Intrinsically Safe
ATEX / IECEx / UKEX
Zero Velocity Gear Tooth Speed Sensor

User Guide
HEX3659NS

Introduction

The HEX3659NS gear tooth Hall effect speed sensor provides an output signal when a ferrous target passes the tip of the sensor. Common targets include gear wheels and turbines. The output from the sensor is a rectangular wave with an amplitude approximately equal to the supply voltage. The frequency of the output signal is proportional to the rotational speed of the target. The sensor has a push-pull output that will both source and sink a current of up to 80mA.

Selection

The HEX3659NS gear tooth Hall effect sensor may be used in Zones 0, 1, or 2 with flammable gases, vapours and mists. The HEX3659NS may be used in the presence of flammable gases and vapours of groups IIC or IIB or IIA, and with temperature classes T1 or T2 or T3 or T4 or T5 or T6, with ambient temperature ranges as defined in the certificate and listed on page 7 of this guide.

The HEX3659NS sensor may also be used in Zones 20, 21 and 22 with combustible dusts of groups IIIC, IIIB or IIIA. Maximum surface temperatures at varying input power levels are given on the certificate and on page 7 of this guide. The maximum ambient temperature for use with combustible dusts is +110°C.

Installation

The sensor is to be installed by suitably trained personnel in accordance with the applicable code of practice (typically EN 60079-14). The sensor must be connected via an ATEX / IECEx / UKEX (as appropriate) certified intrinsically safe barrier with output not exceeding the parameters specified on the certificate and listed on page 7 of this guide.

HEX3659NS is terminated with an MS10SL-3P connector. We recommend that the mating 10SL-3S connector is fitted with 3-core screened cable to connect to the control/monitoring instrumentation. It is advisable to route the cable away from possible sources of interference such as power cables and relays.

HEX3659NS has a solid sealed sensing face, suitable to be used immersed in fluid or in a constantly wet environment.

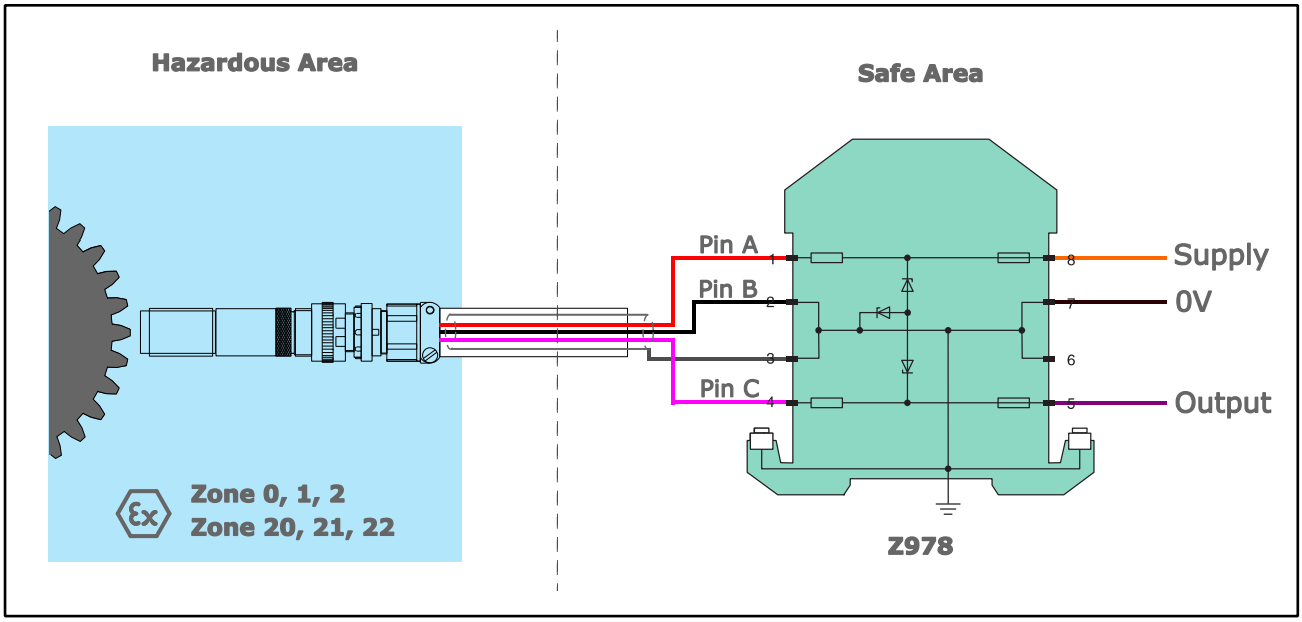
If the sensor is likely to be subjected to harsh external effects or to come into contact with aggressive substances, e.g. acidic liquids or gases that may attack metals or solvents that may affect polymeric materials, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised. If unsure, please contact our sales office to discuss the suitability of the sensor for the application.

Barrier Selection

The selection of a barrier must consider both the zone in which the sensor will be installed and the maximum ambient/process temperature, in order to determine the required factor of safety (FOS) on spark ignition for the barrier. These are defined in the table below.

Zone	Maximum Temperature	Factor of Safety
2	125°C	1
1	100°C	1.5
	125°C	2
0	100°C	1.5
	125°C	2
22	110°C	1
21	100°C	1.5
	110°C	2
20	100°C	1.5
	110°C	2

Example: Pepperl+Fuchs Z978 (or equivalent)

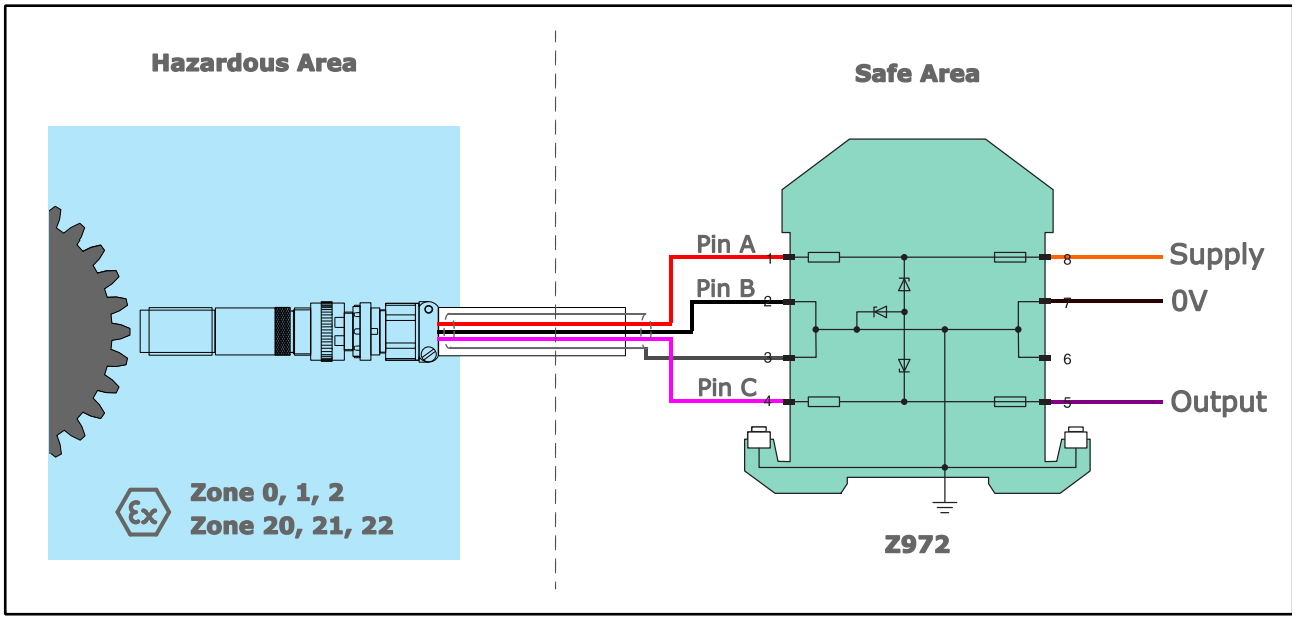


$U_i = 30V$
$I_i = 200mA$
$P_i = 0.9W$ (max)
$L_i = 0\mu H$
$C_i = 25.8nF$

$U_o = 28V$
$I_o = 93mA$
$P_o = 0.65W$
FOS IIC = 1.93
L_o IIC = 4.11mH
C_o IIC = 83nF

As the factor of safety for IIC is less than the required value of 2, this configuration is not permitted for Group IIC in Zone 0 or Zone 1, for operating temperatures > 100°C.

FOS ≥ 2 Example: Pepperl+Fuchs Z972 (or equivalent)



U_i = 30V I_i = 200mA P_i = 0.9W (max) L_i = 0µH C_i = 25.8nF	U_o = 22V I_o = 146mA P_o = 0.8W FOS IIC = 2.3 L_o IIC = 1.66mH / **1.38mH** C_o IIC = 165nF / **72nF**

Worked Example for Group IIC, Zone 0/1, T_a > 100°C. Note that these parameters and calculations are for guidance only. Compatibility of the chosen barrier with the installation must be verified by a qualified individual, in accordance with the applicable installation standards.

The entity parameters for the worst case configuration must be considered. In the case of the Z972 there are 4 possible configurations: Only channel 1 connected, only channel 2 connected, both channels connected in series, both channels connected in parallel. The worst case for Z972 occurs with both channels connected in parallel, which halves the minimum series resistance and therefore doubles the maximum output current I_o and power P_o from the single channel case.

With U_o = 22V, from table A.1 of IEC 60079-11:2023 the maximum permitted short circuit current for IIC is 337mA. With I_o = 146mA, the FOS IIC is 337 / 146 = 2.3. The Z972 barrier has a FOS IIC of >=2, and is therefore permissible for use in Zones 0 and 1 up to +125°C (depending on temperature class) with IIC gasses.

For operation above 100°C in Zones 0 and 1, the permissible capacitance C_o and Inductance L_o must be reduced in order to ensure the required FOS of 2 on spark ignition. For the Z972 these reduced values are given in red above. For other barriers, these can be determined by following the method below for the Z972 barrier.

To determine the maximum permitted capacitance C_o, the voltage is considered to be 2 x U_o. The relevant capacitance value can then be determined from table A.2 in IEC 60079-11:2023, by considering the maximum capacitance for the applicable group (Group IIA, IIB or IIC) at this voltage with a factor of safety of 1. In this case, at 22V the voltage will be considered as: 22V x 2 = 44V. The maximum capacitance at 44V for Group IIC given in table A.2 is **72nF**.

For Group IIC, the minimum ignition energy E is 40µJ. As $E = ½ L I^2$, applying a factor of safety of 2 to the current reduces this value by 2^2, giving E_{max} = 40 / 4 = 10µJ.
$L_{max} = 2E_{max} / I_o^2$. For the Z972, I_o = 146mA. This gives L_{max} = 2 x $(10x10^{-6}) / (0.146)^2$ = **1.38mH**.

The limits for Group IIA and IIB can be determined using the same method.

When determining the limits for IIIA, IIIB or IIIC, apply the limits for Group IIB.

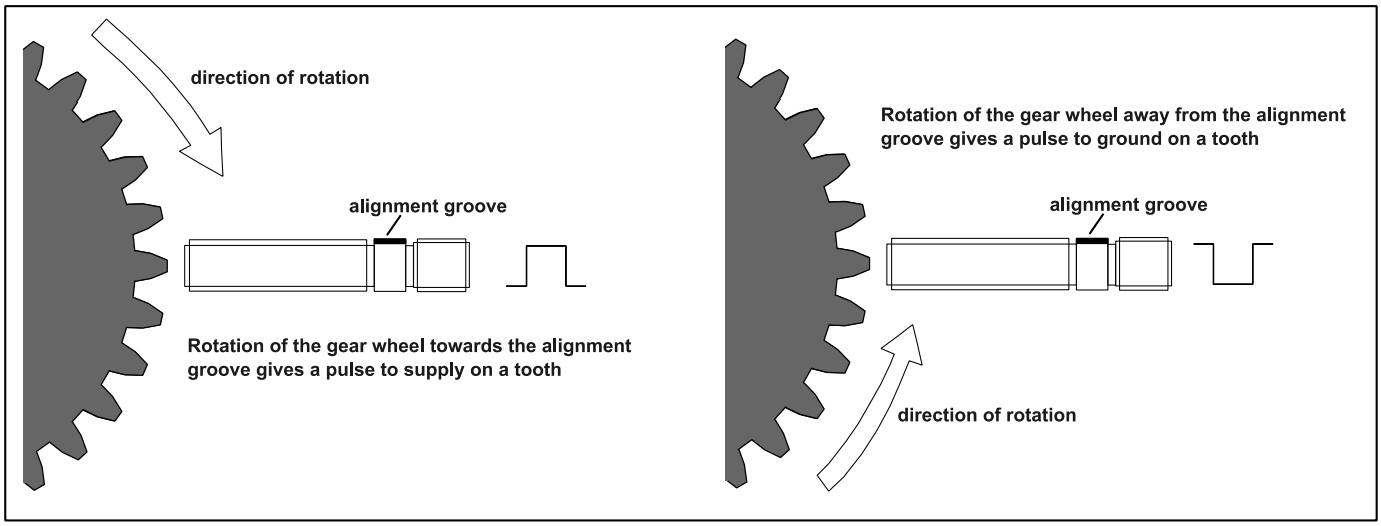
Servicing

Regular periodic inspection of the equipment should be performed by suitably trained personnel in accordance with the applicable code of practice to ensure it is maintained in a satisfactory condition.
The Hall effect sensor contains no serviceable parts. Should the sensor fail a replacement can be ordered from Logitech Electronics Limited or authorised distributor.

Sensor Alignment

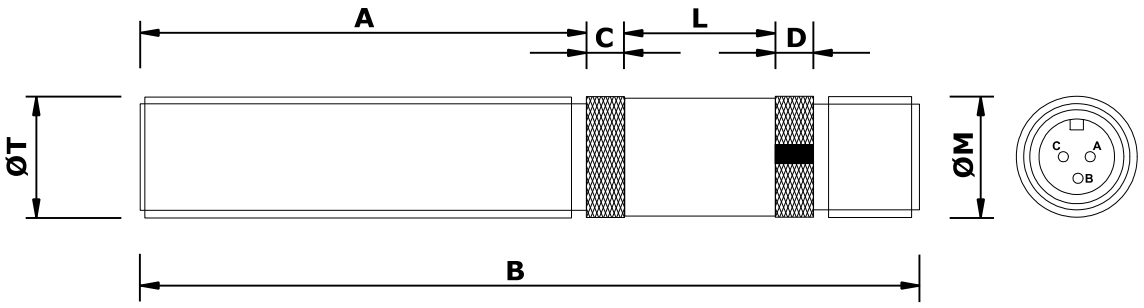
HEX3659NS is a differential Hall effect sensor. The differential signal from 2 Hall effect elements is evaluated, which prevents external factors such as stray magnetic fields or machine vibration from influencing the sensor's output. In order for the differential elements to sense correctly, they must be aligned with the direction of rotation of the target.

The alignment groove can be found on the knurled section that is nearest to the connector end of the sensor. The alignment groove should be aligned with the target as shown below. Rotating the sensor by 180° will reverse the polarity of the output.



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ATEX / IECEx / UKEX
Zero Velocity Gear Tooth Speed Sensor
Pulse to Supply (PLC compatible HTL)

Gear Tooth Hall Effect Sensor
HEX3659NS



Mechanical Specification

Dimensions in mm unless otherwise specified

Dimension		*Part Number*
A	59	
B	103 nominal	
C	5 medium diamond knurl	
D	5 medium diamond knurl with alignment groove	
L	20 plain labelling area	
ØM	5/8" x 24 tpi UNEF-2A (connector thread)	
ØT	5/8" x 18 tpi UNF-2A (body thread)	**HEX3659NS-I**
or	M16 x 1.5 6g	**HEX3659NS-M**
Main body material	303 Stainless Steel	
End face	Solid stainless steel, suitable for permanent liquid immersion	
Locknut	1 off supplied as standard	

Electrical Specification

Supply Voltage (Vs)	7V DC — 30V DC *(see note 1)*
Protection	Reverse polarity, momentary overvoltage and transient surge, short circuit (output to ground, output to supply)
Supply Current	5mA max
High Output Voltage (O/C)	Vs - 0.1V typical, Vs - 0.2V min
Low Output Voltage (O/C)	0.2V typical, 0.65V max
High Output Voltage (Iout = 10mA/20mA)	Vs - 0.6V min / Vs - 1.0V min
Low Output Voltage (Iout = 10mA/20mA)	0.8V max / 1.0V max
Output Current Limit (Sink or Source)	80mA max
Operating Temperature Range	-40°C to +125°C *(see note 2)*
Operating Frequency Range	0Hz – 10kHz
Operating Air Gap (AG)	0 – 3.5mm *(see note 3)*
Termination	MS screw 10SL-3P (3-pin integral plug)
Mating Connector	MS screw 10SL-3S (3-pin socket, not supplied)
Connections	Pin A = Vs Pin B = 0V Pin C = Output

Notes:

1. The voltage drop resulting from the barrier resistance must be considered, to ensure that the supply voltage to the sensor meets the minimum requirement.

2. The permitted ambient temperature range is dependent on environment, input power and temperature class (refer to Pi and Maximum Ambient Temperature (Ta)).

3. The sensing gap must be set such that there can be no collision between the sensor body and the target.

4. Complies with the Dielectric Strength requirements of IEC 60079-11:2023, Section 9.6.

Entity parameters

U_i (V)	I_i (mA)	P_i (W)	C_i (nF)	L_i (µH)
30	200	see below	25.8	0

Uo, Io and Po for the selected barrier must not exceed the respective Ui, Ii and Pi values.

P_i & Maximum Ambient Temperature (T_a)

Group II

The maximum ambient temperature depends on the input power and temperature class as follows:

	Maximum Ambient Temperature			
P_i (W)	T1/T2/T3	T4	T5	T6
0.9	125°C	103°C	68°C	53°C
0.75	125°C	107°C	72°C	57°C
0.5	125°C	113°C	78°C	63°C
0.25	125°C	121°C	86°C	71°C

When the equipment is installed in Zone 0 or Zone 1, with an ambient temperature of greater than 100°C, a factor of safety of 2 must be applied to spark ignition. Refer to "Barrier Selection".

Group III

The maximum ambient temperature for Group III is 110°C. The maximum surface temperature depends on the input power as follows:

Pi (W)	Maximum Surface Temperature
0.9	T_{200} 172°C
0.75	T_{200} 160°C
0.5	T_{200} 139°C
0.25	T_{200} 127°C

Approval

Ex II 1 GD

Ex ia IIC T6...T3 Ga (-40°C ≤ Ta ≤ **)

Ex ia IIIC T** Da (-40°C ≤ Ta ≤ 110°C)

(**See schedule)

ATEX: SGS24ATEX0124

IECEx: IECEx SGS 24.0048

UKEX: SGS24UKEX0123

HEX Series Hall Effect Sensors

Logitech Electronics Limited
Lane End
Church Aston
Newport
Shropshire
TF10 9JJ

CE 0598

UKCA 1180

Certificates and user guides are available to view and download from our website:

www.logitechelectronics.com/ex/download

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Reliability, Guaranteed

Logitech Electronics Limited
e: sales@logitechelectronics.com
t: +44 (0)1952 820444