

# Speed and position sensor

Also suitable for use in hazardous areas

GEL 2478

## Technical Information

Version 2021-11-17

### General

- Contactless measurement of rotational or linear movements
- One or two channel speed sensor
- Magnetic measurement principle
- Optionally available with EC type-examination certificate



II 2G EX ib IIB T4 Gb

BVS 07 ATEX E 030  
IECEX BVS 15.0034

### Features

- Can be used under very harsh conditions
- Detect speed between 0 Hz and a maximum of 20 kHz
- For target wheels with a module of 1.0 to 3.5 or measuring rods with 4.0 mm pitch
- Very precise duty and phase shift of the output signals
- Robust stainless steel housing
- Very high protection class IP 68
- Wide temperature range -40 °C to + 85°C (ATEX ) or -40 °C...+120°C without ATEX certificate

### Fields of application

- Measurement of speed and positions at gears, motors and roller
- Position detection of piston rods
- Speed and position detection in explosion-hazardous areas



Target wheels and measuring rods can be supplied separately

# Technical data

<b>Electrical data</b>	
Supply voltage $V_S$ (reverse polarity protected)	10 to 28 V DC with ATEX 10 to 30 V DC without ATEX
Current consumption per channel $I_S$ (without load)	$\leq 45$ mA
Output signal (short circuit-proof)	Square-wave signals
Output signal level high <sup>(1)</sup>	$> U_B - 1.8$ V
Output signal level low <sup>(1)</sup>	$< 0.5$ V
Output current per channel	$\leq 10$ mA
Measuring frequency	0 Hz to 20 kHz
Duty (depends on measuring scale and air gap)	50% $\pm$ 10 %
Phase shift	typ. 90°
Slew rate (2 m cable)	$\geq 10$ V/ $\mu$ s
Electromagnetic compatibility	Rail vehicles (EN 50121-3-2) Industrial applications (EN 61000-6-1 to 4)
Insulation	500 V AC (EN 61439-1)
<b>Mechanical data</b>	
Module of target wheel	$m = 1.00$ to 3.50
Permissible air gap (for module $m$ or pitch $p$ )	See Air gap table
Width of target wheel	$\geq 10$ mm (smaller ones on request)
Form of target wheel	Involute gear as per DIN 867, rectangular gear 1:1 or slotted disk (on request)
Material of target wheel	Ferromagnetic steel
Operating and ambient temperature	-40 °C to +85 °C with ATEX -40 °C to +120 °C without ATEX
Storage temperature	-40 °C to +120 °C
Degree of protection	IP 68
Vibration resistance	50 m/s <sup>2</sup> (EN 60068-2-6)
Shock resistance	100 m/s <sup>2</sup> (EN 60068-2-27)
Housing material of sensor	Stainless steel (1.4305)
Weight of sensor (2 m cable, without mating connector)	Approx. 500 g
Pressure resistance on sensor side	$< 5$ bar (from sensor tube to flange completely sealed)
<b>Electrical connection</b>	
Connection	PUR or silicone cable, screen connected to sensor housing, cable outlet straight
Maximum cable length	$\leq 100$ m
<b>Cable LK 10691</b>	
Cable material	PUR sheath, halogenfree and screened <sup>(2)</sup>
Cable diameter	8.1 $\pm$ 0.3 mm
Cross section	6 $\times$ 1.0 mm <sup>2</sup> (6 $\times$ AWG 20)
Minimum bending radius static/dynamic	24 mm / 41 mm
<b>Cable LK 10581</b>	
Cable material	Silicone sheath, halogenfree and screened <sup>(2)</sup>
Cable diameter	9.2 $\pm$ 0.4 mm
Cross section	6 $\times$ 0.75 mm <sup>2</sup>
Minimum bending radius static/dynamic	69 mm / 138 mm

<sup>(1)</sup> Output signal level depends on output current and temperature

<sup>(2)</sup> specification upon request

# Connection assignment, Dimensional drawing

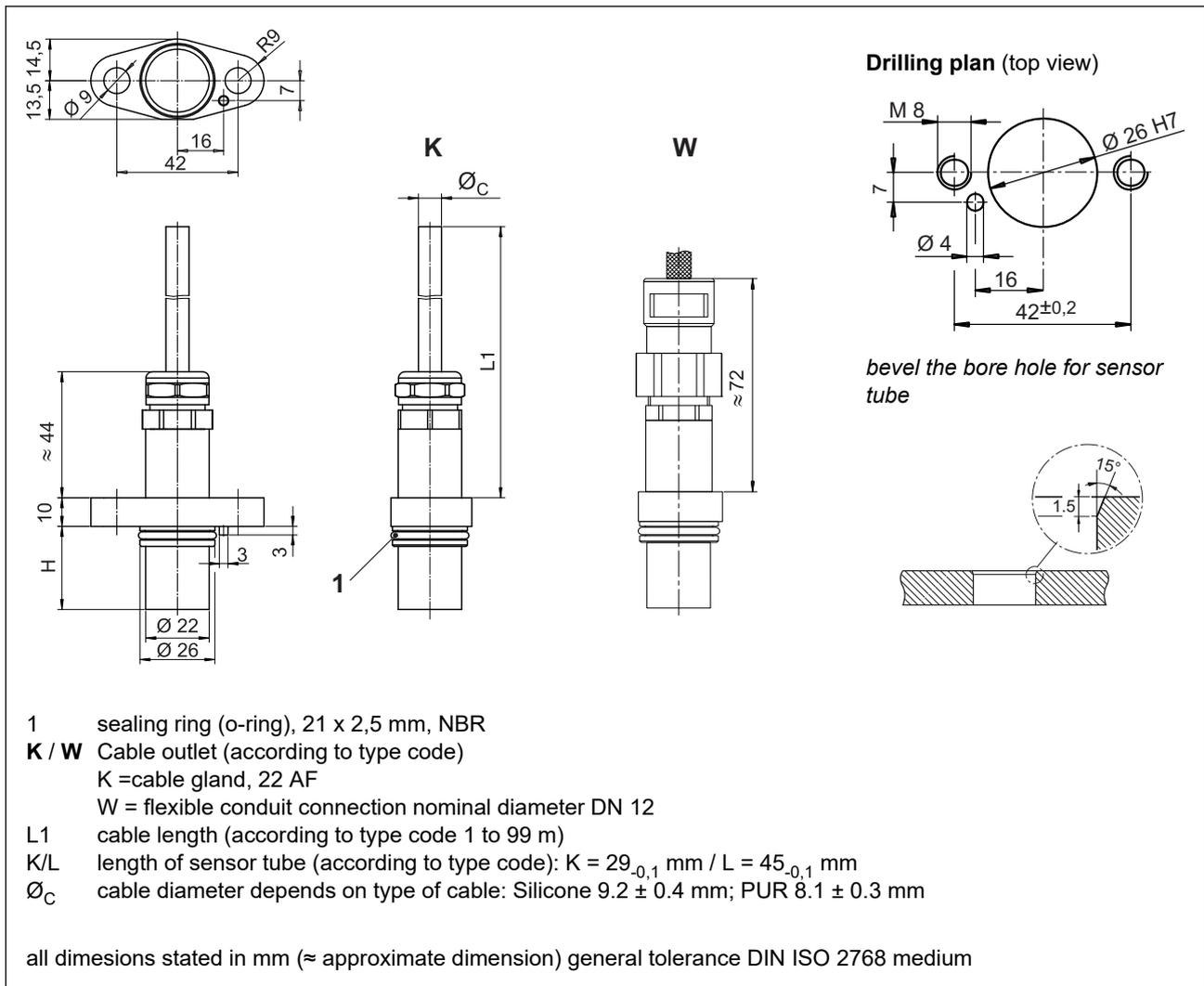
## Connection assignment

Signal pattern		E	F	V	X	E	F	V	X
Function		PUR cable				silicone cable			
track 1		yellow	yellow	yellow	yellow	6	6	6	6
track 2				white	white			3	3
track 1̄			black		black		5		5
track 2̄					brown				2
GND (0 V)		blue	blue	blue	blue	4	4	4	4
+ U <sub>B</sub> *		red	red	red	red	1	1	1	1

\* + U<sub>B</sub> = 10 ... 28 V DC with EX certificate

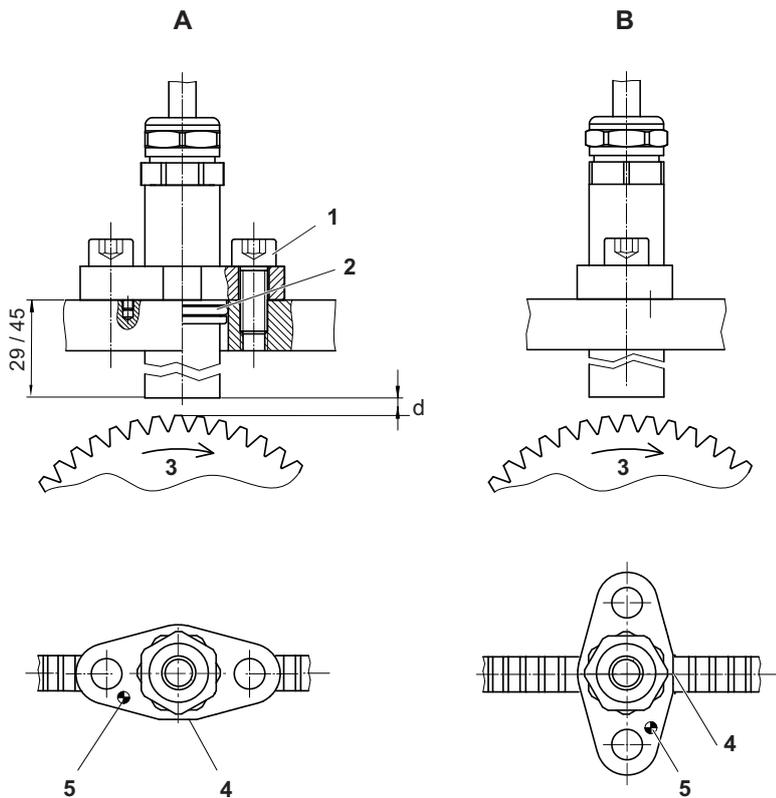
+ U<sub>B</sub> = 10 ... 30 V DC without EX certificate

## Dimensional drawing



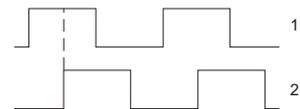
# Assembly drawing

## Target wheel

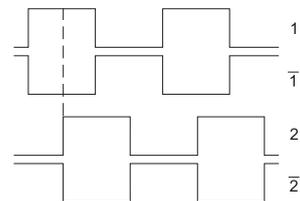


- A mounting position 0°
- B mounting position 90°
- d permissible air gap (see air gap table)
- p pitch ( $p = 4 \text{ mm}$ )
- 1 mounting screw (recommended: M8 x 20, EN ISO 4762)
- 3 direction of rotation forward
- 4 visible surface
- 5 Index pin

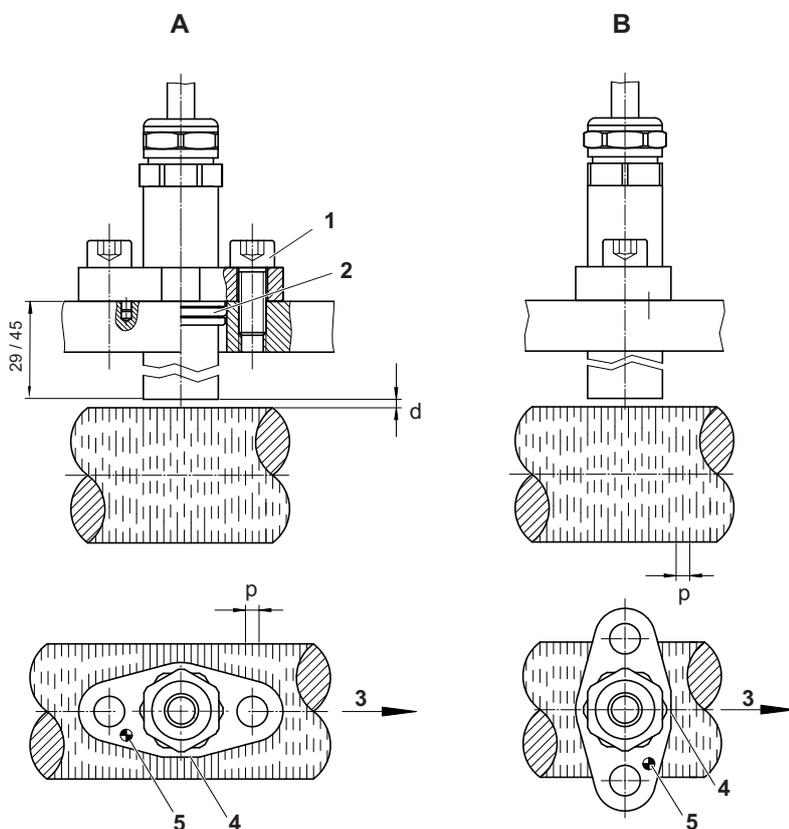
### Signal for direction of rotation forward signal pattern V



### signal pattern X



## Measuring rod



### Air gap table – target wheel

Module m	permissible air gap d
1.0	0.2 to 1.4 mm
1.5	0.2 to 1.8 mm
2.0	0.2 to 2.2 mm
2.5	0.2 to 2.8 mm
3.5	0.2 to 3.0 mm

### Air gap table – measuring rod

pitch p	permissible air gap d
4.0	0.2 to 1.0 mm

# Safety information

## Use in hazardous areas

The following information must be observed when using sensors of type GEL 2478\_Z with ATEX certificate in explosion-hazardous areas.

The maximum electrical and mechanical limiting values given in the technical data may not be exceeded. The **safety parameters** below apply to the GEL 2478 sensor.

The sensor may be operated only within the specified operating temperature range of -40°C to+ 85°C. The cables between the power inlet and the GEL 2478 sensor and between the sensor and the external evaluation unit may not exceed the specified maximum length. Connection and installation of the safety barriers may be carried out only by certificated personnel; installation of modules relevant to explosion hazards may be carried out only by authorised expert technicians. Cables and housing of the GEL 2478 sensor must not be damaged. Installation is prohibited, if one of these components is damaged.

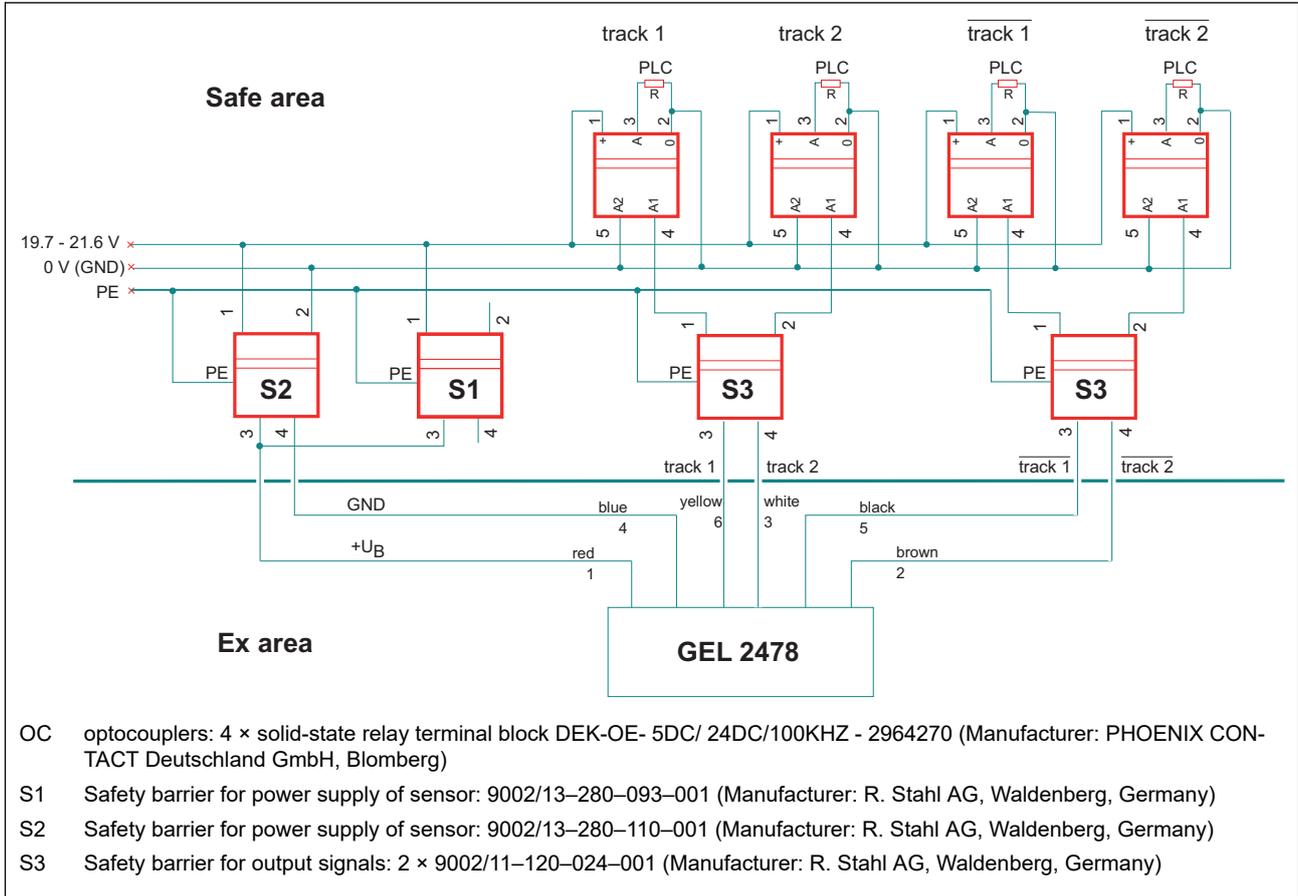
<b>Safety parameters</b>	
Ignition protection type	II 2G EX ib IIB T4 Gb
IECEX certificate	IECEX BVS 15.0034
ATEX certificate number	BVS 07 ATEX E 030
Voltage $V_i$	$\leq 28$ V
Current $I_i$	$\leq 250$ mA
Power $P_i$	$\leq 1000$ mW
Internal inductance $L_i$	0 mH
Internal capacitance $C_i$	450 nF
<b>Typical cable characteristics</b>	
Inductance $L_c$	0.018 mH / 100 m
Capacitance $C_c$	18 nF / 100 m

# Safety information

## Example of a safety circuit

The following diagram shows one possible safety circuit for GEL 2478 sensors using safety barriers. The safety barriers and optocouplers are not supplied with the GEL 2478 sensor.

### Circuit diagram for safety barriers and optocouplers



To limit the power supply of the speed sensor GEL 2478 a safety barrier with 160 Ω is required. Because this is not available, two safety barriers S1 and S2 are connected in parallel. These safety barriers limit the current flowing in the Ex circuit to at most 119 mA and the voltage to at most 28 V.

The output signals from the GEL 2478 sensor are connected to the safety barrier S3. In the event of a malfunction, this barrier limits the current to at most 12 mA and the voltage to at most 12 V. The safety barrier S3 routes each of the output signals to a optocoupler OC. These optocouplers serve to convert the output signals back to a range that can be evaluated by the PLC.

### Summary of resource parameters

No.	Corresponding resource		Manufacturer	U <sub>o</sub> [V]	I <sub>o</sub> [mA]	P <sub>o</sub> [mW]	L <sub>o</sub> [mH]	C <sub>o</sub> [nF]	Ex Group
	Designation	Type							
S1	Safety barrier	9002/13-280-093-001	R. Stahl AG	28	93	651	13	636	IIB
S2	Safety barrier	9002/13-280-110-001	R. Stahl AG	28	110	770	9	635	IIB
S3	Safety barrier	9002/11-120-024-001	R. Stahl AG	12	24	70	230	7100	IIB

## Type examination certificate

Type examination certificate supplement 3 (Page 1 of 3)



### Translation

# 1 EU-Type Examination Certificate Supplement 3

Change to Directive 2014/34/EU

2 **Equipment intended for use in potentially explosive atmospheres  
Directive 2014/34/EU**

3 EU-Type Examination Certificate Number: **BVS 07 ATEX E 030**

4 Product: **Speed sensor type GEL 2478\*Z\*\*\*\*\***

5 Manufacturer: **Lenord, Bauer & Co. GmbH**

6 Address: **Dohlenstraße 32, 46145 Oberhausen, Germany**

7 This supplementary certificate extends EC-Type Examination Certificate No. BVS 07 ATEX E 030 to apply to products designed and constructed in accordance with the specification set out in the appendix of the said certificate but having any acceptable variations specified in the appendix to this certificate and the documents referred to therein.

8 DEKRA Testing and Certification GmbH, Notified Body number 0158, in accordance with Article 17 of Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014, certifies that this product has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II to the Directive.  
The examination and test results are recorded in the confidential Report No. BVS PP 07.2021 EU.

9 The Essential Health and Safety Requirements are assured in consideration of:

**EN IEC 60079-0:2018                      General requirements**  
**EN 60079-11:2012                      Intrinsic Safety "i"**

10 If the sign "X" is placed after the certificate number, it indicates that the product is subject to the Special Conditions for Use specified in the appendix to this certificate.

11 This EU-Type Examination Certificate relates only to the design and construction of the specified product. Further requirements of the Directive apply to the manufacturing process and supply of this product. These are not covered by this certificate.

12 The marking of the product shall include the following:

 **II 2G Ex ib IIB T4 Gb**

DEKRA Testing and Certification GmbH  
Bochum, 2021-10-13

Signed: Jörg-Timm Killisch

Managing Director



Page 1 of 3 of BVS 07 ATEX E 030 / N3 – Jobnumber 342344600  
This certificate may only be reproduced in its entirety and without any change.

DEKRA Testing and Certification GmbH, Handwerkstr. 15, 70565 Stuttgart, Germany  
Certification body: Dinnendahlstr. 9, 44809 Bochum, Germany  
Phone +49.234.3696-400, Fax +49.234.3696-401, e-mail DTC-Certification-body@dekra.com

# Safety information

## Type examination certificate supplement 3 (Page 2 of 3)



13 **Appendix**

14 **EU-Type Examination Certificate**

**BVS 07 ATEX E 030  
Supplement 3**

15 **Product description**

15.1 **Subject and type**

Speed sensor type GEL 2478\*Z\*\*\*\*\*

Instead of \*\*\*, letters and numbers are inserted in the complete designation to indicate different variants (signal pattern, sensor tube length, installation position, cable length); these variations have no influence on the explosion protection.

15.2 **Description**

With this supplement the certificate is changed to Directive 2014/34/EU.  
(Annotation: In accordance with Article 41 of Directive 2014/34/EU, EC-Type Examination Certificates referring to 94/9/EC that were in existence prior to the date of application of Directive 2014/34/EU (20 April 2016) may be referenced as if they were issued in accordance with Directive 2014/34/EU. Supplementary Certificates to such EC-Type Examination Certificates, and new issues of such certificates, may continue to bear the original certificate number issued prior to 20 April 2016.)

**Reason for the supplement**

- Change to Directive 2014/34/EU
- The equipment has been assessed in accordance with current standard versions.
- An alternative encapsulation can be used.

**Description of Product**

The Speed sensor is used for contactless measurement of linear or rotational movements. The electrical circuit is completely encapsulated and mounted in a metal enclosure. The electrical connection is performed by using a cable with a length of up to 100 m.

15.3 **Parameters**

Voltage	$U_i$	DC	28	V
Current	$I_i$		250	mA
Power	$P_i$		1	W
Effective internal capacitance	$C_i$		480	nF
Effective internal inductance	$L_i$		negligible	
Ambient temperature range	$T_a$		-40 °C up to	+85 °C

16 **Report Number**

BVS PP 07.2021 EU, as of 2021-10-13

17 **Special Conditions for Use**

None



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## Type examination certificate supplement 3 (Page 3 of 3)



**18 Essential Health and Safety Requirements**

The Essential Health and Safety Requirements are covered by the standards listed under item 9.

**19 Drawings and Documents**

Drawings and documents are listed in the confidential report.

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We confirm the correctness of the translation from the German original.  
In the case of arbitration only the German wording shall be valid and binding.

DEKRA Testing and Certification GmbH  
Bochum, 2021-10-13  
BVS-Ben/Mu A20210594

Managing Director



Page 3 of 3 of BVS 07 ATEX E 030 / N3 – Jobnumber 342344600  
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# Safety information

## IECEX certificate

Issue No. 1 (Page 1 of 4)

	<h2>IECEX Certificate of Conformity</h2>	
<b>INTERNATIONAL ELECTROTECHNICAL COMMISSION</b> <b>IEC Certification System for Explosive Atmospheres</b> for rules and details of the IECEX Scheme visit <a href="http://www.iecex.com">www.iecex.com</a>		
Certificate No.:	<b>IECEX BVS 15.0034</b>	Page 1 of 4
Status:	<b>Current</b>	Issue No: 1
Date of Issue:	2021-10-22	<a href="#">Certificate history:</a> Issue 0 (2015-04-22)
Applicant:	<b>Lenord, Bauer &amp; Co. GmbH</b> Dohlenstraße 32 46145 Oberhausen Germany	
Equipment:	<b>Speed sensor type GEL 2478*Z*****</b>	
Optional accessory:		
Type of Protection:	<b>Intrinsic Safety "i"</b>	
Marking:	Ex ib IIB T4 Gb	
Approved for issue on behalf of the IECEX Certification Body:	<b>Dr Franz Eickhoff</b>	
Position:	<b>Lead Auditor and officially recognised expert</b>	
Signature: (for printed version)		
Date:	2021-10-22	
<p>1. This certificate and schedule may only be reproduced in full. 2. This certificate is not transferable and remains the property of the issuing body. 3. The Status and authenticity of this certificate may be verified by visiting <a href="http://www.iecex.com">www.iecex.com</a> or use of this QR Code.</p> 		
Certificate issued by: <b>DEKRA Testing and Certification GmbH</b> Certification Body Dinnendahlstrasse 9 44809 Bochum Germany		 <b>DEKRA</b> On the safe side.

	<h2>IECEX Certificate of Conformity</h2>	
Certificate No.:	<b>IECEX BVS 15.0034</b>	Page 2 of 4
Date of issue:	2021-10-22	Issue No: 1
Manufacturer:	<b>Lenord, Bauer &amp; Co. GmbH</b> Dohlenstraße 32 46145 Oberhausen Germany	
Additional manufacturing locations:		
<p>This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements. This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended</p>		
<b>STANDARDS :</b> The equipment and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards		
<b>IEC 60079-0:2017</b> Edition:7.0	Explosive atmospheres - Part 0: Equipment - General requirements	
<b>IEC 60079-11:2011</b> Edition:6.0	Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "I"	
<p style="text-align: center;">This Certificate <b>does not</b> indicate compliance with safety and performance requirements other than those expressly included in the Standards listed above.</p>		
<b>TEST &amp; ASSESSMENT REPORTS:</b> A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in:		
Test Report: <a href="#">DE/BVS/ExTR15.0030/01</a>		
Quality Assessment Report: <a href="#">DE/BVS/QAR15.0004/05</a>		

# Safety information

Issue No. 1 (Page 3 of 4)



## IECEX Certificate of Conformity

Certificate No.: **IECEX BVS 15.0034**

Page 3 of 4

Date of issue: 2021-10-22

Issue No: 1

### EQUIPMENT:

Equipment and systems covered by this Certificate are as follows:

#### General product information:

The Speed sensor Type GEL 2478\*Z\*\*\*\*\* is used for contactless measurement of linear or rotational movements. The electrical circuit is completely encapsulated and mounted in a metal enclosure. The electrical connection is performed by using a cable with a length of up to 100 m.

#### Parameters

Voltage	$U_i$	DC	28	V
Current	$I_i$		250	mA
Power	$P_i$		1	W
Effective internal capacitance	$C_i$		480	nF
Effective internal inductance	$L_i$		negligible	
Ambient temperature range	$T_a$		-40 °C up to +85 °C	

**SPECIFIC CONDITIONS OF USE: NO**

Issue No. 1 (Page 4 of 4)



## IECEX Certificate of Conformity

Certificate No.: **IECEX BVS 15.0034**

Page 4 of 4

Date of issue: 2021-10-22

Issue No: 1

**DETAILS OF CERTIFICATE CHANGES (for issues 1 and above)**

- The equipment has been assessed in accordance with current standard versions.
- An alternative encapsulation can be used.

# Type code

<b>2478</b>	<b>Signal pattern</b>	
	<b>E</b>	1-channel square-wave signals
	<b>F</b>	1-channel square-wave signals and their inversed signals
	<b>V</b>	2-channel square-wave signals shifted by 90°
	<b>X</b>	2-channel square-wave signals shifted by 90° and their inversed signals
	<b>Certification</b>	
	<b>W</b>	No certification
	<b>Z</b>	Ex certificate, ignition protection II 2G Ex ib IIB T4 Gb (ATEX and IECEx certified)
	<b>Module m / Pitch p</b>	
	<b>M100</b>	Module 1.00
<b>M125</b>	Module 1.25	
.		
.		
.		
<b>M350</b>	Module 3.50	
<b>P400</b>	Tooth pitch 4 mm	
<b>Length of sensor tube</b>		
<b>K</b>	29 mm	
<b>L</b>	45 mm	
<b>Mounting position</b>		
<b>A</b>	0° standard mounting position	
<b>B</b>	Mounting position offset by 90°	
<b>Cable type</b>		
<b>N</b>	6 x 1 mm <sup>2</sup> with PUR jacket	
<b>S</b>	6 x 0,75 mm <sup>2</sup> with silicone jacket	
<b>Cable outlet</b>		
<b>K</b>	Cable gland	
<b>W</b>	Flexible conduit fitting	
<b>Cable length L</b>		
<b>00</b>	Cable length in m	

**Notes:**

