DEUTA-WERKE

# HS22 with PP1 output stage

Pulse generator with Hall sensors

## Instruction Handbook


| | |
|---|---|
| **Doc.No.:** | **4AB1253/C-en** |
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| **Created:** | 27/10/2016 - MTU/VD |
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| **Date of issue:** | 06/01/2017 |

# Applies to

This document applies to:

HS22-PP1

# Revision index

| Version | Date | Change | Chapter No.[1] |
|---|---|---|---|
| A | 04/07/2016 | IQT/DL:<br>First compiled.<br>This document is based on the Instruction Handbook 059008540B for the product 4AB854/B-DE status 2012-09-19. | <br>All |
| B | 26/08/2016 | MTU/VD:<br>Chap. "Ordering code" adapted<br>Chap. "Connecting plug" corrected (connection type X3=I )<br>Chap. "Cable/ and cable protection length" corrected (cable protection with protective tubing, X10 = hc)<br>Chap. "Weight" corrected<br>Correction of translation (en) | <br>3.3<br>4.3.2<br><br>4.4<br><br><br>5.5.4<br>9.1 |
| C | 27/10/2016 | MTU/VD:<br>Chap. "HS22" edited<br>Chap. "Mechanical Requirements" extended<br>Chap. "Sensor supply (not galvanically isolated)" supplemented<br>Chap. "Sensor supply (galvanically isolated)" extended<br>Chap. "Pulse output PP1" supplemented | <br>3.1<br>5.5.1<br>5.6.2<br><br>5.6.3<br><br>5.6.3.2 |

[1]: The chapter numbers specified in this table always refer to the preceding document.

# Table of contents

# 1 General

## 1.1 About these instructions

### General notes on how to use these instructions

- Read these instructions carefully before starting up the product for the first time.
- Comply with the warning and safety notes.
- Keep these instructions ready to hand.
- Make sure that every user of the product has read these instructions thoroughly.
- Explanations and definitions to terms and abbreviations are found in the Glossary.

### Copyright



## 1.2 Contact for enquiries

### How to reach us

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### Suggestions for improvement

Please let us know about your suggestions on how to improve the content and layout of this document. We are constantly striving to improve the quality of our customer documentation.

Phone +49 (0) 2202 958-198

**Personal assistance**

If you need personal assistance in using this product, please contact our Support directly.

| Product | Support number |
|---|---|
| Multi functional terminals and displays | +49 (0) 2202 958-325 |
| Recorders and evaluation software | +49 (0) 2202 958-106<br>+49 (0) 2202 958-124<br>+49 (0) 2202 958-186 |
| Sensor technology | +49 (0) 2202 958-235 |
| Video technology, indicators and IconTrust technology | +49 (0) 2202 958-325 |
| or | support@deuta.de |

## 1.3 DEUTA Academy

**DEUTA offers serveral Workshops and seminars**

For over 100 years the name DEUTA-WERKE GmbH has stood for expertise in the areas of sensor technology, travel data recording and visualisation. We are delighted to pass this knowledge on to our customers. Technological developments are advancing at an ever faster pace today which has lead us to offer training for the employees of our rail customers with practical, hands-on seminars for operators. The demands made on users are constantly increasing. New forms of organisation within companies require employees to be qualified, flexible and able to deal with challenges quickly. State-of-the-art knowledge is the precondition for certification and new specifications in safety technology.

The DEUTA Academy training programme is geared closely towards the market requirements of our customers. Qualification measures, customer training and hands-on workshops form an integrated, highquality training concept.

The workshops and seminars are conducted by DEUTA staff members who have many years product experience in the field. This knowledge is supplemented by our colleagues from Project and Innovation Management and from Development. Depending on subject matter, we also engage external instructors because of their expert knowledge of areas such as 'Product Qualification'.

You will find more information at:

**http://www.deuta.de**

## 1.4 Document structure

**The following figure shows you a complex example of possible documents.**

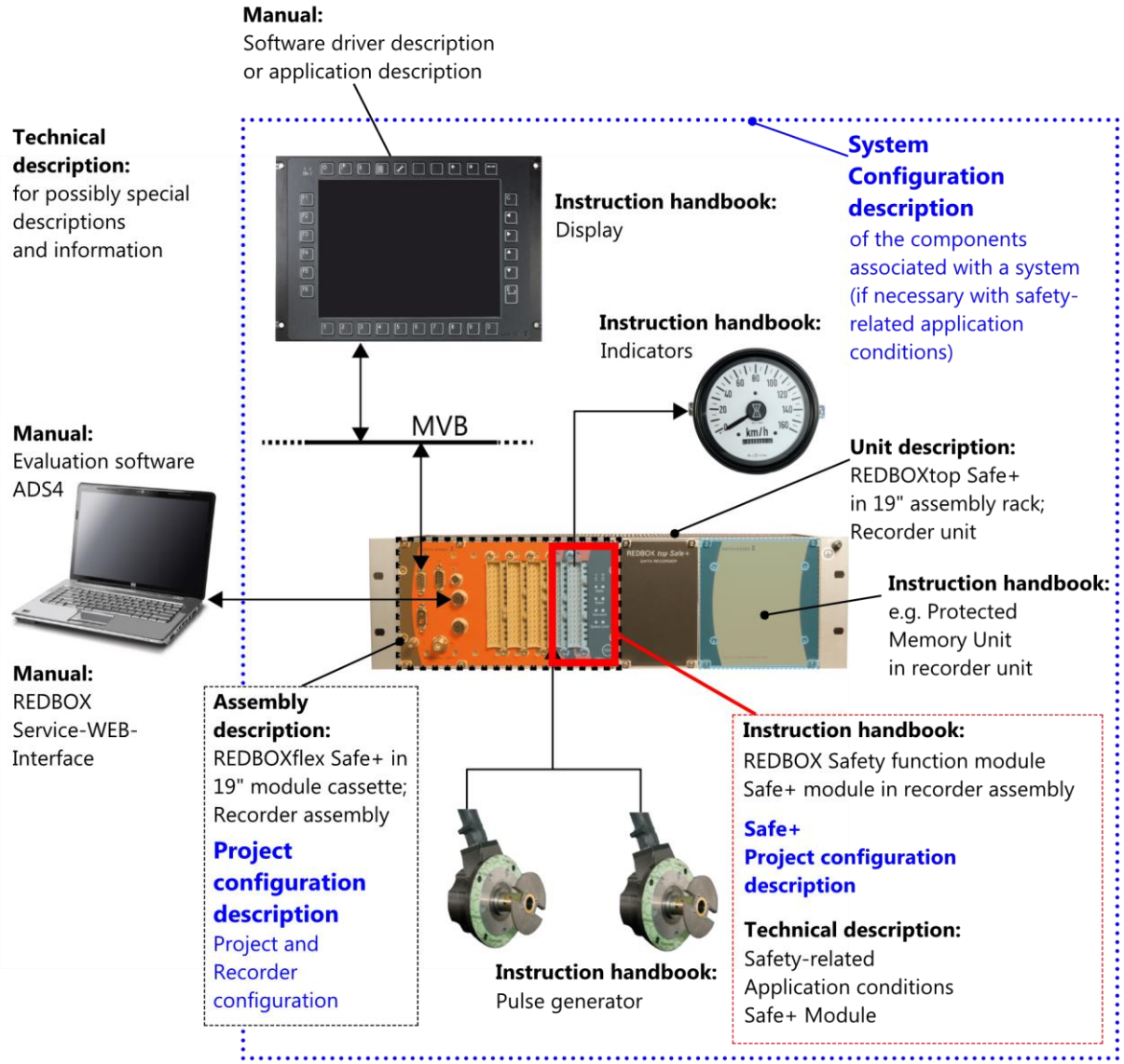



*Fig. 1/1: Documentation example*

| **INFO** |
| --- |
| **Necessary documents**<br>The documentation to a device (recorder, display, sensor, indicator, etc.), a recorder assembly (19" cassette), a recorder unit (19" assembly rack), software, a project or system can consist of one document or of several documents. Make certain that you have all of the necessary documents. |

## 1.5 Additional documents

none

## 1.6 Presentation in the document

### 1.6.1 Markings, symbols and lettering

| Presentation | Usage |
|---|---|
| Character **#** | Used as placeholder for device variants.<br>Example:<br>MFT_L11**##**o could be, e.g.:<br>MFT_L11byo or MFT_L11dyo |
| Angle brackets **<>** | Indicates buttons to be actuated.<br>Examples:<br><F1><br><Shift> + <F1> |
| Font<br>`Courier` | Indicates<br>▪ Screen messages for devices having a display unit or a service PC<br>▪ File name<br>▪ Directories<br>Example<br>`C:\Programs` |
| "Quotation marks" | The **menu commands** and **names of dialogue windows** or **names of chapters** are put in quotation marks<br>(example: "File", "Edit", dialogue window "Data export"). |
| Arrows → | Arrows indicate individual steps of navigation paths or operating steps<br>(Example: "File → Open"). |

| Presentation | Usage |
|---|---|
| underlined | ▪ **Link** in the PDF file to the Glossary<br>▪ Refers to entry and explanation in the Glossary |
| square brackets with arrow and page number | ▪ **Link** in PDF file to the specified page, e.g.: see Figure **[→ Page 33]**<br>▪ You will find further information on the specified page |
| further **Links** in PDF file (via left mouse button) | ▪ In the Table of Contents: e.g. *1.1 About these Instructions .....10* **Link** is on the chapter no., the chapter text and the page no. and jumps to the specified page<br>▪ In the List of Keywords: *Storage temperature 50, 56, 66* **Link** is on the page no. and jumps to the clicked on page |

## 1.6.2 Units

If not shown otherwise, the units of measure in drawings are millimetres [mm].

## 1.6.3 Highlights and notes

Symbols have been used to specifically highlight the following information:

| Symbol | Meaning |
|---|---|
|  | **Important**<br>Indicates technical requirements that are important for the product to function smoothly.<br>Non-compliance can lead to disruptions, but not to damage to persons or objects. |
|  | **Info**<br>Indicates<br>▪ additional important information.<br>▪ Practical tips to simplify your work with the product. |

## 1.6.4 Presentation of warning and safety notes

Warning and Safety notes are indicated by symbols and a signal word. The signal word indicates the severity of the imminent danger.

**Danger classes**

| Symbol | Signal word |
|---|---|
| ⚠ DANGER | **Danger**<br>There is a direct danger for the life and health of people.<br>Non-compliance with these notes will have serious health-related consequences and may even result in death. |
| ⚠ WARNING | **Warning**<br>There is a possible imminent danger for the life and health of people.<br>Non-compliance with these notes can have serious health-related consequences and may even result in death. |
| ⚠ CAUTION | **Caution**<br>There is a possibly dangerous situation.<br>Non-compliance with these notes can result in slight injuries or cause material damage. |
| NOTICE | **Notice**<br>There is a possibility of material damage or malfunctions.<br>Non-compliance with these notes can result in material damage or malfunctions, but will not cause harm to people. |

**Additional symbols**

| Symbol | Explanation |
|---|---|
|  | **Notice**<br>Combined with the signal word **Note** warns of material damage or malfunctions. |
|  | **General danger**<br>Combined with a signal word, warns of dangers that could result in injuries or even death. |
|  | **High voltage**<br>Combined with a signal word, warns of occurring dangerous electrical voltages that could result in injuries or even death. |
|  | **Hot surfaces**<br>Combined with a signal word, warns of hot surfaces that could result in burns. |
|  | ESD **protection**<br>Combined with a signal word, warns of damage to components at risk of electrostatic discharge. |

## 1.7 Overview of standards and issue statuses

You will find the issue statuses of the standards used in this document in the Glossary.

## 1.8 Application of EU Directives

- Our products are designed for installation in rail vehicles, ships or in industrial large-scale plants/machines and may only be mounted, installed, dismantled and disposed of by expert personnel.
- The intended use is only possible in an installed condition in conjunction with other equipment.
- 2014/30/EU (EMC)
  These products fall within the scope of the 2014/30/EU (EMC) directive. These products can cause radio interference in residential areas. In this case, the operator can be requested to implement appropriate measures.
- 2011/65/EU (RoHS)
  Due to the application, these products do not fall within the scope of the 2011/65/EU directive (RoHS). But they can contain materials for which there are restrictions. If technically possible, we constantly strive to avoid or reduce the stated materials.
- 2014/35/EU (NSR)
  Due to the application in rail vehicles and on ships, these products do not fall within the scope of the 2014/35/EU (NSR) directive.
  For industrial use, the products do not fall within the scope of the 2014/35/EU (NSR) directive, provided that voltages with a nominal voltage of > 50 VAC or > 75 VDC are not supplied to the product.

| **IMPORTANT** |
| --- |
| **Voltages > AC 50 V or > DC 75 V in industrial use**<br>In industrial use, voltages with a nominal voltage of > 50 VAC or > 75 VDC must not be supplied to the product. |

- If these products are to comply with the requirements of a directive that is not listed in the EC Declaration of Conformity, it must be clarified by contract before use.

# 2 Safety

## 2.1 Intended use

The electronic pulse generators HS22 are designed for use on railway vehicles and are utilised there for rpm coverage. The sensors can be flange-mounted to axle box covers or to gears on rail vehicles.

Any other use is not permitted without prior consultation with DEUTA.

## 2.2 Ancillary documents

**INFO**

**Complete documentation**
The complete documentation of this product includes the following documents:

| Documents | No. |
|---|---|
| EC Declaration of Conformity<br>(see chapter "Certificates") | |
| Installation requirements HS22<br>(see chapter "Installation requirements") | ZU 1383 |

**IMPORTANT**

**Observe ancillary documents!**
To ensure smooth and safe operation, the instructions and information in all ancillary documents must be observed!

## 2.3 General warning and safety notes

**IMPORTANT**

**Observe clearance gauge**
After completion of the assembly, no parts may extend beyond the clearance gauge.

**IMPORTANT**

**Requirement for assembly work**
For all work you must comply with the local process and safety regulations.

## 2.4 Personnel requirements and operator duties

**Prior knowledge and qualification**

- This document is written solely for personnel (specialists) trained and instructed technically in electronics, electrical engineering and railway technology. Basic knowledge about the installation, EMC measures and safe conduct are presumed.
- It is presumed that only qualified personnel (specialists) will be deployed for the installation, commissioning, operation, maintenance, troubleshooting and possibly repairs of the existing components. Damages due to non-compliance are not included in the guarantee.
- Definition of specialists: see EN50110, DIN VDE 0105, IEC 60364. Qualified specialists in the meaning of these principal safety notes are persons who are familiar with the assembly, installation, commissioning, operation, etc., of the product and possess the qualifications according to their activities.
- Only personnel especially trained and certified by DEUTA may work on the device as well as the software of the device.

**Operator duties**

The operator is obliged

- to choose reliable and knowledgeable personnel (specialists) to operate the devices
- to provide training and on-going instruction on how to use the devices to personnel who are entrusted with operating the devices
- to ensure that special activities requiring special knowledge are carried out by suitably knowledgeable and specifically trained specialist personnel (specialists); if necessary, specialists from outside should be brought in
- to ensure the devices are sufficiently maintained, repaired and tested

## 2.5 Accident prevention regulations

The locally applicable accident prevention regulations must be obeyed.

## 2.6 Fire protection requirements

The device meets the requirements of fire protection in accordance with DIN EN 45545-2.

## 2.7 Environmental details on materials

All materials are halogen-free, asbestos-free and are rustproof.

Environmentally hazardous or harmful materials such as PCB-bearing capacitors and materials are not used.

## 2.8 Information REACH regulation (EC) No. 1907/2006

**The required information in accordance with Art. 33 of the** REACH **regulation (EC) No.1907/2006**

How do the DEUTA-WERKE meet their obligation towards the customers:

- We ensure that the materials we use are registered.
- We principally instruct our suppliers to always provide current safety data sheets.
- We obliged our raw material suppliers to notify us immediately should they become aware of the existence of a substance of very high concern (SVHC) which exceeds a mass concentration of 0.1 % in the raw materials delivered to us.
- The EU suppliers of the products, which are processed in our products in a relevant scale, are also obliged to inform us voluntarily as soon as an SVHC substance of more than 0.1 mass percent is contained in the products they supply.
- We will inform our customers immediately and comprehensively if we in turn become aware of the presence of an SVHC substance in one of our processed pre-products.
- Our register of hazardous substances was supplemented by the item "REACH". The list of candidates of the European Chemicals Agency (ECHA) was included in the register.
- The procurement, handling and disposal of hazardous substances is clearly regulated in our integrated management system.

Based on the data currently available to us, we can confirm that none of the momentarily substances of very high concern (SVHC) specified in the list of candidates is contained in our products and in the products that they contain in a concentration of more than 0.1 mass percent.

# 3 Product description

## 3.1 HS22

The two-channel pulse generator HS22 with Hall sensors is used for the non-contacting acquisition of speed, distance covered, angular speed, speed and acceleration until standstill. The two-channel designs are also suitable for direction of rotation detection due to the phase offset of the output signals of 90° relative to each other.

The pulse generator is flange-mounted vertically above the gear wheel to axle box covers of bogies or to rail vehicle gear boxes, industrial machines or to electric motors. For the defined working gap, that is, air gap (X = 0.5 mm to 2.0 mm) it scans a gear wheel or a gear rack made of ferromagnetic steel with low carbon content and converts the intensity fluctuation of the magnetic field to a digital signal.

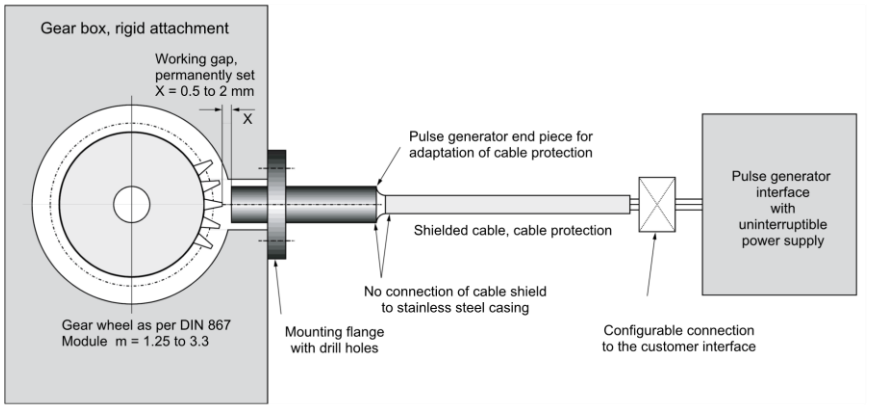



*Fig. 3/1: Typical operating environment of a pulse generator HS22*

A quick change of the working gap during operation is not allowed with the exception of the periodic gap modifications caused by bearing clearance.

The gear wheel should ideally have teeth in accordance with DIN 867 with a module m = 2 mm.

The electronics of the pulse generator are assembled in a stainless steel casing and are completely surrounded by a sealing compound. The compound protects the electronics permanently from strong mechanical stress and other harmful environmental influences. The electronics have an integrated, high-quality EMC protection permitting trouble-free operation in environments strongly affected by electromagnetism; however, an uninterruptible power supply for proper operation is required. Electronics with output stages in various versions are available. In addition to numerous types of push-pull output stages, two-wire current outputs are also available. Adaptation to almost every interface specification is possible. The electronics are equipped with a simple diagnostics function which permits examination of the connection and the signal level.

The pulse generator cable consists of a halogen-free material and corresponds to the high requirements of modern passenger transportation.

An adapter with PG09 external screw thread at the pulse generator end enables installation of a cable protection. Four different types of cable protection are available. Connection to the pulse generator interface of the user is also variably executed.

Altogether, the modularity of the pulse generator concept permits the adaptation to almost every project specification.

### 3.1.1 Application

When used for the intended purpose, the pulse generator HS22 serves as a non-contacting scanner of gear wheels and racks.

The voltage pulses produced by the unit can be used to derive the

- Wheel speed
- Direction of rotation
- Angular speed
- Speed
- Acceleration
- Distance covered

.

The HS22 represents a pulse generator with dual system, supplying two output signals phase-shifted by ±90° in relation to each other. Rotary or driving direction signals can thus be generated with the help of downstream electronics.

Both systems or channels work until absolute zero speed, i.e., the lower frequency limit is 0 Hz.

Both channels can be utilised for different tasks as well as for functional monitoring of 2-channel systems with high reliability and availability.

## 3.2 Block diagram

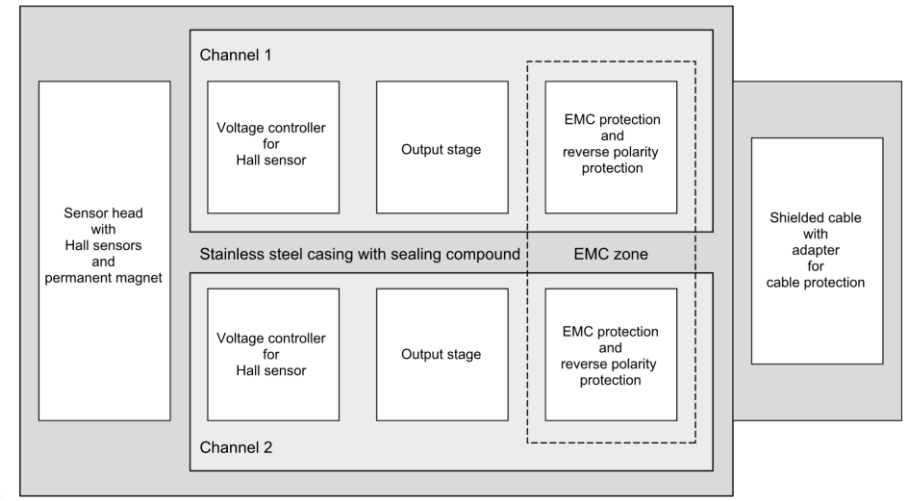



*Fig. 3/2: Block diagram of a two-channel Hall pulse generator HS22*

## 3.3 Ordering code

The ordering code contains information about the features of the product:

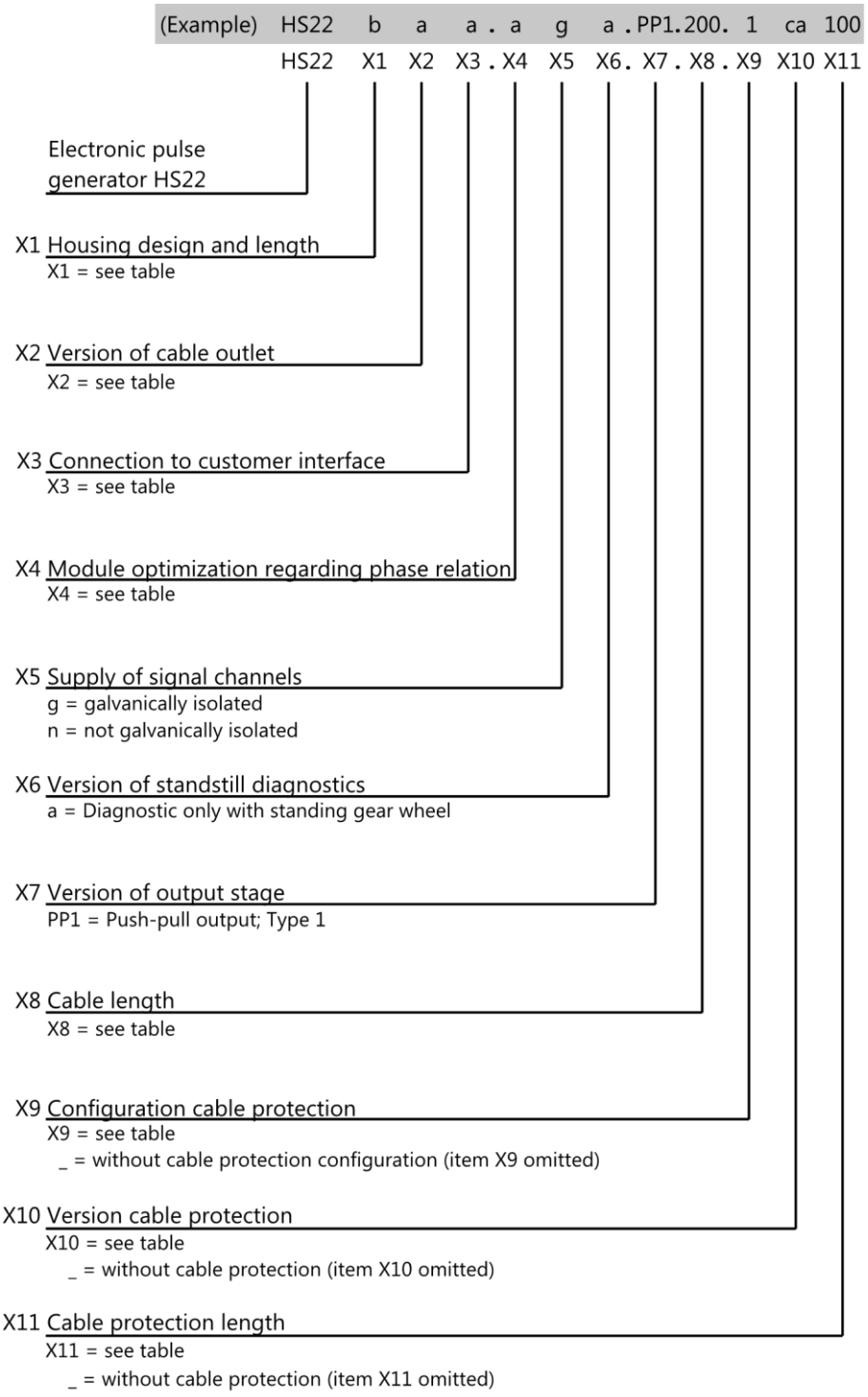



*Fig. 3/3: Ordering code HS22 PP1*

## 3.4 Overview of variants

**Different features**
**of the product variants described in this document:**

**X1 (housing design and length)**

The housing length includes the entire stainless steel casing. The dimensions for the sensor head and the flange are constant. The length of the variable sensor body depends on the printed circuit board in the housing, i.e., on the parameters X5 (galvanic isolation), X6 (diagnostics) and X7 (output stage).

| HS22 (housing design and length) | X1 |
|---|---|
| short housing 2 (80 mm) | b |
| short housing 3, angular (80 mm)<br>with insertion depth 67 mm and special installation position: Pulse generator flange is positioned at right angles to the gear wheel. | k |
| short housing 1, angular (80 mm) | l |

For further information: see chapter "Mechanical drawings [→ Page 29]".

**X2 (cable outlet direction)**

| HS22 (cable outlet direction) | X2 |
|---|---|
| Straight cable outlet | a |
| bent cable outlet 90° at the vertical,<br>at right angles to the centre line of both mounting drill holes of the flange | b |
| bent cable outlet 90° at the vertical,<br>parallel to the centre line of both mounting drill holes of the flange | c |
| Cable outlet bent, vertical to centre line of the mounting drill hole of the flange, coding pin across from cable outlet | d |
| Cable outlet bent, parallel to centre line of the mounting drill hole of the flange, coding pin across from cable outlet | e |

For further information: see chapter "Mechanical drawings [→ Page 32]".

**X3 (connection type)**

Connection type of the pulse generator to customer interface:

| HS22 (connection type) | X3 |
|---|---|
| tin-coated flexible leads | a |
| Square plug connector HARTING Han3HPR, 8-pin | c |
| Round plug connector MIL series, 10-pin | i |
| Square plug connector HARTING Han6M, 10-pin | k |
| Bayonet round plug connector MIL series, 7-pin | l |

For further information: see chapter "Mechanical drawings [→ Page 34]" and "Plug-pin assignment [→ Page 75]".

**X4 (module)**

Module of gear wheels in acc. with DIN 867.

| HS22 (module) | X4 |
|---|---|
| Module m = 2.0 mm (standard) | a |
| Module m = 1.25 mm | b |
| Module m = 1.6 mm | c |
| Module m = 2.5 mm | d |
| Module m = 3.3 mm | e |
| Module m > 3.3 mm | f |

For further information: see chapter "Appendix [→ Page 94]".

**X5 (supply)**

For the two-channel generator HS22/2, an electrical supply of both channels through galvanic isolation is possible.

| HS22 (supply) | X5 |
|---|---|
| Channels are galvanically isolated from each other and possess a separate supply | g |
| Channels are **not** galvanically isolated from each other and feature a shared supply | n |

For more information: see chapter "Electrical data [→ Page 51]" and "Plug-pin assignment [→ Page 75]".

**X6 (diagnostics)**

| HS22 (diagnostics) | X6 |
|---|---|
| Standard diagnostics: Diagnostics only at standing gear wheel ($F_z$ = 0 Hz) possible | a |

For further information: see chapter "Diagnostic and service functions [→ Page 87]".

**X7 (output stage)**

| HS22 (output stage) | X7 |
|---|---|
| Push-pull output Type 1 | PP1 |

For more information: see the chapter "Technical Data [→ Page 47]".

**X8 (cable length)**

Nominal length of the cable as of customer's connection level of the flange. For cable termination with a plug connector, the cable length is measured up to the mounting level of the plug connector.

| HS22 (cable length) | X8 |
|---|---|
| Cable length in cm | ### |

For further information: see chapter "Mechanical drawings [→ Page 41]".

**Configuration and version of cable protection**

X9, X10 and X11 are related parameters which describe the outlet of the cable as well as the type and the outlet of the connected cable conduit from the pulse generator housing.

Individually, the parameters mean:

**X9 (cable protection index)**

X9 specifies the configuration variant with sequential index from X10.

| HS22 (cable protection index) | X9 |
|---|---|
| no cable protection planned | _ |
| Cable protection with open end | 1 |
| Standard end adapter for cable protection | 2 |
| Cable protection with end cover BVNV with external thread PG13.5 | 3 |
| Cable protection for EMC adapter NVEZ | 4 |
| Cable protection for EMC adapter NVEZ (iris spring) | 5 |

For further information: see chapter "Mechanical drawings [→ Page 41]".

**X10 (cable protection version)**

| HS22 (cable protection version) | X10 |
|---|---|
| no cable protection planned, however standard cable outlet with cable end piece and anti-kink protection | _ |
| Corrugated pipe PCST: Heavy polyamide corrugated pipe PCST from PMA<br>with PG09 plastic internal thread adapter for frequent cable movement<br>with dynamic load (> 4,000,000 load cycles guaranteed)<br>even at lowest temperatures | ca |
| Corrugated pipe VAMLT: Medium polyamide corrugated pipe VAMLT from PMA<br>with PG09 plastic internal thread adapter for infrequent cable movement<br>with minor dynamic load (> 30,000 load cycles guaranteed)<br>suitable for applications in passenger transportation | cb |
| Corrugated pipe VOHD: Very heavy polyamide corrugated pipe from PMA<br>with PG09 metal internal thread adapter for infrequent cable movement<br>with minor dynamic load (> 10,000 load cycles guaranteed),<br>suitable for quasi-static applications in the machine range<br>with increased resistance to tearing out of the corrugated pipe | cc |

| HS22 (cable protection version) | X10 |
|---|---|
| The end piece of the pulse generator housing is equipped with a PG09 thread to subsequently attach a corrugated pipe with PG09 internal thread adapter. | cx |
| Pre-assembled termination plug BVNZ,<br>prepared for cable protection with corrugated pipe | cy |
| Protective tubing Parker 681 DB-8 | hc |

For further information: see chapter "Mechanical drawings [→ Page 41]".

**X11 (cable protection length)**

| HS22 (cable protection length) | X11 |
|---|---|
| no cable protection planned | _ |
| Cable protection length in centimetres:<br>Nominal length of cable protection (tolerance +1.5 cm) in cm;<br>for open cable end: as of customer's flange assembly surface<br>otherwise: as of assembly level of end adapter or plug connector | ### |
| PG09 thread for subsequent accommodation of a corrugated pipe with PG09 internal thread adapter | 000 |

For further information: see chapter "Mechanical drawings [→ Page 41]".

## 3.5 Common features

### 3.5.1 Standstill detection

The Hall sensor is DC-coupled. Zero-speed detection is possible with the help of external electronics.

### 3.5.2 Detection of the sense of rotation

The detection of the sense of rotation is possible by evaluating the phase difference between the positive slopes of both output signals.

### 3.5.3 Control of performance and function

Functional check is possible by monitoring the level of both output signals or by utilising the diagnostics function (X6).

## 3.6 Device labelling

### 3.6.1 Type plate

The product designation, CE mark, serial number and date of manufacture are on the pulse generator.

*Fig. 3/4: Product designation top side (exemplary)*

| | |
|---|---|
| Example: | Ordering code<br>HS22.lba.fna<br>PP1.400.1cy000 |

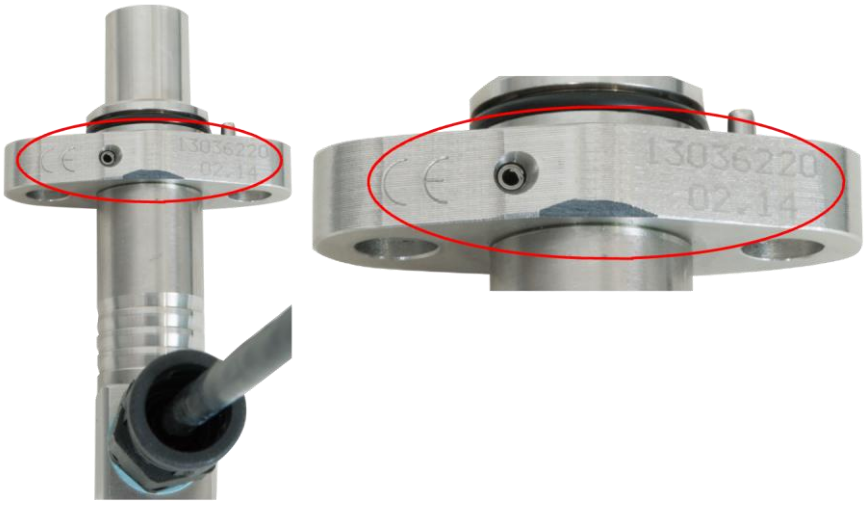


*Fig. 3/5: Product identification bottom side (exemplary)*

| | |
|---|---|
| Example: | CE mark<br>Serial number: 13036220<br>Date of manufacture: 02/14 (mmyy) |

## 3.7 Scope of delivery

- Pulse generator
- Protective transport cap for sensor head

## 3.8 Accessories

No accessories.

## 3.9 Additional DEUTA products

- DEUTA REDBOX recorder series

# 4 Mechanical drawings

## 4.1 Dimensional drawings of the flange

**For standard flange with 29mm insertion depth**

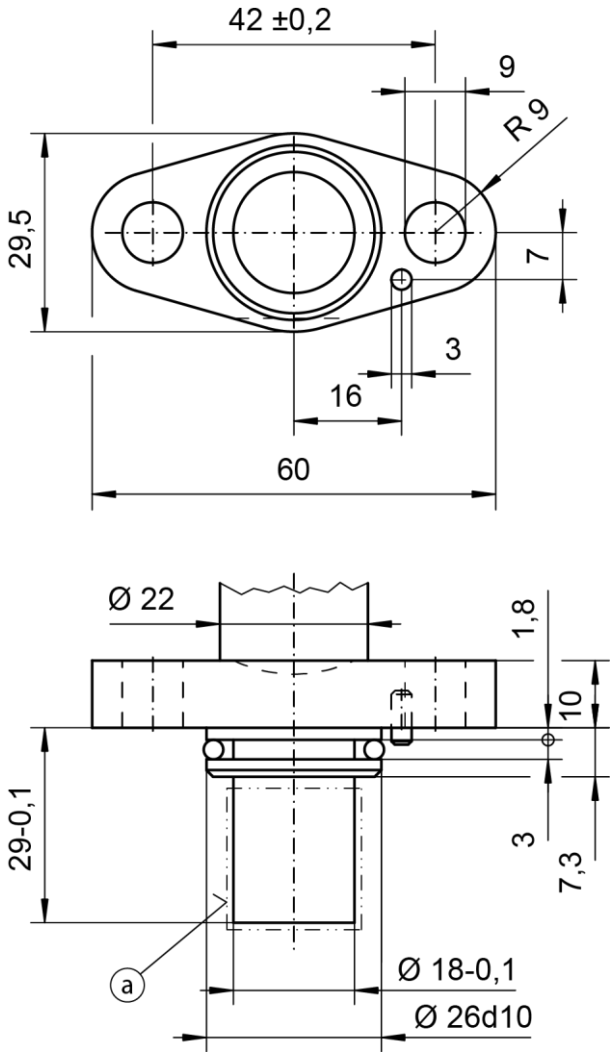



*Fig. 4/1: Flange for pulse generator HS22 (insertion depth 29mm)*

| | |
|---|---|
| a | Protective transport cap |

**For standard flange with 67mm insertion depth**

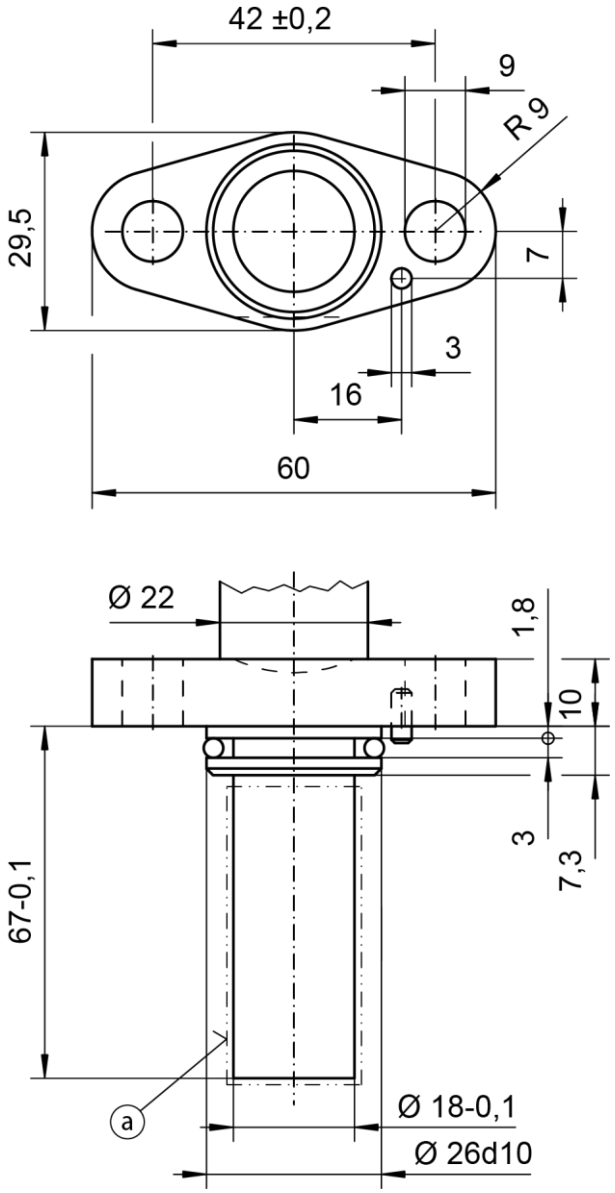



*Fig. 4/2: Flange for pulse generator HS22 (insertion depth 67mm)*

| | |
|---|---|
| a | Protective transport cap |

## 4.2 Housing variants

### 4.2.1 Design

**Housing design X1 = b**

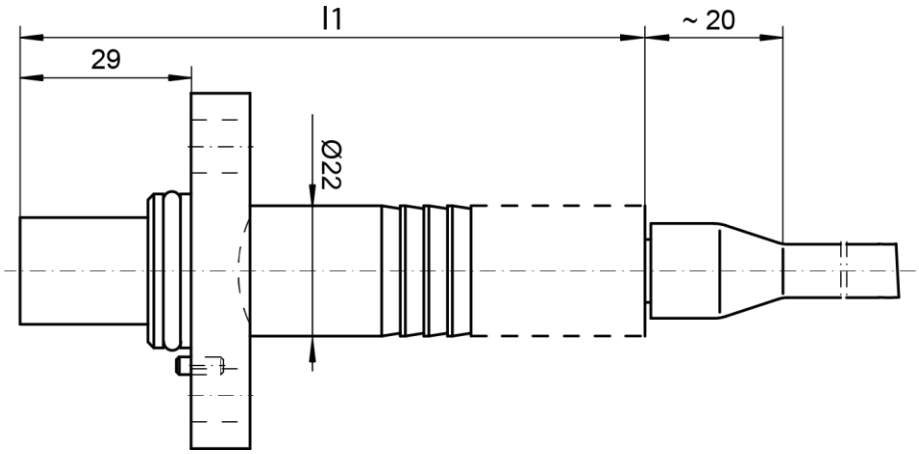



*Fig. 4/3: Housing design X1 = b (example)*

| Housing design | Housing length I1 in mm |
|---|---|
| b | 80 |

**Housing design X1 = k**

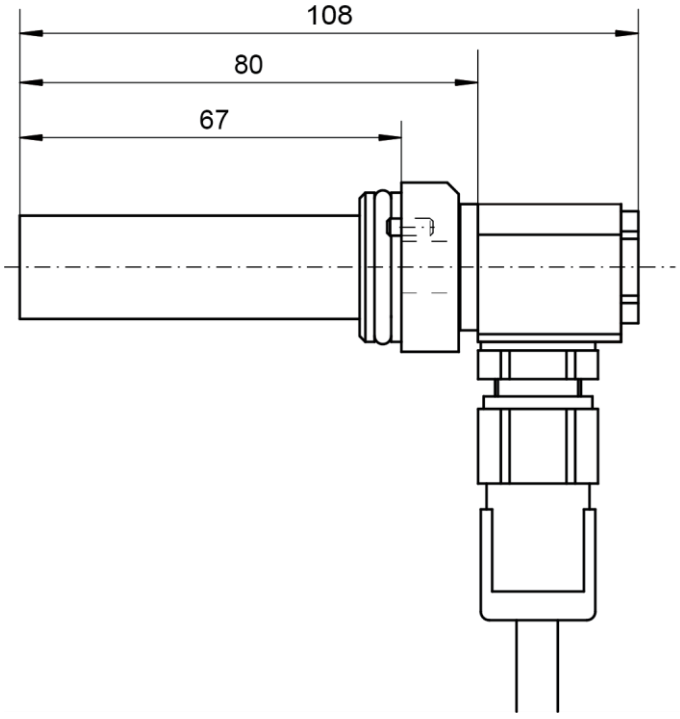



*Fig. 4/4: Housing design X1=k (example)*

**Housing design X1 = l**

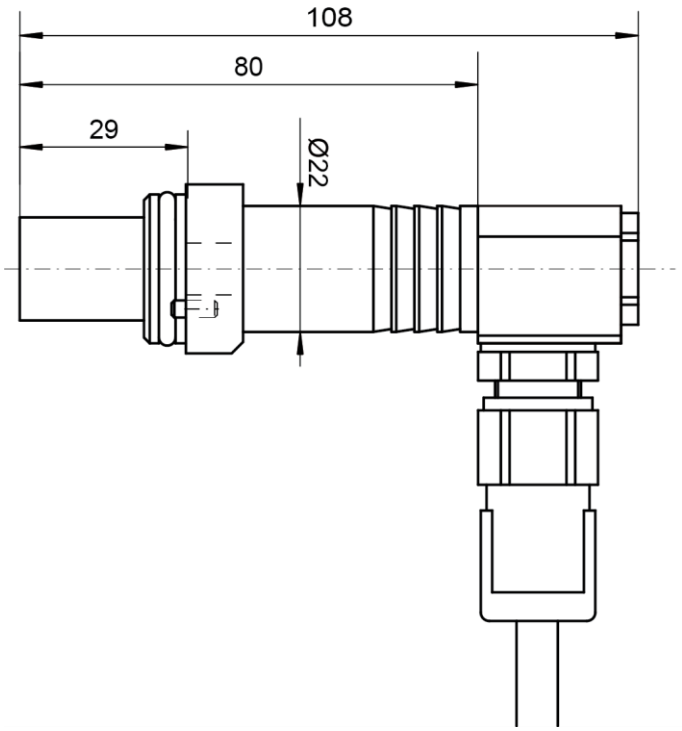



*Fig. 4/5: Housing design X1 = l (example)*

## 4.2.2 Cable outlet

**Cable outlet X2 = a**

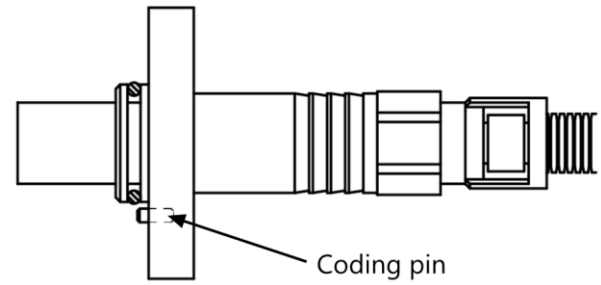



*Fig. 4/6: Cable outlet straight (example)*

**Cable outlet X2 = b**

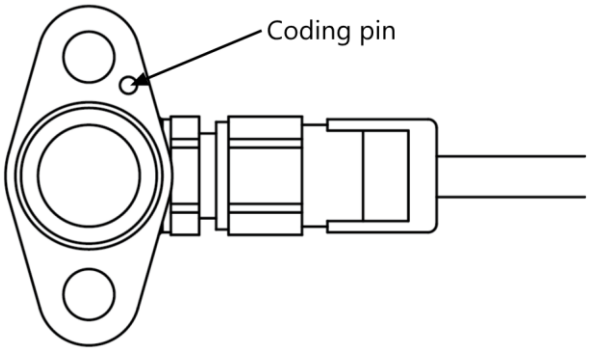



*Fig. 4/7: Cable outlet bent, vertical to centre line of the mounting drill hole of the flange (example)*

**Cable outlet X2 = c**

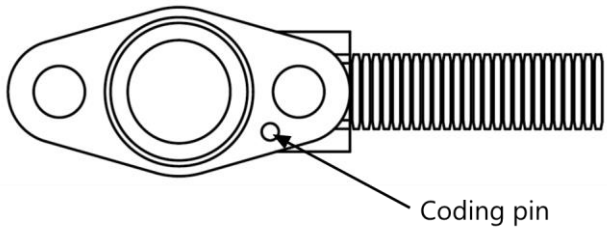



*Fig. 4/8: Cable outlet bent, parallel to centre line of the mounting drill hole of the flange (example)*

**Cable outlet X2 = d**

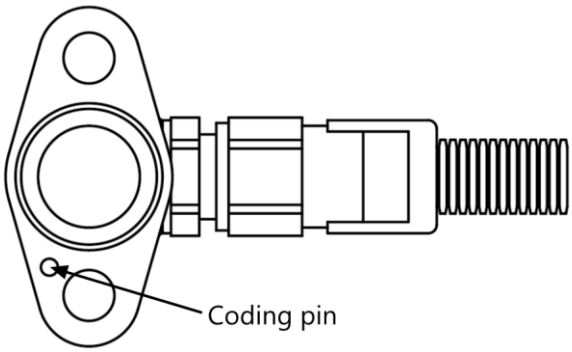



*Fig. 4/9: Cable outlet bent, vertical to centre line of the mounting drill hole of the flange, coding pin across from cable outlet (example)*

**Cable outlet X2 = e**

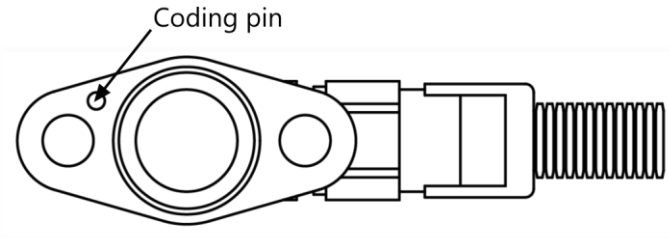



*Fig. 4/10: Cable outlet bent, parallel to centre line of the mounting drill hole of the flange, coding pin across from cable outlet (example)*

## 4.3 Connection type models

### 4.3.1 Cable strands

**Connection type X3 = a, without cable protection**

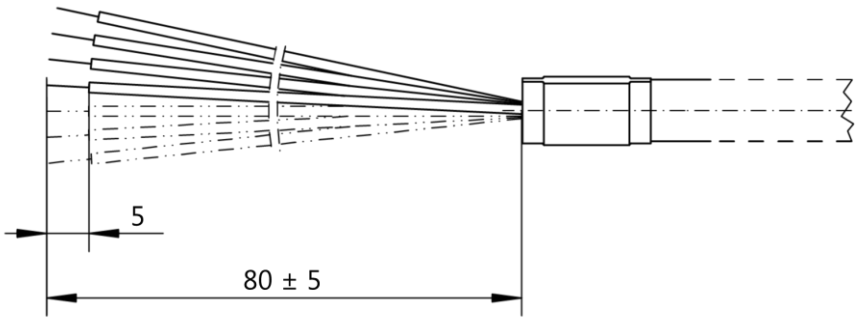



*Fig. 4/11: Connection with cable strands (X3 = a)*

**Connection type X3 = a, with cable protection (corrugated pipe)**

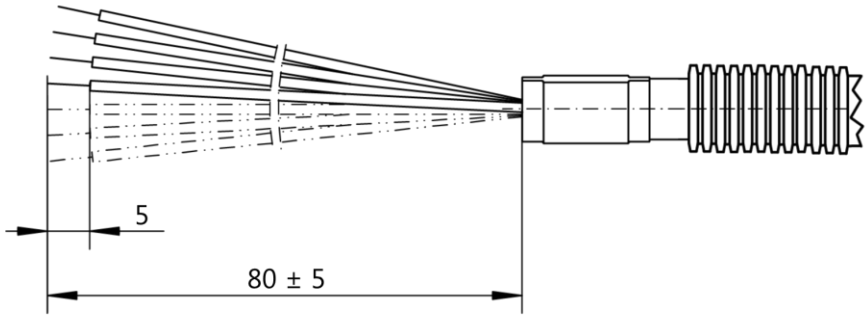



*Fig. 4/12: Connection with cable strands (X3 = a)*
*with corrugated pipe (X10 = ca, X10 = cb , X10 = cc)*

**Connection type X3 = a, with cable protection (protective tubing)**

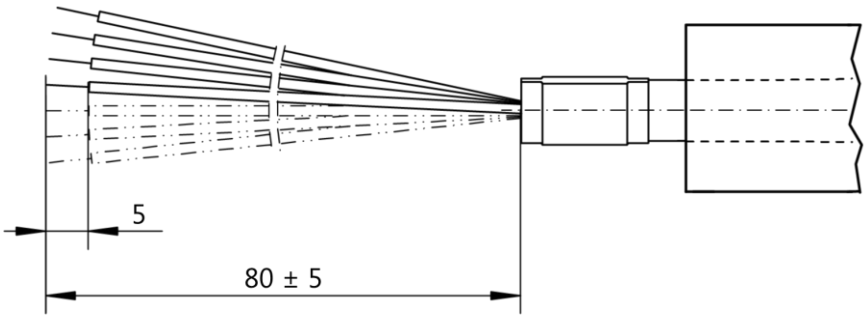



*Fig. 4/13: Connection with cable strands (X3 = a), protective tubing (X10 = hc)*

## 4.3.2 Connecting plug

**Connection type X3 = c**

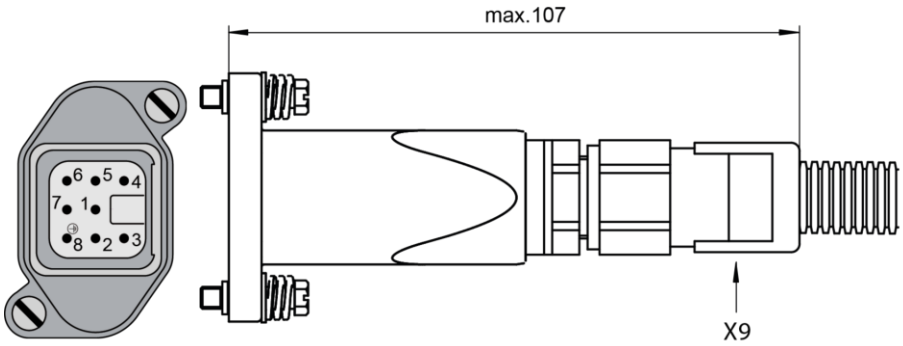



*Fig. 4/14: Connection with 8-pin square plug connector (X3 = c) and corrugated pipe (example)*

| | |
|---|---|
| Plug connector: | Square plug connector, 8-pin, pins<br>HARTING, Han3HPR-gg-SV-M20 (19400030410)<br>Pin insert, Han8D-M (09360083001)<br>Contact pin 0.5 mm², gold-plated (09150006123) |
| End cover | |
| X9 = 2: | Screw connection (PMAFIX PG09, BVNZ-P090) |
| X9 = 3: | Screw connection (PMAFIX PG09, BVNV-P090) |
| X9 = 4: | EMC screw connection (NVEZ-P090V) |
| X9 = 5: | EMC screw connection with reduction<br>(Screw connections suitable for all corrugated pipe types) |
| End cover | |
| X9 = 2: | Screw connection (Pflitsch 22052sd13.09)<br>(Screw connection suitable for protective tubing Parker 681 DB-8) |

**Connection type X3 = i**

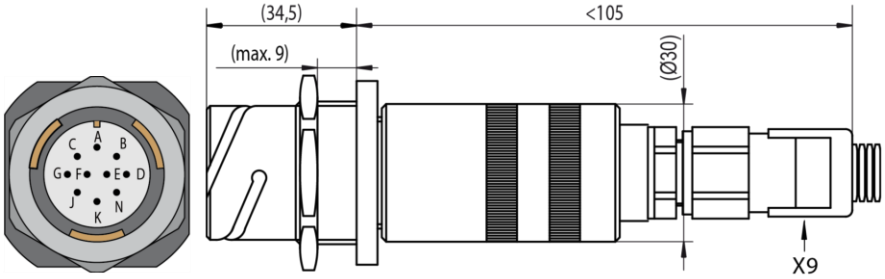



*Fig. 4/15: Connection with 10-pin round plug connector (X3 = i) and corrugated pipe (example)*

| | |
|---|---|
| Plug connector: | Round plug connector, 10-pin, pins<br>Souriau VGE1 H 1819 PN<br>Contact pin 0.5 to 1.5 mm², gold-plated RM16M23K<br>End cover PG13.5 VGE1 PS 1819 00 M |
| End cover | |
| X9 = 2: | Screw connection (PMAFIX PG09, BVNZ-P090) |
| X9 = 3: | Screw connection (PMAFIX PG09, BVNV-P090) |
| X9 = 4: | EMC screw connection (NVEZ-P090V) |
| X9 = 5: | EMC screw connection with reduction M20 to M16 (NVEZ-M160V/P2<br>(Screw connections suitable for all corrugated pipe types) |
| End cover | |
| X9 = 2: | Screw connection (Pflitsch 22052sd13.09)<br>(Screw connection suitable for protective tubing Parker 681 DB-8) |

**Connection type X3 = k**

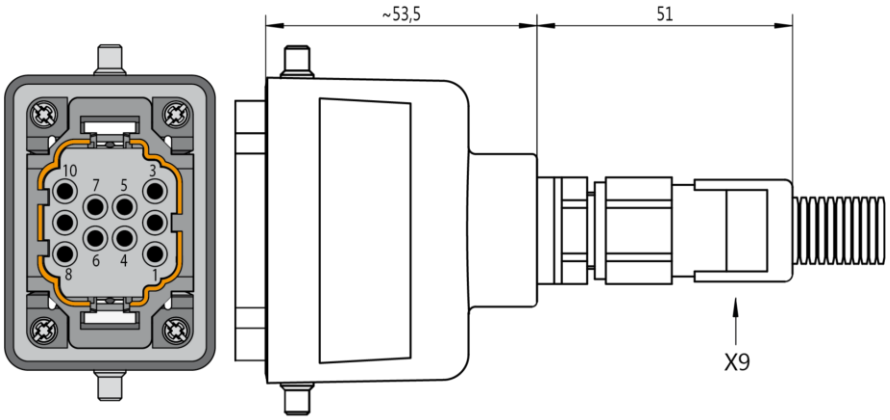



*Fig. 4/16: Connection with 10-pin square plug connector (X3 = k) ) and corrugated pipe (example)*

| | |
|---|---|
| Plug connector: | Square plug connector, 10-pole, pins<br>Harting Han 6M-gg-M20 (19370061440)<br>pin insert Han 10EE-M-c (09320103001)<br>contact pin 0.5 mm², gold-plated (09330006122) |
| End cover | |
| X9 = 2: | Screw connection (PMAFIX PG09, BVNZ-P090) |
| X9 = 3: | Screw connection (PMAFIX PG09, BVNV-P090) |
| X9 = 4: | EMC screw connection (NVEZ-P090V) |
| X9 = 5: | EMC screw connection with reduction<br>(Screw connections suitable for all corrugated pipe types) |
| End cover | |
| X9 = 2: | Screw connection (Pflitsch 22052sd13.09)<br>(Screw connection suitable for protective tubing Parker 681 DB-8) |

**Connection type X3 = l**

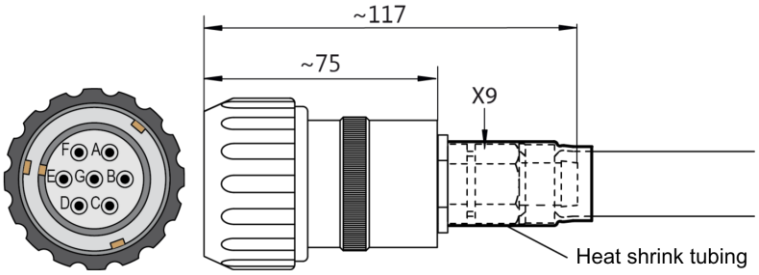



*Fig. 4/17: Connection with 7-pin bayonet round plug connector (X3 = l) ) and protective tubing (example)*

| | |
|---|---|
| Plug connector: | Bayonet round plug connector 7-pin, pins<br>Glenair FRITS series<br>Contact pin 0.5 mm², gold-plated |
| End cover<br>X9 = 2: | Screw connection (Pflitsch 22052sd13.09)<br>(Screw connection suitable for protective tubing Parker 681 DB-8) |

## 4.4 Cable/ and cable protection length

### Length with open cable end

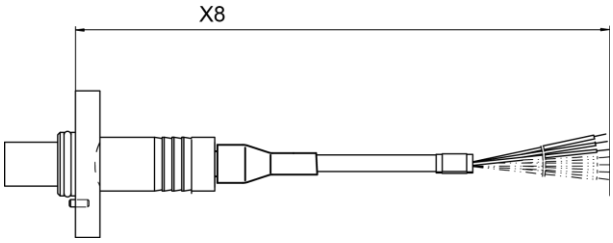



*Fig. 4/18: Cable length (X8) (example)*

### Length with cable protection and open cable end

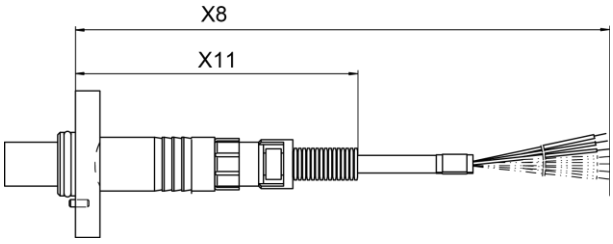



*Fig. 4/19: Cable length (X8), protective tubing length (X11) (example)*

### Length with end cover

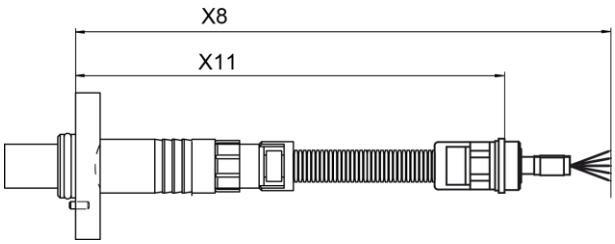



*Fig. 4/20: Cable length (X8), cable protection length (X11) (example)*

### Length with plug connector

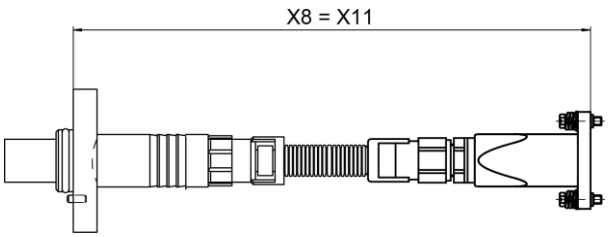



*Fig. 4/21: Cable length = protective tubing length (X8 = X11) (example)*

## 4.5 Cable protection variants

**Cable protection with corrugated pipe, X10 = ca**

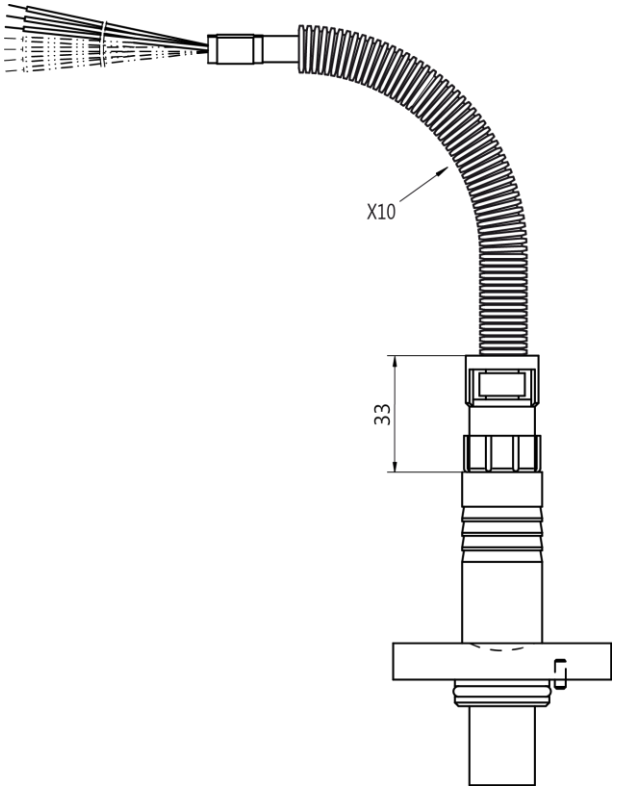



*Fig. 4/22: Cable protection corrugated pipe (X10 = ca ) (exemplary)*

| | |
|---|---|
| Cable protection: | Corrugated pipe PMAFLEX NW10; PCST-10B<br>for frequently moved cables (flexible installation) |
| Resistance to bending: | > 4,000,000 |
| dyn. bending radius: | 50 mm |
| Mounting: | Internal thread adapter<br>PMAFIX PG09, BFIL-P090 |

**Cable protection with corrugated pipe, X10 = cb**

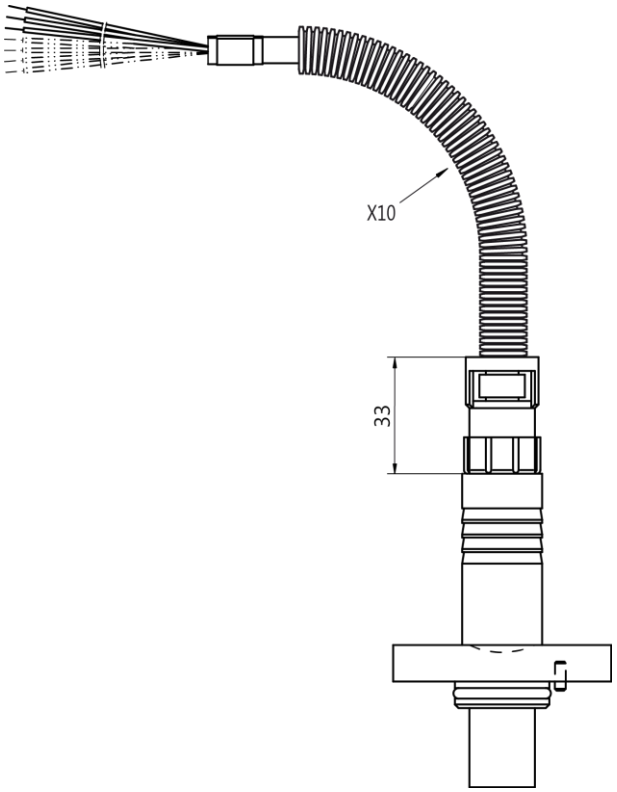



*Fig. 4/23: Cable protection corrugated pipe (X10 = cb ) (example)*

| | |
|---|---|
| Cable protection: | Corrugated pipe PMAFLEX NW10; VAMLT-10B<br>(in acc. with NF16-101/-102)<br>for infrequently moved cables (fixed installation) |
| Resistance to bending: | > 30,000 |
| dyn. bending radius: | nominal 20 mm, but not less than the bending radius of the cable |
| Mounting: | Internal thread adapter<br>PMAFIX PG09, BFIL-P090 |

**Cable protection with corrugated pipe, X10 = cc**

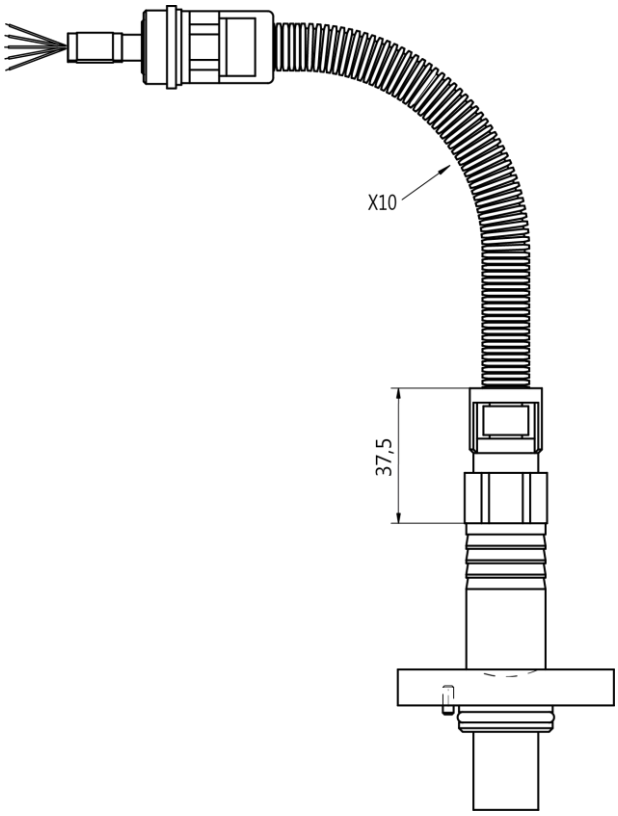



*Fig. 4/24: Cable protection corrugated pipe (X10 = cc ) (example)*

| | |
|---|---|
| Cable protection: | Corrugated pipe PMAFLEX NW10; VOHD-10B<br>for infrequently moved cables (fixed installation) |
| Resistance to bending: | > 10,000 |
| static bending radius: | 20 mm, but not less than the bending radius of the cable |
| Mounting: | Internal thread adapter PMAFIX PG09, NVIZR-P090 |

**Cable protection can be installed subsequently, X10 = cx**

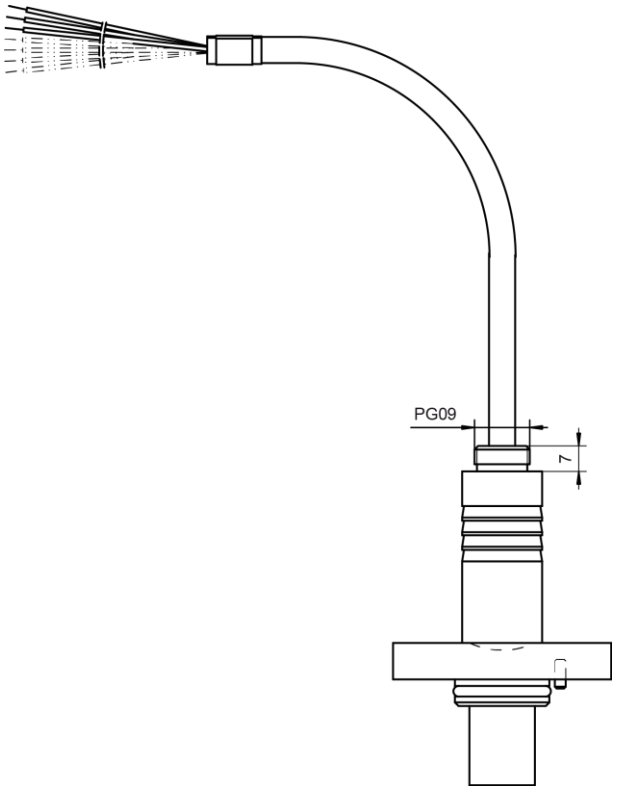



*Fig. 4/25: Cable protection can be installed subsequently (X10 = cx) (example)*

| | |
|---|---|
| Cable protection: | cable protection installed by customer |
| Mounting: | End cover of pulse generator housing with PG09 thread, **without anti-kink protection** |

**Cable protection can be installed subsequently, X10 = cy**

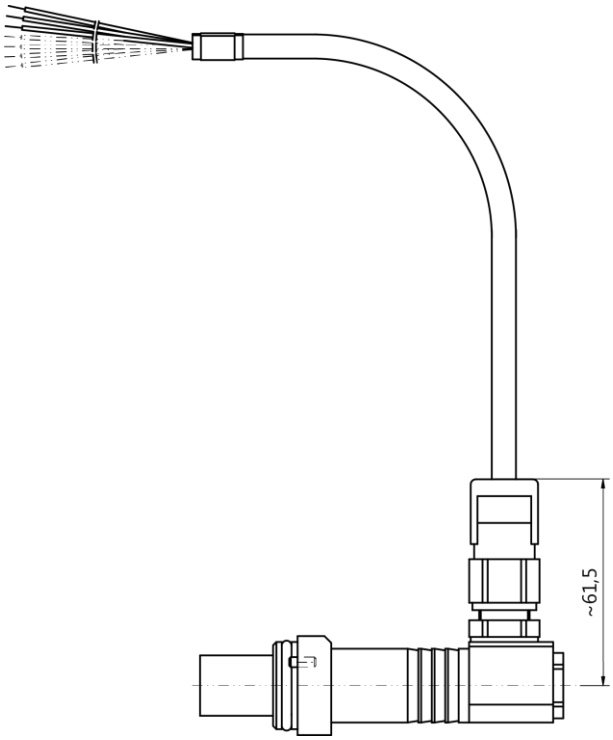



*Fig. 4/26: Cable protection can be installed subsequently (X10 = cy) (example)*

| | |
|---|---|
| Cable protection: | can be installed by customer,<br>corrugated pipe PMAFLEX NW10; PCST-10B<br>for frequently moved cables (flexible installation) |
| Resistance to bending: | > 4,000,000 |
| dyn. bending radius: | 50 mm |
| Mounting: | pre-assembled, PMAFIX NW10, BVNZ-P090S |

**Cable protection with protective tubing, X10 = hc**

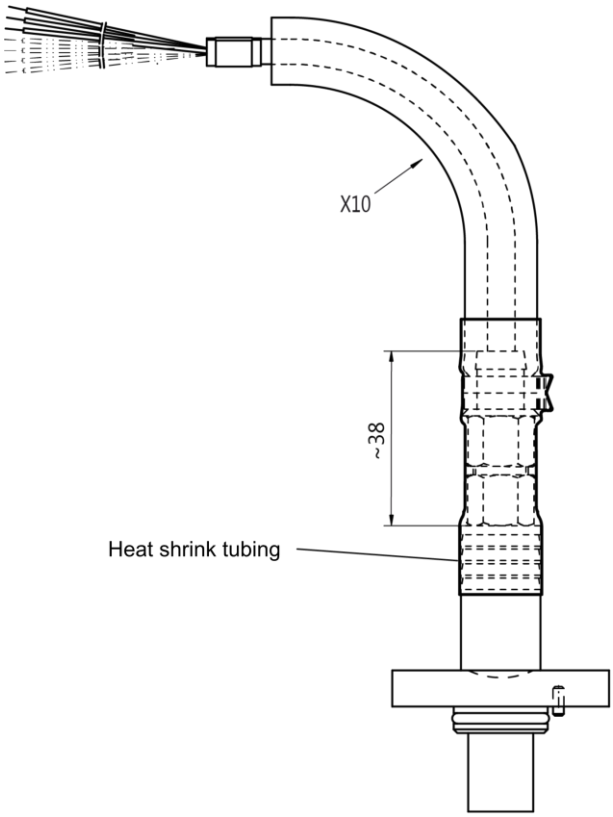



*Fig. 4/27: Cable protection with protective tubing (X10 = hc) (example)*

| | |
|---|---|
| Cable protection: | Parker 681DB-8 |
| Temperature range: | -40 °C to +100 °C |
| Bending radius: | > 70 mm |

# 5 Technical Data

## 5.1 General

| | |
|---|---|
| Measuring principle: | Non-contacting, wear-free |
| Sensor principle: | Hall effect, differential |

## 5.2 Basic standards for product

### 5.2.1 EN50155

- The requirements from EN 50155 are fulfilled.
- EN 50155, 6.2 Useful life (economic life):
  The useful life is agreed in individual contracts with the user or customer;
- Replacement parts see Maintenance chapter.

## 5.3 Reliability

| | |
|---|---|
| MTBF: | (both channels, VCC = DC 24 V) |
| HS22***.*na.PP1.*** | 4,690,000 hrs. **(forecast value)** |
| HS22***.*ga.PP1.*** | 3,810,000 hrs. **(forecast value)** |

Calculation according to
DIN EN 61709 (SN 29500)
and manufacturer's specifications,
without replacement parts

**Environmental conditions:**
55 °C ambient temperature,
operating time 8,760 hrs./year

## 5.4 Climate and environmental conditions

| | |
|---|---|
| Environmental conditions: | tested in acc. with IEC 60571 , EN 50155 |

### 5.4.1 Operating temperature

| | | |
|---|---|---|
| Operating temperature range: | -40 °C to +120 °C | for pulse generators and cables |
| | -40 °C to +100 °C | for pulse generators and cables, with cable protection / protective tubing and associated adapters |

### 5.4.2 Storage temperature

| | |
|---|---|
| Storage temperature range | -40 °C to +85 °C |

### 5.4.3 Humidity

| | |
|---|---|
| Humidity: | acc. to EN 50155<br>annual average: ≤ 75 % relative humidity<br>on 30 successive days of the year:<br>95% relative humidity |

### 5.4.4 Elevation (air pressure)

| | |
|---|---|
| Elevation (Air pressure): | acc. to EN 50125-1 :<br>Class AX: up to 2,000 m<br>(with reference to sea level) |

### 5.4.5 Shock/Vibration

| | |
|---|---|
| Shock/Vibration: | according to EN 61373 Category 3 |

### 5.4.6 Fire protection

| | |
|---|---|
| Fire protection | as per DIN EN 45545-2 |

## 5.5 Mechanical data

### 5.5.1 Mechanical prerequisites

Scan medium:

- Gear wheel or rack
- Ferromagnetic
- Material: e.g. ST37, ST50 or steel of type 10-10 according to DIN EN 10025 , grade FE430A
- Recommended tooth geometry according to DIN 867
  (test condition)
  Other tooth systems are possible
  (see chapter "Factors of influence [→ Page 82]")

Recommended size of teeth:

Module m = 2 (DP=13,0)
(test condition)
Other modules are possible (see chapter "Overview of variants [→ Page 23]" and "Factors of influence [→ Page 82]")

Working gap / air gap:

X = 0.5 to 2.0 mm (for m = 2)
(see chapter "Installation [→ Page 66]")
For small modules the permissible max. working gap drops continuously.

### 5.5.2 Dimensions

| | | |
|---|---|---|
| Width | approx. 60 mm | |
| Height: | approx. 30 mm | |
| **Design X1 = b** | | |
| Length: | approx. 100 mm | without cable protection |
| | max. 118 mm | with corrugated pipe |
| | approx. 118mm | with protective tubing |
| **Design X1=k, X1=l** | | |
| Length: | approx. 108 mm | |

## 5.5.3 Material

Housing material: rust-resistant high-grade steel

## 5.5.4 Weight

**Cable weight with and without cable conduit**

| **Output stage** | **PP1 (not galv. isol.)** | **PP1 (galv. isol.)** |
|---|---|---|
| Weight with 1 m cable | Approx. 260 g | Approx. 280 g |
| additional weight per meter of cable | + 73 g | + 93 g |
| Weight with 1 m cable + cable protection X10 = hc | Approx. 510 g | Approx. 530 g |
| additional weight per meter cable + cable protection X10 = hc | + Approx. 323 g | + Approx. 343 g |
| Weight with 1 m cable + cable protection X10 = c* | Approx. 300 g | Approx. 320 g |
| additional weight per meter cable + cable protection X10 = c* | + Approx. 113 g | + Approx. 133 g |

## 5.5.5 Protection category

Housing: In accordance with EN 60529
IP67

### 5.5.6 Cable data

The following cable data apply to all connection type models.

| **Output stages** | **PP1 not galv. isolated** | **PP1 galv. isolated** |
|---|---|---|
| Connecting cable: | 4 x 0.6 $mm^2$ | 6 x 0.5 $mm^2$ |
| Shielding: | 1 x black flexible lead (additional) | |
| Cable diameter: | 6.5 ± 0.3 mm | 7.2 ± 0.4 mm |
| min. bending radius: | 49 mm | 54 mm |
| Shield: | Copper, tin-coated | |
| Case: | Zerohal, black | |

## 5.6 Electrical data

### 5.6.1 Electric strength

**INFO**

**Electric strength**
The **insulation voltage** specification always refers to the:
1. electric strength of the connection point against the housing
2. electric strength between electrically isolated connection points

For further information: see chapter "Potential overview"

## 5.6.2 Sensor supply (not galvanically isolated)

| | |
|---|---|
| Number: | 1 |
| Function: | Power supply |
| Plug connection: | See chapter "Plug-pin assignment" |
| Signal designation: | $U_{B+}$ , $U_{B-}$ |
| Rated power supply: | DC +24 V |
| Supply voltage range: | DC +10 to +30 V |
| Current consumption without load $I_{B+}$ (pulse generator in total): | max. 44 mA at $\vartheta$ = 25 °C<br>max. 54 mA otherwise<br>(typical 18 mA per channel) |
| Current consumption at short circuit (one channel is short-circuited): | (against $U_{B+}$):<br>max. 110 mA at $\vartheta$ = - 40°C<br>(against $U_{B-}$):<br>max. 85 mA at $\vartheta$ = - 40°C |
| Protection against incorrect polarity: | yes |
| Electrical isolation: | yes (against housing)<br>no (channel to channel) |
| Dielectric strength: | AC 500 V (against housing) |

## 5.6.3 Sensor supply (galvanically isolated)

| | |
|---|---|
| Number: | 2 |
| Function: | Power supply |
| Plug connection: | See chapter "Plug-pin assignment" |
| Signal designation: | See chapter "Plug-pin assignment" |
| Rated supply voltage (one channel): | DC +24 V |
| Supply voltage range (one channel): | DC +10 to +30 V |
| Current consumption without load $I_{B+}$ (one channel): | max. 22 mA at $\vartheta$ = 25 °C,<br>max. 27 mA otherwise<br>(typical 18 mA per channel) |
| Current consumption at short circuit (one channel is short-circuited): | (against $U_{B+}$):<br>max. 100 mA at $\vartheta$ = - 40 °C<br>(against $U_{B-}$):<br>max. 85 mA at $\vartheta$ = - 40 °C , |
| Protection against incorrect polarity: | yes |
| Electrical isolation: | yes (against housing)<br>yes (channel to channel) |
| Dielectric strength: | AC 500 V (against housing)<br>AC 500 V (channel to channel) |

## 5.6.4 Outputs

### 5.6.4.1 Basic circuit

For the PP1 output stage the following principle is applicable for measuring $U_{ALow}$ and $U_{AHigh}$.

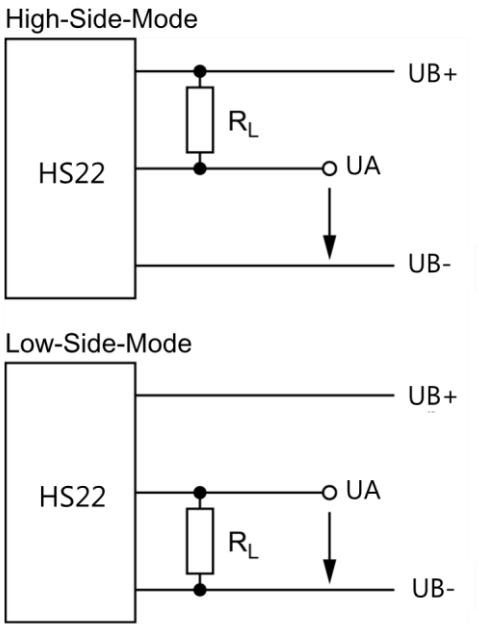



*Fig. 5/1: Basic circuit for the measurement*

### 5.6.4.2 Pulse output PP1

Push-pull output with one output current of max. ±20 mA. During the switching process from the high level to low level or vice versa, the output stage can supply up to 80 mA switching current in an external load which permits the connection of longer cables less than 20 m in length.

| | |
|---|---|
| Number of channels: | 2 |
| Function: | Output signal, rectangular |
| Plug connection: | See chapter "Plug-pin assignment" |
| Signal names: | See the "Plug-pin assignment" chapter |
| Type: | PP1 |
| Frequency range: | 0 Hz to 20 kHz<br>(depending on cable length and external load) |
| Output current $I_A$: | max. ±20 mA |
| Permissible cable length: | Max. 20 m |
| Output level High $U_{AH}$: | **High-Side-Mode** ($R_L$ against $U_{B+}$):<br>$(U_{B+} - 1.9\ V) < U_{AH} < (U_{B+} - 0.7\ V)$<br>**Low-Side-Mode** ($R_L$ against $U_{B-}$):<br>$(U_{B+} - 3.3\ V) < U_{AH} < (U_{B+} - 1.6\ V)$ |
| Output level Low $U_{AL}$: | **High-Side-Mode** ($R_L$ against $U_{B+}$):<br>$0.3\ V < U_{AL} < 2.0\ V$<br>**Low-Side-Mode** ($R_L$ against $U_{B-}$):<br>$0.3\ V < U_{AL} < 0.7\ V$ |
| Output resistance $R_A$: | max. 68 Ω |
| Short-circuit proof (one channel is short-circuited): | yes<br>Short-circuit at $\vartheta$ = 120 °C and $U_{B+}$ = +24 V<br>In case of a sustained short circuit, the life of the output driver above 85°C is considerably reduced. |
| Protection against incorrect polarity: | yes |
| Pulse duty factor: | $t_i / t_o = 0{,}5$ (± 10 %)<br>In case of larger modules (m > 3, DP < 8.8) the pulse duty factor depends on the ratio of tooth width to tooth gap.<br>(see chapter "Phase relation") |

| | |
|---|---|
| Phase relation between the slopes: | 90° channel 1 before channel 2<br>but dependent on tooth geometry, working gap and temperature<br>(see chapter "Phase relation") |
| Detection of rotation /driving direction: | is determined via phase relation of both output signals<br>(see chapter "Installation direction") |
| Overlap safety of output pulses: | at least 30°<br>(see chapter "Phase relation") |
| Edge steepness: | |
| (rise time) | 1.0 µs without load; |
| (Decay time) | < 2.0 µs with an ohmic load current of $I_L$ = ±20 mA |
| Diagnostics function: | yes, (see chapter "Diagnostics function through evaluation unit [→ Page 87]" |
| Electrical isolation: | yes |
| Dielectric strength: | AC 500 V |
| **Test conditions:** | |
| Supply voltage $U_B$: | DC 10 to 30 V |
| Output current $I_L$: | 0 to 20 mA |
| Cable length: | 20 m |
| Mechanical requirements: | see chapter [→ Page 49] |

## Diagrams for UALow and UAHigh

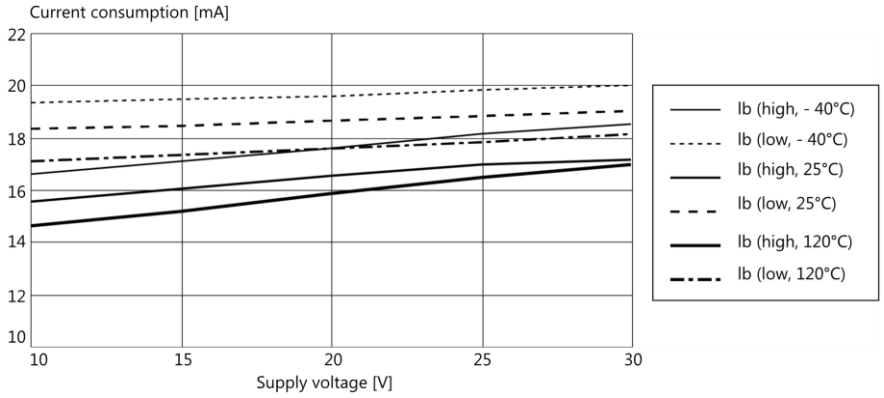



*Fig. 5/2: Current consumption via supply voltage (typical paths per channel)*

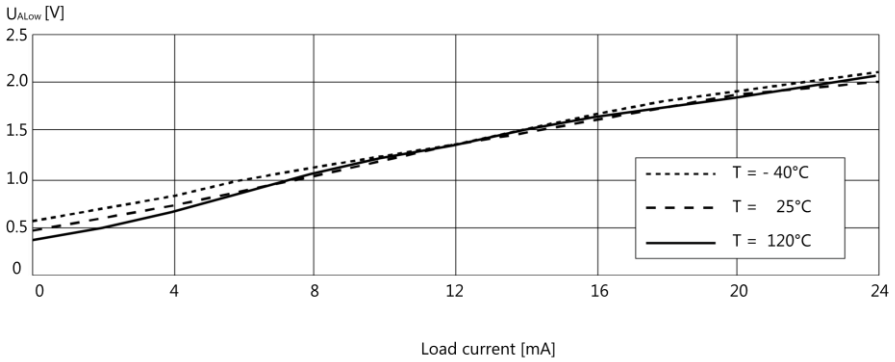



*Fig. 5/3: Voltage drop at the output for load against UB (typical paths per channel)*

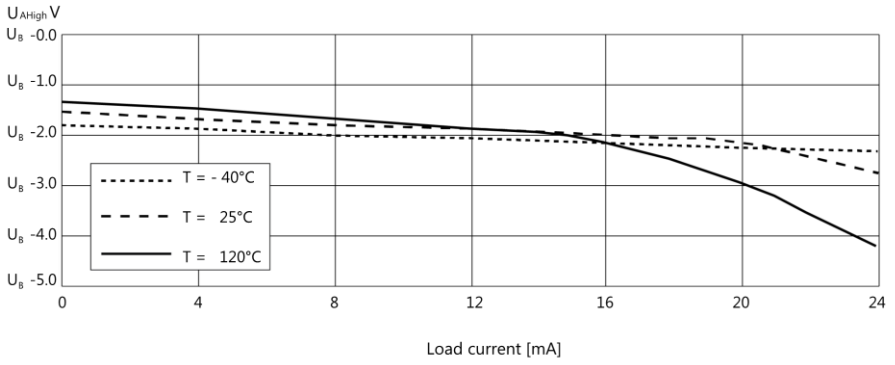



*Fig. 5/4: Voltage drop at the output for load against GND (typical paths per channel)*

### 5.6.4.3 Phase relation

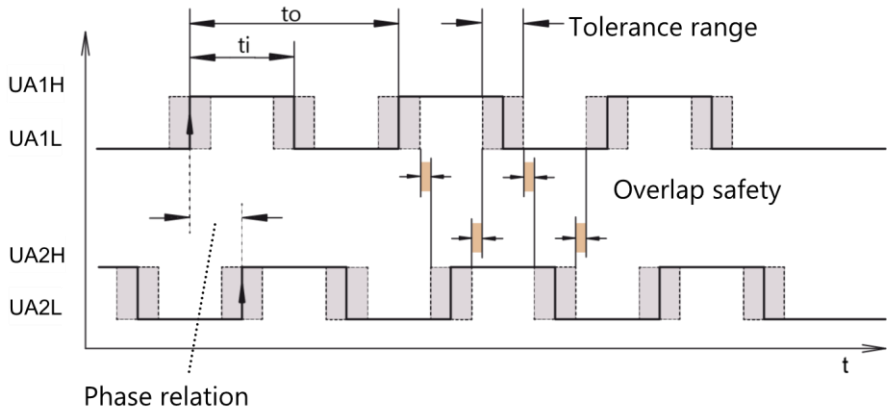



*Fig. 5/5: Output signal 2-channel*

The figure represents the following information on output signals:

- Phase relation
- Overlap safety
- Pulse duty factor ( $t_i/t_o$ )
- Tolerance range for pulse duty factor

For more information: see chapter "Outputs"

The illustrated signal sequence corresponds with a clock-wise rotation with a view of the gear wheel and with a view of the visual reference edge (A) of the installed pulse generator.

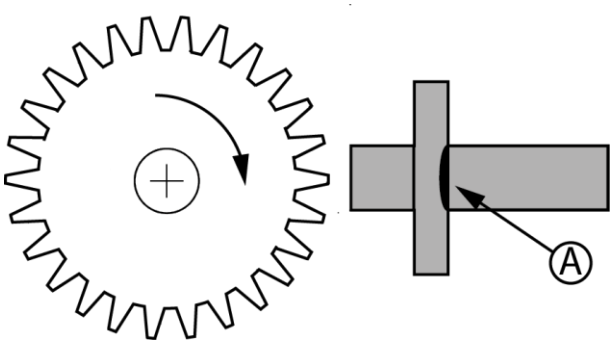
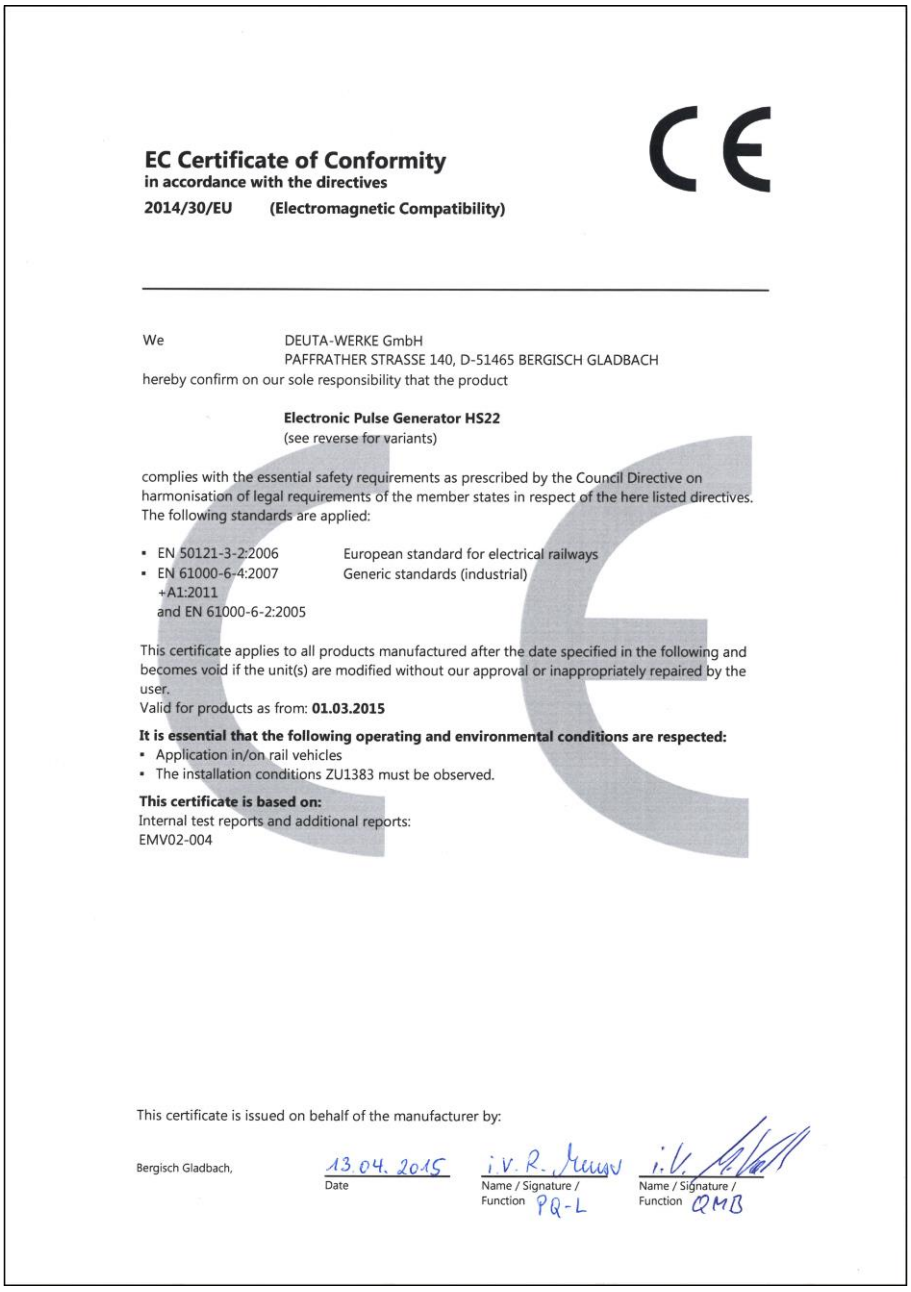



*Fig. 5/6: Direction of rotation of gear wheel*

# 6 Certificates



**EC Certificate of Conformity**
**in accordance with the directives**
**2014/30/EU (Electromagnetic Compatibility)**

We DEUTA-WERKE GmbH
PAFFRATHER STRASSE 140, D-51465 BERGISCH GLADBACH
hereby confirm on our sole responsibility that the product

**Electronic Pulse Generator HS22**
(see reverse for variants)

complies with the essential safety requirements as prescribed by the Council Directive on harmonisation of legal requirements of the member states in respect of the here listed directives.
The following standards are applied:

- EN 50121-3-2:2006 European standard for electrical railways
- EN 61000-6-4:2007 +A1:2011 and EN 61000-6-2:2005 Generic standards (industrial)

This certificate applies to all products manufactured after the date specified in the following and becomes void if the unit(s) are modified without our approval or inappropriately repaired by the user.
Valid for products as from: **01.03.2015**

**It is essential that the following operating and environmental conditions are respected:**
- Application in/on rail vehicles
- The installation conditions ZU1383 must be observed.

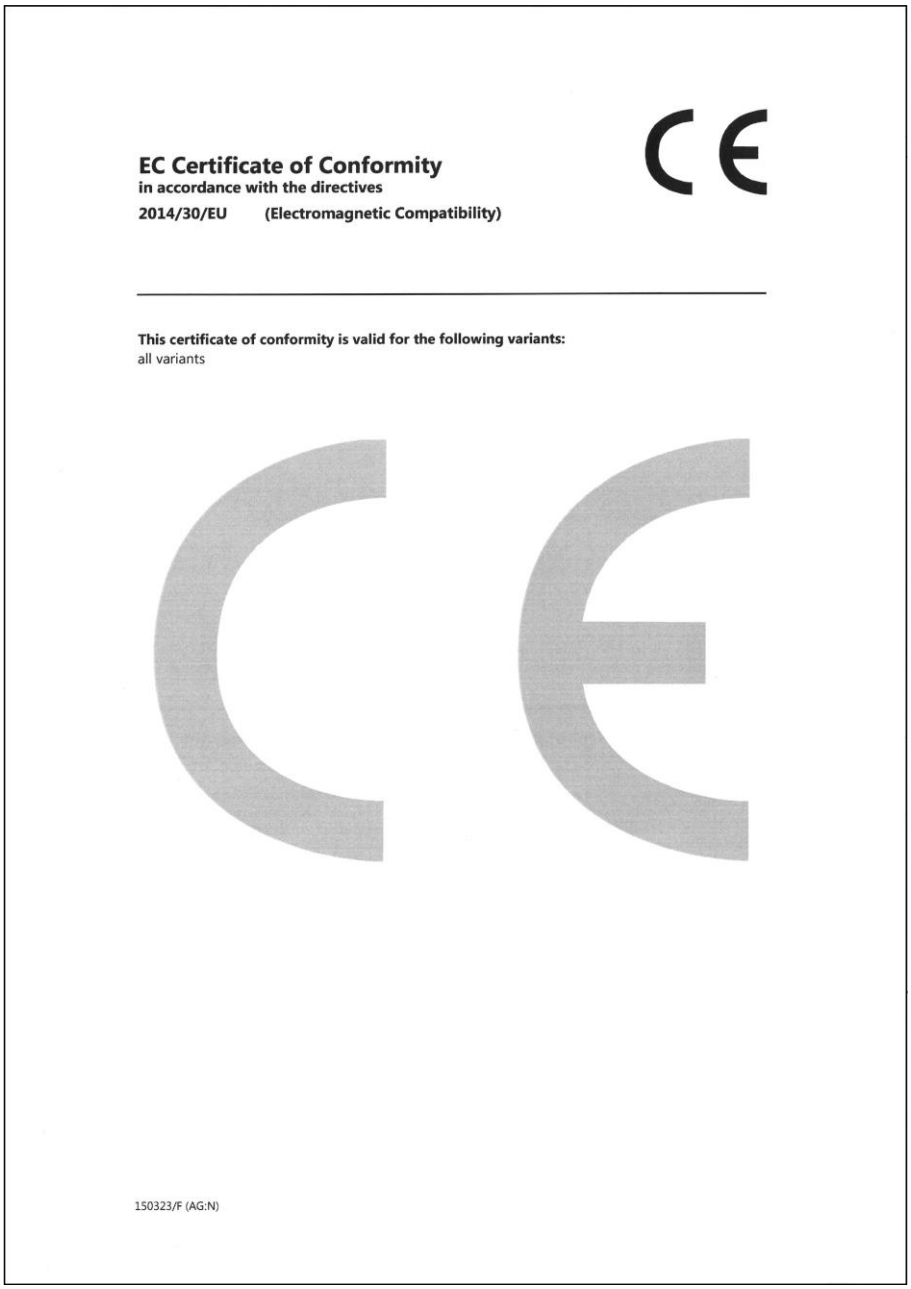
**This certificate is based on:**
Internal test reports and additional reports:
EMV02-004

This certificate is issued on behalf of the manufacturer by:

Bergisch Gladbach, 13.04.2015 (Date) i.V. R. Meuser (Name / Signature / Function PQ-L) i.V. (Name / Signature / Function QMB)

*Fig. 6/1: EC Declaration of Conformity Page 1*

| **INFO** |
| --- |
| If necessary, you can request a more current version of the Declaration of Conformity from DEUTA. |



**EC Certificate of Conformity**
**in accordance with the directives**
**2014/30/EU (Electromagnetic Compatibility)**

**This certificate of conformity is valid for the following variants:**
all variants

150323/F (AG:N)

*Fig. 6/2: EC Declaration of Conformity Page 2*

| **INFO** |
| --- |
| If necessary, you can request a more current version of the Declaration of Conformity from DEUTA. |

# 7 Important utilisation notes

## 7.1 Important notes

**Check for complete delivery**

| Step | Description |
|---|---|
| 1 | Carefully unpack the device. |
| 2 | Check for completeness, correct type, correct connections as well as for possible signs of transport damage. |
| 3 | We recommend you keep some of the original packaging in the event of returns. |
| 4 | Only dispose of the packaging after you have completed these steps, if you do not intend to store the device. |

## 7.2 Transportation

- **Transportation**
  The device should only be transported in the originally supplied or similar packaging.
- **Returning**
  When returning the device, sufficient protective measures must be taken to avoid damaging the device.

## 7.3 Storage

| INFO |
| --- |
| **Storage**<br>To protect the seal (O-ring) from the effects of ageing, the pulse generator should be stored dust-free and dry and protected from UV radiation. |

| | |
| --- | --- |
| Storage temperature range | -40 °C to +85 °C |
| Humidity: | acc. to EN 50155<br>annual average: ≤ 75 % relative humidity<br>on 30 successive days of the year:<br>95% relative humidity |
| Elevation (Air pressure): | acc. to EN 50125-1 :<br>Class AX: up to 2,000 m<br>(with reference to sea level) |
| Packaging: | The device should only be stored in the originally supplied or similar packaging. |

# 8 Installation requirements

**NOTICE**

To avoid disturbances and damage:

1. Comply with all instructions given in this chapter.

## 8.1 Applicable EMC Standards

For the Electronic Pulse Generator HS22 - designed for use on rail vehicles and in industrial machines - are based on the following inspection specifications:

**European Standard for Electrical Railways, EN 50121-3-2 with the basic standards:**

| | |
|---|---|
| EN 55016-2-3 | Radio disturbance characteristics; Limits and methods of measurement (housing) |
| EN 55016-2-1 | Radio disturbance characteristics; Limits and methods of measurement (wiring) |
| EN 61000-4-2 | Electrostatic discharge immunity (ESD) |
| EN 61000-4-3 | Radiated, radio-frequency, electromagnetic field immunity test |
| EN 61000-4-4 | Electrical fast transient/burst immunity test |
| EN 61000-4-5 | Immunity to powerful surges |
| EN 61000-4-6 | Immunity to conducted disturbances, induced by radio-frequency fields |

The conducted tests also comply with the requirements of the following specifications:

| | |
|---|---|
| EN 61000-6-2 | Generic standards. Immunity for industrial environments |
| EN 61000-6-4 | Generic standards. Emission standard for industrial environments |

**Tolerable function impairments**

The tolerable function impairments under the effects of interference (with respect to the evaluation criteria listed in the above product standard) are:

- **Evaluation criterion A:**
  During the test no additional pulses must be issued and no pulses triggered by the toothed wheel must be lost.

- **Evaluation criterion B:**
  At the moment that interference occurs, error- or additional pulses can occur. After the interference the generator must be fully functional again.
- **Evaluation criterion C:**
  Not applicable

## 8.2 Installation instructions

### Designated operational location

The electronic pulse generators HS22 are designed for use on railway vehicles and in industrial machines and are utilised there for rpm coverage. The sensors could be attached to box covers or gears on rail vehicles, for example, as well as in the area of (electric) motors or industrial machines.

### Installation conditions

Since the Hall sensors are directly on the back of the end face of the pulse generator with their permanent magnets, this surface must be handled carefully. The bearing surface of the pulse generator and the bearing surface at the assembly site must be free from varnish and grease. Please note before assembly that the coding pen in the flange of the pulse generator and the corresponding coding in the bearing surface must be available. The protective cap must be removed before assembling the end faces.

To protect the operating resource, the service and maintenance personnel must be electrostatically discharged during disassembly and installation.

### Wiring and signal requirements

The supply and signal lines are laid together in a screened cable that is permanently connected with the pulse generator. The cable screen must be laid out supply-sided (single-sided). The cables length for the pulse generator HS22 ***. *g*.PP2.*.*** may not exceed 50 m. The cable length of the remaining pulse generators may not exceed 20 m. Larger cable lengths lead to a decrease of signal quality and EMC resistance. The generator housing must have a connection through the attachment to the local vehicle earth, that is, to the operational ground. The pulse outputs with push-pull output stages (PPx, LVPx, LPCx) may be loaded in continuous operation with a maximum of 20 mA. When using the pulse generator in the area of rail vehicles, the use of one power supply isolated from the battery voltage is specified. The output signals may not be referenced to the battery potential either. If the pulse generators are used in the industrial area, using an uninterruptible powersupply galvanically isolated from the mains is specified.

### Evaluation and peripheral device requirements

All connected devices must comply with the technical specifications given in the instruction handbook and have sufficient interference immunity for the corresponding ambient conditions to guarantee correct function.

**Restricted operating behaviour caused by electromagnetic interferences**

This resource is suitable for the electromagnetic ambient conditions as designated in the test basics. A deviating behaviour from the data in the evaluation criteria is not expected.

**Scope and frequency of EMC relevant maintenance procedures**

(Note in acc. with § 4, EMC Law)

EMC relevant maintenance measures (maintenance of EMC protective components, definition of the term "maintenance" see DIN 31051, IEC 60050-191) shall not be performed. If operating behaviour occurs which deviates from the evaluation criteria of the relevant product norm or from the specified permitted impairments [→ Page 63], the device must be tested at DEUTA and repaired if necessary.

**General notes**

To guarantee the operating quality, basic EMC measures to avoid unnecessary interference coupling mechanisms are assumed and are therefore not mentioned in detail. These include the selection of suitable lines and components, approved and permanently assured connections, sensible routing and arrangement of cables, awareness of possible potential differences, the shortest possible connections, the separation of critical signal groups, range of interference sources, etc.

Enclosed installation material (see scope of supply, appropriate spare parts or accessories or other prescribed material such as lines, cables or connectors) must be used.

In consideration of the stated installation specifications, compliance with the specified standards shall be guaranteed. Deviations from the installation specifications can only be implemented at own responsibility.

The pertinent fire safety standards with regard to lines, cables or connectors must be observed in the installation.

# 9 Installation

## 9.1 Important notes

**IMPORTANT**

**Requirements for error-free installation and trouble-free operation**
For the installation, comply with the following notes:

- To achieve the optimum use of this device, we recommend implementing the initial start-up with DEUTA support.
- Unused equipment connectors must always be provided with suitable covers as protection against contamination, contact, damage and fault.

**INFO**

**Protection against incorrect polarity**
The output stages are protected against incorrect polarity of all wires amongst each other.

**IMPORTANT**

**Observe clearance gauge**
After completion of the assembly, no parts may extend beyond the clearance gauge.

**IMPORTANT**

**Requirement for assembly work**
For all work you must comply with the local process and safety regulations.

## 9.2 Assembly/Installation

## 9.2.1 Installation

### 9.2.1.1 Installation direction

The installation direction is defined as standard for all assembled pulse generators. In the viewing direction from above, the marked edge of the pulse generator must be installed generally in the "forward" direction and aligned to the right. If viewing the pulse generator from the side with its marked edge, the corresponding gear wheels must show the "clockwise" direction of rotation – as an alternative definition for the "forward" direction.

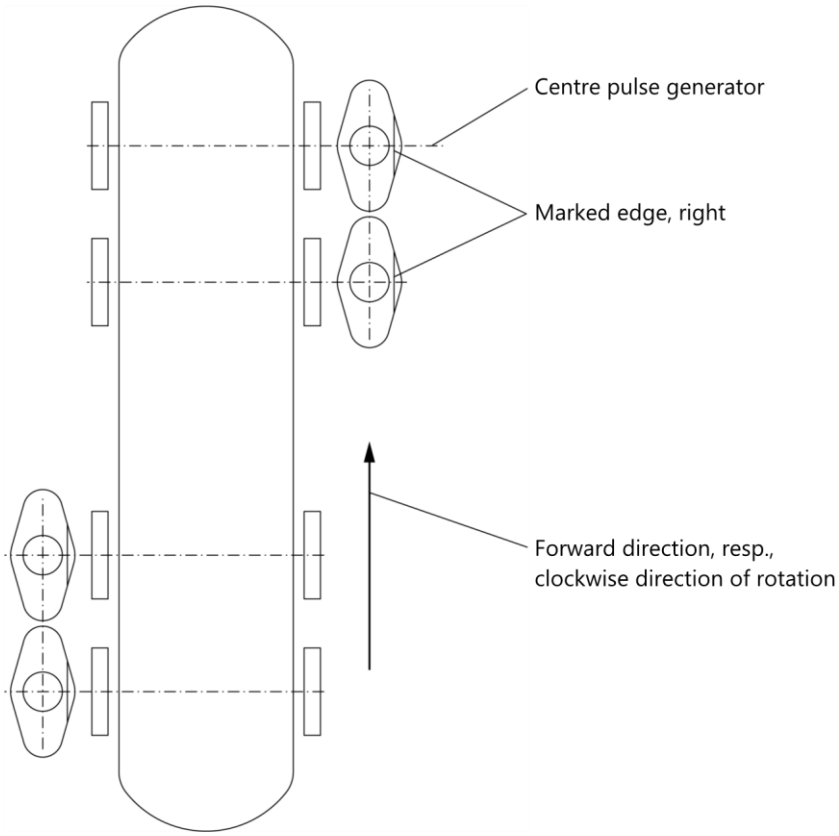



*Fig. 9/1: Installation direction with viewing direction from above*

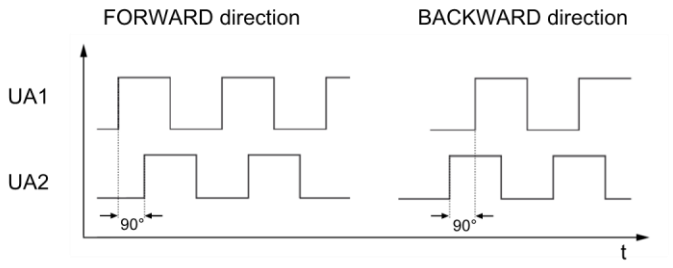



*Fig. 9/2: Phase relation in dependence on driving direction*

### 9.2.1.2 Mounting space

The mounting space is specified according to the dimensional drawing.

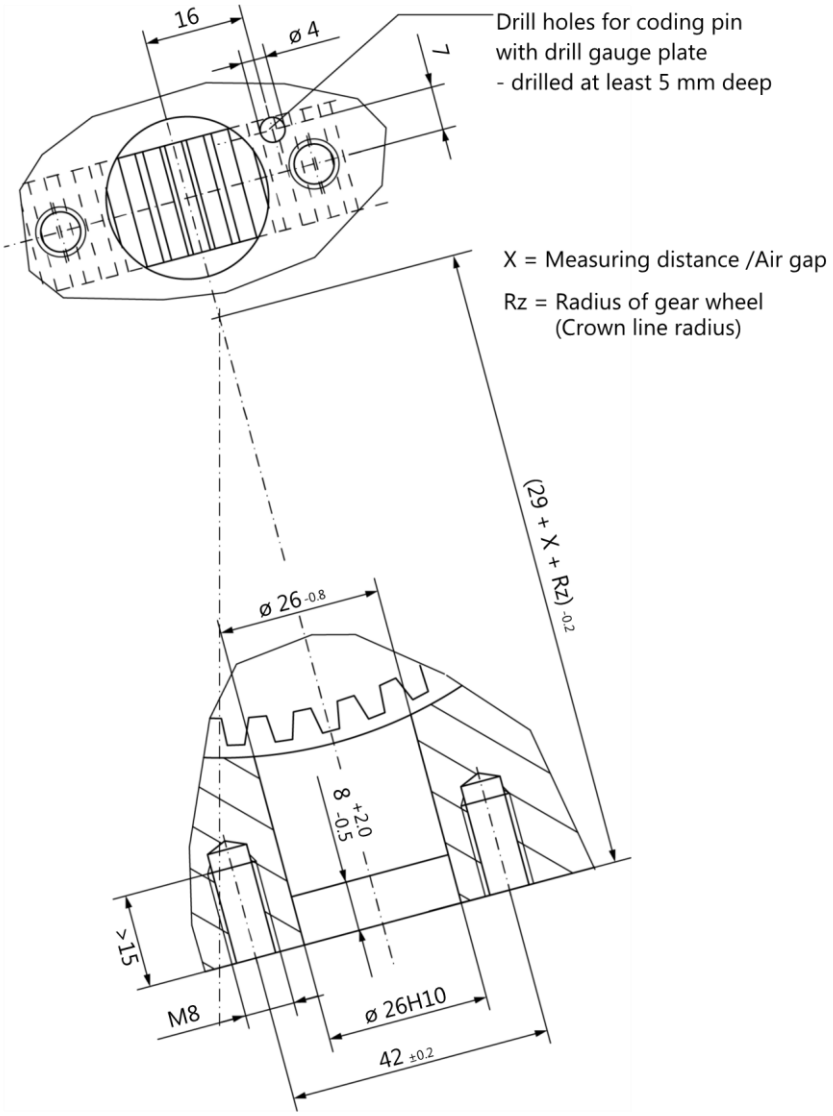



*Fig. 9/3: Mounting space*

### 9.2.1.3 Installation angle

The flange of the pulse generator must be basically mounted in such a way that its centre axle is positioned vertically to the rotating axle of the gear wheel and the sensor head is positioned as centrally over the gear wheel as possible.

**INFO**

**Measuring distance X and exact mounting position**
You will find the information on this in the chapter "Adjusting the working gap". The exact mounting position of the pulse generator is defined by three mounting angles α, β and γ.

The angle α determines the mounting position below the gear wheel. The deviation of the pulse generator centre axle to the vertical amounts to 15° to 75° (referring to the vertex corresponding to the gear wheel centre).

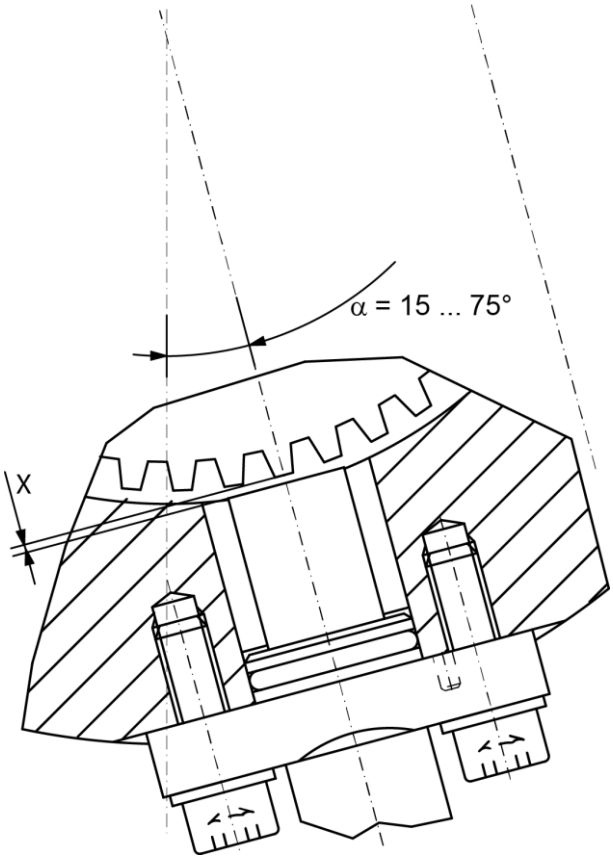



*Fig. 9/4: Mounting angle α*

The flange should ideally be mounted vertically to the above supposed centre line, which runs through the gear wheel centre and the sensor head. The angle β determines a tilt deviation of maximally ±0.57° of the pulse generator centre axle to the supposed centre line. This dimension corresponds to a displacement with a mechanical tolerance of ±0.2mm in the area of the mounting holes of the flange.

| **IMPORTANT** |
| --- |
| **Do not install the sensor on a slant**<br>If the sensor is installed on a slant, the magnetic circuit will change and thus affect the pulse duty factors and the phase relation of the two output signals! |

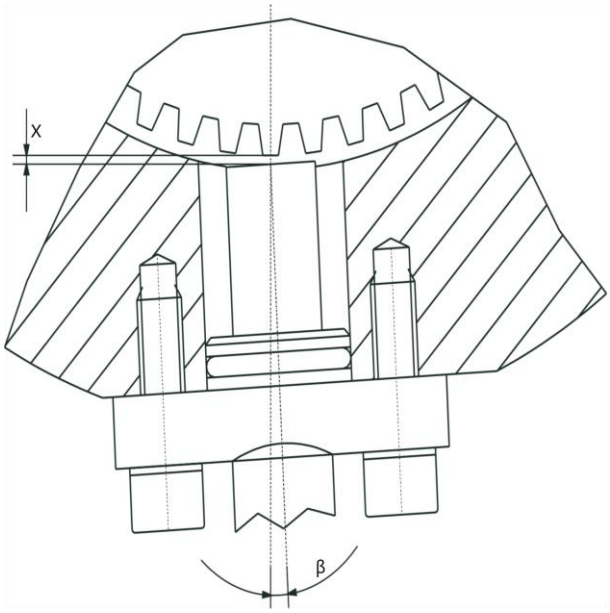



*Fig. 9/5: Installation angle β*

The flange should ideally be aligned in such a way that the flange centre line running through the two centre points of the mounting holes runs parallel to the gear wheel-wide centre line. (The existing marked edge at the border of the flange also runs parallel to the flange centre line.) The angle γ determines a permissible torsion deviation of a maximum of ±15°.

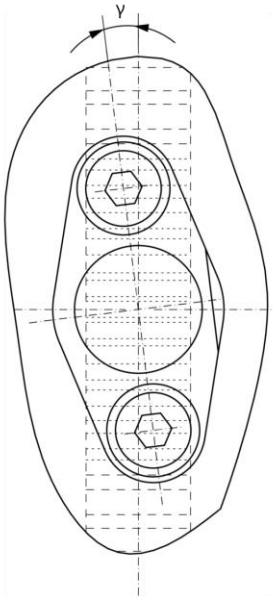



*Fig. 9/6: Mounting angle γ*

**IMPORTANT**

**Do not exceed permissible rotational deviation**

If required by the mounting situation, the pulse generator may also be installed in an offset position over the gear wheel. The permissible torsion deviation of a maximum of ±15° should never be exceeded, otherwise the functional safety of the pulse generator cannot be guaranteed. However, it must be assumed that an offset leads to the restriction of the permissible working temperature range or that of the maximally permissible measuring distance.

DEUTA has only analysed the effects described below in terms of quality and therefore cannot guarantee that the pulse generator will operate properly outside the specified boundary conditions:

- The rotation of the gear wheel induces an alternate voltage signal in the Hall sensors. During offset installation, the signal will decrease proportionally to the factor cos γ. The drift parameters of the Hall sensors will have a stronger effect and the temperature drift of the pulse duty factors and the phase angles of the output signals will increase.
- The pulse centres of the high/low pulse of the output signals will shift with cos γ towards smaller values. The installed offset pulse generator would now be better suited for a gear wheel with a smaller module. In purely mathematical terms, an offset of γ = 2.5° would suit a module of 1.8 and an offset of γ = -2.6° would suit a module of 2.2. If one retains a gear

wheel with Module 2, not only will the pulse centres shift but also the phase angles of the output signals. A minimum overlap of the output pulses of 30° can then no longer be guaranteed.

### 9.2.1.4 Adjusting the measuring distance

First, mount the pulse generator according to the installation instructions vertically above the gear wheel in working gap X (see chapter "Mounting angle"). Then the power supply is switched on and the gear wheel is put into rotation. The output signal on the oscilloscope shows a clean square wave with the pulse duty factor of 50%  ±10%.

### 9.2.1.5 Flange assembly

The pulse generator is mounted radially with the end face of the sensor head over the gear wheel. The assembly of the flange is performed under observance of the installation regulations [→ Page 66] (see chapter "Assembly/Installation") with commercial attachments (screws, discs, pins).

**INFO**

**Measuring distance X**
Use suitable equipment (vernier depth gauge, vernier callipers) to check the distance between the mating surface (at the flange foot) and tooth crest (at the crown line) and make sure that the measuring distance X is maintained and will not fall below or be exceeded by a possibly eccentrically mounted gear wheel or due to bearing clearance (see chapter "Influence of mechanical tolerances").

**IMPORTANT**

**Check the distance x and sealing ring**
To guarantee safe non-contacting scanning of the gear wheel, it is not permitted to exceed or drop below the maximum measuring distance X (see chapter "Commissioning and system parameter")!
During assembly of the pulse generator, make sure that the sealing ring at the sensor body is neither pinched nor damaged.

### 9.2.1.6 Cable assembly

The assembly of the cable is usually performed after mounting the flange.

**IMPORTANT**

**Criteria for installing the cable**
For trouble-free operation, the following criteria must be observed when installing the cable:

- The cable must be installed and fastened properly as short and directly as possible whereby travel operation and possible movements of the bogie must be taken into account.
- The cables and plugs may not be exposed to permanent torsional forces during installation and cabling.
- The cable must be fixed vibration-free by suitable fixtures. The movements of the bogie must also be taken into account here also.
- The greatest of the specified bending radii (cable, protective tubing, see chapter "Mechanical drawings"), may not be dropped below (not in travel operation and bogie movements either).
- The cable end must be laid in such a way that the wire connection ideally can occur in a connecting box of the required protection category (e.g. IP 67). This high level of protection category will prevent moisture from penetrating along the cable wires. If this procedure is not observed, internal hydrolysis could lead to malfunction of the pulse generator. If necessary, a protective tubing must be used.

If you have ordered a model with protective tubing, then make sure that the end of the protective tubing and the cable are sealed against moisture (splashwater or water jets).

**INFO**

**Protective tubing**
DEUTA also offers models complete with protective tubing ex-works. If in doubt, we recommend you consult our Applications Technology Department.

## 9.3 Wiring and earthing concept

### 9.3.1 Earthing regulation

In all versions of the HS22 pulse generator family, the cable shield is not connected electrically conductive to the stainless steel casing of the pulse generator and must be connected at the customer interface with the reference earth UB- or the local reference earth.

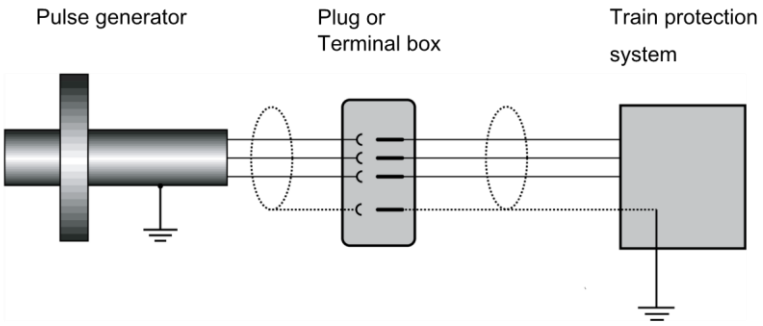


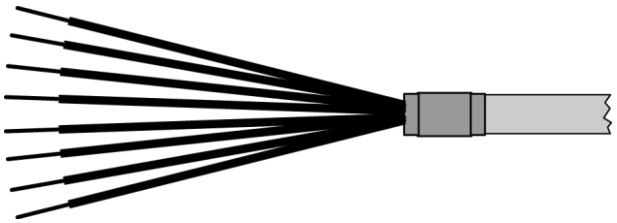

*Fig. 9/7: Earthing of shield connection pulse generator*

## 9.4 Plug-pin assignment

### 9.4.1 Connection with open cable ends (connection type X3 = a)

**Output stage: PP1 (not galvanically isolated)**

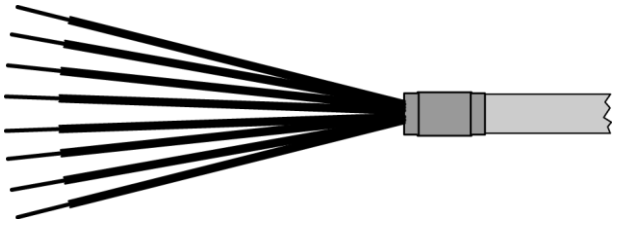
Flexible lead, open cable ends, tin-coated



| Colour | Signal designation | Function |
|---|---|---|
| Blue | UA2 | Signal channel 2 |
| Orange | UB+ | Power supply UB+ |
| White | UA1 | Signal channel 1 |
| Green | UB- | Power supply UB- |
| Black | Cable shield | |

**Output stage: PP1 (galvanically isolated)**

Flexible lead, open cable ends, tin-coated

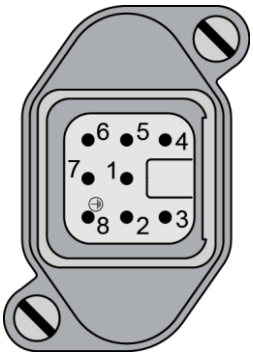


| Colour | Signal designation | Function |
|---|---|---|
| Red | UB1+ | Power supply UB1+ |
| Blue | UA1 | Signal channel 1 |
| Yellow | UB1- | Power supply UB1- |
| Orange | UB2+ | Power supply UB2+ |
| White | UA2 | Signal channel 2 |
| Green | UB2- | Power supply UB2- |
| Black | Cable shield | |

## 9.4.2 Connection for sensors with galvanic isolation

### Connection type X3=c

Plug connector, 8-pin, pins
Housing: Han3HPR-gg-SV-M20
Pin insert: Han8D-M
Contacts: Pin 0.5 mm² (gold-plated)
Cable plug connection with screw-type locking

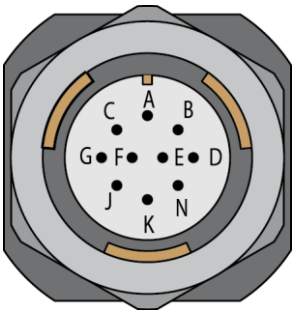



| PIN | Signal designation | Function |
|---|---|---|
| 1 | reserved | |
| 2 | **UA2** | **Signal channel 2** |
| 3 | **UB2+** | **Power supply UB2+** |
| 4 | **UB1+** | **Power supply UB1+** |
| 5 | **UA1** | **Signal channel 1** |
| 6 | **UB1-** | **Power supply UB1-** |
| 7 | **UB2-** | **Power supply UB2-** |
| 8 | **Cable shield** | |

Pins labelled with "reserved" may not be connected!

### Connection type X3=i

Plug connector, 10-pin, pins
Housing: Souriau VGE1 H 1819
Pin insert: RM1M23K
Contacts: Pin 0.5 to 1.5 mm² (gold-plated)
Cable plug connection with bayonet catch

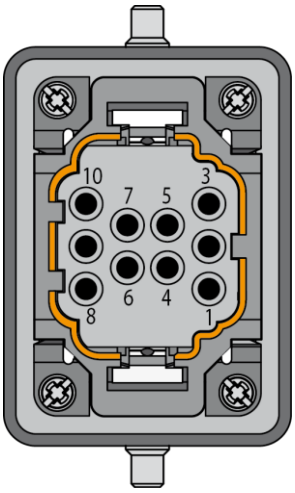



| PIN | Signal designation | Function |
|---|---|---|
| A | **UB1+** | **Power supply UB1+** |
| B | **UA1** | **Signal channel 1** |
| C | **UB1-** | **Power supply UB1-** |
| D | reserved | |
| E | **UB2+** | **Power supply UB2+** |
| F | **UA2** | **Signal channel 2** |
| G | **UB2-** | **Power supply UB2-** |
| H | reserved | |
| I | reserved | |
| J | reserved | |
| Housing | **Cable shield** | |

Pins labelled with "reserved" may not be connected!

### Connection type X3=k

Plug connector, 10-pin, pins
Housing: Han 6M-gg-M20
Pin insert: Han 10EE-M-c
Contacts: Pin 0.5 mm² (gold-plated)
Cable plug connection (square) with locking bolts

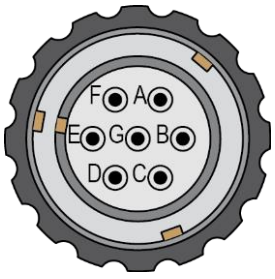



| PIN | Signal designation | Function |
|---|---|---|
| 1 | UB1+ | Power supply UB1+ |
| 2 | UA1 | Signal channel 1 |
| 3 | UB1- | Power supply UB1- |
| 4 | reserved | |
| 5 | UB2+ | Power supply UB2+ |
| 6 | UA2 | Signal channel 2 |
| 7 | UB2- | Power supply UB2- |
| 8 | Cable shield | |
| 9 | reserved | |
| 10 | reserved | |

Pins labelled with "reserved" may not be connected!

### Connection type X3=l

Plug connector, 7-pin, pins
Housing: Glenair FRITS series
Contacts: Pin 0.5 mm² (gold-plated)
Cable plug connection with bayonet catch



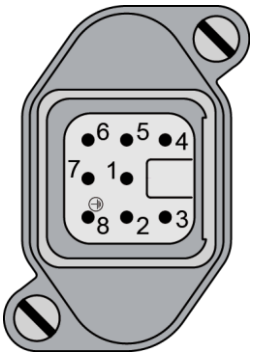

| PIN | Signal designation | Function |
|---|---|---|
| A | UB1+ | Power supply UB1+ |
| B | UA1 | Signal channel 1 |
| C | UB1- | Power supply UB1- |
| D | UB2- | Power supply UB2- |
| E | UA2 | Signal channel 2 |
| F | UB2+ | Power supply UB2+ |
| G | Cable shield | |
| Housing | | |

Pins labelled with "reserved" may not be connected!

## 9.4.3 Connection for sensors without galvanic isolation

### Connection type X3=c

Plug connector, 8-pin, pins
Housing: Han3HPR-gg-SV-M20
Pin insert: Han8D-M
Contacts: Pin 0.5 mm² (gold-plated)
Cable plug connection (square) with screw-type locking

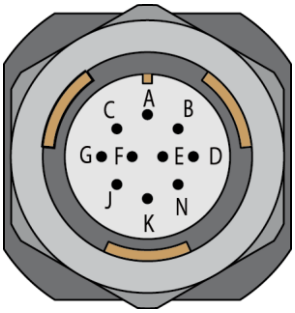



| PIN | Signal designation | Function |
|---|---|---|
| 1 | UB+ | Power supply UB+ |
| 2 | UB- | Power supply UB- |
| 3 | UA1 | Signal channel 1 |
| 4 | UA2 | Signal channel 2 |
| 5 | reserved | |
| 6 | reserved | |
| 7 | reserved | |
| 8 | Cable shield | |

Pins labelled with "reserved" may not be connected!

### Connection type X3=i

Plug connector, 10-pin, pins
Housing: Souriau VGE1 H 1819
Pin insert: RM1M23K
Contacts: Pin 0.5 to 1.5 mm² (gold-plated)
Cable plug connection with bayonet catch

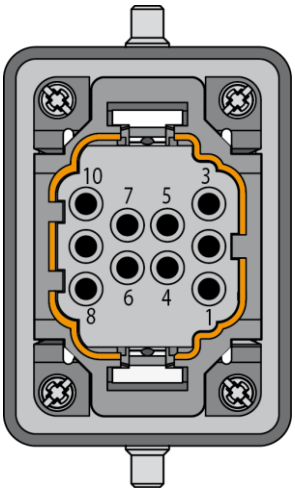



| PIN | Signal designation | Function |
|---|---|---|
| A | UB+ | Power supply UB+ |
| B | UA1 | Signal channel 1 |
| C | UB- | Power supply UB- |
| D | reserved | |
| E | UA2 | Signal channel 2 |
| F | reserved | |
| G | Cable shield | |
| Housing | reserved | |

Pins labelled with "reserved" may not be connected!

**Connection type X3=k**

Plug connector, 10-pin, pins
Housing: Han 6M-gg-M20
Pin insert: Han 10EE-M-c
Contacts: Pin 0.5 mm² (gold-plated)
Cable plug connection (square) with locking bolts

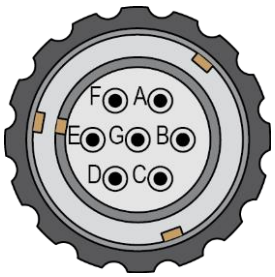



| PIN | Signal designation | Function |
|---|---|---|
| 1 | UB+ | Power supply UB+ |
| 2 | UB- | Power supply UB- |
| 3 | UA1 | Signal channel 1 |
| 4 | reserved | |
| 5 | reserved | |
| 6 | reserved | |
| 7 | UA2 | Signal channel 2 |
| 8 | Cable shield | |
| 9 | reserved | |
| 10 | reserved | |

Pins labelled with "reserved" may not be connected!

**Connection type X3=l**

Plug connector, 7-pin, pins
Housing: Glenair FRITS series
Contacts: Pin 0.5 mm² (gold-plated)
Cable plug connection with bayonet catch




| PIN | Signal designation | Function |
|---|---|---|
| A | UB+ | Power supply UB+ |
| B | UA1 | Signal channel 1 |
| C | UB- | Power supply UB- |
| D | reserved | |
| E | UA2 | Signal channel 2 |
| F | reserved | |
| G | Cable shield | |
| Housing | reserved | |

Pins labelled with "reserved" may not be connected!

# 10 Commissioning and system parameters

## 10.1 Parameters

The pulse generator HS22 cannot be parametrized. It is a sensor which uses a defined module to scan the gear wheel provided by the customer. The output pulses are generated from tooth and tooth gap of this gear wheel. The output frequency thus depends on the speed of the gear wheel AND of the provided number of teeth corresponding to the distance section (wheel revolution).

This value is to be stored in the downstream evaluation system (e.g. train protection, recorder) or considered during manual evaluation (oscilloscope measurement).

## 10.2 Commissioning

**INFO**

**Switching on the power supply**
Please note that the power supply is only to be switched on after the assembly.

For commissioning, the installation conditions in chapter "Installation conditions [→ Page 63]" and "Installation [→ Page 66]" must be observed.

- Before final installation we recommend performing a function test. The HS22 should be electrically integrated directly into the final vehicle wiring and connected to the evaluation system (e.g. train protection, recorder).
- Once the proper function of the HS22 in combination with the evaluation system has been tested successfully, the final mechanical attachment to the vehicle can be performed.
- A conclusive test trip enables the evaluation of the overall functionality under consideration of external influences during regular vehicle in operation.

## 10.3 Function test

Before the mounting (attachment to vehicle), it must be ensured that both signal channels of the pulse generator work properly. The HS22 is mounted mechanically to the customer's test set-up with powered gear wheel or a DEUTA testing stand XP20D with measuring wheel as according to the installation conditions (see chapter "Installation requirements [→ Page 63]"). The HS22 will then be electrically connected either directly at the downstream evaluation system (e.g. train protection, recorder) or, for manual measurement, to an oscilloscope or comparable measuring device.

The function test is then performed by turning the gear wheel. The DEUTA test bench XP20D enables the optional use of travel profiles for activating the drive. System tests based on defined test processes or previously travel data previously recorded in real time can be performed here.

# 11 Operation

## 11.1 Function and operating principles

The pulse generator of the HS series converts a magnetic sensor signal into an electric square wave signal. The electrical signal is sent over a shielded cable to an evaluation unit from which it acquires the necessary information (e.g. distance travelled, present speed).

The running gear wheel causes a periodic intensity fluctuation of the magnetic field strength through the periodic change of the magnetic circuit. The differential Hall sensor placed in the magnetic circuit is able to measure the gradient (first derivation dB/dz) of the changing magnetic field and converts it into an electric signal. The temperature drift of the Hall sensor is compensated by the integrated automatic correction circuit. The greatest effect of the magnetic circuit assumes a change of the measuring distance X.

The rectangular electric signal at the output of the Hall sensor is reinforced by the downstream pulse generator electronics and fed via cable to the connected interface.

The pulse generator electronic is completely enclosed by a sealing compound within the stainless steel tube.

It offers protection from environmental influences and shock-like mechanical vibrations. The stainless steel tube end is sealed with a metallic end piece. Among other functions, the end piece assumes the important function of cable strain relief.

The pulse generator cable has a simple cable shield (> 85 % degree of shield coverage) that has no electrically conductive connection with the stainless steel tube. For this reason, the cable shield must be connected at the pulse generator interface with a local earth potential or a galvanically isolated earth, see Earthing regulation [→ Page 74]. The interrupted cable shield allows unrestricted operation of the pulse generator at the bogie. The EMC requirements are fulfilled despite the interrupted cable shield thanks to the expanded two-stage EMC protective wiring.

## 11.2 Signal behaviour

The signal behaviour principally depends on the measuring distance X, the tooth shape of the gear wheel and its tooth pitch or module m.

(For further information: See chapter "Adjusting the working gap [→ Page 72]")

## 11.3 Weighted factors

## 11.3.1 Influence of toothing and module

The utilised gear wheels are ideally specified according to DIN 867, whereby the tooth edge should have an involute shape. The gear wheel consists of steel with low carbon content and is demagnetised.

The pulse duty factor of the rectangular output signal is essentially determined for larger modules by the underlying tooth geometry (see Fig. 11/2) and, in case of an asymmetrical tooth profile, shows a pulse duty factor that can clearly deviate from 50%.

### Signal form and output signal in dependency of different gear wheels

The output signal of the signal processing unit $U_{SP}$ has approximately sine form in modules m = 1.25 to 2 and working gaps X > 0.8 mm (see fig. 11/1). For smaller working gaps or larger modules, "distortions" of the standardised signal $U_{SP}$ occurs. This influences the pulse duty factor at the output of the comparator.

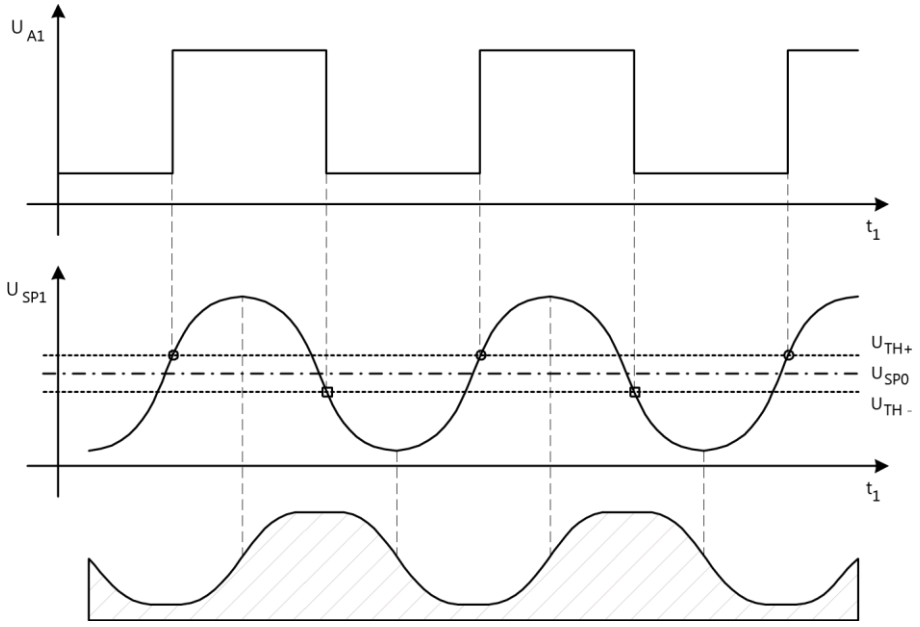



*Fig. 11/1: Tooth profile symmetrical and involute, module m = 1.25 to 2, working gap X > 0.8mm*

In this regard, gear wheels with larger modules m > 3 and rectangular tooth profiles must be mentioned particularly because positive and negative peaks in the differential signal $U_{AD}$ occur in the area of the tooth edges due to the measurement of the field gradient, whereas the signal between the peaks assumes a value of 0 V. The comparator converts the output signal exactly in the range of the signalling peaks of the signal $U_{SP}$ (standardised $U_{AD}$).

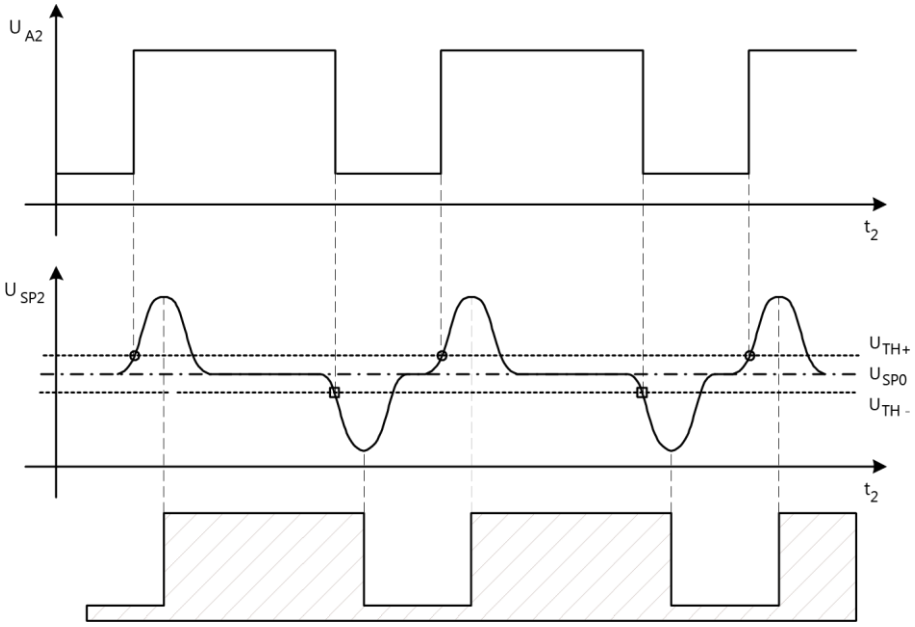



*Fig. 11/2: Tooth profile asymmetrical and square, module m > 3, working gap X > 0.8mm*

## 11.3.2 Influence of mechanical tolerances

The accuracy of the pulse generator system gear wheel evaluation is understood to be the precision of the output signal frequency in relation to the gear wheel movement. The working gap X of 0.5 mm to 2 mm to be maintained is defined by the distance of a tooth crest (at the crest diameter) to the sensor head surface. Bound by manufacture, the sum of the single tolerances of the gear wheel, the wave, the bearing and the bearing seat influences the working gap X:

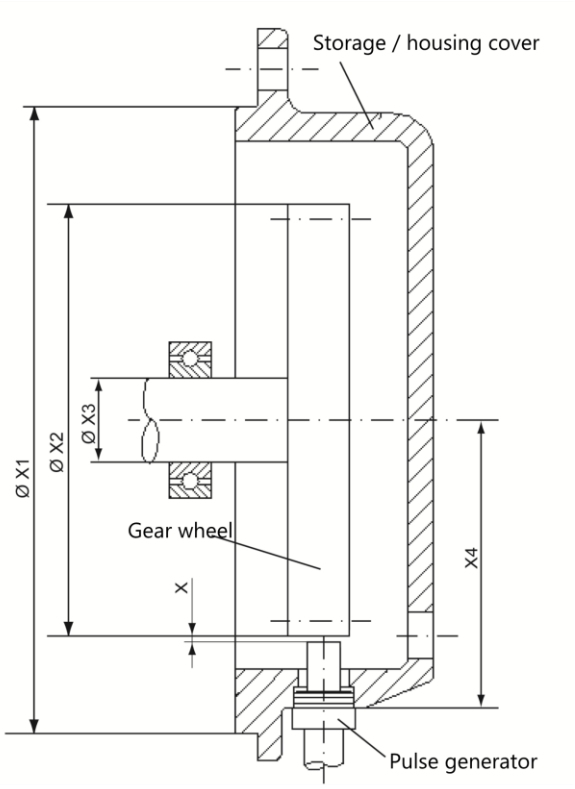



*Fig. 11/3: Example presentation of a pulse generator installed in a bearing cap piece*

| | |
|---|---|
| ØX1 | Diameter of bearing cap piece |
| ØX2 | Tooth crest diameter of the gear wheel (e.g. with concentricity tolerance, true running tolerance to the wave surface) |
| ØX3 | Shaft diameter (e.g. with concentricity tolerance) |
| X4 | Distance flange to reference axis |

When the shaft is rotating uniformly, the frequency may fluctuate within one revolution due to:

- Eccentrically mounted gear wheel (including bearing clearance):
  The periodic tooth edge spacing of a gear wheel with module 2 is 6.28 mm. When a gear wheel with 80 teeth is eccentrically mounted by, e.g., 0.1 mm, this will produce a sinusoidal error of ±1.1 % per wheel revolution for

distance and travel speed. Although the total error for one wheel revolution is zero, the frequency of the output signal may return an instantaneous deviation of ±1.1 % from the mean value. This error will produce a spurious change in travel speed of ±1.6% during one gear wheel revolution.

- Tooth pitch error:
  If the tooth pitch error is, e.g. ±0.1 mm, then this error will also produce a spurious change in travel speed of ±1.6 %.
- Inhomogeneous ferromagnetic behaviour of the gear wheel:
  The toothed structure of the gear wheel is intended to modulate the magnetic field intensity in the area of the Hall sensors. Since it is a part of the magnetic circuit, it must consist of ferromagnetic material exhibiting low losses. Suitable materials are cold-rolled steels with low carbon content, such as St37 or St50. Errors due to inhomogeneity of the ferromagnetic material can also reach a level of ±1.6 % during one gear wheel revolution.

In the worst case, the three errors discussed above can produce an instantaneous deviation of up to 5 % of the actual measured value.

The mean value of the total error over one complete wheel revolution is, of course, negligible.

### 11.3.3 Possibilities of improving error analysis

- Better centring of the gear wheel can be achieved by appropriately precise machining of the blank on an original mandrel (original shaft). This will reduce the error to about ±0.3 %.
- The tooth pitch error can be reduced by applying sophisticated - and thus expensive - manufacturing methods, such as automatic gear hobbing or tooth profile grinding processes.
- The homogeneous ferromagnetic characteristics of the standard gear wheel material St50 can be improved by applying more stringent manufacturing quality requirements. Further improvement can be achieved by demagnetising the gear wheel after mounting with an alternating field approx. 2000 AWdg, decreasing.

### 11.3.4 Operational safety of the pulse generator

No generation of spurious signals for:

- Rotary vibrations in conjunction with direction of rotation detection
- Radial vibrations (< 0.3 mm)
- Eccentric gear wheel (for concentricity tolerance < 0.6 mm)
- Operating voltage ripple factor (up to 3 Vss)
- Dirt, dust, splashwater

# 12 Diagnostics and service functions

| INFO |
| --- |
| The implemented diagnostics function enables the electrical examination of the cable distance between the pulse generator and the interface. |

## 12.1 Diagnostics function through evaluation unit

In all pulse generators of the HS family, the "diagnostics function" is activated through periodic switching off and switching on of the supply voltage with a frequency of 10Hz to 100Hz. The output signal will follow the "modulation" of the voltage supply. This feature can be used to check the signal distance and the signal level.

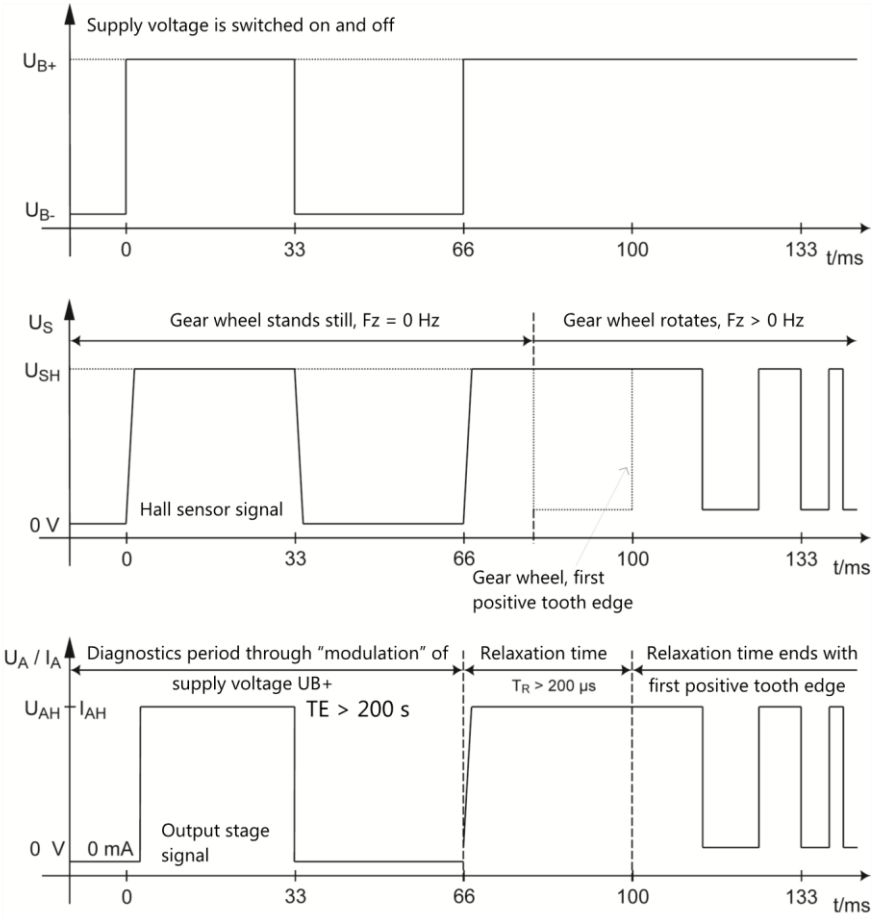



*Fig. 12/1: Diagnostic function of the pulse generator of the HS family, type X6 = a*

In case of diagnostics type X6 = a (see ordering code), the diagnostics function can only function properly during physical standstill (gear wheel frequency = 0Hz), (see Fig. 12/1). The Hall sensor awakes after a valid supply voltage with high level has been positioned at the output. Only 200 µs later, the Hall sensor is ready for operation and expects the first positive signal

edge to start the basic calibration (see chapter "Basic calibration cycle when installed"). At the same time it supplies the first valid output level $U_A = U_{AH}$.

In case of diagnostics type X6 = b, the gear wheel may turn (i.e. gear wheel frequency > 0 Hz). A reset module in the diagnostic circuitry blocks the connection of the Hall sensor in the diagnostic condition (=periodic switch on and switch off of the supply voltage with 10 Hz to 100 Hz) to the output stage electronics for a period of at least 140 ms and sets the output of the output stage electronics belonging to the pulse generator to high level. Thanks to this blockade, a rotating gear wheel during the diagnostics period no longer influences the output signal (see Fig. 12/2). This enables the inspection or analysis of the connection from pulse generator to interface at any time.

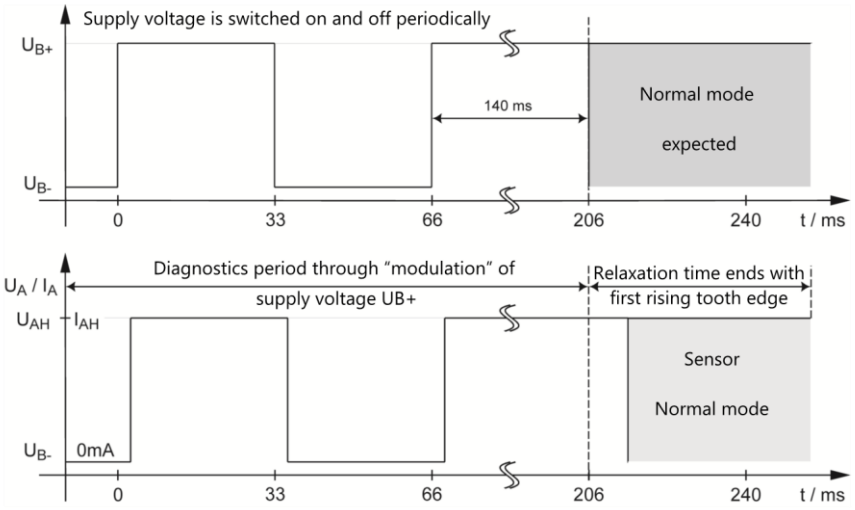



*Fig. 12/2: Diagnostic function of the pulse generator of the HS family, type X6 = b*

## 12.2 Application of the diagnostics function in SIL applications

The diagnostics function can also be used in applications having a defined Safety Integrity Level (SIL). An essential element for SIL considerations, apart from the error possibility analysis, is also the error disclosure time. To achieve a low degree of danger a low error disclosure time must be guaranteed.

If the gear wheel rotates, SIL capability can easily be proven using a plausibility check (profile count of both channels, output level and operating power monitoring) with two independent channels. If the time between two sequential events which allow error disclosure in standstill or at a crawl becomes too great, simply switch to the diagnostics mode. This aspect is of importance above all for higher SIL stages, SIL03 and SIL 04. If a channel with a rotating gear wheel suddenly no longer supplies a signal, or if it is interrupted, a temporary, massive disturbance of the magnetic circuit could be the cause. Switching off and switching back on the supply voltage once should immediately eliminate the problem, otherwise it is a (beginning) fault. Such events in practice, however, are extremely rare.

## 12.3 Basic calibration cycle when installed

In principle, the two different operating states can be differentiated.

**Characteristics for running gear wheel**

If the supply voltage with running gear wheel is switched off and then switched back on, a basic calibration cycle is automatically initialised. The basic calibration cycle of the sensor element begins with a signal search and ends after 16 signal periods after the calibration parameters have been saved, however, the sensor supplies a valid output signal already during the passage of the first signal edge.

**Slow tracking of the calibration parameters**

After the basic calibration, the correctional electronics switches to slow tracking of the calibration parameters to compensate the temperature drifts and minor changes of the magnetic circuit. Large, rapidly appearing changes of the magnetic circuit cannot be compensated, if signal loss also occurred. It is now helpful to restart a search by quickly switching the pulse generator supply off and back on again to retrieve the Hall sensor signal (see also "Diagnostics function through evaluation unit"). Further details about signal processing can be referred to in the chapter "Operation".

# 13 Maintenance

## 13.1 Important notes

### 13.1.1 Special personnel requirements

This instruction handbook is written exclusively for personnel trained and instructed in electronics and railway technology.

Only railway technical or electrotechnically trained personnel may work at the pulse generator HS22.

## 13.2 Smallest exchangeable unit

The pulse generator HS22 is the smallest exchangeable unit.

## 13.3 Preventive maintenance

Within the scope of usual inspections for the system, or the vehicle, the installation and possible contamination of the HS22 (e.g. through metal cuttings) must be checked.

### 13.3.1 Inspection

The cable and the cable conduit must be regularly inspected for damage. A leaky cable conduit should be replaced as soon as possible to avoid further damage to the pulse generator. If a defective pulse generator has been determined without a doubt, it must be replaced by the correspondingly trained expert personnel.

Please send the defective pulse generator along with a short error description to the DEUTA-Werke or dispose of it yourself, see the Disposal [→ Page 93]chapter.

The distance between sensor head and gear wheel (measuring distance X) must also be checked for target dimension. A too low air gap due to, e.g., high wear of the gear wheel bearing or similar could affect the measurement results, that is, could damage the sensor head.

### 13.3.2 Maintenance

The actual pulse generator HS22 is maintenance-free.

### 13.3.3 Cleaning notes

If necessary, clean the pulse generator HS22.

## 13.4 Corrective maintenance

If required, the distance between the gear wheel crest and the sensor head must be checked and corrected, if necessary. To do so, disassemble the pulse generator HS22 and reassemble it again (see chapter "Installation"). Afterwards, the system parameters must be checked.

## 13.5 Spare parts

None

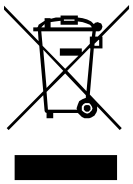
# 14 Decommissioning

## 14.1 Disassembly

May only occur in a de-energised condition.

# 15 Disposal

## 15.1 Instructions for disposal



The disposal of old devices should be carried out based on the 04.07.2012 Directive 2012/19/EU of the European Parliament and Council regarding electrical and electronic appliances.

The complete devices are delivered to a certified disposal plant that breaks the devices down into their constituent materials and disposes of them.

In case the user disposes of the devices himself, the devices must be disassembled and also disposed of according to their materials (for example metals, plastics, electronics waste and glass). (This must be done in accordance with the Directive 2012/19/EU mentioned above).

For example,

• Metals may be handed over to a scrap metal dealer

• Plastics and glass can be recycled.

The electronic scrap must be delivered to a certified disposal plant. In this context, the respective applicable national laws and regulations must be observed each time material is disposed of. The devices may also be disposed of by returning them to **DEUTA** in connection with a corresponding agreement.

# 16 Appendix

## 16.1 Definition of module and diametric pitch

**INFO**

**Explanation to units of measure**
Module and diametric pitch are basically defined with the respective units [mm] or [inch$^{-1}$]. Since linear measures in technology are obligatorily specified in [mm] or in [inch], the module as well as the diametric pitch are often mentioned without linear unit of measure – however, the size of the affiliated unit of measure is meant in principle.

For a gear wheel with z teeth, the following applies according to DIN 867:

$$m = \frac{d}{z}$$

| | |
|---|---|
| m [mm] | Module |
| d [mm] | Reference circle diameter |
| z [ ] | Number of teeth |

$$DP = \frac{z + 2}{d} * 25{,}4 \frac{mm}{inch}$$

| | |
|---|---|
| DP [inch$^{-1}$] | Diametric Pitch |
| d [mm] | Reference circle diameter |
| z [ ] | Number of teeth |

## 16.2 Conversion of module and diametric pitch

For the conversion, the following applies:

$$DP * m = \frac{z + 2}{z} * 25{,}4 \frac{mm}{inch}$$

| | |
|---|---|
| DP [inch$^{-1}$] | Diametric Pitch |
| m [mm] | Module |
| z [ ] | Number of teeth |

# Glossary

**Ambient temperature**

in acc. with EN 50155: a) Outside ambient temperature; b) temperature inside the cabinet (ambient temperature of device); c) temperature of the air surrounding the PCB assembly (temperature inside the device)

**DIN 31051**

DIN 31051 issue status: 2003

**DIN 867**

DIN 867 issue status: 1986

**DIN EN 10025**

DIN EN 10025 issue status: 1994

**DIN EN 61709**

DIN EN 61709 issue status: 2012+Rep.:2012-7

**DIN VDE 0105**

DIN VDE 0105 issue status: 2005

**ECHA**

The European Chemicals Agency ECHA is an agency of the European Union which manages the technical, scientific and administrative aspects of the registration, evaluation and authorisation of chemicals system. ECHA is the central coordination point of REACH.

**EMC**

Electromagnetic compatibility

**EN 45545-2**

EN 45545-2 issue status: 2013 + A1:2015

**EN 50110**

EN 50110 issue status: 2005

**EN 50121-3-2**

EN 50121-3-2 issue status: 2006

**EN 50125-1**

EN 50125-1 issue status: 2014

**EN 50155**

EN 50155 issue status: 2008+Cor:2010

**EN 55016-2-1**

EN 55016-2-1 issue status: 2009

**EN 55016-2-3**

EN 55016-2-3 issue status: 2010

**EN 60529**

EN 60529 edition: 2014

**EN 61000-4-2**

EN 61000-4-2 issue status: 2009

**EN 61000-4-3**

EN 61000-4-3 issue status: 2006+A1:2008+A2:2010

**EN 61000-4-4**

EN 61000-4-4 issue status: 2004+A1:2010

**EN 61000-4-5**

EN 61000-4-5 issue status: 2006

**EN 61000-4-6**

EN 61000-4-6 issue status: 2009

**EN 61000-6-2**

EN 61000-6-2 Ausgabestand: 2005

**EN 61000-6-4**

EN 61000-6-4 Ausgabestand: 2007

**EN 61373**

EN 61373 issue status: 2010

**ESD**

Immunity to electrostatic discharge

**Glossary**

Explanation and definition of terms and abbreviations used

**IEC 60050-191**

IEC 60050-191 issue status: 2002

**IEC 60364**

IEC 60364 issue status: 2005

**IEC 60571**

IEC 60571 issue status: 1998

**MTBF**

Mean Time Between Failures (mean operating time between two failures)

**NSR**

Low voltage directive

**Operating temperature**

Air temperature (in max. and min. limits) in the immediate vicinity of the device at which the device may be operated.

**REACH**

Regulation (EC) No 1907/2006 (REACH Regulation) is an EU chemicals regulation which entered into force on 1 July 2007. REACH stands for Registration, Evaluation, Authorisation and Restriction of Chemicals.

**RoHS**

Restriction of certain Hazardous Substances, EU directive 2011/65/EU for restricting the use of certain hazardous substances in electrical and electronic devices

**Storage temperature**

Air temperature (in max. and min. limits) in the vicinity of the device at which the device may be stored. Important: Device is voltage-free!

**SVHC**

SVHCs (substances of very high concern) are chemical compounds (or part of a group of chemical compounds) which are identified under the REACH Regulation as substances with particularly dangerous properties.

# List of keywords