

## DF16/1S10.80d#k-3S with EB40/2d610.# #.1# # cc06 s83

Electronic pulse generator examined for SIL applications with Structure 3

### Instruction Handbook



# = placeholder for parameters

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Product variants, see page 2

## Applies to

This document applies to:

### Electronic pulse generator

DF16/1 S10 .80 d >**X4**< k -3S

----- ---- ---- ---- >a<

----- ---- ---- ---- >ac<

----- ---- ---- ---- >ad<

----- ---- ---- ---- >af<

----- ---- ---- ---- >nf<

Number of channels: 4

Pulses per revolution: 80: all channels

Phase relation between the slopes: Channel 1 before channel 2: 90°  
channel 3 before channel 4: 90°  
(other phase relations not defined)

Further characteristics:

Cable break detection: via current loop

### With fixed connecting cable

EB40/2 d61 >**X2**< X3 1 >**X5**< X6 cc06 s83  
0

----- ---- >.11c<

----- ---- >.20c<

----- ---- >.30c<

----- ---- ---- ---- ><

----- ---- ---- ---- >p3t<

----- ---- ---- ---- >p6t<

----- ---- ---- ---- >p14t<  
<

X2 = cable type

X3 = cable length

X5 = cable protection type (> < = n/a, without cable protection)

X6 = cable protection length

## Revision index

| Version | Date       | Change                    | Chapter No. <sup>1</sup> |
|---------|------------|---------------------------|--------------------------|
| A       | 06/07/2021 | SSC/VD:<br>First compiled | All                      |
|         |            |                           |                          |
|         |            |                           |                          |

<sup>1</sup>: The chapter numbers specified in this table always refer to the preceding document.

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# 1 General

## 1.1 About these instructions

### General notes on how to use these instructions

- Read these instructions thoroughly before you install the sensor and start it up for the first time.
- Comply with the warning and safety notes.
- Keep the instructions ready to hand.
- Make sure that every user has read the instructions thoroughly.
- Explanations and definitions to terms and abbreviations are found in the [Glossary](#).

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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                                   |
| Recorder and evaluation software                      | +49 (0) 2202 958-106<br>+49 (0) 2202 958-186           |
| Sensor technology                                     | +49 (0) 2202 958-235                                   |
| Video technology, indicator and IconTrust® technology | +49 (0) 2202 958-325                                   |
| or                                                    | <a href="mailto:support@deuta.de">support@deuta.de</a> |

### 1.3 DEUTA Academy

#### **DEUTA offers various workshops and seminars.**

For more than 100 years the DEUTA-WERKE stand for expert knowledge in the areas of sensor technology, travel data recording and visualisation. We also enjoy passing on this knowledge to our customers. We train our customers' employees in practically oriented user seminars because technological development is progressing faster today than ever before. The requirements toward users are rising steadily.

New forms of organization in the companies make it necessary for employees to solve tasks in a more qualified, flexible and rapid manner. Current knowledge is the necessary prerequisite for retaining certifications and meeting new requirements in safety engineering.

The DEUTA Academy training schedule is closely oriented toward the market requirements of our customers. Qualification measures, customer training courses and hands-on workshops form a consistent, high quality training concept.

The workshops and seminars are carried out by DEUTA employees with many years of product and field experience. This knowledge is supplemented by our employees from project and innovation management and development. External speakers are engaged as per topic to provide their special knowledge as optimal supplement to seminar contents such as e.g. "Product Qualification".

You will find more information at:

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

## 1.4 Presentation in the document

### 1.4.1 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 <ul style="list-style-type: none"> <li>Screen messages for devices having a display unit or a service PC</li> <li>File name</li> <li>Directories</li> </ul> Example<br>C:\Programs                                                                                                                                                                                               |
| "Quotation marks"                                        | The <b>menu commands</b> and <b>names of dialogue windows</b> or <b>names of chapters</b> 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").                                                                                                                                                                                                                                                                                       |
| underlined                                               | <ul style="list-style-type: none"> <li><b>Link</b> in the PDF file to the <u>Glossary</u></li> <li>Refers to entry and explanation in the <u>Glossary</u></li> </ul>                                                                                                                                                                                                                       |
| square brackets with arrow and page number               | <ul style="list-style-type: none"> <li><b>Link</b> in PDF file to the specified page, e.g.: see Figure <b>[→ Page 33]</b></li> <li>You will find further information on the specified page</li> </ul>                                                                                                                                                                                      |
| further <b>Links</b> in PDF file (via left mouse button) | <ul style="list-style-type: none"> <li>In the Table of Contents: e.g.<br/><i>1.1 About these Instructions ..... 10</i><br/><b>Link</b> is on the chapter no., the chapter text and the page no. and jumps to the specified page</li> <li>In the List of Keywords:<br/><i>Storage temperature 50, 56, 66</i><br/><b>Link</b> is on the page no. and jumps to the clicked on page</li> </ul> |

## 1.4.2 Units

- If not shown otherwise, the units of measure in drawings are millimetres [mm].
- For dimensions without specified tolerances, the general tolerances according to ISO 2768-1 apply, tolerance class: "c".

## 1.4.3 Highlights and notes

Symbols have been used to specifically highlight the following information:

| Symbol                                                                             | Meaning                                                                                                                                                                                           |
|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <b>Important</b><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. |
|  | <b>Info</b><br>Indicates <ul style="list-style-type: none"><li>▪ additional important information.</li><li>▪ Practical tips to simplify your work with the product.</li></ul>                     |

### 1.4.4 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                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <b>Danger</b><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.            |
|    | <b>Warning</b><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. |
|  | <b>Caution</b><br>There is a possibly dangerous situation.<br>Non-compliance with these notes can result in slight injuries or cause material damage.                                                  |
|  | <b>Notice</b><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                                                                                                                                       |
|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <b>Notice</b><br>Combined with the signal word <b>Note</b> warns of material damage or malfunctions.                                              |
|   | <b>General danger</b><br>Combined with a signal word, warns of dangers that could result in injuries or even death.                               |
|   | <b>High voltage</b><br>Combined with a signal word, warns of occurring dangerous electrical voltages that could result in injuries or even death. |
|   | <b>Hot surfaces</b><br>Combined with a signal word, warns of hot surfaces that could result in burns.                                             |
|  | <b>ESD protection</b><br>Combined with a signal word, warns of damage to components at risk of electrostatic discharge.                           |

**1.5 Overview of standards and issue statuses**

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

## 1.6 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 > AC 50 V or > DC 75 V are not supplied to the product.



### IMPORTANT

#### **Voltages > AC 50 V or > DC 75 V in industrial use**

In industrial use, voltages with a nominal voltage of > AC 50 V or > DC 75 V 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 EU Declaration of Conformity, this must be clarified by contract before use.

## 2 Safety

### 2.1 Intended use

The electronic pulse generator DF 16/1 is designed for use on railway vehicles and generates signals for distance and speed measurement. 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.    |
|-------------------------------------------------------------------------------|--------|
| EU Declaration of Conformity DF16/1<br>(see chapter "Certificates")           |        |
| Installation requirements DF16/1<br>(see chapter "Installation requirements") | Zu1044 |



#### 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 Safety-related application conditions

The wearing parts of the wheel pulse generators must be inspected by trained personnel after 10 years or 2,000,000 km travel. If any defects are detected on the wearing parts, the wheel pulse generator must be sent in to DEUTA GmbH for professional repair.

## 2.5 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 EN 50110, DIN VDE 0105, IEC 60364. Qualified specialists as envisaged by these principal safety notes are those who are familiar with the assembly, installation, commissioning, operation, etc., of the product and who possess the qualifications appropriate for their work.
- 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

## 2.6 Accident prevention regulations

The locally applicable accident prevention regulations must be obeyed.

## 2.7 Device safety

The requirements for device safety of the following standards are fulfilled:

- Requirements for equipment on rail vehicles according to EN 50155
- Requirements for the protection of persons against electric shock according to EN 50153
- Requirements for insulation coordination according to EN 50124-1
- Requirements for fire protection characteristics according to EN 45545

## 2.8 Environmental details on materials

All materials are halogen-free and asbestos-free.

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

## 2.9 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.
- The procurement, handling and disposal of hazardous substances is clearly regulated in our integrated management system.

## 3 Product description

### 3.1 DF16/1

The electronic pulse generator DF16/1 is evaluated for use in SIL applications with Structure No. 3 (see chapter "Appendix") and serves to record the speed and distance covered. It has at least two channels for SIL-compliant evaluation, e.g. with a DEUTA Safety System (DSS). An additional output can be used to detect a cable break.

Due to the defined phase offset, the multi-channel version is also suitable for detection of the direction of rotation.

The modular structure of the DF16/1 allows both different output stages and different electrical connections and up to 6 signal channels.

Electronics, pulse wheel and electrical connections of the electronic pulse generator are encased in a robust aluminium housing.

The mechanical coupling transfers the rotation of the vehicle axle to the shaft of the electronic pulse generator. The pulse generator contains a pulse wheel with varying number of slots on the outer and/or inner track. The optoelectronic scanning of the pulse wheel generates a speed-dependent pulse signal.

The drive shaft is mounted in a double-row inclined ball bearing (enclosed design). This ball bearing absorbs loads in both radial and axial direction. The bearing has a grease filling for its entire service life. The critical axial bearing clearance lies in the  $\mu$  range.

The DF16/1 can be connected to all DEUTA data recorders with the appropriate DF input. A portable test bench for the axle mounted generator XP20DR or XP20DS can be used to perform the inspection.

The figure below shows an example of a DF16/1 with a round flange and a drive disc mounted on a cross slotted shaft.



*Fig. 3/1: DF16/1 with round flange and drive disc (example)*

### 3.2 Block diagram

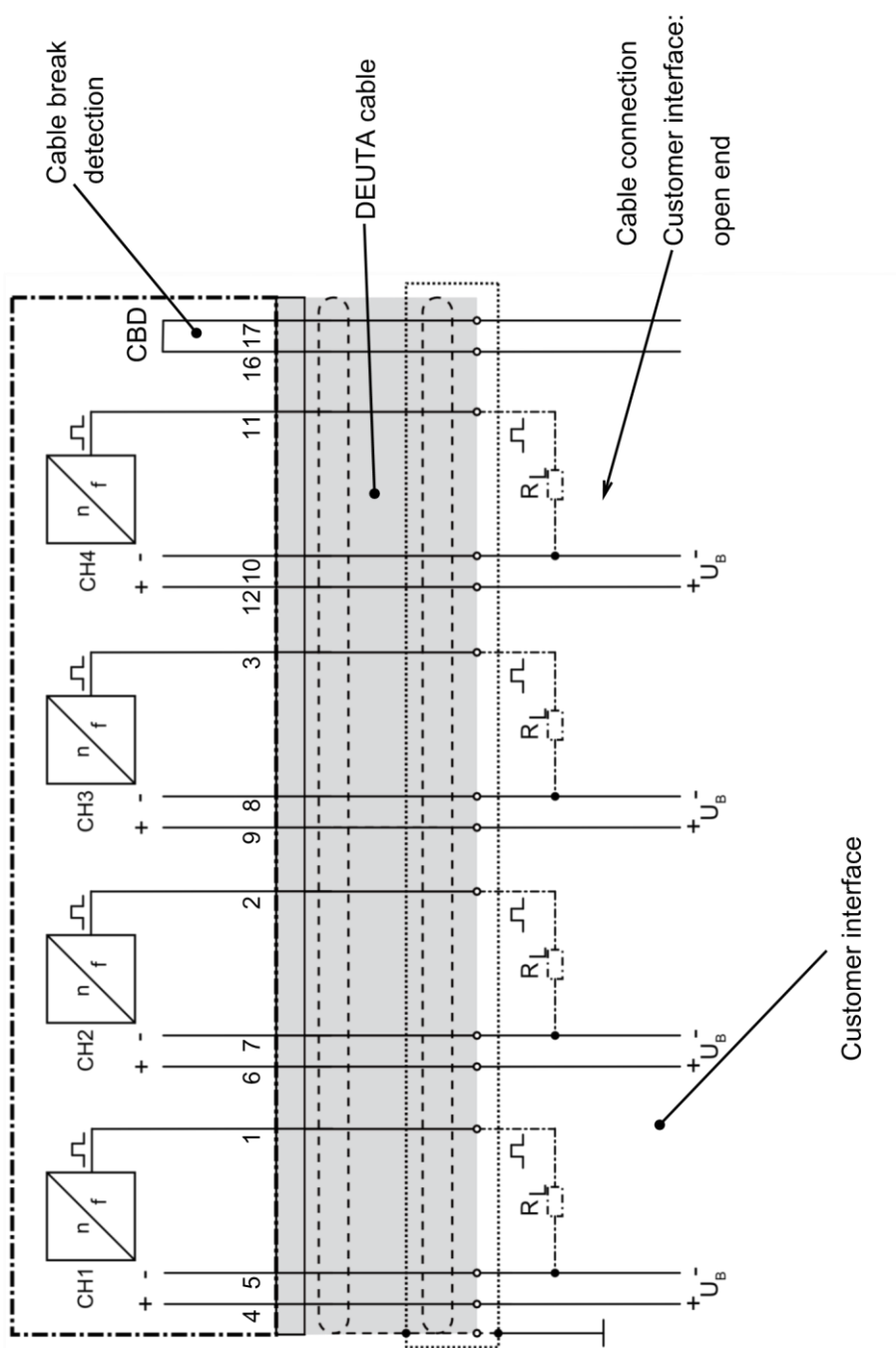


Fig. 3/2: Block diagram sensor with four galvanically isolated channels and cable break detection

### 3.3 Identification code sensor

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

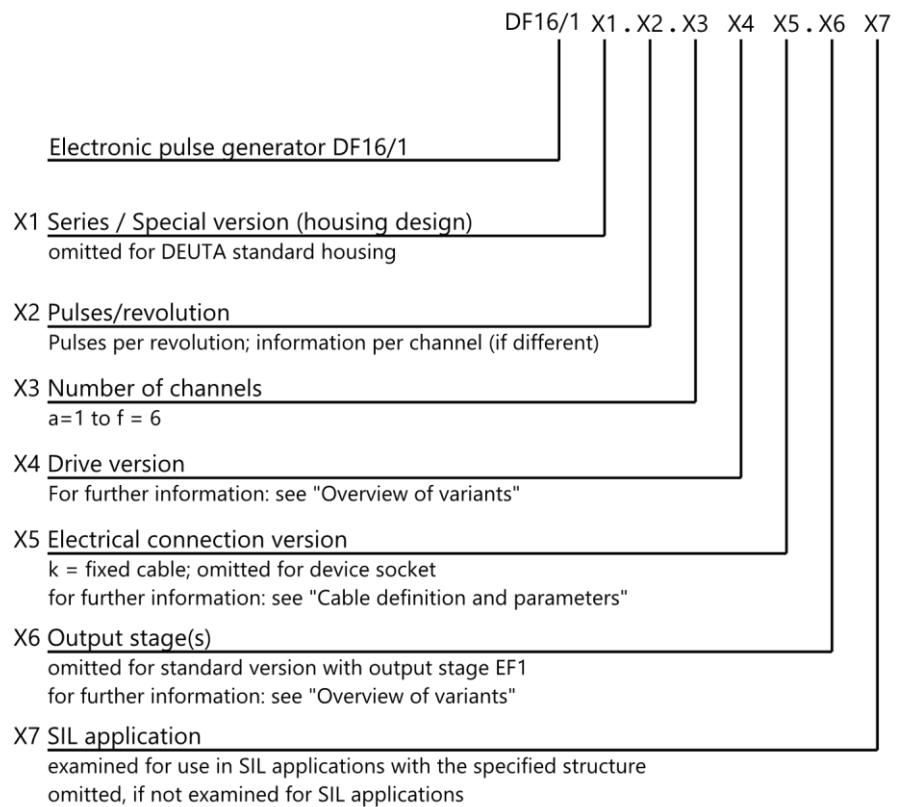


Fig. 3/3: Identification code



#### INFO

##### Supplements to identification code

The general identification code can be supplemented by further project and/or customer-specific parameters. If this is the case, you will find the relevant explanation in chapter "Overview of variants".

### 3.4 Identification code cable

The identification code contains information about the cable properties.

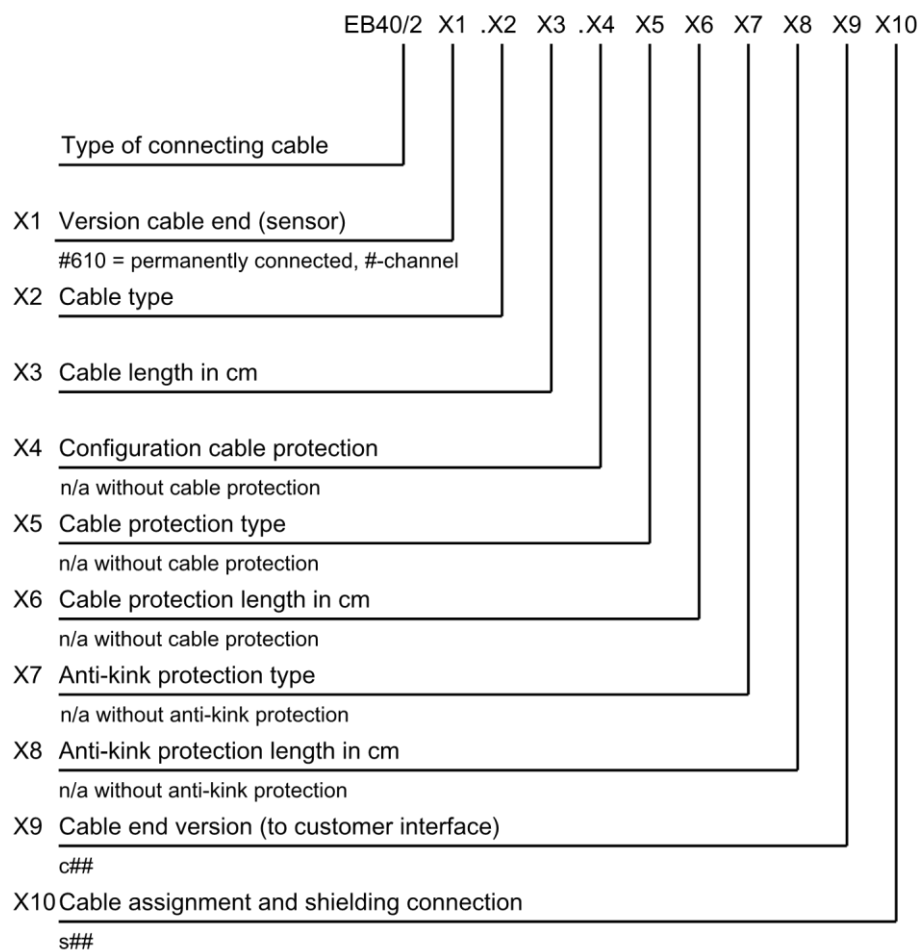


Fig. 3/4: Definition of identification code for permanently connected cables EB40/2

### 3.5 Overview of variants

Different features of the product variants described in this document:

#### Features DF16/1S10.80d#k-3S

|                                                                                                                                                                                                                |                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| <b>X1 (series):</b><br>Special flange housing, round                                                                                                                                                           | S10                                  |
| <b>X2 (pulses per revolution):</b><br>all channels                                                                                                                                                             | 80                                   |
| <b>X3 (number of channels):</b><br>4-channel<br><b>Note:</b> The -3S variant provides an additional pair of strands (current loop) to detect a cable break.                                                    | d                                    |
| <b>X4 (drive version):</b><br>Cross slotted shaft<br>Drive fork<br>Drive tongue 20x7<br>Prepared for subsequent assembly of a drive tongue 20x7<br>Drive disc (mounted on cross slotted shaft)<br>smooth shaft | a<br>ac<br>ad<br><br>ado<br>af<br>nf |
| <b>X5 (electrical connection version):</b><br>Fixed connecting cable                                                                                                                                           | k                                    |
| <b>X6 (output stage):</b><br>Standard output stage EF1                                                                                                                                                         | n/a                                  |
| <b>X7 (SIL application):</b><br>Examined for use in SIL applications with Structure No. 3                                                                                                                      | -3S                                  |

|                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Phase relation of channels:</b> <ul style="list-style-type: none"> <li>▪ defined relation: <ul style="list-style-type: none"> <li>– Channel 1 before channel 2: 90°</li> <li>– Channel 3 before channel 4: 90°</li> </ul> </li> <li>▪ no defined relation between: <ul style="list-style-type: none"> <li>– Channel 2 and channel 3</li> <li>– Channel 4 and channel 1</li> </ul> </li> </ul> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### 3.6 Type plate

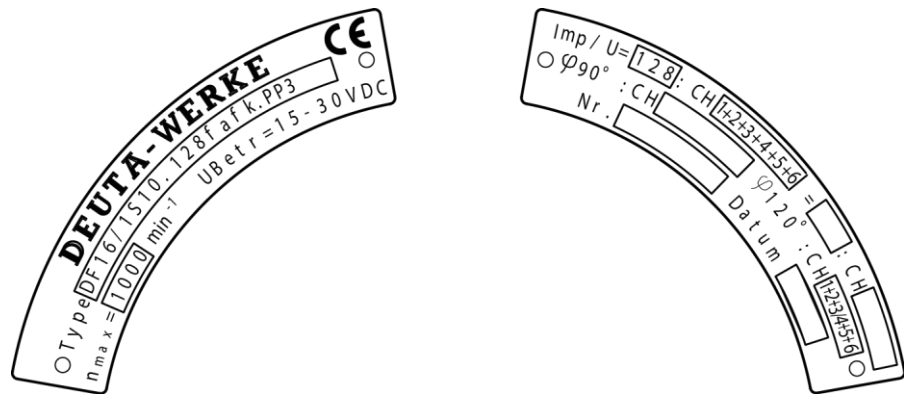


Fig. 3/5: Type plate (example)

### 3.7 Scope of delivery

The scope of delivery includes:

- Electronic pulse generator DF16/1 with a fixed cable

### 3.8 Accessories

#### 3.8.1 Couplings for drive adapter

| Designation                                                                                                                                                                                                                                                                                           | Type         | Article No.  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|
| <b>Flange coupling</b><br>XZ66#<br><br>Suitable for: <ul style="list-style-type: none"> <li>▪ Drive version "Drive tongue 20x7 (X4 = ad)" with drive length D1 = 40 mm</li> </ul>                                                                                                                     | Upon request | Upon request |
| <b>Metal bellows coupling</b><br><br>Suitable for: <ul style="list-style-type: none"> <li>▪ Drive version "smooth shaft (X4 = nf)" suitable. Project planning required!</li> </ul>                                                                                                                    | Upon request | Upon request |
| <b>Driver pin</b><br><br>Suitable for: <ul style="list-style-type: none"> <li>▪ Drive version "drive fork" (X4=ac)"</li> <li>▪ Drive version "drive disc (X4=af)"</li> </ul> Project planning required!                                                                                               | Upon request | Upon request |
| <b>Drive tongue</b><br>20x7 with specified drive length<br>40 mm ≤ D1 ≤ 210 mm<br><br>Necessary for: <ul style="list-style-type: none"> <li>▪ Drive version "Prepared for subsequent assembly of a drive tongue 20x7 (X4 = ado)"</li> </ul> For further information see chapter "Mechanical drawings" | Upon request | Upon request |

## 4 Mechanical drawings

## 4.1 Device views

### 4.1.1 Front view

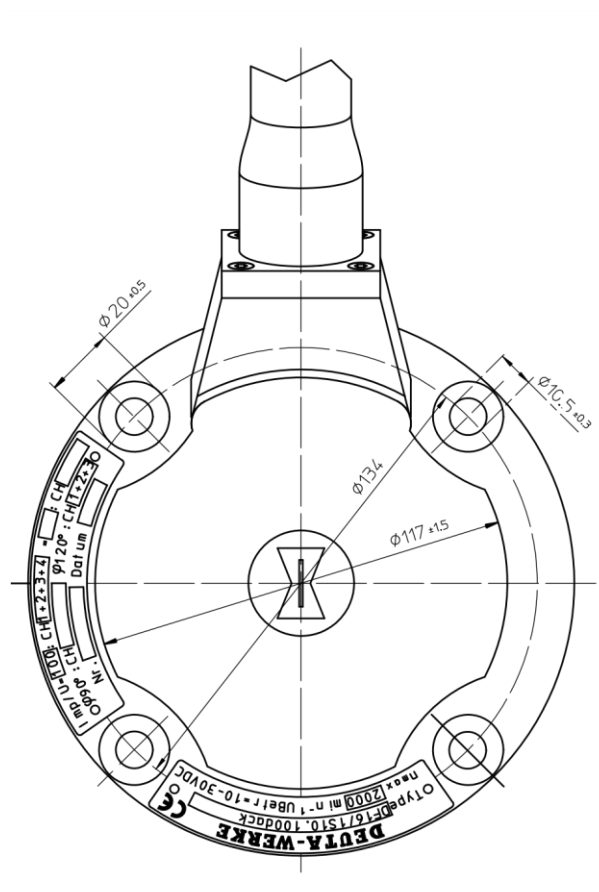
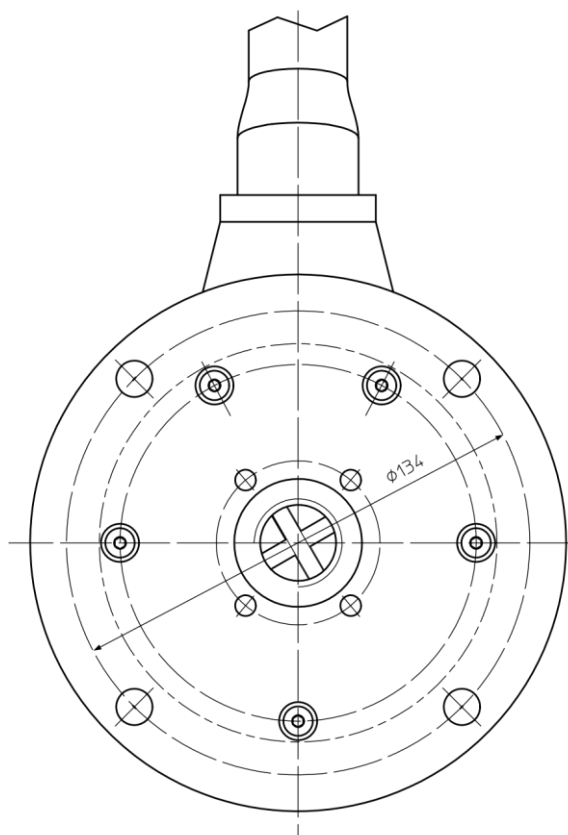


Fig. 4/1: Front view sensor with fixed connecting cable

### 4.1.2 Rear view



*Fig. 4/2: Rear view sensor with fixed connecting cable*

### 4.1.3 Side view

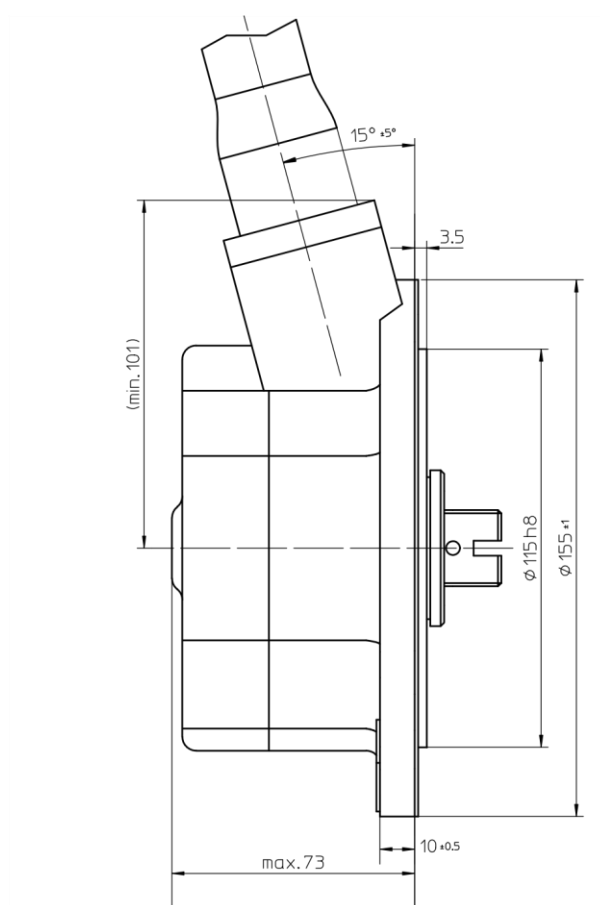


Fig. 4/3: Side view sensor with fixed connecting cable

## 4.2 Drive versions

### 4.2.1 Drive version "cross slotted shaft" (X4 = a)

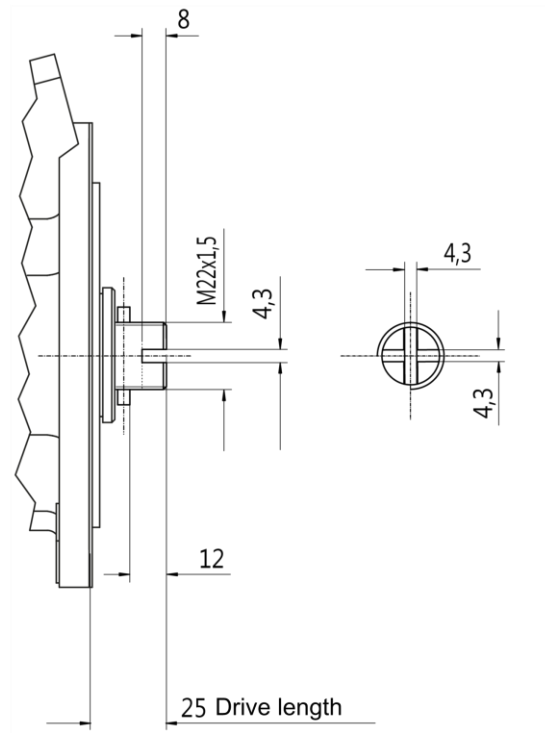


Fig. 4/4: Drive version a = cross slotted shaft

### 4.2.2 Drive version "drive fork" (X4 = ac)

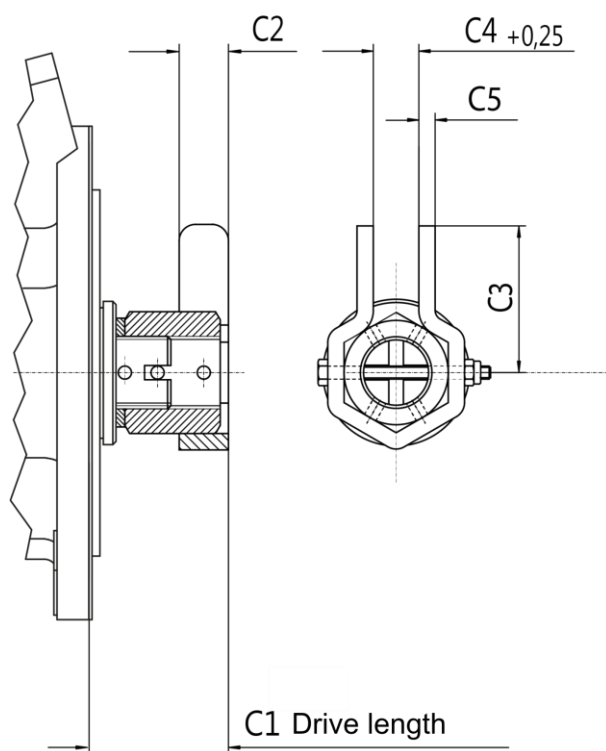


Fig. 4/5: Drive version ac = drive fork

The variable dimensions have the following meanings:

- Drive length C1
- Drive depth C2
- Drive height C3
- Fork width for driver pin diameter C4
- Material strength of the drive fork C5

The table lists the dimensions for standard versions of the drive fork.

|          | <b>C1<sub>+0.5</sub></b><br><b>C1<sub>-1.5</sub></b> | <b>C2<sub>+0.25</sub></b> | <b>C3</b>          | <b>C4</b> | <b>C5</b> |
|----------|------------------------------------------------------|---------------------------|--------------------|-----------|-----------|
| Standard | min. 40.5<br>max. 70                                 | 15                        | min. 45<br>max. 70 | 14        | 5         |

The dimension data for C1 – C5 belong to the drive definition and can be found on the order and/or delivery documents.

### 4.2.3 Drive version "drive tongue 20x7" (X4 = ad)

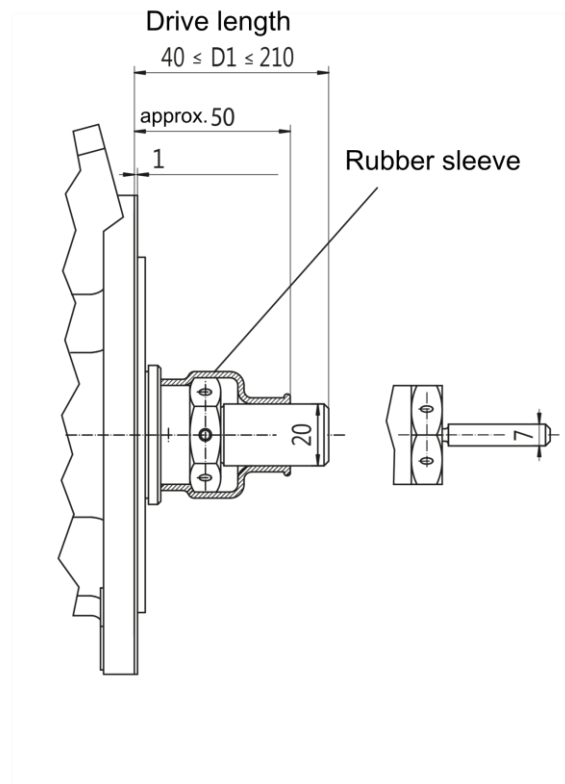


Fig. 4/6: Drive version ad = drive tongue 20x7



#### INFO

##### Drive length

The drive length can be a minimum of 40 mm and a maximum of 210 mm.

The dimension data for D1 belong to the drive definition and can be found in the order and/or delivery documents.

#### Rubber sleeve

The type of mounting on the drive shaft enables easy mobility of the drive tongue. It is necessary to restrict the mobility of the tongue to make it easier to thread the tongue into the counterpart on the vehicle side. From a drive length of 60 mm and more the sensors have a rubber sleeve so that the position of the tongue can be "fixed".

#### 4.2.4 Drive version "prepared for subsequent assembly of a drive tongue 20x7"(X4= ado)

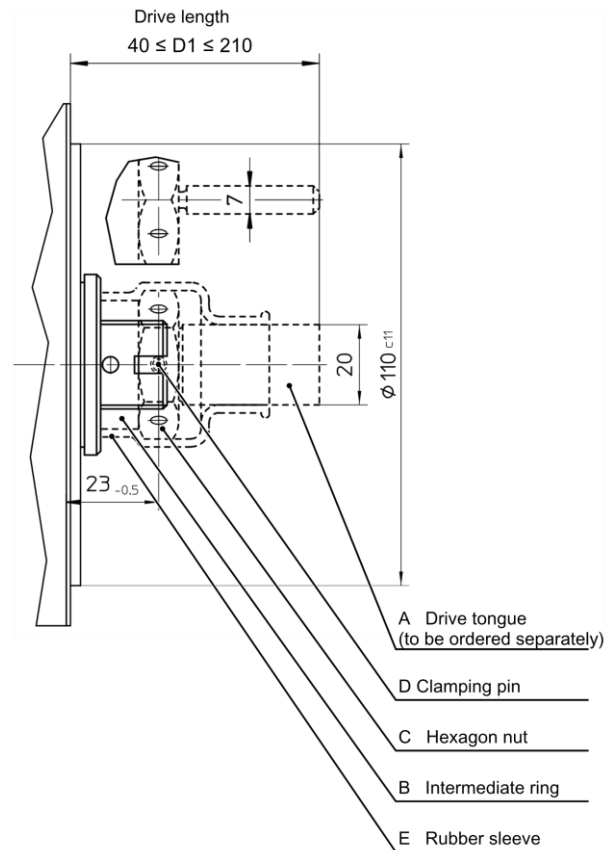


Fig. 4/7: Drive version ado = prepared for drive tongue 20x7

The assembly set consisting of items (B) to (E), are enclosed separately.

The dimension data D1 for the nominal drive length belong to the drive definition and can be found in the order and/or delivery documents.

To assemble the drive tongue, see chapter "Coupling of the generator drive to the vehicle axle (only variant X4 = ado: Drive version "prepared for subsequent assembly of a drive tongue 20x7")"

#### Drive tongue

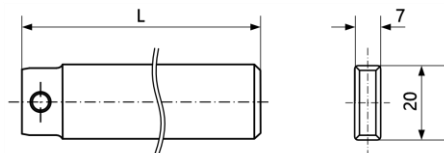


Fig. 4/8: Drive tongue 20x7

For a given drive length D1, the length of the drive tongue results from the following calculation:  **$L = D1 - 18 \text{ mm}$**

#### 4.2.5 Drive version "drive disc" (X4 = af)

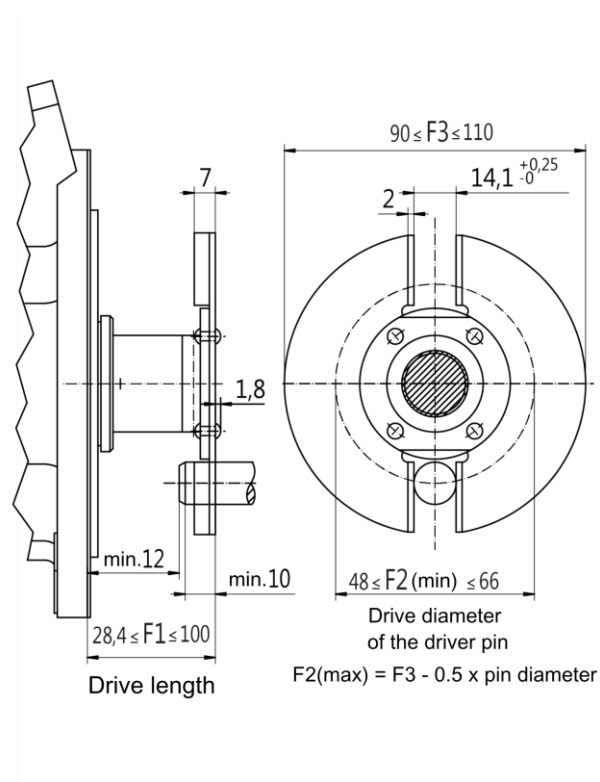


Fig. 4/9: Drive version af = drive disc

The variable dimensions have the following meanings:

- Drive length F1
- Drive diameter F2
- Outer diameter of the drive disc F3

If the maximum limit values of the diameters F2 or F3 are not enough, we recommend the drive version ac = drive fork.

The dimensions for standard versions of the drive disc are shown in the table.

|          | F1 ±1                  | F2 (min) ±1        | F2 (max) ±0.5      | F3 ±0.5             |
|----------|------------------------|--------------------|--------------------|---------------------|
| Standard | min. 28.4<br>max. 58.4 | min. 48<br>max. 66 | min. 83<br>max. 93 | min. 90<br>max. 100 |

The dimension data for F1 – F3 belong to the drive definition and can be found in the order and/or delivery documents.

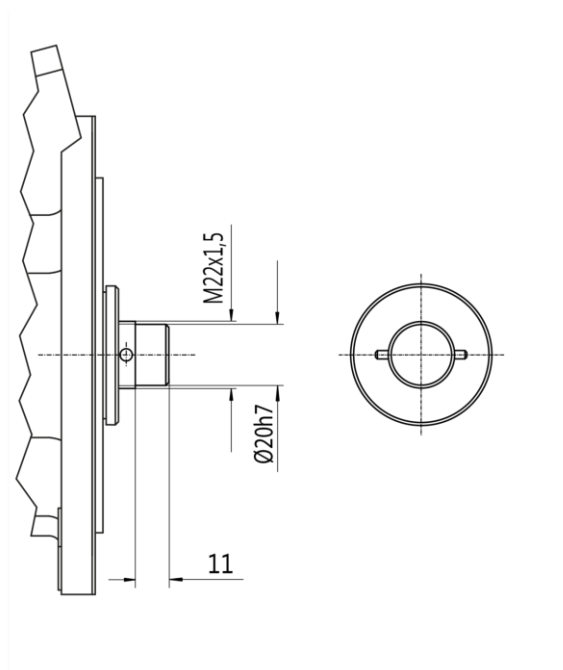
**4.2.6 Drive version "smooth shaft" (X4 = nf)**

Fig. 4/10: Drive version *nf* = smooth shaft

## 5 Technical Data

### 5.1 Basic standards for product

#### 5.1.1 EN 50155

- 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 chapter "Maintenance".

### 5.2 Reliability

#### MTBF

206,000 hrs. **(predicted value)**

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

**Ambient conditions:**

50 °C mean ambient temperature,

Operation duration 8,760 hrs./year  
(uninterrupted operation)

Installation in ground vehicles

A real MTBF value can also deviate  
significantly from the predicted value,  
depending on the project-specific conditions  
of use and ambient conditions.

## 5.3 Climate and environmental conditions

### 5.3.1 Operating temperature

Operating temperature range: -40 °C to +70 °C

### 5.3.2 Storage temperature

Storage temperature range: -40 °C to +70 °C

### 5.3.3 Humidity

Humidity: acc. to EN 50155  
yearly average: ≤ 75 % relative humidity  
on 30 successive days of the year:  
95 % relative humidity

### 5.3.4 Elevation (air pressure)

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

### 5.3.5 Shock/Vibration

Shock/Vibration: according to EN 61373 Category 3

### 5.3.6 Fire protection

Fire protection evaluated as per EN 45545-2  
with Hazard Level 3

### 5.3.7 Pollution degree

Macro  
environmental conditions  
(EN 50124-1):

The device may only be installed and  
operated in an environment which ensures  
the pollution degree of **PD4** (or better).

Micro  
environmental conditions  
(EN 50124-1):

The pollution degree **PD2** applies.

### 5.3.8 Overvoltage category

for

applicable acc. to EN 50124-1

signals referenced to the  
battery:

**OV2**

Signals without battery  
reference:

**OV1**

safety-related signals  
with increased requirements:

**OV2**

## 5.4 Mechanical data

### 5.4.1 Dimensions

|         |                                |
|---------|--------------------------------|
| Width:  | approx. 155 mm                 |
| Height: | approx. 179 mm (without cable) |
| Depth:  | approx. 73 mm + drive length   |

### 5.4.2 Material

|                  |           |
|------------------|-----------|
| Housing material | Aluminium |
|------------------|-----------|

### 5.4.3 Sensor weight

|         |                                |
|---------|--------------------------------|
| Weight: | approx. 3.3 kg (without cable) |
|---------|--------------------------------|

The exact weight depends on the cable length, cable protection and drive version. Further information upon request.

### 5.4.4 Protection category

|               |                                                                              |
|---------------|------------------------------------------------------------------------------|
| Housing side: | IP66                                                                         |
| Flange side:  | IP54 (drive side, flange without seal)<br>in accordance with <u>EN 60529</u> |

### 5.4.5 Colour

|          |       |
|----------|-------|
| Housing: | black |
|----------|-------|

### 5.4.6 Drive versions

| X4  | Drive version                                           | Drive length               |
|-----|---------------------------------------------------------|----------------------------|
| a   | Cross slotted shaft                                     | approx. 25.5 mm            |
| ac  | Drive fork                                              | min. 40.5 mm; max. 70 mm   |
| ad  | Drive tongue                                            | min. 40 mm; max. 210 mm    |
| ado | Prepared for subsequent assembly of a drive tongue 20x7 | min. 40 mm; max. 210 mm    |
| af  | Driving disc                                            | min. 28.4 mm; max. 58.4 mm |
| nf  | Smooth shaft                                            | approx. 25 mm              |

## 5.5 Product characteristics

### 5.5.1 Rotational speed range

Revolutions: 0 to 2,000 min<sup>-1</sup>

### 5.5.2 Cable break detection

Cable break detection: via current loop

## 5.6 Electrical data



#### 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

### 5.6.1 Sensor supply

|                                                        |                                                                          |
|--------------------------------------------------------|--------------------------------------------------------------------------|
| Number:                                                | 4                                                                        |
| Function:                                              | Power supply                                                             |
| Plug-in connection:                                    | See chapter "Plug-pin assignment"                                        |
| Signal designation:                                    | See chapter "Plug-pin assignment"                                        |
| Supply voltage range:                                  | DC +10 to +30 V                                                          |
| Current consumption I <sub>B</sub> :<br>(without load) | < 35 mA per channel                                                      |
| Protection against reverse polarity:                   | yes                                                                      |
| Electrical isolation:                                  | yes (against housing)<br>yes (channel to channel)<br>(see block diagram) |
| Electric strength:                                     | AC 1500 V (against housing)                                              |

## 5.6.2 Outputs

### 5.6.2.1 Basic circuit

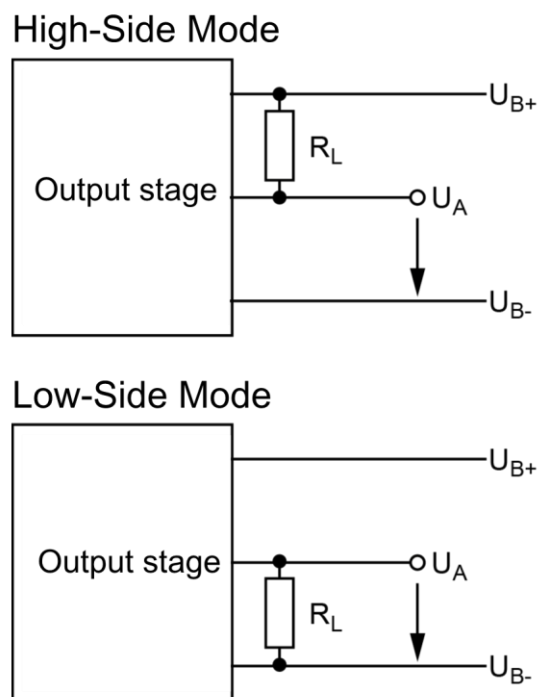


Fig. 5/1: Basic circuit impedance at the signal output

### 5.6.2.2 Pulse outputs

|                                        |                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function:                              | Output signal, rectangular                                                                                                                                                                                                                                                                                                                                                                            |
| Plug-in connection:                    | See chapter "Plug-pin assignment"                                                                                                                                                                                                                                                                                                                                                                     |
| Signal designation:                    | See chapter "Plug-pin assignment"                                                                                                                                                                                                                                                                                                                                                                     |
| Number of channels:                    | 4                                                                                                                                                                                                                                                                                                                                                                                                     |
| Pulses per revolution:                 | 80: all channels                                                                                                                                                                                                                                                                                                                                                                                      |
| Phase relation between the slopes:     | Channel 1 before channel 2: 90°<br>channel 3 before channel 4: 90°<br>(other phase relations not defined)                                                                                                                                                                                                                                                                                             |
| Type:                                  | EF1                                                                                                                                                                                                                                                                                                                                                                                                   |
| Output current $I_A$<br>(per channel): | Max. 100 mA (with external $R_L$ )                                                                                                                                                                                                                                                                                                                                                                    |
| Output level High $U_{AH}$ :           | <b>High-Side-Mode</b> ( $R_L$ against $U_{B+}$ ):<br>$U_{AH} \approx U_{B+}$<br><b>Low-Side-Mode</b> ( $R_L$ against $U_{B-}$ ):<br>$U_{AH} \approx U_{B+}$ <div style="text-align: right;"><math>R_L &gt; U_{B+} / 3 \text{ mA}</math></div><br>$U_{AH} \approx \frac{U_{B+} + 14 \text{ V}}{1 + \frac{4k7}{R_L}}$ <div style="text-align: right;"><math>R_L &lt; U_{B+} / 3 \text{ mA}</math></div> |
| Output level Low $U_{AL}$ :            | typ. 1.5 V ( $1 \text{ V} < U_{AL} \leq 2.2 \text{ V}$ )                                                                                                                                                                                                                                                                                                                                              |
| Load resistance $R_L$ :                | depending on the High-Side-Mode or Low-Side-Mode the relation to the load resistance $R_L$ can be determined.                                                                                                                                                                                                                                                                                         |
| Short-circuit-proof:                   | yes                                                                                                                                                                                                                                                                                                                                                                                                   |
| Protection against incorrect polarity: | yes                                                                                                                                                                                                                                                                                                                                                                                                   |
| Electrical isolation:                  | yes (against housing)<br>yes (channel to channel)<br>(see block diagram)                                                                                                                                                                                                                                                                                                                              |
| Electric strength:                     | AC 1500 V (against housing)<br>AC 1500 V (channel to channel)                                                                                                                                                                                                                                                                                                                                         |

### 5.6.2.3 Phase relation

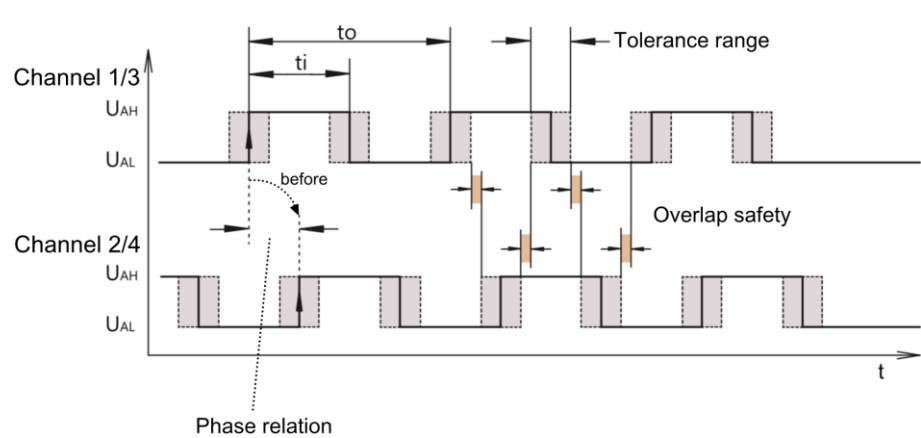


Fig. 5/2: Pulse output for output signal of channel 1 before 2, 3 before 4

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

The illustrated sequence of signals corresponds to clockwise rotation looking onto the drive shaft.

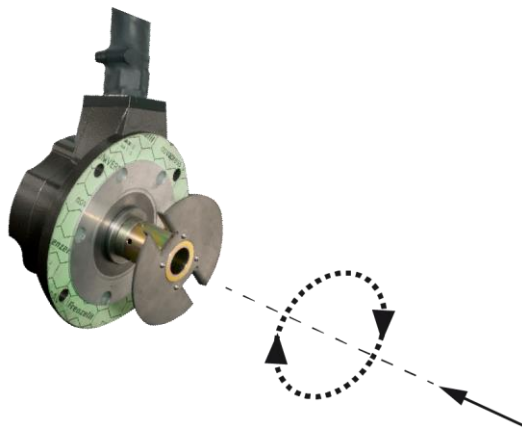


Fig. 5/3: DF16/1 direction of rotation (example)

### 5.6.2.4 Cable break detection

|                     |                                   |
|---------------------|-----------------------------------|
| Function:           | Cable break detection             |
| Plug-in connection: | See chapter "Plug-pin assignment" |
| Signal designation: | See chapter "Plug-pin assignment" |
| Number:             | 1x 2-pin                          |
| Type:               | Current loop                      |

## 6 Certificates

### 6.1 Declaration of Conformity DF16/1, DF17/1, DF27/1

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <p><b>EU Declaration of Conformity</b><br/>in accordance with the directives<br/><b>2014/30/EU (Electromagnetic Compatibility)</b></p> <hr/> <p>We <b>DEUTA-WERKE GmbH</b><br/>PAFFRATHER STRASSE 140, D-51465 BERGISCHE GLADBACH<br/>hereby confirm on our sole responsibility that the product</p> <p style="text-align: center;"><b>Electronic pulse generator DF16/1, DF17/1, DF27/1</b><br/>(see reverse for variants)</p> <p>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.<br/>The following standards are applied:</p> <ul style="list-style-type: none"> <li>▪ EN 50121-3-2:2016                      European standard for electrical railways</li> </ul> <p>This declaration 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.<br/>Valid for products as from: <b>01.01.2017</b></p> <p><b>It is essential that the following operating and environmental conditions are respected:</b></p> <ul style="list-style-type: none"> <li>▪ Application in/on rail vehicles</li> <li>▪ The installation conditions ZU1044 must be observed.</li> </ul> <p><b>This declaration is based on:</b></p> <ul style="list-style-type: none"> <li>▪ Internal test reports and additional reports.</li> </ul> |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|

This declaration is issued on behalf of the manufacturer by:

Bergisch Gladbach, 20.03.2018

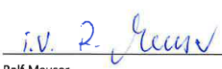
|                                                                                                                                         |                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <br>i.v. R. Meuser<br>Head of Product Qualification | <br>i.v. Elmar Schraetz<br>Head of Application Development |
|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|

Fig. 6/1: EU Declaration of Conformity, page 1



#### INFO

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



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

---

**This declaration of conformity is valid for the following variants:**

**DF16/1:**  
all variants

**DF17/1:**  
all variants

**DF27/1:**  
DF27/1.110bacae,  
DF27/1.110bagae,  
DF27/1.110daae,  
DF27/1.110dagae,  
DF27/1.110dbae,  
DF27/1S1.128daae

VD180319/G (AG:U)

Fig. 6/2: EU 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

To protect the flange face against influences of ageing, the pulse generator must be protected against UV radiation and must be stored in a dust-free, dry place.

Storage temperature range: -40 °C to +70 °C

Humidity: acc. to EN 50155  
yearly average: ≤ 75 % relative humidity  
on 30 successive days of the year:  
95 % relative humidity

Elevation (Air pressure): acc. to EN 50125-1 :  
Class AX: up to 2,000 m  
(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

The electronic pulse generators DF16/1, DF17/1, DF27/1 - designed for use on rail vehicles - are based on the following inspection specifications:

**European Standard for Railway Applications, EN 50121-3-2 with the basic standards:**

|                     |                                                                            |
|---------------------|----------------------------------------------------------------------------|
| <u>EN 55016-2-3</u> | Measurement of radiated radio disturbance transmission (housing)           |
| <u>EN 55016-2-1</u> | Measurement of conducted radio disturbance transmission                    |
| <u>EN 61000-4-2</u> | Electrostatic discharge immunity test (ESD)                                |
| <u>EN 61000-4-3</u> | Radiated, radio-frequency, electromagnetic field immunity test             |
| <u>EN 61000-4-4</u> | Electrical fast transient/burst immunity test                              |
| <u>EN 61000-4-5</u> | Surge immunity test                                                        |
| <u>EN 61000-4-6</u> | Immunity to conducted disturbances, induced by radio-frequency fields test |

### 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:**  
No false pulses or supplementary pulses when stationary and in motion.
- **Evaluation criterion B:**  
False pulses or supplementary pulses at the moment of interference. After the disturbance the sensor functions exactly as it did before the disturbance.
- **Evaluation criterion C:**  
Not applicable.

## 8.2 Installation regulation

### Designated operational location

- The electronic pulse generators DF16/1, DF17/1, DF27/1 are designed for use on rail vehicles and generate signals for position and speed measurement.

### Installation conditions

- The unit is mounted on the axle bearing lid, for vehicles with axles on internal bearings the sensor is fastened directly to the outside of the wheel by means of a carrier bridge. A holder with a rubber cushioned socket attached to the sensor prevents the sensor from twisting.
- It must be ensured that the sensor housing is earthed to the vehicle body.
- Further information on the prescribed installation position can be found in the appropriate documentation, e.g. in the Instruction Handbook in chapter: "Assembly/Installation".
- To protect the equipment, the service and maintenance personnel must be electrostatically discharged when removing and installing the device.

### Wiring and signal requirements

- It is mandatory to supply power to the sensors separately from the battery potential. The pulse signals may not be referenced to the battery potential.
- Lines with signals referenced to the battery may not be connected as a group to the device in conjunction with other signalling lines.
- The lines that have no battery-referenced signals must be installed close to the operating earth along the entire course (e.g. vehicle earth, metallic and earthed cable shafts).

#### Interfaces with shielded cables

Connection via shielded cables is mandatory for the interfaces listed below:

- Basically, all signals that do not have a battery reference must be connected along the entire course via shielded cables.

Applicable if the sensor is provided with a device socket:

- To use the 2-channel version of the sensor when applied in the territory of German Rail, a standardised special cable with the designation EZ75/2... (6 x 1.5 mm<sup>2</sup> shielded, halogen-free, with cast connector) must be used.
- To use the 1 to 6-channel sensors, we recommend our special cable with the designation EZ146/2... (18 x 0.75 mm<sup>2</sup> shielded, halogen-free, mounted with connector)
- The maximum cable length for the DEUTA electronic pulse generators DF16/1, DF17/1, DF27/1 up to the connection in the evaluation unit is 20 m when using an EZ75/2 or EZ146/2 cable. This specification applies to cables that are not interrupted by connection terminals.

**Interfaces without shielded cables**

Connection via shielded cables is **not** mandatory for the interface(s) listed below:

- not applicable

**Connecting plugs and screens**

- The cable shield must not be connected to the sensor housing.
- The shield must be connected to the operating earth (vehicle earth) on one side of the evaluation unit.
- For the specification of a shielded line, the use of metallic plug housings is principally assumed.
- The braiding of all shielded lines must have a minimum optical covering grade of 85 %.
- The connection of all cable shielding shall be made appropriately in relation to EMC. Ensure a large contact surface for all shielding and earth connections. Equipotential bonding current may not flow through the screen.

**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.
- All connections of the operating equipment may only be used for their prescribed function. A connection used for purposes other than intended can result in faults or damage. Connection contacts marked n. c. or reserved must not be connected or used.
- The supply voltage must be uninterruptible and stay within the limits specified in the data sheet.

**Restricted operating behaviour caused by electromagnetic interferences**

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

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

- 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 permissible impairments [→ Page 47] stated in the evaluation criteria, 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 carried out on own responsibility or expressly require DEUTA's written consent.
- 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 enable the optimum use of this device, we recommend implementing the initial start-up with DEUTA support.
- Unused equipment connectors and any connected open lines must always be provided with suitable covers as protection against contamination, contact, damage and fault.



#### **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 System requirements

#### 9.2.1.1 Installation regulations/notes

The DF 16/1 is mounted on the axle bearing lid.

It is mandatory to comply with the following points during the assembly:

- The drive of the DF16/1 may not be subjected to impermissible axial loads. Axial loads during normal as well as brief operation will quickly result in the destruction of the angular contact ball bearing.
- Brief impact stress of the generator drive must be avoided. This can be caused by incorrect assembly of the DF16/1 when the generator drive is not positioned properly on the coupling element (see chapter "Coupling of the generator drive to the vehicle axle").
- Follow the assembly instructions in the chapter "Coupling of the generator drive to the vehicle axle".

#### 9.2.2 Permissible installation position

The electronic pulse generator DF16/1 is mounted on the axle in such a way that the cable outlet faces downwards at an angle of 15° to 45°. The recommended installation angle is approx. 30° (see fig. 9.1 below). This avoids accumulation of dirt and water (moisture) in the area of the generator side cable end or plug.

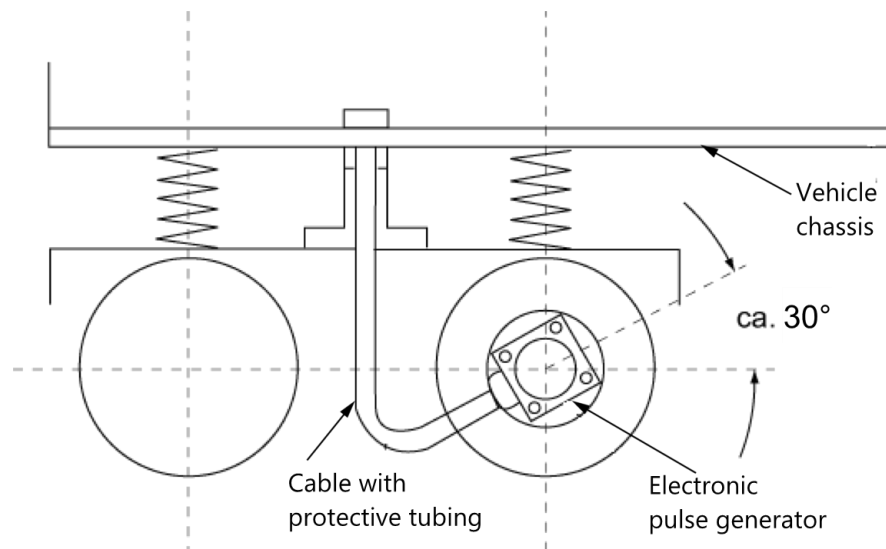


Fig. 9/1: Assembly of the electronic pulse generator

## 9.2.3 Installation



### INFO

#### Installation position

It must be ensured that the generator drive adopts the right installation position on the coupling element of the vehicle axle.

### 9.2.3.1 Installation direction

The figure shows the possible installation directions at the vehicle.

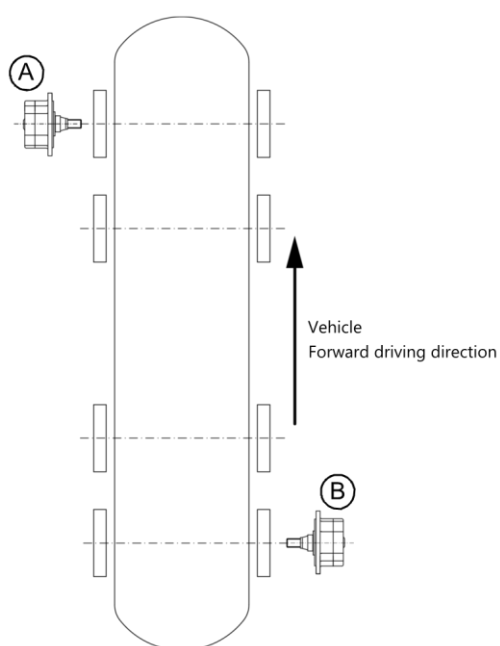
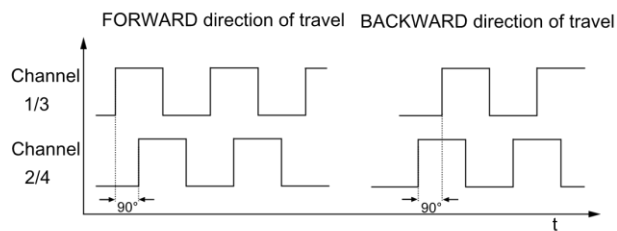
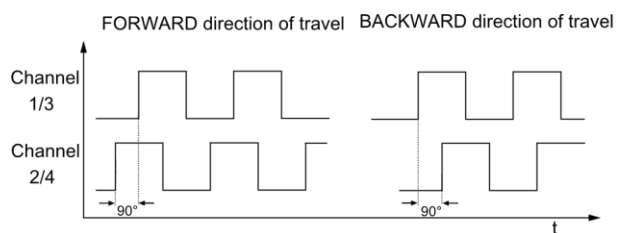


Fig. 9/2: Installation direction with viewing direction from above

The viewing direction from above with direction of travel "forwards" at channel 1/3 and channel 2/4 with 90° phase relation results in the signal sequence shown below:

**(A) Assembly left****(B) Assembly right**

*Fig. 9/3: Phase relation in dependence on direction of travel*

For further information: see chapter "Technical data".

### 9.2.3.2 Coupling of the generator drive to the vehicle axle (only variant X4 = a: drive version "cross slotted shaft")

During assembly, make sure that the vehicle side driver is inserted correctly into the cross slotted shaft.

### 9.2.3.3 Coupling of the generator drive to the vehicle axle (only variant X4 = ac: drive version "drive fork")

The installation position of the vehicle side driver pin (D) must be noted during assembly. This can be taken from the following figure:

- The driver pin must be at least 12 mm (A) away from the housing.
- The depth of penetration (B) of the driver pin must be at least 10 mm.
- Pin diameter (C) =  $14^{+0.05}_{-0}$  mm

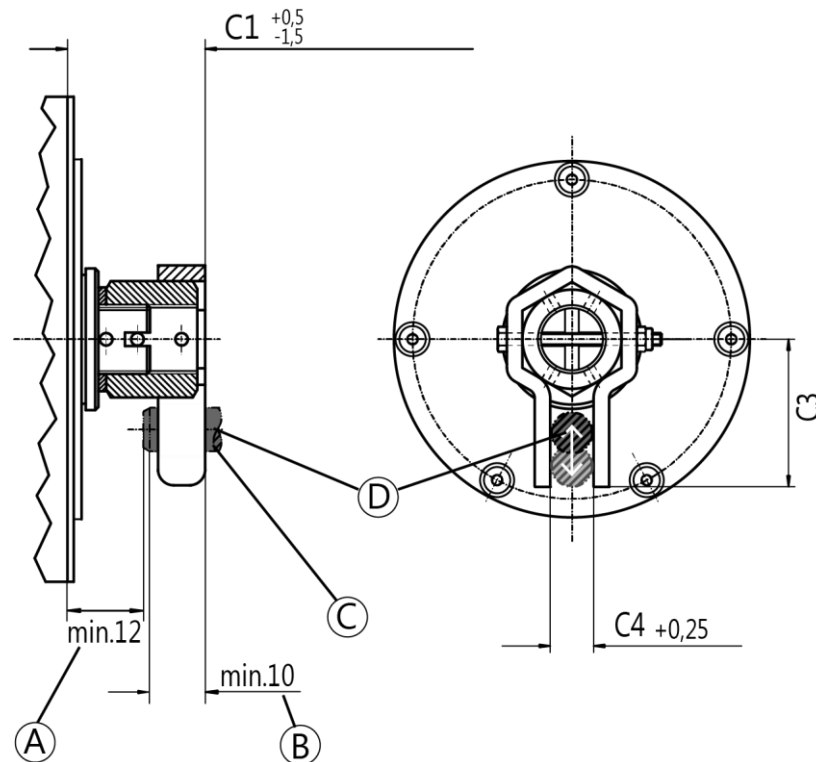


Fig. 9/4: Assembly note drive fork ac

### 9.2.3.4 Coupling of the generator drive to the vehicle axle (only variant X4 = ad: drive version "drive tongue 20x7")

During the assembly, the drive tongue must be correctly inserted into the elongated hole of the coupling element on the vehicle axle.

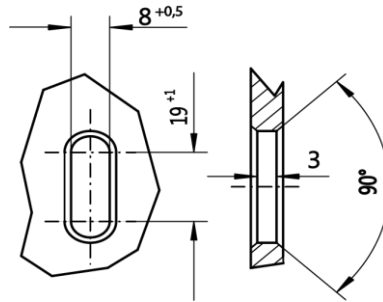


Fig. 9/5: DF16/1 elongated hole on the coupling element

### 9.2.3.5 Coupling of the generator drive to the vehicle axle

(only variant X4 = ado: Drive version "prepared for subsequent assembly of a drive tongue 20x7")

#### Assembly of the drive tongue

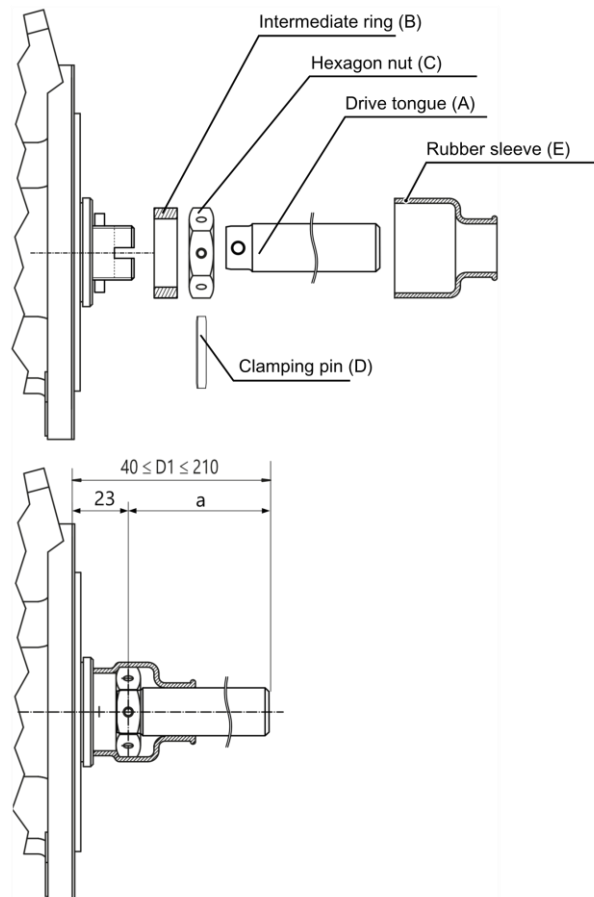


Fig. 9/6: DF 16/1 drive type ado: Assembly of the drive tongue

- Place the intermediate ring (B) on the cross slotted shaft.
- Screw the hexagon nut (C) onto the Phillips shaft up to the stop. If necessary, loosen the hexagon nut until the drill holes are aligned with a slot in the drive shaft.
- Insert the drive tongue (A) into the cross slotted shaft and align the drill holes so that the clamping pin (D) can be inserted through the hexagon nut, cross slotted shaft and drive tongue.
- Carefully and without canting, press in the clamping pin (D) with the help of a steel pin (diameter 4 mm) and toggle press.
- For  $D1 \geq 60$  mm: Put the rubber sleeve (E) over the hexagon nut and the intermediate ring.

**INFO****Rubber sleeve**

The type of fastening on the drive shaft enables easy mobility of the drive tongue. It is necessary to restrict the mobility of the tongue to make it easier to thread the tongue into the counterpart on the vehicle side. As of a drive length of 60 mm the rubber sleeve must be fitted so that the position of the tongue can be "fixed".

**Coupling to the vehicle axle**

During the assembly, the drive tongue must be correctly inserted into the elongated hole of the coupling element on the vehicle axle.

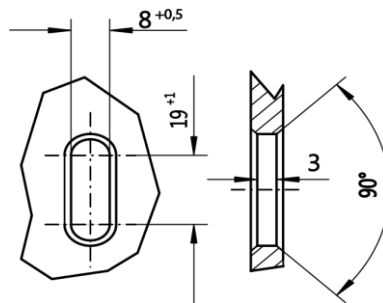


Fig. 9/7: DF16/1 elongated hole on the coupling element

### 9.2.3.6 Coupling of the generator drive to the vehicle axle (only variant X4 = af: drive version "drive disc")

The installation position of the vehicle side driver pin (D) must be noted during assembly. This can be taken from the following figure:

- The driver pin must be at least 12 mm (A) away from the housing.
- The depth of penetration (B) of the driver pin must be at least 10 mm.
- Pin diameter (C) =  $14^{+0.05}_{-0}$  mm
- The maximum drive diameter can be determined by the following formula:  

$$F2_{(max)} = F3 - (0.5 \times \text{pin diameter})$$

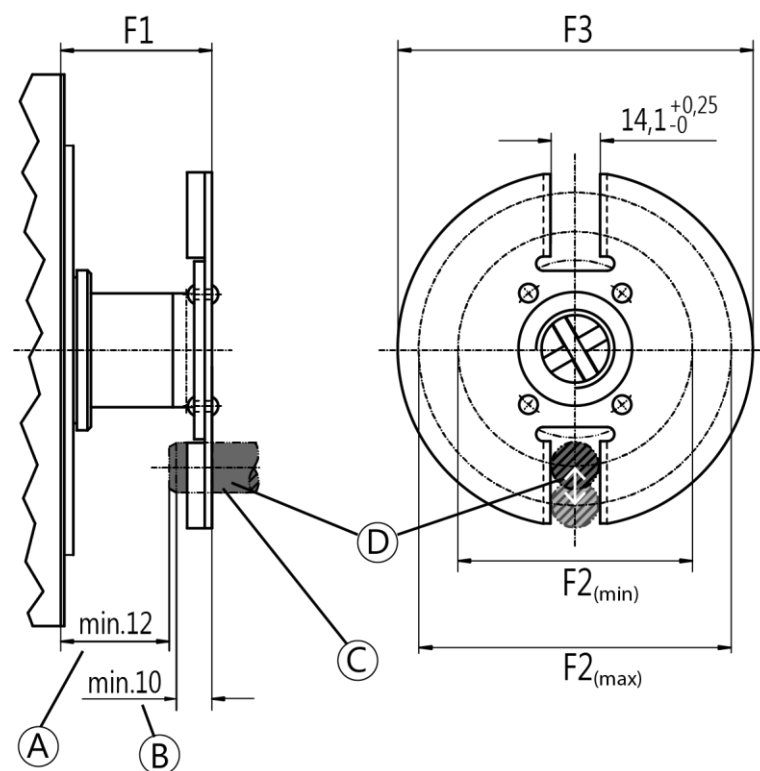


Fig. 9/8: Assembly note drive disc af

### 9.2.3.7 Coupling of the generator drive to the vehicle axle (only variant X4 = nf: drive version "smooth shaft")

During assembly, make sure that the vehicle side driver is placed correctly on the smooth shaft.

### 9.2.3.8 Flange assembly

- The assembly surface intended for the electronic pulse generator must be clean and flat.
- Fasten the DF16/1 with respectively 4 appropriate M12 hexagon head or hexagon socket head screws.
- As a loosening protection as from a strength class of the screws > 8.8, the use of Nord-Lock washers (NL) or wedge lock washers (NLX) is recommended.
- The tightening torque must be selected depending on the friction coefficient and the lubrication.
- The selection of the appropriate assembly paste depends on the material of the axle bearing housing.

When using M12x90 hexagon screws according to ISO 4014, Nord-Lock NLX12 washers and a copper-graphite fitting paste, the following tightening torques must be used:

| Property class of the screw | Friction coefficients of the tooth lock washer | Tightening torque |
|-----------------------------|------------------------------------------------|-------------------|
| 8.8                         | $\mu_{th} = 0.13$<br>$\mu_b = 0.18$            | 98 Nm             |
| 10.9                        | $\mu_{th} = 0.13$<br>$\mu_b = 0.15$            | 126 Nm            |
| 12.9 *)                     | $\mu_{th} = 0.13$<br>$\mu_b = 0.14$            | 146 Nm            |

\*) use only in conjunction with NL! Not suitable for NLX!

### 9.2.3.9 Cable assembly



#### INFO

##### **Protective tubing**

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



#### INFO

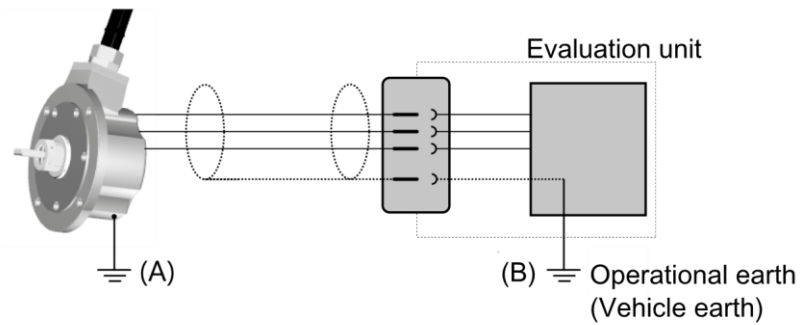
##### **Sensor with fixed cables and protective tubing**

The protective tubing may show slight mobility (rotatability) at the cable screw gland on the sensor side. This is not a defect. The protective tubing is only used for the mechanical protection of the cable against whirled up dust and stones during travel operation. The sealing of the cable to the sensor is ensured by encapsulation of the internal wiring.

- 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 specified bending radius (cable, protective tubing) must not be less than the maximum bending radius (also not in travel operation and bogie movement).
- 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.

## 9.3 Wiring and earthing concept

### 9.3.1 Earthing regulation



*Fig. 9/9: Earthing regulation DF pulse generator (example)*

Due to the potential difference between the vehicle earth (chassis) (B) and the bogie (installation site of the generator) (A), the cable shield must not be connected to the generator ground.

The shield must be connected consistently via shielded cables along the entire course. The shield must be connected to the operating earth (vehicle earth) on one side of the evaluation unit.

## 9.4 Plug-pin assignment



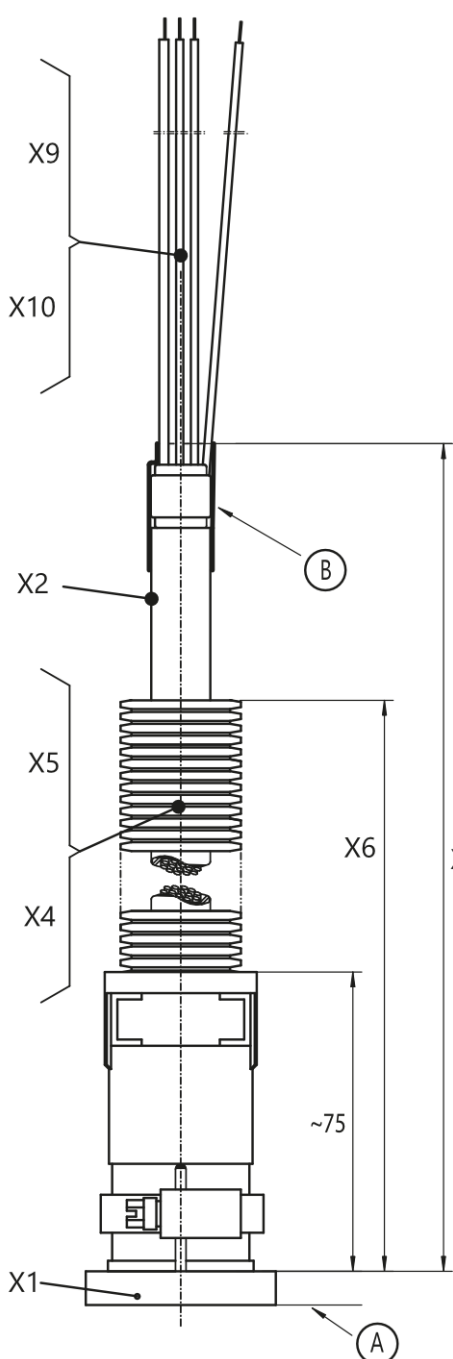
### IMPORTANT

#### Observe in installation

1. Only plug or disconnect plug connections without voltage applied.
2. Observe installation conditions.
3. Do not connect contacts marked **reserved**.

### 9.4.1 Cable definition and parameters

#### fixed cable

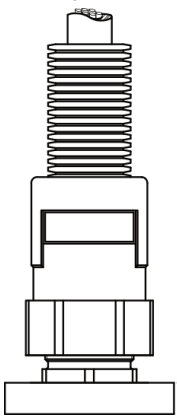
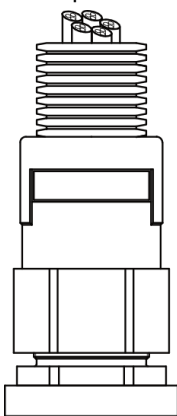
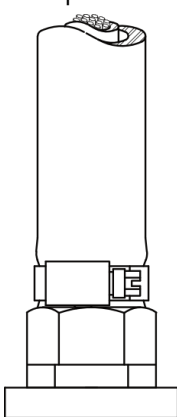
| EB40/2 #610. ##c ###.# p#t ### cc# s#                                                                                                                                          |                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p><b>A</b> = connection for housing upper edge DF16/1<br/> <b>B</b> = shrink-on tubing</p> | <b>X1 = #610</b><br>for #-channel DF16/1 pulse generator                                                                                                                                                                     |
|                                                                                                                                                                                | <b>X2 = ##c</b><br>cable type, see following table                                                                                                                                                                           |
|                                                                                                                                                                                | <b>X3 = ###</b><br>nominal cable length in cm                                                                                                                                                                                |
|                                                                                                                                                                                | <b>X4 = #</b><br>cable protection at cable end, see following table<br>(for cables without cable protection, item X4 omitted)                                                                                                |
|                                                                                                                                                                                | <b>X5 = p#t</b><br>cable protection type, see following table<br>(for cables without cable protection, item X5 omitted)                                                                                                      |
|                                                                                                                                                                                | <b>X6 = ###</b><br>nominal cable protection length in cm<br>(for cables without cable protection, item X6 omitted)                                                                                                           |
|                                                                                                                                                                                | <b>X9 = cc#</b><br>customer's cable end<br>(open cable end or plug-in connector)                                                                                                                                             |
|                                                                                                                                                                                | <b>X10 = s#</b><br>Connection assignment with shielding connection:                                                                                                                                                          |
|                                                                                                                                                                                | When parameter items are omitted, the following parameters move up to the left.                                                                                                                                              |
|                                                                                                                                                                                | <b>Examples for cable designations</b><br>with cable protection:<br>EB40/2 d610 . 10c 200 . 1 p1t 170 cc03 s15<br>X1 X2 X3 X4 X5 X6 X9 X10<br>without cable protection:<br>EB40/2 d610 . 10c 200 cc03 s15<br>X1 X2 X3 X9 X10 |
| <div style="border: 1px dashed black; padding: 5px; text-align: center;"> <b>The example presentation shows the positions of the cable parameters.</b> </div>                  |                                                                                                                                                                                                                              |


**INFO**
**Note bending radius**

If two bending radii are specified, the larger of the two must be used.

| <b>Cable type</b>                                                                                                                                                                                 | <b>X2</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| System cable, shielded, 8 x 2 x 0.5 mm <sup>2</sup><br>- Outside diameter (D): 12.5 mm to 13.5 mm<br>- Bending radius: > 6 x D (free moving)<br>- Fire protection: <u>EN 45545-2</u> , HL1 to HL3 | 11c       |
| Special cable, shielded, 6 x 1.5 mm <sup>2</sup><br>- Outside diameter (D): 11.3 mm to 12.3 mm<br>- Bending radius: > 6 x D (free moving)<br>- Fire protection: <u>EN 45545-2</u> , HL1 to HL3    | 20c       |
| Special cable, shielded, 18 x 0.75mm <sup>2</sup><br>- Outside diameter (D): 12.5 mm to 13.5 mm<br>- Bending radius: > 6 x D (free moving)<br>- Fire protection: <u>EN 45545-2</u> , HL1 to HL3   | 30c       |

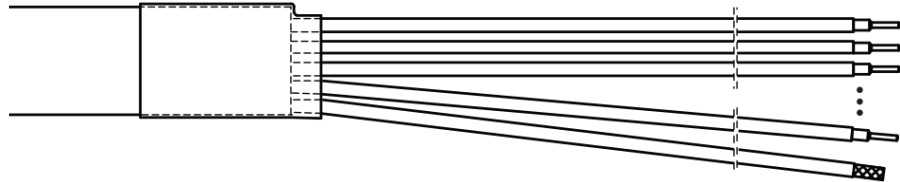
| <b>Cable protection configuration at cable end</b> | <b>X4</b> |
|----------------------------------------------------|-----------|
| Cable protection with open end                     | 1         |
| Standard end adapter at cable protection           | 2         |

| Cable protection type                                                                                                                                                                                            | X5                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Heavy, highly flexible corrugated pipe<br>- Nominal width: 17 mm<br>- for cable diameter: <16 mm<br>- Bending radius: stat. > 40 mm<br>- Bending radius: dyn. > 110 mm<br>- Fire protection: DIN EN 45545-2, HL3 | <p>p3t</p>     |
| Heavy, highly flexible corrugated pipe<br>- Nominal width: 23<br>- Cable diameter: < 19 mm<br>- Bending radius: stat. > 40 mm<br>- Bending radius: dyn. > 110 mm<br>- Fire protection: DIN EN 45545-2, HL3       | <p>p6t</p>    |
| Protective tubing<br>- Outer diameter: 28 mm<br>- Inner diameter: 19 mm<br>- Bending radius: > 110 mm<br>- Fire protection: DIN EN 45545-2, HL3                                                                  | <p>p14t</p>  |

### 9.4.2 Connection assignment cable ...cc06s83

Cable with open end cc06 s83

19-pin, wire end ferrules



| Wire  | Signal designation | Function              |
|-------|--------------------|-----------------------|
| 1     | UA1                | Signal channel 1      |
| 2     | UA2                | Signal channel 2      |
| 3     | UA3                | Signal channel 3      |
| 4     | UB1+               | Power supply UB1+     |
| 5     | UB1-               | Power supply UB1-     |
| 6     | UB2+               | Power supply UB2+     |
| 7     | UB2-               | Power supply UB2-     |
| 8     | UB3-               | Power supply UB3-     |
| 9     | UB3+               | Power supply UB3+     |
| 10    | UB4-               | Power supply UB4-     |
| 11    | UA4                | Signal channel 4      |
| 12    | UB4+               | Power supply UB4+     |
| 13    | reserved           |                       |
| 14    | reserved           |                       |
| 15    | reserved           |                       |
| 16    | CBD_in             | Cable break detection |
| 17    | CBD_out            | Cable break detection |
| 18    | reserved           |                       |
| gn/yl | Shield             | Shielding             |

## 10 Commissioning and system parameters

### 10.1 Parameters

The DF16/1 pulse generator is not parametrisable.

### 10.2 Commissioning

For commissioning, the installation conditions in chapter "Installation conditions" and "Installation" must be observed.

- We recommend you carry out a function test according to chapter "Function test [→ Page 68]" before final installation. For this, the DF16/1 should be electrically integrated directly into the final vehicle wiring and connected to the evaluation unit (e.g. train security, recorder).
- If proper functioning of the DF16/1 in connection with the evaluation unit has been tested successfully, the final mechanical installation on the vehicle can take place.
- 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 installation (attachment to vehicle), it must be ensured that all signal channels of the pulse generator work properly. To do this, the DF16/1 is mounted mechanically on a customer test rig or a DEUTA test bench XP20D / XP20DS according to the installation conditions in the "Installation" chapter. The electrical connection of the DF16/1 is then made either directly on the evaluation unit (e.g. train security, recorder) or, for manual testing, to an oscilloscope or a similar measuring instrument.

The function test is then performed by turning the drive. The DEUTA test bench XP20D enables the optional use of travel profiles for activating the drive. Here, system tests can be conducted based on defined test procedures or previously recorded actual travel data.

(For further information: see Instruction Handbook XP20D – XP20DS – XP20R, 4AB1269)

## 11 Operation

### 11.1 Function and operating principles

The pulse generators of the DF family include sensor electronics with integrated light barrier. The DF16/1 has a slotted disc (pulse disc) and one sensor element per signal channel with light barrier and electronics.

The slotted disc interrupts the light beam and generates a defined number of pulses for each channel per revolution. The electronics convert the signal proportionally to the speed of rotation of the vehicle axle into a square-wave signal and has a defined pulse duty factor (pulse length  $t_i$  to period length  $t_0$ ) of typically 0.5.

The electrical signals are sent over a shielded cable to an evaluation unit from which it acquires the necessary information (e.g. distance travelled, present speed).

If the phase relation between adjacent channels is defined, the evaluation electronic can determine the direction of rotation of the vehicle axle and thus the direction of travel of the vehicle.

## **12 Diagnostics and service functions**

### **12.1 Diagnostics function through evaluation unit**

none

## **13 Maintenance**

### **13.1 Important notes**

#### **13.1.1 Special personnel requirements**

This operating manual is aimed exclusively at technically and electronically trained and qualified personnel (specialists).

Only personnel trained in railway technology and electrical engineering may work on the electronic pulse generator DF16/1.

### **13.2 Smallest exchangeable unit**

The DF16/1 electronic pulse generator is the smallest exchangeable unit.

The flange seal is an exception; its replacement is described in the following chapters.

### **13.3 Basic maintenance instructions**

- Customer intervention (corrective maintenance measures) during the warranty period is not permissible and may only occur after express agreement by DEUTA.
- Maintenance measures must be carried out by the operator during intermission periods or during scheduled downtimes. They may never be carried out during normal operating periods!
- Maintenance measures must be performed by trained personnel. If required, enlist the assistance of the DEUTA customer service personnel.
- The implementation of maintenance measures and the work carried out in this time must be documented.

## 13.4 Preventive maintenance

Within the scope of preventive maintenance, especially inspections of the various components and preventive component exchange must be implemented as necessary, or sent for repairs to DEUTA.

Preventive maintenance is performed outside of normal operating times by the user.

During this maintenance, attention must be given to

- external damage,
- loose and missing parts
- the condition of the cable/plug-in connections and their connections (terminal box) as well as
- mounting of the sensor.

### 13.4.1 Inspection

As part of regular inspections of the vehicle associated with the dismantling of the bearing of the vehicle axle, the following points must be checked:

- normal signs of wear at the drive of the generator, on the flange seal and on the coupling on the car side
- Installation of the sensor
- Soiling of the sensor (e.g. through metal chips)
- Damage to cable or cable protection

A leaky cable protection 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 back to DEUTA-WERKE with a brief description of the fault or dispose of it yourself if necessary, see chapter "Disposal".

We recommend having a factory overhaul performed at DEUTA after 10 years or 2,000,000 km.

### 13.4.2 Checking the functions

The sensor functions can be performed using a portable test bench for XP20DS or XP20DR axle mounted generators.

For further information: see chapter "Function test"

### 13.4.3 Cleaning notes

The electronic pulse generator DF16/1 can be cleaned with conventional cleaning agents when necessary.

### 13.5 Corrective maintenance

The flange seal of the DF16/1 should be changed in the course of corrective maintenance if it is damaged. The old flange seal must be removed from the DF16/1 completely without residue. Then the surface for the new flange seal of the DF16/1 must be cleaned with conventional cleaners. Finally, attach the new self-adhering flange seal to the corresponding surface.

### 13.6 Spare parts

#### Flange seal

| Designation | Type    | Article No. |
|-------------|---------|-------------|
| Flange seal | DF16E96 | 32607246    |

## 14 Decommissioning

### 14.1 Important notes



#### **IMPORTANT**

##### **Requirement for assembly work**

For all work you must comply with the local process and safety regulations.

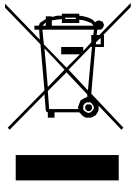
### 14.2 Disassembly

To disassemble the electronic pulse generator, carry out the following steps:

1. Switch the electronic pulse generator voltage-free.
2. Disconnect the electrical and mechanical connection of the connecting cable from the vehicle.
3. Remove the 4 mounting screws (M12) of the sensor.
4. Remove the electronic pulse generator from the vehicle.

## 15 Disposal

### 15.1 Instructions for disposal



The disposal of old devices should be carried out based on the Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment.

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 DEUTA Safety System (DSS) Structure 3

A DEUTA Safety System (DSS) with **Structure 3** requires at least one Safe+ module in a recorder assembly (e.g. REDBOXflex Safe+) and two axle mounted generators DF16/1#-3S. These axle mounted generators have a channel for detecting a cable break.

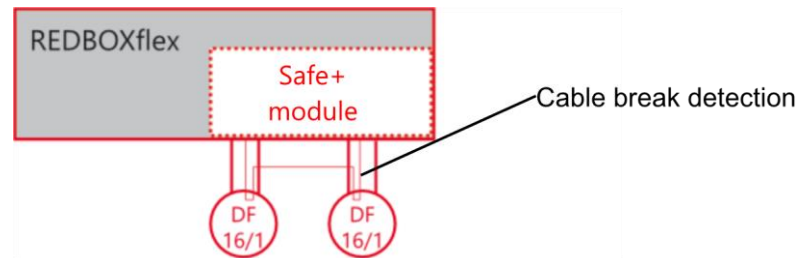


Fig. 16/1: System components DSS with Structure 3

In the process, the **DF16/1#-3S** must

- have at least two channels with an output stage EF1 and also
- have a defined phase relation (90°) on these channels,
- have an independent supply (galv. isolated) at every channel,
- be mounted on two independent axles and
- each be equipped with a fixed connecting cable with current loop (pair of strands, jumpered).

The **wiring on the vehicle side** must connect one flexible lead of the current loop to each of the 1st and 2nd sensors. The other flexible lead of the current loop is connected to the designated contact of the Safe+ module.

With these system components, the following safety-related functions can be fulfilled, e.g.:

- DSD function (SIL3)
- Speed transmission over CAN (SIL2)
- Roll back protection (SIL3)
- Speed monitoring (SIL3)
- Limit speed monitoring (SIL3)
- Standstill detection (SIL3)
- Cold Movement Detection (CMD) (SIL4)

## 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)

### CMD

Cold Movement Detection

### DIN 31051

current valid issue status

### DIN EN 61709

current valid issue status

### DIN VDE 0105

current valid issue status

### EMC

Electromagnetic compatibility

### EN 45545

current valid issue status

### EN 45545-2

current valid issue status

### EN 50110

current valid issue status

### EN 50121-3-2

current valid issue status

### EN 50124-1

current valid issue status

### EN 50125-1

current valid issue status

### EN 50153

current valid issue status

### EN 50155

current valid issue status

### EN 55016-2-1

current valid issue status

### EN 55016-2-3

current valid issue status

### EN 60529

current valid issue status

### EN 61000-4-2

current valid issue status

### EN 61000-4-3

current valid issue status

### EN 61000-4-4

current valid issue status

### EN 61000-4-5

current valid issue status

### EN 61000-4-6

current valid issue status

### EN 61373

current valid issue status

### ESD

Immunity to electrostatic discharge

### Glossary

Explanation and definition of terms and abbreviations used

### IEC 60050-191

current valid issue status

### IEC 60364

current valid issue status

### ISO 2768-1

current valid issue status

### 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.

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