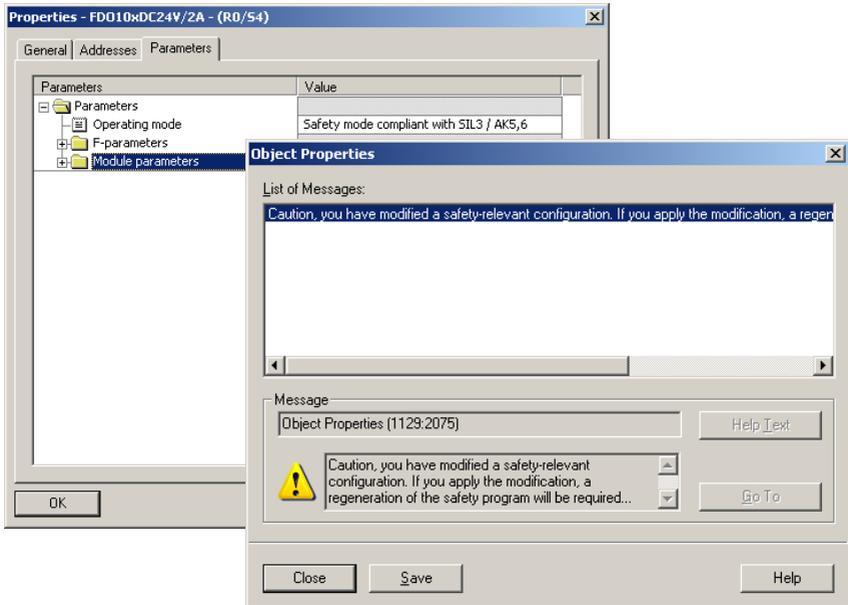
- A few seconds after pressing the button “Assign name” the list refreshes automatically and the new device name is taken over.



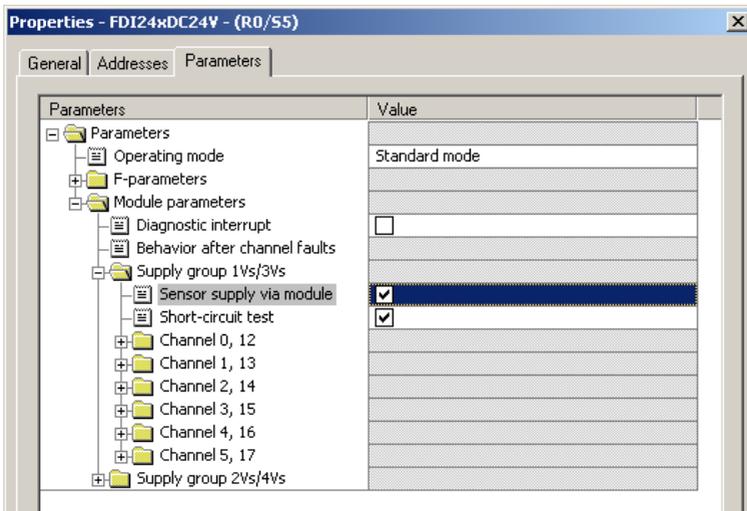
## NOTES!

In the delivery state as well as after a system boot up the measuring system has not saved a device name.

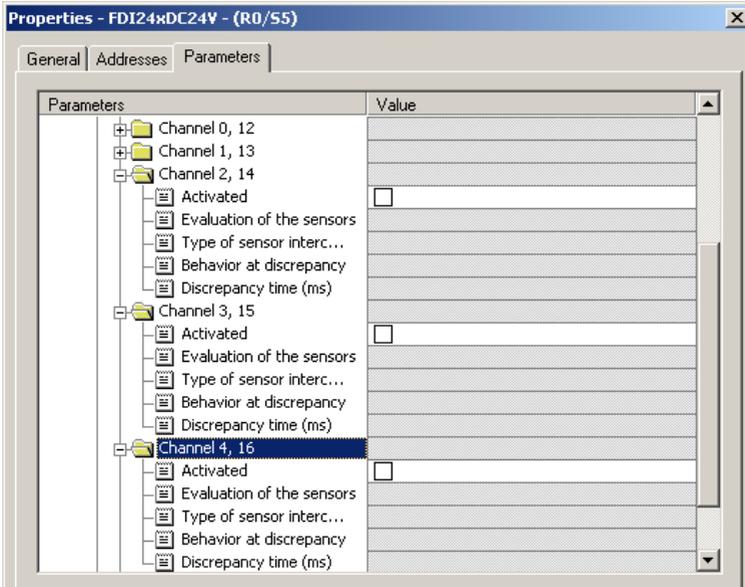
- For the digital output module, in the Parameters register configure Operating mode → Safety mode compliant with SIL3/AK5,6 and confirm the following window with Close.



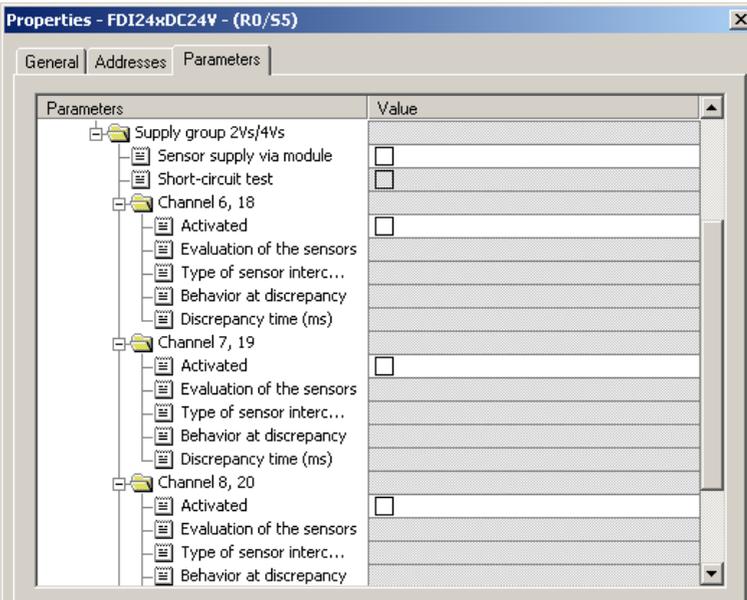
- For the digital input module, in the Parameters register in folder structure Parameters → Module parameters → Supply group 1Vs/3Vs, put a tick in the items Sensor supply via module and Short-circuit test.



- The settings for channels 0, 12 and 1, 13 remain unchanged.  
For channels 2, 14 / 3, 15 / 4, 16 and 5, 17, the tick must be removed under Activated.



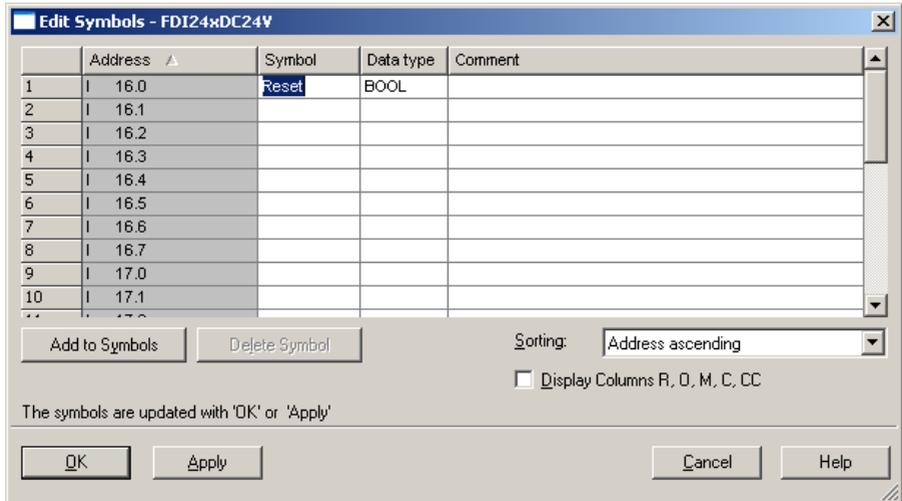
- In the sub-folder Supply group 2Vs/4Vs, for all channels 6, 18 / 7, 19 / 8, 20 / 9, 21 / 10, 22 and 11, 23 the tick must also be removed under Activated.



For the operator acknowledgment of the F-Periphery, a RESET symbol is required for the digital input I 16.0.

→ To do this, click with the right mouse button on the item FDI24xDC24V in the rack or slot and select Edit Symbols... In the Symbol column enter the symbol name Reset, the data type BOOL will then be applied automatically.

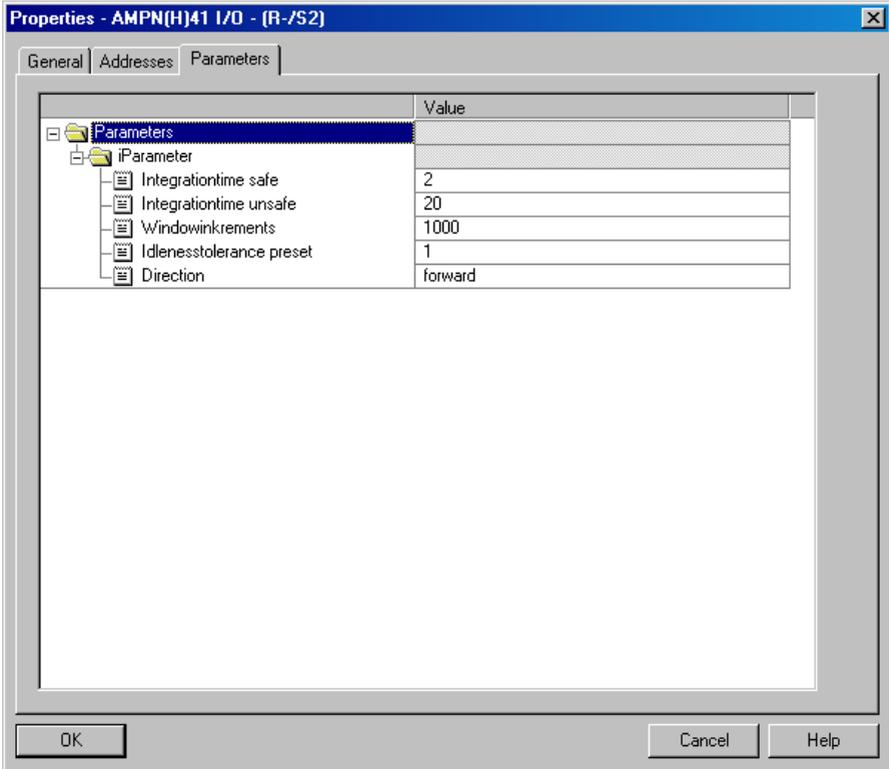
→ Press OK to update.



## 8.3 Parameterization

### 8.3.1 Setting the iParameters

→ The iParameters can be set by selecting the Symbol for the measuring system → Double click on the slot item AMPN(H) 41 I/O → Select the Parameters register.



If different parameter values are required, as shown above, a F\_iPar\_CRC calculation must occur for this new parameter data set, **see chapter 7 “Parameter Definition / CRC Calculation” on page 45.**

The calculated value must then be entered in the parameter data set for the F-Parameters under F\_iPar\_CRC, **see chapter 8.3.2 “Setting the F-Parameters” on page 63.**

## 8.3.2 Setting the F-Parameters

- The F-Parameters can be set by selecting the *Symbol* for the measuring system
  - Double-click on the slot item AMPN(H)41 I/O safety → Select the PROFIsafe register.

The screenshot shows a software window titled "Properties - AMPN(H)41 I/O safety - (R-/S1)". It has three tabs: "General", "Addresses", and "PROFIsafe". The "PROFIsafe" tab is active and contains a table of parameters. Below the table is a text field for the "Current F parameter CRC (CRC1) hexadecimal" with the value "B42". At the bottom of the window are "OK", "Cancel", and "Help" buttons.

Parameter name	Value	Hex
F_Check_iPar	NoCheck	
F_SIL	SIL3	
F_CRC_Length	3-Byte-CRC	
F_Block_ID	1	
F_Par_Version	1	
F_Source_Add	2000	
F_Dest_Add	99	63
F_wD_Time	125	
F_iPar_CRC	1132081116	437A2FDC

Current F parameter CRC (CRC1) hexadecimal:



### NOTES!

The `F_Dest_Add` entry and the setting of the address switches of the measuring system must be matching.

The parameter value for the parameter `F_iPar_CRC` results from the set parameter data set for the iParameters and the calculated CRC value **see chapter 8.3.1 "Setting the iParameters" on page 62.**

To enable automatic generation of the safety program, the hardware configuration must now be compiled via the menu *Station* → *Save and Compile*.

→ Finally the HW-Configuration must be downloaded to the hardware via the menu "PLC → Download...".

The screenshot shows the SIMATIC Manager HW Config interface. The 'Download...' menu is open, showing options like 'Download Module Identification...', 'Upload Module Identification to PG...', 'Family Modules...', 'Module Information...', 'Operating Mode...', 'Clear/Reset...', 'Get Time of Day...', 'Monitor/Modify', 'Update Firmware...', 'Save Device Name to Memory Card...', 'Ethernet', 'PROFIBUS', and 'Save Service Data...'. The hardware configuration table below shows the following data:

Slot	Module	Order number	I address	Q address	Diagnostic address	Comment
0	AMPN41	AMPN41H1			8182*	
X1	Interface				8186*	
P1	RI45-10/100Mbps				8185*	
P2	RI45-10/100Mbps				8184*	
1	AMPN41H1 I/O safety		26..39	26..39		
2	AMPN41H1 I/O		0..7			
3						
4						
5						
6						
7						
8						
9						
10						

Additional information at the bottom right of the table:

- AMPN(H)41
- Huebner/Giessen
- Safe/Unsafe: Multium (15 Bit), Singletum (13 Bit)
- Velocity (16 Bit / signed)

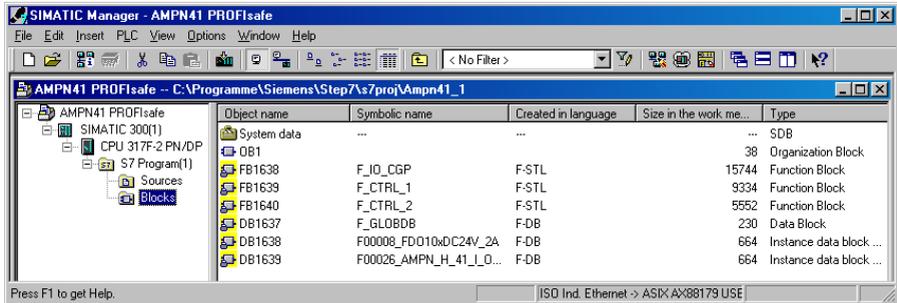
The HW Config can now be closed.

## 8.4 Creating the missing (F-)blocks

The blocks that have already been automatically created can be viewed in the project folder of the SIMATIC Manager under:

AMPN41 PROFIsafe → SIMATIC 300(1) → CPU 317F-2 PN/DP → S7 Program(1) → Blocks.

All fail-safe blocks are shown with a yellow background to distinguish them from blocks of the standard user program.



### 8.4.1 Program structure

The safety program is accessed by calling up the F-CALL from the standard user program.

The F-CALL is called up directly e.g. in the cyclic interrupt OB OB 35.

Cyclic interrupt OBs have the advantage that they interrupt the cyclic program processing in OB 1 of the standard user program at fixed time intervals, i.e. in a cyclic interrupt OB the safety program is called up and processed at fixed time intervals.

After the safety program has been processed, the standard user program is further processed.

### 8.4.2 F-Runtime Group

To facilitate handling, the safety program consists of an "F-Runtime Group". The F-Runtime Group is a logic construct consisting of a number of related F-Blocks, which is formed internally by the F-System.

The F-Runtime Group comprises:

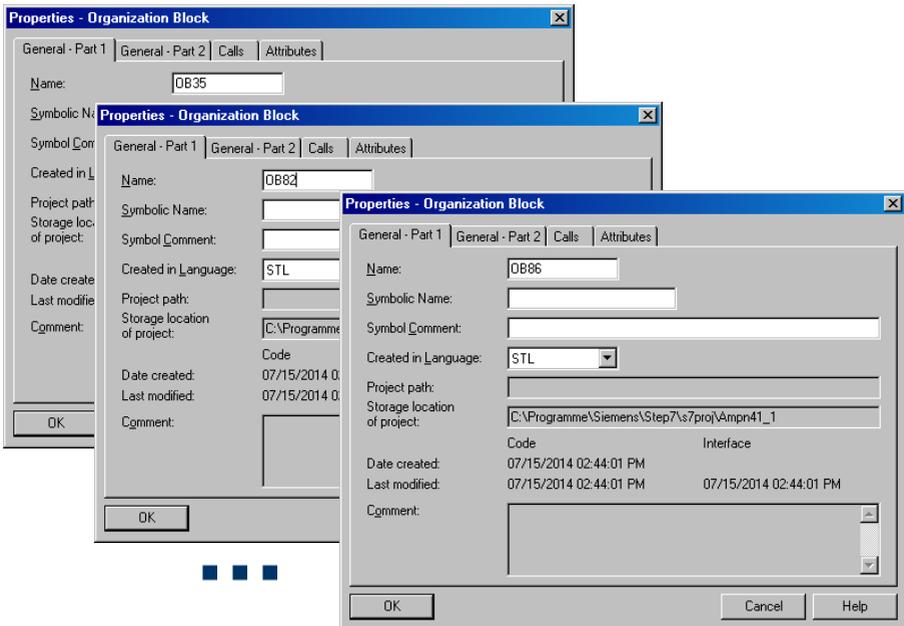
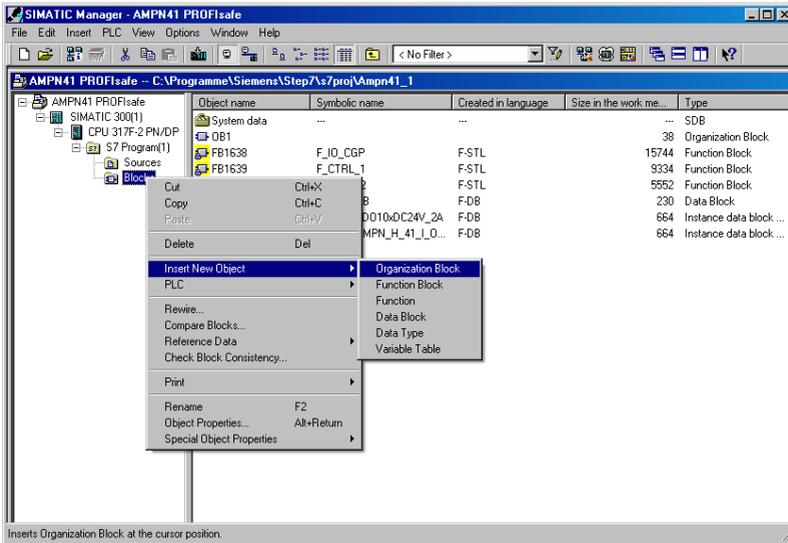
- one F-Call block F-CALL, "FC1"
- one F-Program block, to which the F-CALL is assigned, "FC2"
- further F-FBs
- several F-DBs
- F-Periphery-DBs
- F-System blocks F-SBs
- automatically generated F-Blocks

## 8.4.3 Generating the Object Blocks (OBs)

The necessary Organization Blocks OB35 and OB82 to OB86 are created below.

→ The Organization Blocks are inserted with the right mouse button in the project window  
Insert New Object → Organization Block.

The programming language is STL for all Organization Blocks.



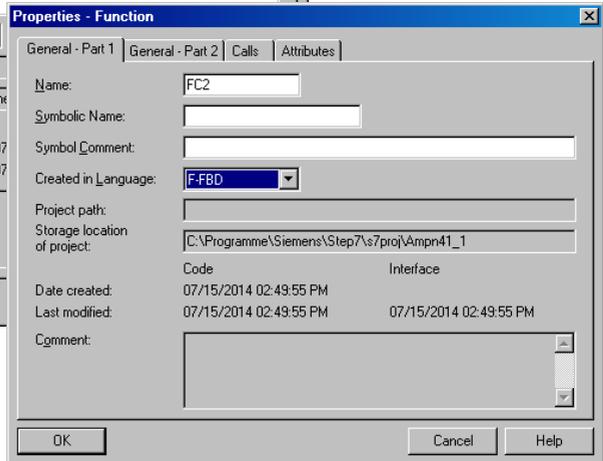
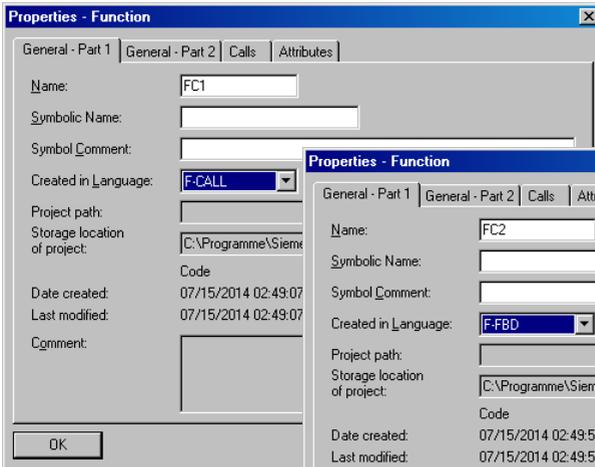
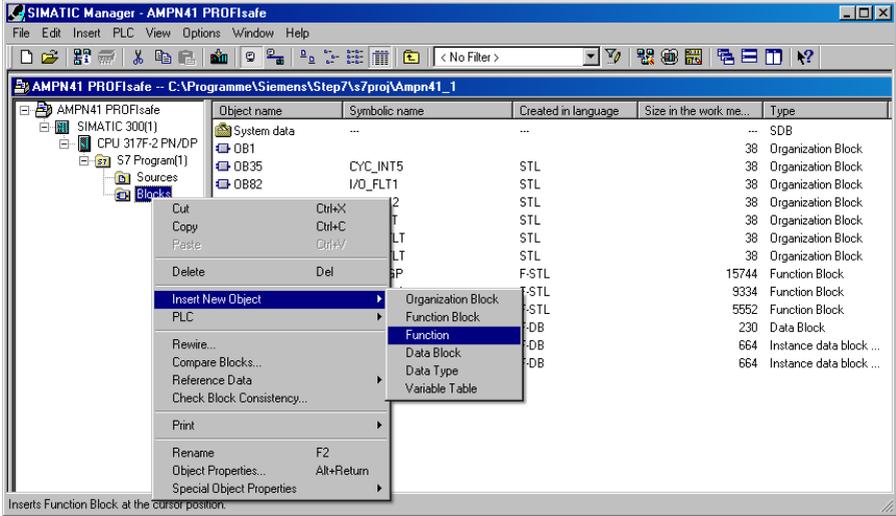
## 8.4.4 Generating the functions (F-FCs)

The necessary functions FC1 and FC2 are created below.

→ The functions are inserted with the right mouse button in the project window

Insert New Object → Function.

The programming language for FC1 is F-CALL, for FC2 F-FBD.



## 8.4.5 Programming the F-Blocks

The programming and modifications for blocks OB35, FC1 and FC2 are carried out below.

- The safety program is called up in OB35 by double-clicking on the object name OB35 in the project window. The instruction `CALL FC1` must be entered in the open LAD/STL/FBD program window. Finally save the item and close the window again.

OB35 : "Cyclic Interrupt"

Comment:

Network 1: Title:

Comment:

```
CALL FC 1
```

For the operator acknowledgment of the F-Periphery after the elimination of errors, the variable `ACK_REI` of the F-Periphery-DB must be interconnected to the digital input `I 16.0 RESET` of the digital input module. The function `FC2` must be programmed accordingly for this purpose.

- An And Box is inserted from the tool bar, one input is deleted and the `Reset` symbol is assigned to the second input.

FC2 : Title:

Comment:

Network 1: 1 = Acknowledgement for re/integration

Comment:

r		
	F00008_FD010xDC24V_2A	FB 1638 DB
	F00026_203	FB 1638 DB
	F_GLOBDB	DB 1637 DB
	Reset	BOOL I

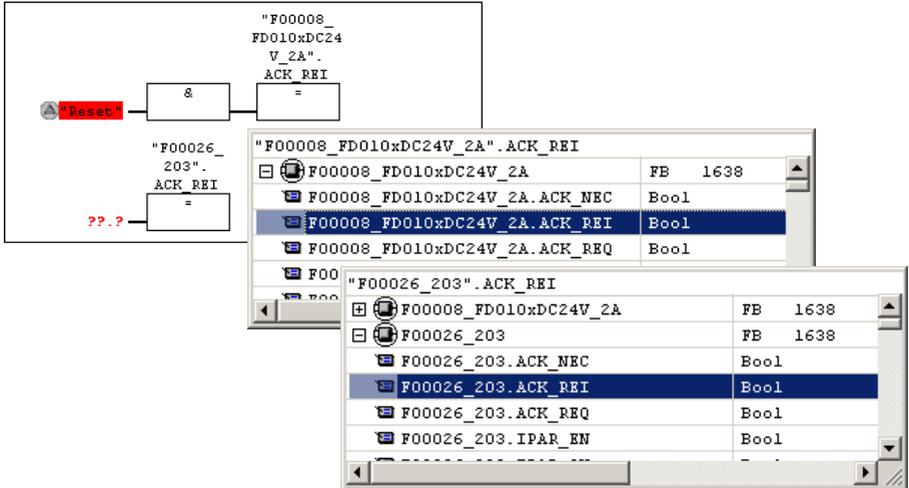
→ Two Assignments are inserted from the tool bar, the variable "F00008...".ACK\_REI is assigned to one assignment, and the variable "F00026...".ACK\_REI to the other.

FC2 : Title:

Comment:

**Network 1:** 1 = Acknowledgement for re/integration

Comment:



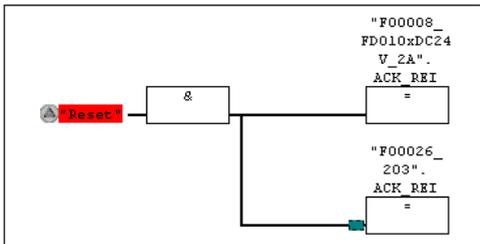
→ Finally, the Assignment not yet interconnected is interconnected to the output of the And Box by a Branch. Save the programming and close the window.

FC2 : Title:

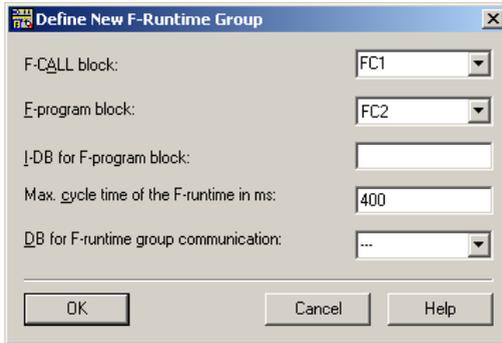
Comment:

**Network 1:** 1 = Acknowledgement for re/integration

Comment:



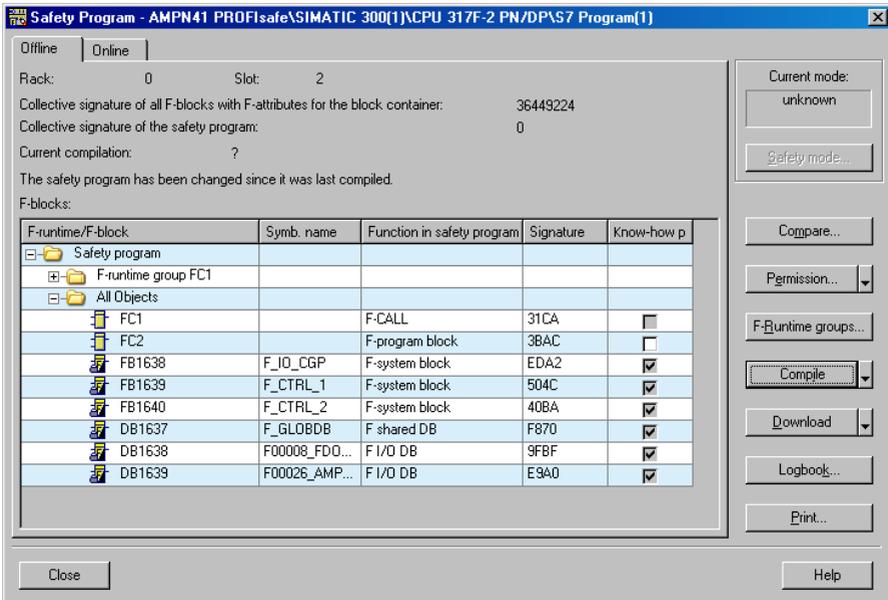
- The Runtime Group is defined with the function FC1. In the field `Max. cycle time` of the F-runtime in ms: enter the value 400 and confirm with OK. Also confirm the next window `Edit F-Runtime Groups` with OK.



The programming and modifications are now complete.

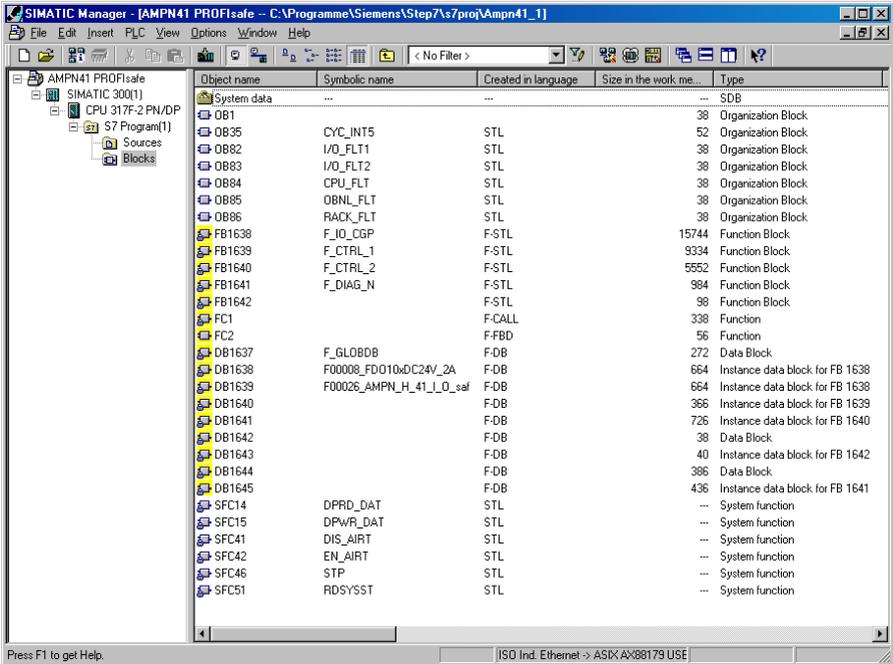
## 8.5 Generating the safety program

- To generate the safety program, in SIMATIC Manager, `Options` → `Edit safety program` menu, open the `Safety Program` dialog. The safety program is compiled and generated with the `Compile` switch.



If compilation is successful 0 warnings are displayed, and the windows can then be closed.

All necessary blocks are now displayed in the project window:



## 8.6 Loading the safety program

When the safety program has been generated, it can be loaded into the F-CPU. It is advisable to transfer the complete safety program to the F-CPU in STOP operating status. This guarantees that a consistent safety program is loaded. The program is loaded with the menu Options → Edit safety program → Download switch.

## 8.7 Testing the safety program

After generating the safety program, a complete functional test must be carried out according to the automation task.

After modifications to an already completely function-tested safety program, it is sufficient to test the modifications.

## 9 Access to the safety-oriented data channel

The safety-oriented data channel in the AMPN(H) 41 I/O safety module is accessed via the process image, as with a standard periphery. However, direct access is not permitted. The safety-oriented data channel of the measuring system may only be accessed from the generated F-Runtime Group.

The actual communication between F-CPU (process image) and measuring system for updating the process image occurs concealed in the background, by means of the PROFIsafe protocol.

The measuring system uses a larger area in the process image in the AMPN(H) 41 I/O safety module, due to the PROFIsafe protocol, than would be necessary for the measuring system function. The F-Parameter-block contained in the process image

is not included in the user data. When accessing the process image in the safety program, only access to the pure user data is permitted!

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

The safety function requires that for passivation in the safety-oriented channel in the JHG-PROFIsafe module, the substitute values (0) are used in the following cases instead of the cyclically output values. This status is indicated via the F-Periphery-DB with `PASS_OUT = 1`, see below.

- at start-up of the F-System
- in the case of errors in the safety-oriented communication between F-CPU and measuring system via the PROFIsafe protocol
- if the value set for the `Window increments` under the `iParameters` is exceeded and/or the internally calculated PROFIsafe telegram is defective
- if the permissible operating temperature range, as defined under the corresponding article number, is fallen below or exceeded
- if the measuring system is supplied with >36 V DC for longer than 200 ms
- if the measuring system is disconnected in RUN mode, the F-Host is reconfigured and the measuring system is then reconnected

## 9.2 F-Periphery-DB

For each F-Periphery, measuring system and digital output module, an F-Periphery-DB is automatically generated during compilation in `HW Config`. With reference to the generated safety program, see chapter 8 “Safety Program Creation – Configuration Example“ on page 48, this is block `DB1638` for the measuring system and `DB1639` for the digital output module. The F-Periphery-DB contains variables which can be analyzed in the safety program and can or must be written. An exception is the variable `DIAG`, which may only be analyzed in the standard user program. Modification of the initial/current values of the variables directly in the F-Periphery-DB is not possible, as the F-Periphery-DB is `know-how-protected`.

The variables of the measuring system F-Periphery-DB must be accessed in the following cases:

- during operator acknowledgment of the measuring system after communication errors or after the start-up phase
- during execution of the preset adjustment function
- when analyzing whether passivated or cyclical data are output
- if the cyclical data of the AMPN(H) 41 I/O safety module are to be passivated depending on defined states of the safety program, e.g. group passivation

## 9.2.1 Measuring system F-Periphery-DB “DB1638” – Overview of variables

Variable	Data Type	Function	Access
PASS_ON	BOOL	1 = Passivation of the cyclical data of the AMPN(H) 41 I/O safety module via the safety program	Read/Write Default value: 0
ACK_NEC	BOOL	1 = Operator acknowledgment in the event of F-I/O faults	Read/Write Default value: 1
ACK_REI	BOOL	1 = Operator acknowledgment after communication errors or after the start-up phase	Read/Write Default value: 0
IPAR_EN	BOOL	Variable for execution of the preset adjustment 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 the operator acknowledgment	Read
IPAR_OK	BOOL	1 = Execution of preset adjustment function successfully completed	Read
DIAG	BYTE	Service information, only possible in the standard program	Read
QBAD_I_xx	BOOL	1 = Substitute values are output in input channel	Read
QBAD_O_xx	BOOL	1 = Substitute values are output in output channel	Read

### 9.2.1.1 PASS\_ON

With the variable `PASS_ON = 1` a passivation of the safety-oriented data of the AMPN(H) 41 I/O safety module can be activated, e.g. depending on defined states in the safety program. The passivation is not performed directly in the measuring system, instead the status of these variables is registered by the F-Host and the passivation is only activated by means of the safety program data. Cyclical data are still output by the measuring system! If a passivation is performed with `PASS_ON = 1`, the preset adjustment function is switched off.

### 9.2.1.2 ACK\_NEC

The official application of this variable would be an operator acknowledgment for the measuring system after F-I/O faults. However, for the measuring system no process is defined, for which this procedure is permissible. For safety reasons these faults must be removed first and then the supply voltage must be switched OFF/ON, **also see chapter 11 “Troubleshooting and Diagnosis Options“ on page 79.**

## 9.2.1.3 ACK\_REI

If a communication error is detected by the F-System for the measuring system, a passivation of the measuring system is performed.

For the operator acknowledgment of the measuring system after the elimination of errors a positive edge of variable `ACK_REI` of the F-Periphery-DB is required, which is linked to the input of the digital input module → I 16.0, symbol name: "RESET".

An operator acknowledgment is required:

- after communication errors
- after the start-up phase

An acknowledgment is only possible if the variable `ACK_REQ = 1`.

An operator acknowledgment must be provided for each F-Periphery in the safety program via the variable `ACK_REI`. This requirement has already been taken into account for the measuring system and digital output module.

## 9.2.1.4 IPAR\_EN

The variable `IPAR_EN` is used to execute the preset adjustment function. The process sequence for execution of this function is described in **chapter 10 "Preset Adjustment Function" on page 77**.

A precise description of when the variables must be set/reset during a re-parameterization of fail-safe DP standard slaves/IO standard devices can be found in the *PROFIsafe Specification* from V1.20, or the documentation on the fail-safe *DP Standard Slave/IO Standard Device*.



### NOTES!

No passivation of the measuring system is triggered by `IPAR_EN = 1`! With reference to the preset execution, the warning note contained in **chapter 10 "Preset Adjustment Function" on page 77** must be observed!

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

The variables `PASS_OUT = 1` and `QBAD = 1` indicate that a passivation of the measuring system is present.

The F-System sets `PASS_OUT`, `QBAD`, `QBAD_I_xx` and `QBAD_O_xx = 1`, while the measuring system outputs substitute values (0) instead of cyclical values.

If a passivation is performed via the variable `PASS_ON = 1`, only `QBAD`, `QBAD_I_xx` and `QBAD_O_xx = 1` are set. However `PASS_OUT` does not change its value for a passivation via `PASS_ON = 1`. `PASS_OUT` can therefore be used for the group passivation of further F-Peripheries.

## 9.2.1.6 ACK\_REQ

If a communication error is detected by the F-System for the measuring system, a passivation of the measuring system is performed. `ACK_REQ = 1` indicates that an operator acknowledgment for the measuring system is required.

The F-System sets the variable `ACK_REQ = 1` as soon as the error has been eliminated and an operator acknowledgment is possible. After the acknowledgment the variable `ACK_REQ` is reset to 0 by the F-System.

### 9.2.1.7 IPAR\_OK

The variable `IPAR_OK` is used to indicate successful execution of the preset adjustment function. The process sequence for execution of this function is described in chapter 10 "Preset Adjustment Function" on page 77.

A precise description of how the variable can be analyzed in the event of a re-parameterization of fail-safe DP standard slaves/IO standard devices can be found in the *PROFIsafe Specification* from V1.20, or the documentation on the fail-safe *DP Standard Slave/IO Standard Device*.

### 9.2.1.8 DIAG

The `DIAG` variable provides non-fail-safe information of 1 byte on errors that have occurred, for service purposes. Access to this variable in the safety program is not permitted!

The coding and use of this variable can be found in the SIEMENS manual **S7 Distributed Safety - Configuring and Programming**, document order number: **A5E00109537-04**.

## 9.3 Access to variables of the F-Periphery-DB

For each F-Periphery, measuring system and digital output module, an `F-Periphery-DB` is generated automatically during compilation in `HW Config` and a symbolic name is entered in the symbol table at the same time.

The symbolic name is formed from the fixed prefix "F", the initial address of the F-Periphery and the name entered for the F-Periphery in `HW Config` in the `Object Properties`, max. 17 characters.

Variables of the `F-Periphery-DB` of an F-Periphery may only be accessed from an F-Runtime Group and only from the F-Runtime Group from which the channels of this F-Periphery are accessed, when access is available.

The variables of the `F-Periphery-DB` can be accessed by specifying the symbolic name of the `F-Periphery-DB` and the name of the variable: "fully qualified DB access".

It must be ensured in `SIMATIC Manager`, that in the `FBD/LAD Editor` in the menu `Options` → `Customize` in the `General` register the option "Report cross-accesses as error" is not activated. Otherwise access to variables of the `F-Periphery-DB` will not be possible.

## 9.4 Passivation and Operator acknowledgment of the measuring system

### 9.4.1 After start-up of the F-System

After a start-up of the F-System, the communication between F-CPU and measuring system via the PROFIsafe protocol must first be established. A passivation of the measuring system occurs during this time.

During use of the substitute values (0), the variables `QBAD`, `PASS_OUT`, `QBAD_I_xx` and `QBAD_O_xx` = 1.

The operator acknowledgment of the measuring system, i.e. the output of cyclical data at the fail-safe outputs, automatically occurs, from the viewpoint of the F-Host, independently of the setting at the `ACK_NEC` variable, at the earliest from the 2nd cycle of the F-Runtime Group after start-up of the F-System. Depending on the cycle time of the F-Runtime Group and the PROFINET, the operator acknowledgment can only occur after a few cycles of the F-Runtime Group.

If the establishment of communication between F-CPU and measuring system takes longer than the monitoring time set in `HW Config` in the `Object Properties` for the F-Periphery, no automatic operator acknowledgment occurs. In this case a positive edge of variable `ACK_REI` of the F-Periphery-DB is required, which is linked to the input of the digital input module → I 16.0, symbol name: "RESET".

### 9.4.2 After communication errors

If the F-System detects an error in the safety-oriented communication between the F-CPU and measuring system via the PROFIsafe protocol, a passivation of the measuring system occurs.

During use of the substitute values (0), the variables `QBAD`, `PASS_OUT`, `QBAD_I_xx` and `QBAD_O_xx` = 1.

The operator acknowledgment of the measuring system, i.e. the output of cyclical data at the fail-safe outputs, only occurs if:

- no further communication errors are present, and the F-System has set the variable `ACK_REQ` = 1
- an operator acknowledgment with positive edge of variable `ACK_REI` of the F-Periphery-DB has occurred, which is linked to the input of the digital input module → I 16.0, symbol name: "RESET".

## 10 Preset Adjustment Function



### WARNING! NOTICE!

*Danger of death, serious physical injury and/or damage to property due to uncontrolled start-up of the drive system during execution of the preset adjustment function!*

- Execute preset function only in the standstill, **see chapter 6.5.2.4 “Idleness Tolerance Preset” on page 44.**
- The relevant drive systems must be locked to prevent automatic start-up.
- It is advisable to protect the preset triggering via the F-Host by means of additional protective measures, such as e.g. key-operated switch, password etc.
- The operational sequence described below is to be kept mandatorily. In particular the status bits are to be evaluated by the F-host, in order to check the successful and/or incorrect execution.
- The new position must be checked after execution of the preset function.

The preset adjustment function is used to set the currently output position value to any position value within the measuring range. The displayed position can thus be set to a machine reference position purely electronically.

The execution of the preset adjustment function is a critical process, as the resulting actual value jump, e.g. when using a controller, could cause uncontrolled machine movements. The preset adjustment function may therefore only be executed when the relevant system part is at a safe standstill.

After completion of the preset process, you must check that the position output by the measuring system matches the position transmitted to the measuring system.

The preset adjustment function is already locked in the measuring system and can only be activated via the variable `IPAR_EN` in the F-Periphery-DB `DB1638`. Even if all preconditions are fulfilled from the viewpoint of the F-Host, the preset adjustment function is only executed when the shaft of the measuring system is stationary. However, a certain edge jitter, e.g. caused by machine vibrations, is permitted within a certain tolerance window. This tolerance window can be set with the iParameter `Idleness tolerance Preset`, **see chapter 6.5.2.4 “Idleness Tolerance Preset” on page 44.**

## 10.1 Procedure

**Prerequisite: The measuring system is in cyclical data exchange.**

- Write the `Preset Multi-Turn` and `Preset Single-Turn` registers in the output data of the AMPN(H) 41 I/O safety module with the desired preset value.
- The F-Host must set the variable associated to the control bit `20 iPar_EN` to 1. With the rising edge, the measuring system is now switched ready to receive.
- With the rising edge of Bit `20 Preset_Request` in the `Controll` register, the preset value is accepted. The receipt of the preset value is acknowledged in the `Status` register by setting Bit `20 Preset_Status`.
- After receipt of the preset value, the measuring system checks that all prerequisites for execution of the preset adjustment function are fulfilled. If so, the preset value is written as the new position value. In case of error, the execution is rejected and an error message is output via the `Status` register by setting Bit `215 Error`.
- After successful execution of the preset adjustment function, the measuring system sets the variable associated to the status bit `20 iPar_OK` to 1 and thus indicates to the F-Host that the preset execution is complete.
- The F-Host must now reset the variable associated to the control bit `20 iPar_EN` to 0. The variable associated to the status bit `20 iPar_OK` and Bit `20 Preset_Status` in the `Status` register are thus also reset with the falling edge. Bit `20 Preset_Request` in the `Controll` register must be reset manually again.
- Finally, the F-Host must check that the new position corresponds to the new nominal position.

## 11 Troubleshooting and Diagnosis Options

### 11.1 Optical Displays

For assignment and position of the status LEDs see chapter 6.3 "Bus status display" on page 32.

#### 11.1.1 Device Status, LED1 Bicolor

Green	Cause	Remedy
OFF	Power supply absent	Check power supply, wiring
	Hardware error, measuring system defective	Replace measuring system
3 x 5 Hz repeating	<ul style="list-style-type: none"> <li>– Measuring system could not synchronize with the F-Host in the start-up phase and requests an operator acknowledgment</li> <li>– An error in the safety-oriented communication or a parameterization error was detected, and has been eliminated</li> </ul>	For the operator acknowledgment of the measuring system an acknowledgment about the safety program at the corresponding variable is required
ON	Measuring system ready for operation	–

Red	Cause	Remedy
ON	<b>A safety-relevant error was detected, the measuring system was put into fail-safe status and is outputting its passivated data:</b>	<b>In order to restart the measuring system after a passivation the error must generally be eliminated first of all and then the supply voltage switched OFF/ON.</b>
	Error in the safety-oriented communication	<ul style="list-style-type: none"> <li>– Try to localize the error with the aid of diagnosis variables (dependent on the control unit).</li> <li>– Check that the set value for the <code>F_WD_Time</code> parameter is suitable for the automation task, see chapter 6.5.1.7 "F_WD_Time" on page 43.</li> <li>– Check whether the PROFINET connection between F-CPU and measuring system is faulty.</li> </ul>
	The set value for the <code>Windows Increments</code> parameter was exceeded.	Check that the set value for the <code>Windows Increments</code> parameter is suitable for the automation task, see chapter 6.5.2.3 "Windows Increments" on page 44.
	The permissible operating temperature range was fallen below or exceeded.	Suitable measures must be taken to ensure that the permissible operating temperature range can be observed at all times.
	The measuring system was supplied with >36 V DC for longer than 200 ms.	The measuring system must be shut down immediately and checked in the factory. When sending the measuring system to the factory, the reasons and circumstances relating to the overvoltage must be specified.
	The internally calculated PROFIsafe telegram is defective.	Power supply OFF/ON. If the error persists after this measure, the measuring system must be replaced.

## 11.1.2 Bus Status, LED2

Red	Cause	Remedy
OFF	No error	–
0.5 Hz	<ul style="list-style-type: none"> <li>– F-Parameterization defective, e.g. incorrectly set PROFIsafe destination address F_Dest_Add</li> <li>– Incorrectly configured F_iPar_CRC value</li> </ul>	<ul style="list-style-type: none"> <li>– Check the PROFIsafe destination address set with the hardware switches. Valid PROFIsafe destination addresses: 1–99, see <b>chapter 5.3.4 “PROFIsafe Destination address “F_Dest_Add” on page 27.</b></li> <li>– The checksum calculated for the defined iParameter set is incorrect, or was not included in the projection, <b>see chapter 7 “Parameter Definition / CRC Calculation” on page 45.</b></li> </ul>
ON	No connection to the IO-Controller	Check Device name, IP-address and Subnet mask

## 11.1.3 Link Status, PORT1:LED3; PORT2:LED5

Green	Cause	Remedy
OFF	Voltage supply absent or too low	Check voltage supply and wiring
	No Ethernet connection	Check Ethernet cable
	Hardware error, measuring system defective	Replace measuring system
ON	Measuring system ready for operation, Ethernet connection established	–

## 11.2 PROFINET IO Diagnostic

PROFINET IO supports a continuous diagnostic concept, which makes possible an efficient fault locating and recovery. At occurrence of an error the faulty IO-Device generates a diagnostic alarm to the IO-Controller. This alarm calls a corresponding program routine in the user program to initiate a reaction to the error.

By means of record data, alternatively the diagnostic information can be read directly from the IO-Device and can be displayed on an IO-Supervisor.

### 11.2.1 Diagnostic alarm

Alarms are part of the acyclic frames which are transferred about the cyclical RT-channel. They are also indicated with the EtherType 0x8892.

The measuring system supports only manufacturer specific diagnostic alarms which can be identified about the *UserStructureIdentifier* 0x5555. After this identification a 4 byte error code (*user data*) follows. Here the first occurred error is reported, saved and is displayed about the LED “Device status, LED1 Bicolor”. The IOPS bit is set to *BAD*.

Because the measuring system can generate hundreds of error codes, these are not indicated here.

Error remedy see chapter “Optical displays”. If the error cannot be eliminated, the error code with information of the order number can be transmitted for evaluation to the company Johannes Hübner Gießen.

## 11.2.2 Diagnostic about Record Data

Diagnostic data can be requested also with an acyclic read service *RecordDataRead (DiagnosisData)*, if they were saved in the IO-Device.

For the requested diagnostic data from the IO-Controller a read service with the corresponding record index must be sent.

The diagnostic information is evaluated on different addressing levels:

- AR (Application Relation)
- API (Application Process Identifier)
- Slot
- Subslot

A group of diagnostic records are available at each addressing level. The exact structure and the respective size is indicated in the PROFINET specification *Application Layer protocol for decentralized periphery and distributed automation*, order no.: 2.722.

Synonymously to the manufacturer specific diagnostic alarm, the diagnostic data can be read also manually about the record index 0xE00C. Similar as in the case of a diagnostic alarm a saved error is indicated with the *UserStructureIdentifier* 0x5555. Immediately afterwards the error code is transferred, see diagnostic alarm above.

## 11.3 Data status

With cyclic Real-Time communication the transferred data contains a status message. Each subslot has its own status information: *IOPS/IOCS*.

This status information indicates whether the data are valid = *GOOD* (1) or invalid = *BAD* (0).

During parameterization, as well as in the boot-up phase the output data can change to *BAD* for a short time. With a change back to the status *GOOD* a "Return-Of-Submodule-Alarm" is transferred.

In the case of a diagnostic alarm the status is also set to *BAD*, but can be reset only with a re-start.

Example: Input data IO-Device → IO-Controller

VLAN	Ethertype	Frame-ID	Data	IOPS	...	IOPS	...	Cycle	Data Status	Transfer Status	CRC
4	0x8892	2	1..	1		1		2	1	1	4

Example: Output data IO-Controller → IO-Device

VLAN	Ethertype	Frame-ID	IOCS	IOCS	...	Data	IOPS ...	Data... IOCS	Cycle	Data Status	Transfer Status	CRC
4	0x8892	2	1..	1		1...		1..	2	1	1	4

## 11.4 Return of Submodule Alarm

By the measuring system a so-called "Return-of-Submodule-Alarm" is reported if

- the measuring system for a specific input element can provide valid data again and in which it is not necessary to execute a new parameterization
- or if an output element can process the received data again.

In this case the status for the measuring system (submodule) IOPS/IOCS changes from the condition "BAD" to "GOOD".

## 11.5 Information & Maintenance

### 11.5.1 I&M0, 0xAFF0

The measuring system supports the I&M-Function “**I&M0 RECORD**” (60 byte), like PROFIBUS “Profile Guidelines Part 1”.

I&M-Functions specify the way how the device specific data, like a nameplate, must be created in a device.

The I&M record can be read with an acyclic read service.

The record index is 0xAFF0, the read service is sent to module 1 / submodule 1.

The received 60 bytes have the following contents:

Contents	Number of bytes
Manufacturer specific (block header type 0x20)	6
Manufacturer_ID	2
Order_ID	20
Serial no. (internal)	16
Hardware revision	2
Software revision	4
Revision state	2
Profile-ID	2
Profile-specific type	2
I&M version	2
I&M support	2

## 12 Replacing the measuring system

The following points must be noted when replacing the measuring system:

- The new measuring system must have the same order number as the measuring system being replaced; any deviations must be expressly clarified with Johannes Hübner Gießen.
- It must be ensured that the PROFIsafe destination address set via hardware switch for the new measuring system matches the previous PROFIsafe destination address.
- The measuring system must be installed in accordance with the specifications and requirements in **chapter 4 “Assembly” on page 17**.
- The new measuring system must be connected in accordance with the specifications in **chapter 5.3 “Connection” on page 25**.
- As the F-Parameters and iParameters of the measuring system are stored in the safety program of the control, the new measuring system is parameterized with the projected settings in the start-up phase.
- If the project does not support a neighbourhood detection, in case of a device replacement it must be ensured that the device name assigned before also is assigned to the new device. When the system boots up the device name is detected again and the new MAC-Address and IP-Address is assigned to the device name automatically.
- When recommissioning the replaced measuring system, correct functioning must be ensured first of all by means of a protected test run.

## 13 Checklist

We recommend that you print out and work through the checklist for commissioning, replacing the measuring system and when changing the parameterization of a previously accepted system and store it as part of the overall system documentation.

Documentation reason		Date	Edited	Checked
Sub-item	To note	Can be found under		Yes
Present user manual has been read and understood.			Document no.: AMPN(H)41_MANUAL- en_R12	<input type="checkbox"/>
Check that the measuring system can be used for the present automation task on the basis of the specified safety requirements.	<ul style="list-style-type: none"> <li>Intended use</li> <li>Compliance with all technical data</li> </ul>		Chapter 2.3 <i>Intended use</i> Page 12  Chapter 14 <i>Technical data</i> page 84	<input type="checkbox"/>
Fulfillment of the installation requirements defined in the user manual	Safe mechanical fixing of the measuring system and safe positive connection of the driving shaft with the measuring system		chapter 4 <i>Assembly</i> page 17	<input type="checkbox"/>
Requirements for the power supply	The power supply used must meet the requirements of SELV/PELV (IEC 60364-4-41:2005).		Chapter 5.3.1 <i>Supply voltage</i> page 25	<input type="checkbox"/>
Correct PROFINET installation	Observance of the international standards valid for PROFINET / PROFI-safe or the directives specified by the PROFIBUS User Organization		Chapter 5 <i>Installation / Preparation for Commissioning</i> page 23  Chapter 6 <i>Commissioning</i> page 30	<input type="checkbox"/>
System test after commissioning and parameter changes	During commissioning and after each parameter change all affected safety functions must be checked		Chapter 6.5 <i>Parameterization</i> page 42	<input type="checkbox"/>
Preset Adjustment Function	The preset adjustment function may only be executed when the affected axis is stationary. It must be ensured that the preset adjustment function cannot be inadvertently triggered. After execution of the preset adjustment function the new position must be checked before restarting.		Chapter 10 <i>Preset Adjustment Function</i> page 77	<input type="checkbox"/>
Device replacement	It must be ensured that the new device corresponds to the replaced device. All affected safety functions must be checked.		Chapter 6.5 <i>Parameterization</i> page 42  Chapter 12 <i>Replacing the measuring system</i> page 82	<input type="checkbox"/>

## 14 Technical data

### 14.1 Safety

<b>Functional safety</b>	
EN 61508 Part 1-7:2010	<b>Safety Integrity Level (SIL):</b> CL3
EN ISO 13849-1:2008/AC:2009	<b>Performance Level (PL):</b> e
<b>Startup time</b> Overall system	Time between POWER-UP and safe position output ≤ 7 s with SIMATIC S7, CPU317F-2
<b>PFH, "High demand" operating mode</b>	$1.46 * 10^{-9}$ 1/h
<b>PFD<sub>av</sub> (T<sub>1</sub> = 20 a)</b>	$1.27 * 10^{-4}$
<b>MTTF<sub>d</sub> high</b>	421 a
<b>* DC<sub>avg</sub> high</b>	95 %
<b>Internal process safety time</b> Overall system	Time between occurrence of an F-Error and alarm indication ≤ 6.5 ms
<b>Process safety angle</b> Through channel comparison	Angle between error occurrence and alarm indication Parameterizable with iParameter Windows Increments
<b>T<sub>1</sub>, Proof test</b>	20 years

\* The assessment occurred in accordance with Note 2 on Table 6 of EN ISO 13849-1.

### 14.2 Electrical characteristics

#### 14.2.1 General

<b>Supply voltage</b>	13...27 V DC acc. to IEC 60364-4-41, SELV/PELV For UL and CSA Class 2 supplied
Feed	single feed input, but electrically separated internally by means of two power supplies
Reverse polarity protection	yes
Short-circuit protection	yes, by internal 2 A safety fuse
Overvoltage protection	yes, up to ≤ 36 V DC
<b>Current consumption without load</b>	< 180 mA at 24 V DC
Option HTL-Level, 13...27 V DC	Increased current consumption, see page 29

## 14.2.2 Device-specific

<b>Total resolution</b>	≤ 28 bit
Single-Turn functional	≤ 13 bit (8192 steps/revolution)
Single-Turn safety oriented	8 bit (256 steps/revolution)
Multi-Turn	≤ 15 bit (32768 revolutions)
<b>Safety principle</b>	2 redundant scanning units with internal triangulation
<b>PROFINET IO interface</b>	according to IEC 61158 und IEC 61784
PROFIsafe profile	3.192b according to IEC 61784-3-3
Additional functions	Preset
Parameter (parameterizable via PROFINET IO)	
– Integration Time Safe	50 ms...500 ms
– Integration Time Unsafe	5 ms...500 ms
– Size of monitoring window	50...4000 increments
– Idleness tolerance preset	1...5 increments/Integration Time Safe
– Counting direction	forward, backward
PROFINET specification	V2.2
Software stack	V3.2.0.1
Conformance class	Conformance Class B, C
Physical Layer	PROFINET 100Base-TX, Fast Ethernet, ISO/IEC 8802-3
Output code	Binary
Cycle time	≥ 1 ms (IRT / RT)
Transmission rate	100 Mbit/s
Transmission	CAT-5 cable, shielded (STP), ISO/IEC 11801
Addressing (parameterizable via PROFINET IO)	Per Name (name allocation about engineering tool). Assignment Name→MAC during system boot
Real-Time-Classes	RT Class 1 Frames (RT), RT Class 2 Frames (RT), RT Class 3 Frames (IRT)
JHG-specific functions (parameterizable via PROFINET IO)	Speed output in increments/Integration Time Safe
<b>Incremental interface</b>	Signals twisted in pairs and shielded
Incremental output without reference pulse	4096 pulses/revolution
A, /A, B, /B, TTL	RS422 (2-wire) according to EIA standard
A, /A, B, /B, HTL	Optional 13 ...27 V DC, see page 29
Output frequency, TTL	≤ 500 kHz
Output frequency, HTL	See page 29
<b>Cycle time</b>	
Not safety-oriented	0.5 ms, output via AMPN(H)41 I/O module
Safety-oriented	5 ms, output via AMPN(H)41 I/O safety module
Preset write cycles	≥ 4 000 000

## 14.3 Environmental conditions

<b>Vibration</b>	
EN 60068-2-6:2008	≤ 100 m/s <sup>2</sup> , sine 55...500 Hz
<b>Shock</b>	
EN 60068-2-27:2009	≤ 1000 m/s <sup>2</sup> , half-sine 11 ms
<b>EMC</b>	
Immunity to disturbance	EN 61000-6-2:2005
Transient emissions	EN 61000-6-3:2007
<b>Operating temperature (housing surface temperature)</b>	-25 °C...+70 °C
<b>Storage temperature</b>	-30 °C...+60 °C, dry
<b>Relative air humidity, EN 60068-3-4:2002</b>	98 %, non condensing
<b>Degree of protection, EN 60529:2000</b> (valid with screwed-on mating connector)	IP54 with labyrinth seal IP66 with axial shaft seal (UL/CSA Type 1)

## 14.4 Mechanical characteristics

### 14.4.1 AMPN 41

<b>Mechanically permissible speed</b>	
– Degree of protection IP54	≤ 6000 min <sup>-1</sup>
– Degree of protection IP66	≤ 4000 min <sup>-1</sup>
<b>Shaft load, at the shaft end</b>	≤ 100 N axial, ≤ 120 N radial
<b>Bearing life time L<sub>10</sub>, ISO 281:2007</b>	≥ 1.1 * 10 <sup>11</sup> revolutions at
– Speed	6000 min <sup>-1</sup>
– Operating temperature	70 °C
– Shaft load, at the shaft end	100 N axial, 120 N radial
<b>Bearing grease life time</b>	10 years at
– Speed	6000 min <sup>-1</sup>
– Operating temperature	70 °C
<b>Permissible angular acceleration</b>	≤ 10 <sup>4</sup> rad/s <sup>2</sup>
<b>Moment of inertia</b>	
– Degree of protection IP54	ca. 400 gcm <sup>2</sup>
– Degree of protection IP66	ca. 330 gcm <sup>2</sup>
<b>Breakaway torque</b>	
– Degree of protection IP54	ca. 2.0 Ncm
– Degree of protection IP66	ca. 3.5 Ncm
<b>Mass</b>	
– Construction type B5	ca. 3.0 kg
– Construction type B35	ca. 3.5 kg

**14.4.2 AMPNH 41**

<b>Mechanically permissible speed</b>	
– Degree of protection IP54	≤ 4000 min <sup>-1</sup>
– Degree of protection IP66	≤ 2000 min <sup>-1</sup>
<b>Shaft load</b>	Own mass
<b>Bearing life time L<sub>10</sub>, ISO 281:2007</b>	≥ 3.9 * 10 <sup>11</sup> revolutions at
– Speed	4000 min <sup>-1</sup>
– Operating temperature	70 °C
<b>Bearing grease life time</b>	12 years at
– Speed	4000 min <sup>-1</sup>
– Operating temperature	70 °C
<b>Permissible angular acceleration</b>	≤ 10 <sup>4</sup> rad/s <sup>2</sup>
<b>Moment of inertia</b>	
– Degree of protection IP54	ca. 1085 gcm <sup>2</sup>
– Degree of protection IP66	ca. 785 gcm <sup>2</sup>
<b>Breakaway torque</b>	
– Degree of protection IP54	ca. 2.0 Ncm
– Degree of protection IP66	ca. 7.0 Ncm
<b>Mass</b>	ca. 3.1 kg

## 15 Maintenance



### WARNING!

**At inspection of the measuring system and the mounting, the basic safety instructions contained in chapter 2 must be observed.**

The inspection of the measuring system and the mounting must only be carried out by qualified personnel!

The device is maintenance-free. However, to guarantee safe and fault-free operations we recommend that you carry out the following inspections of the measuring system and the mounting on a regular basis. Inspections must be recorded in a log book.

Interval	Inspections
Yearly	Inspect the coupling for damage and ensure it is properly tightened and free of play.
	Ensure the fastening screws are properly tightened.
	Check the torque bracket (applies to hollow shaft devices only): check link heads can move freely. You must be able to move the link rod manually. If it proves difficult to move, lightly oil the link rod heads or apply lubricant spray.
After approx. 16 000 – 20 000 hours of operation or higher levels of continuous load	Check deep groove ball bearings for noise, running smoothly. Bearings must be replaced by the manufacturer only.

## 16 Appendix

### 16.1 References

1st	IEC/PAS 62411	Real-time Ethernet PROFINET IO International Electrotechnical Commission
2nd	IEC 61158	Digital data communications for measurement and control - Fieldbus for use in industrial control systems
3rd	IEC 61784	Digital data communications for measurement and control - Fieldbus for use in industrial control systems - Profile sets for continuous and discrete manufacturing relative to fieldbus use in industrial control systems
4th	ISO/IEC 8802-3	Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications
5th	IEEE 802.1Q	IEEE Standard for Priority Tagging
6th	IEEE 1588-2002	IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems
7th	PROFINET Guideline	PROFIsafe – Environmental Requirements Order no.: 2.232
8th	PROFIBUS Guideline	Profile Guidelines Part 1: Identification & Maintenance Functions. Order no.: 3.502
9th	PROFINET Guideline	Design Guideline Order no.: 8.061
10th	PROFINET Guideline	Installation Guideline for Cabling and Assembly Order no.: 8.071
11th	PROFINET Guideline	Installation Guideline for Commissioning Order no.: 8.081

## 16.2 Abbreviations and terms used

0x	Hexadecimal representation
AMPN 41	Absolute encoder with redundant dual scanning, solid shaft design
AMPNH 41	Absolute encoder with redundant dual scanning, hollow shaft design
AMPN(H) 41	Absolute encoder with redundant dual scanning, all designs
B35	Construction type with flange and foot
B5	Construction type with flange
CAT	<b>Category:</b> Organization of cables, which is used also in connection with Ethernet.
CRC	<b>Cyclic Redundancy Check</b>
DC <sub>avg</sub>	<b>D</b> iagnostics <b>C</b> overage Average diagnostic coverage
EC	<b>E</b> uropean <b>C</b> ommunity
EMC	<b>E</b> lectro <b>M</b> agnetic <b>C</b> ompatibility
Engineering tool	Projection and commissioning tool
ESD	<b>E</b> lectro <b>S</b> tatic <b>D</b> ischarge
F	Generally stands for the term safety or fail-safe
F-Device	Safety device for safety applications
Fault exclusion	Compromise between the technical safety requirements and the theoretical possibility of an error occurring
F-Host	Safety control for safety applications
FMEA	<b>F</b> ailure <b>M</b> ode and <b>E</b> ffects <b>A</b> nalysis, reliability engineering methods, for finding potential weak points
Functional safety	Part of the overall system safety, which depends on the correct functioning of safety-related systems for risk reduction. Functional safety is ensured when each safety function is executed as specified.
GSD	Device Master File
GSDML	<b>G</b> eneral <b>S</b> tation <b>D</b> escription <b>M</b> arkup <b>L</b> anguage
I&M	<b>I</b> dentification & <b>M</b> aintenance
IEC	<b>I</b> nternational <b>E</b> lectrotechnical <b>C</b> ommission
IEEE	<b>I</b> nstitute of <b>E</b> lectrical and <b>E</b> lectronics <b>E</b> ngineers
IOCS	<b>IO</b> <b>C</b> onsumer <b>S</b> tatus: Thus the Consumer of an IO Data Element signals the condition (good, bad with error location)
IOPS	<b>IO</b> <b>P</b> rovider <b>S</b> tatus: Thus the Provider of an IO Data Element signals the condition (good, bad with error location)
IP	<b>I</b> nternet <b>P</b> rotocol
IRT	<b>I</b> synchronous <b>R</b> eal- <b>T</b> ime communication
ISO	<b>I</b> nternational <b>S</b> tandard <b>O</b> rganization
JHG	Johannes Hübner Gießen
MAC	<b>M</b> edia <b>A</b> ccess <b>C</b> ontrol, <b>E</b> thernet-ID
MTTF <sub>d</sub>	<b>M</b> ean <b>T</b> ime <b>T</b> o <b>F</b> ailure (dangerous) Mean time until dangerous failure

NRT	<b>Non-Real-Time</b> communication
Operator Acknowledgment	Switching from substitute values to process data
PAS	<b>Publicly Available Specification</b>
Passivation	In the case of an F-Periphery with outputs, the F-System transmits substitute values (e.g. 0) to the fail-safe outputs during a passivation instead of the output values provided in the process image by the safety program.
PFD <sub>av</sub>	<b>Average Probability of Failure on Demand</b> Average probability of failure of a safety function with low demand
PFH	<b>Probability of Failure per Hour</b> Operating mode with high requirement rate or continuous demand. Probability of dangerous failure per hour.
PNO	PROFIBUS User Organization ( <b>PROFIBUS NutzerOrganisation e.V.</b> )
PROFIBUS	Manufacturer independent, open field bus standard
PROFINET	PROFINET is the open Industrial Ethernet Standard of the PROFIBUS User Organization for the automation.
Proof test	Recurring check for detection of hidden dangerous failures in a safety-related system.
RT	<b>Real-Time</b> communication
SIL	<b>Safety Integrity Level</b> : Four discrete levels (SIL1 to SIL4). The higher the SIL of a safety-related system, the lower the probability that the system cannot execute the required safety functions.
SIS	<b>Safety Instrumented System</b> : is used to protect a dangerous process and reduce the risk of an accident. Process instruments are a constituent of a Safety Instrumented System. This comprises the essential components of a complete safety-relevant process unit: Sensor, fail-safe processing unit (control) and actuator
Slot	Plug-in slot: can be meant also in the logical sense as addressing of modules.
SNMP	<b>Simple Network Management Protocol</b>
STP	<b>Shielded Twisted Pair</b>
Subslot	Addressing of data
TCP	<b>Transmission Control Protocol</b>
UDP	<b>User Datagram Protocol</b>
VDE	Verein <b>Deutscher Elektrotechniker</b> (Association of German Electrotechnicians)
XML	<b>EXtensible Markup Language</b>

## 16.3 TÜV certificate

### EC Type-Examination Certificate





Product Safety  
Functional  
Safety

www.tuv.com  
ID 0600000000

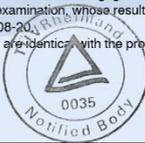
**Reg.-Nr./No.: 01/205/5422.02/21**

<b>Prüfgegenstand</b> Product tested	Sicheres absolutes Multiturn-Winkelmesssystem mit PROFIsafe-Schnittstelle Safe absolute Multiturn Rotary Encoder with PROFIsafe Interface	<b>Zertifikatsinhaber</b> Certificate holder	Johannes Hübner Fabrik elektrischer Maschinen GmbH Siemensstr. 7 35394 Gießen Germany
<b>Typbezeichnung</b> Type designation	AMP 41 K-1315, AMPH 41 K-1315 (PROFIBUS-DP), AMPN 41 K-1315, AMPNH 41 K-1315 (PROFINET IO)		
<b>Prüfgrundlagen</b> Codes and standards	EN 61800-5-2:2007 EN 61800-5-2:2017 EN 602061:2005 + AC:2010 + A1:2013 + A2:2015	EN ISO 13849-1:2015 EN ISO 13849-1:2015 EN ISO 13849-1:2015	
<b>Bestimmungsgemäße Verwendung</b> Intended application	Erfassung der Absolutposition an rotierenden Maschinen. Die Geräte erfüllen die Anforderungen der Prüfgrundlagen (SIL3 / SILCL 3 nach EN 61800-5-2 / EN 61508 / EN 62061, Kat. 4 / PL e nach EN ISO 13849-1) und können in Anwendungen bis PL e nach EN ISO 13849-1 und SIL 3 nach EN 62061 / EN 61508 und im Anwendungsbereich der EN 60204-1:2018 eingesetzt werden. Acquisition of the absolute position at rotating machines. The devices comply with the requirements of the relevant standards (Cat. 4 / PL e acc. to EN ISO 13849-1, SILCL 3 / SIL 3 acc. to EN 62061 / EN 61508, EN 61800-5-2) and can be used in applications up to PL e acc. to EN ISO 13849-1 and SIL 3 acc. to EN 62061 / EN 61508 and in the application area of EN 60204-1:2018.		
<b>Besondere Bedingungen</b> Specific requirements	Die Hinweise in der zugehörigen Installations- und Betriebsanleitung sind zu beachten. The instructions of the associated Installation and Operating Manual shall be considered.		

Es wird bestätigt, dass der Prüfgegenstand mit den Anforderungen nach Anhang I der Richtlinie 2006/42/EG über Maschinen übereinstimmt.  
It is confirmed that the product under test complies with the requirements for machines defined in Annex I of the EC Directive 2006/42/EC.

Gültig bis / Valid until 2026-08-25

Der Ausstellung dieses Zertifikates liegt eine Prüfung zugrunde, deren Ergebnisse im Bericht Nr. 968/FSP 1061.03/21 vom 20.08.2021 dokumentiert sind.  
Dieses Zertifikat ist nur gültig für Erzeugnisse, die mit dem Prüfgegenstand übereinstimmen.  
The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/FSP 1061.03/21 dated 2021-08-20.  
This certificate is valid only for products which are identical with the product tested.



Köln, 2021-08-25

Notified Body for Machinery, NB 0035



Dipl.-Ing. Jelena Stenzel

TÜV Rheinland Industrie Service GmbH, Am Grauen Stein, 51105 Köln / Germany  
Tel.: +49 221 806-2434, Fax: +49 221 806-1354, E-Mail: industrie-service@ds.tuv.com

10222 12, E A4 © TÜV, TÜV und TÜV are registered trademarks. Utilisation and application requires prior approval.

www.fs-products.com  
www.tuv.com

 **TÜVRheinland®**  
Precisely Right.

16.4 PROFINET IO certificate



**Certificate**

PROFIBUS Nutzerorganisation e.V. grants to

**Johannes Hübner Fabrik elektrischer Maschinen GmbH**  
Siemensstrasse 7, 35394 Giessen, Germany

the Certificate No: **Z10716** for the PROFINET IO Device:

Model Name: AMPN(H)41  
Revision: SW/FW: V1.0.9; HW: 1  
Identnumber: 0x024A; 0x03E8  
GSD: GSDML-V2.3-HU-024A-AMPN(H)41-20150424.xml  
DAP: IDD\_1: AMPN(H)41, 0x00000001

This certificate confirms that the product has successfully passed the certification tests with the following PROFINET scope:

<input checked="" type="checkbox"/> Hardware	Auto_Negotiation, Auto_Polarity, Auto_Crossover
<input checked="" type="checkbox"/> Conformance Class B, C	RT_CLASS_1, RT_CLASS_2, RT_CLASS_3, RTA, LLDP, SNMP, MIB-II, LLDP-MIB

Test Report Number: PN277-1, IRT060-1  
Authorized Test Laboratory: Siemens AG, Fürth, Germany

The tests were executed in accordance with the following documents:  
 "Test Specifications for PROFINET IO devices, Version 2.2.4 from December 2010" and  
 "Test Cases for PN-Tester for PROFINET IO devices, Version 2.2.4.16.21",  
 "Test Specifications for PROFINET IO devices, Version V2.2.4 from December 2010",  
 "PROFINET IO IRT Test Cases V2.2.4.2 from December 2010", "test system V2.2.4.16.21 with annex spirta 2.4.2.212".

This certificate is granted according to the document:  
 "Framework for testing and certification of PROFIBUS and PROFINET products".  
 For all products that are placed in circulation by **March 12, 2023** the certificate is valid for life.

Karlsruhe, March 20, 2020

Board of PROFIBUS Nutzerorganisation e. V.

(Official in Charge)



(Karsten Schneider)

(Dr. Jörg Hähnliche)

## 16.5 PROFIsafe certificate



### Certificate

PROFIBUS Nutzerorganisation e.V. grants to

**Johannes Hübner Fabrik elektrischer Maschinen GmbH**  
Siemensstrasse 7, 35394 Giessen, Germany

the Certificate No: **Z20115** for the PROFIsafe Module:

Model Name: AMPN(H)41  
Order-Number: AMPN(H)41  
Revision: -; SW: V1.0.8; HW: 1  
Application CRC: Channel A: 0x8D1473B1  
Channel B: 0x53598149

This certificate confirms that the product has successfully passed the certification tests with the following PROFIsafe scope:

PROFIsafe\_V2 functionality on PROFINET IO

Test Report Number: PS073-1  
Authorized Test Laboratory: SIEMENS AG, Fürth, Germany

The tests were executed in accordance with the following documents:  
"PROFIsafe - Test Specification for F-Slaves, F-Devices, and F-Hosts, Version 2.1, March 2007".

This certificate is granted according to the document:  
"Framework for testing and certification of PROFIBUS and PROFINET products".

For all products that are placed in circulation by **March 12, 2023** the certificate is valid for life.

Karlsruhe, March 20, 2020

Board of PROFIBUS Nutzerorganisation e. V.

(Official in Charge)



(Karsten Schneider)

(Dr. Jörg Hähnliche)

## 16.6 UKCA certificate

### UK Type-Examination Certificate

For UK Regulations SI 2008 No. 1597  
The Supply of Machinery Regulations 2008

**Reg.-No.: 01/205U/5422.00/22**

<b>Product tested</b>	Safe absolute Multiturn Rotary Encoder with PROFIsafe Interface	<b>Certificate holder</b>	Johannes Hübner Fabrik elektrischer Maschinen GmbH Siemensstr. 7 35394 Gießen Germany						
<b>Type designation</b>	AMP 41 K-1315, AMPH 41 K-1315 (PROFIBUS-DP), AMPN 41 K-1315, AMPNH 41 K-1315 (PROFINET IO)								
<b>Codes and standards</b>	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">EN 61800-5-2:2007</td> <td style="width: 50%;">EN ISO 13849-1:2015</td> </tr> <tr> <td>EN 61800-5-2:2017</td> <td>EN 61508 Parts 1-7:2010</td> </tr> <tr> <td>EN 62061:2005 + AC:2010 + A1:2013 + A2:2015</td> <td></td> </tr> </table>			EN 61800-5-2:2007	EN ISO 13849-1:2015	EN 61800-5-2:2017	EN 61508 Parts 1-7:2010	EN 62061:2005 + AC:2010 + A1:2013 + A2:2015	
EN 61800-5-2:2007	EN ISO 13849-1:2015								
EN 61800-5-2:2017	EN 61508 Parts 1-7:2010								
EN 62061:2005 + AC:2010 + A1:2013 + A2:2015									
<b>Intended application</b>	Acquisition of the absolute position at rotating machines. The devices comply with the requirements of the relevant standards (Cat. 4 / PL e acc. to EN ISO 13849-1, SILCL 3 / SIL 3 acc. to EN 62061 / EN 61508, EN 61800-5-2) and can be used in applications up to PL e acc. to EN ISO 13849-1 and SIL 3 acc. to EN 62061 / EN 61508 and in the application area of EN 60204-1:2018.								
<b>Specific requirements</b>	The instructions of the associated Installation and Operating Manual shall be considered.								
	<p>This product is in conformity with all requirements of SCHEDULE 2, PART 1 (Annex I) of SI 2008 No. 1597. This Type-Examination certificate refers to an evaluation of the above mentioned product as stipulated in SCHEDULE 2, PART 9 (Annex IX) of SI 2008 No. 1597.</p>								
<b>Valid until</b>	2026-08-25								
	<p>The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/FSP 1061.04/22 dated 2022-12-21. This certificate is valid only for products which are identical with the product tested.</p>								
<b>Köln, 2022-12-22</b>	TÜV Rheinland UK Ltd.								
	Approved Body for Machinery, No. 2571	Dipl.-Ing. Gebhard Bouwer							

4.08.E.4.4 © TÜV, TÜV and TÜV are registered trademarks. Utilization and application requires prior approval.

TÜV Rheinland UK Ltd., Friars Gate (Third Floor), 1011 Stratford Road, Shirley, Solihull B90 4BN / United Kingdom  
Tel.: +44 (0)121 795 8400, E-Mail: UKCA@uk.tuv.com, Web: https://www.tuv.com/united-kingdom/en/

www.fs-products.com  
www.tuv.com

**TÜVRheinland®**  
Precisely Right.

## 16.7 Accessories

The scope of delivery includes a data CD which may also be requested separately:

**AMP(H) 41 / AMPN(H) 41 Software and Support CD**, order no.: **ID 21771**

Content:

- Connection diagrams
- CRC tool
- Data sheets
- Dimension drawings
- GSD and XML files
- User manuals

---

**Mounting kit friction-enhancing shims**, order no.: **ID 22364**

for enhancing friction in screw connections

4 pcs. shims  $\varnothing 18/7,5 \times 0,18$  mm  
with friction-enhancing nickel diamond coating EKagrip® 35

(not included in the scope of delivery)

---

**Draw-off-tool**, order no.: **ID 11193**



for hollow shaft encoder AMPNH 41

(not included in the scope of delivery)

---

**Sealing kit**, order no.: **ID 22403**

Content:

- 2 x Sealing cap, brass nickel-plated, M12x1 internal thread with O-ring, IP67
- 3 x, Screw plug, Al, M12x1 external thread without O-ring, IP67
- 3 x O-ring DIN 3771 7x1 NBR 70 SHORE, suitable for screw plug with external thread



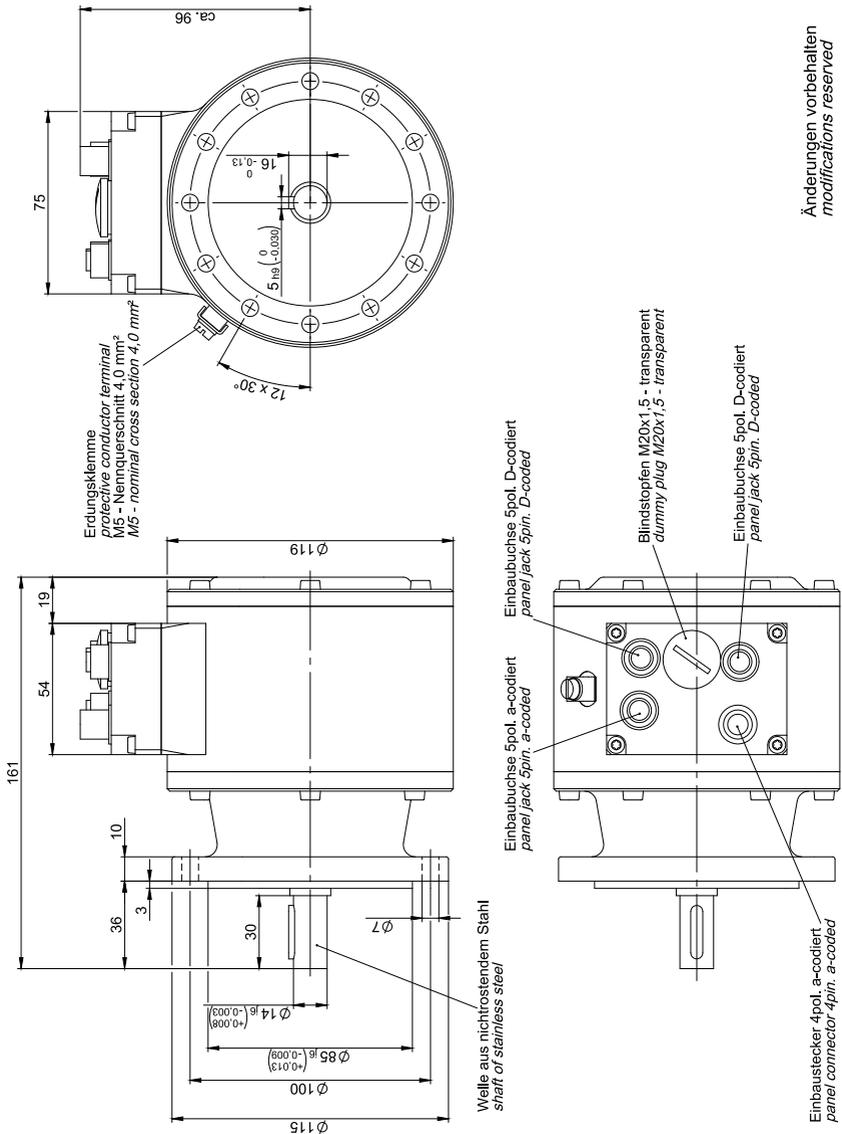
for the protection of unused sockets against moisture

(not included in the scope of delivery)

## 16.8 Dimension drawings

Further dimension drawings on our website or on request.

### 16.8.1 AMPN 41, construction type B5 (flange)



Änderungen vorbehalten  
modifications reserved

AMPN 41

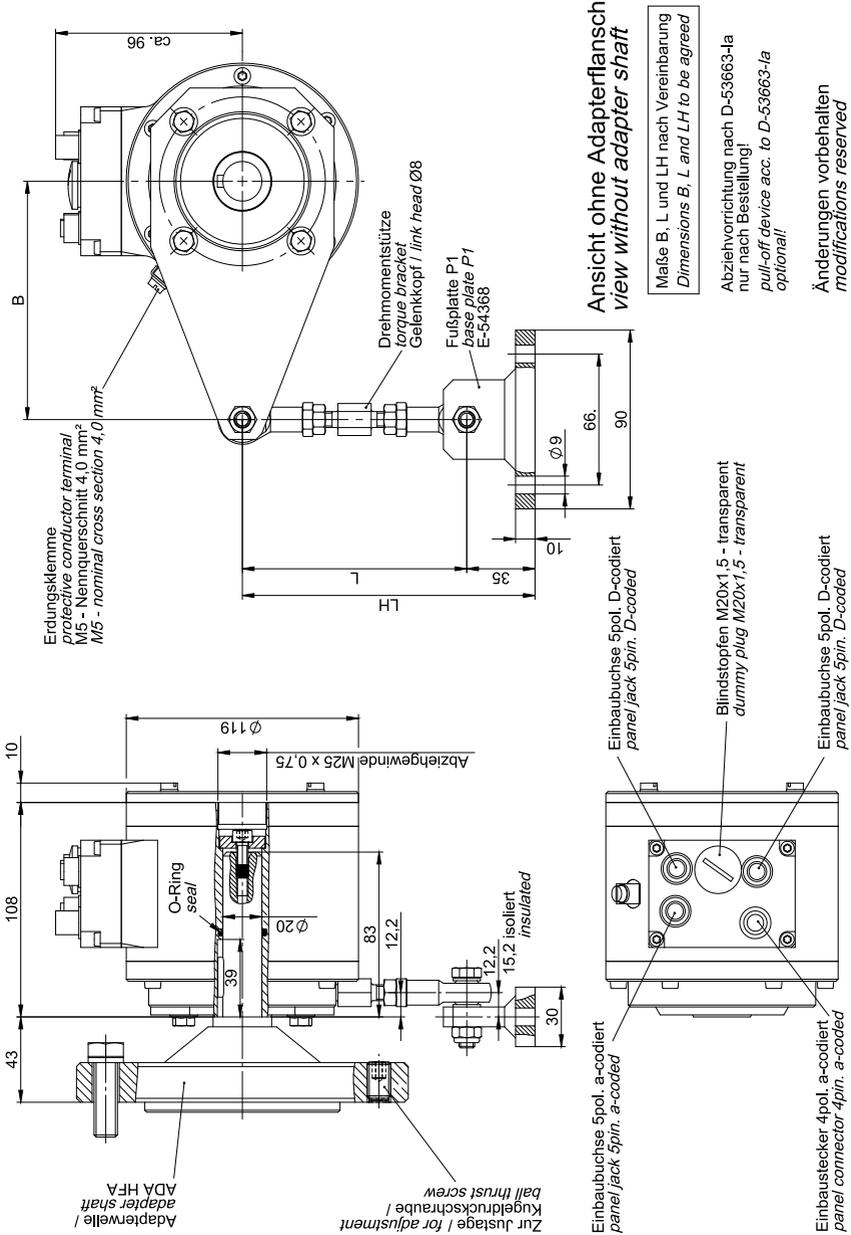
PROFIsafe over PROFINET

HM 13 M 106326





## 16.8.4 AMPNH 41 with adapter shaft ADA HFA (external centering)



AMPNH 41

PROFIsafe over PROFINET

HM 13 M 106329





## 16.10 Type code

