



Brüel & Kjær Vibro

A member of the NSK Group

BK vibro

Instruction

INA-08x ATEX

Non-Contacting Displacement Sensor with integrated Oscillator



Keep accessible for future reference



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Instruction **Sensor INA-08x**, C102769.002 / V16, en, date of issue: 15.11.2021

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DE Achtung !

Vor Inbetriebnahme des Produktes muss die Betriebsanleitung gelesen und verstanden werden.

Bei Bedarf die Betriebsanleitung in fehlender EU-Sprache unter folgender Adresse anfordern:

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EN Note!

Before operating the product the manual must be read and understood.

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Avant utilisation de l'appareil, il faut impérativement avoir lu et compris le manuel d'emploi.

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Przed rozpoczęciem użytkowania urządzenia uprzejmie prosimy o uważne zapoznanie się z instrukcją obsługi.

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Před uvedením výrobku do provozu je nutné přečíst si návod k provozu a porozumět mu.

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Pred uvedením zariadenia do prevádzky si treba dôkladne prečítať prevádzkový návod a treba jeho obsah správne pochopiť.

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RO ATENȚIE!

Înainte de utilizarea produsului trebuie să citiți și să înțelegeți prezentul manual de operare.

La nevoie puteți comanda manualul de operare într-una din limbile recunoscute oficial în U.E. la următoarea adresă:

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1 Hints

**NOTE!**

This manual is a part of the product. Read the manual carefully before using the product and keep it accessible for future use.

1.1 Pictograms and their Meanings



This symbol warns of dangerous situations which can result from misuse of the product.

1.2 User Qualification

Ensure that all work in conjunction with our systems is performed by skilled, expert and authorized workers. Among these works are:

Installation and Commissioning

Installation and commissioning primarily concern work on electrical equipment. These works may be performed exclusively by electricians or workers instructed and supervised by an electrician in accordance with electrotechnical regulations/directives.

Change of System Specification

Any change of system specification has its effects on monitoring process with stationary systems and on the measuring sequence with portable measuring systems.

1.3 Intended Use

If sensors and the cables are used in a way not described in the relevant user manuals, function and protection may be impaired and serious personal damage, death or serious, irreversible injuries may result.

- Exclusively use sensor as specified in data sheet. Any use other than specified is considered inappropriate. Brüel & Kjær Vibro does not assume any liability for damages resulting from inappropriate use. The user is solely responsible. For originally intended use, see system documentation.
- Mounted sensors must not be used as steps.
- Ensure that system is exposed only to admissible environmental influences specified in technical system data sheet.
- Handle the systems with care in order to prevent damage to the systems or personal damage due to falling.
- Maintain electrical equipment in regular intervals. Remedy defects, e.g. loose wires, defective connectors, immediately.
- Check cable and connectors in regular intervals.
- Never use cable to pull plug out of socket.





Hot surfaces

- In line with the user manuals, sensors and cables can be operated in extensive ambient temperature ranges, whereby they can become hot through self-heating on housing walls and can produce burning.
- When mounted at external heat or cold sources (e.g. machine parts), systems, sensors and cables can adopt dangerous temperatures, whereby burning, among other things, can occur in the event of contact.

1.3.1 Recommendations to User

If the use of the system in conjunction with machines or plant sections can produce risks outside of Brüel & Kjær Vibro's responsibility, the user is expected to prepare and distribute safety technical instructions or warnings and to ensure that the personnel concerned has received and understood same.



If system is integrated into a machine or designed to be assembled, commissioning must not take place until the machine the system is to be integrated in conforms to the EC directives.

1.3.2 Prohibition of Unauthorized Modifications

System and accessories must not be changed neither in construction nor safety technology without the express consent of Brüel & Kjær Vibro. Any unauthorized modification excludes Brüel & Kjær Vibro's liability for resulting damages.

2 Application

With the non-contacting displacement sensor type INA-08x (hereafter some-times called a sensor) relative shaft vibrations, relative shaft displacement, rotor speed etc. can be measured. The prerequisite is a metallic, conducting measurement surface, preferably 42CrMo4.

The output voltage of the sensor, within its displacement measuring range, is directly proportional to the distance between the sensor tip and the measurement surface. External, disturbing influences such as earth returns, temperature effects and dielectric influences such as oil and gas are negligible.



3 Dimension drawings

3.1 INA-081

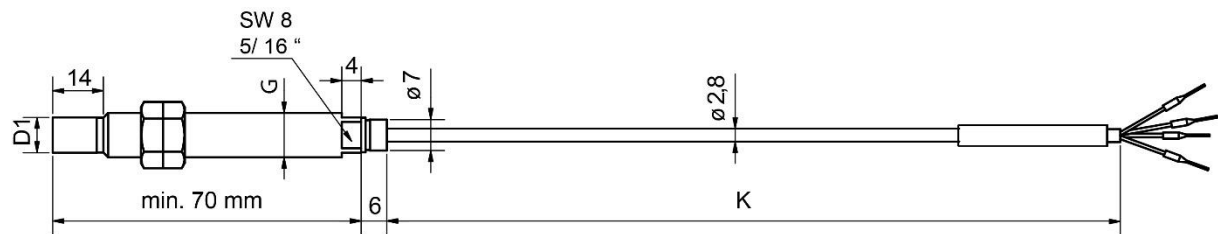


Figure 3-1) Dimension drawings INA-081

3.2 INA-083

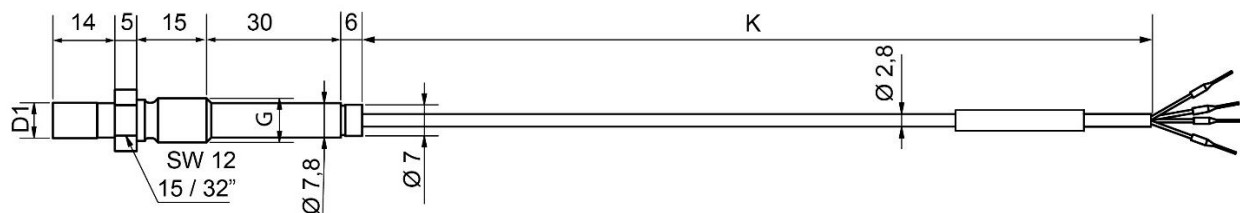


Figure 3-2) Dimension drawings INA-083

Sensor length L1	
INA-081	70 ... 250 mm
INA-083	70 mm
Thread G, diameter d ₁	M10 x 1 - 6 g, Ø 8,5 mm or alternatively 3/8" - 24 UNF -2 A, Ø 8 mm
Cable length K	approx. 5,3 m open-ended cable
Cable diameter Ø	2,6 mm
Sensor tip d	Ø 8,5 for M10 x 1 - 6 g Ø 8,2 for 3/8" - 24 UNF -2 A

4 Connection

4.1 Connections for INA - 081

Cable	3-core, shielded, open-ended		
Shield	isolated from the sensor housing		
Cable colours	red	=	-DC
	white	=	COM
	yellow	=	SIG
	yellow/black	=	shield
Cable jacket material	ETFE		
Colour identification of the signal wire	blue		
Cable weight	approx. 120 g		



5 Sensitivity of the displacement sensor

5.1 Dependent on measurement track material

The sensor sensitivity is standardized to material no. 1.7225 (42CrMo4) acc. to DIN 17 200, corresponding to AISI/SAE 4140.

The sensitivity amounts to -8 mV/ μm .

Other materials and their respective sensitivities are listed in the table below.

The sensitivity to other materials can be determined using a sample of the respective material and a Brüel & Kjær Vibro model AC-126 calibration instrument. A calibration to other materials is done in the measurement electronics.

5.2 At room temperature

Mat. no.: acc. to DIN 17 200	Abbreviated description in Germany	Abbreviated description outside Germany	Country Designation	Transmission factor -mV/ μm
1.0050	St 50-2			7,90
1.0062	St 60			7,90
1.0501	C 35			7,95
1.0503	C 45G			7,80
1.1181	CK 35	xC 38	F	7,85
1.1191	C 45			7,90
1.2241	51CrV4			8,20
1.2841	90MnCrV4			7,80
1.4006	X10Cr13			7,40
1.4028	X30Cr13	Z30C13	F	7,50
1.4057	X22CrNi17			7,25
1.4104	X12CrMoS17			7,50
1.4313	G-X5CrNi13 4			7,35
1.4406	X5CrNiMoN18 12	Z3CND1812	F	10,45
1.4449	X5CrNiMo17 13	Z5CND174	F	7,65
1.4500	G-X7NiCrMoCaNb2520	Uranus B	I	10,35
1.4541	X10CrNiTi18 9			7,80
1.4571	X6CrNiMoTi17 12(2)			10,40
1.4922	X22CrMoV12 1			7,45
1.6562	40NiMoCr7.3	40NiMoCr7	I	7,50
1.6580	30CrNiMo8			7,80
1.6587	17CrNiMo6			7,80
1.7219	27CrMo5			8,05
1.7225	42CrMo4	42CD4	F	8,00
1.8070	21CrMoV5 11			7,80



6 Mounting the displacement sensor

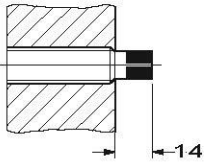
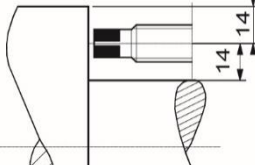
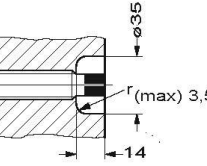
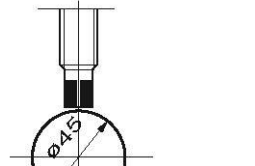
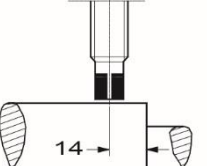
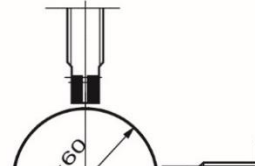
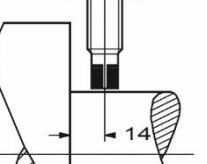
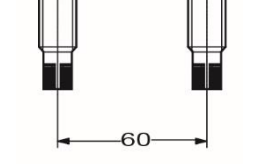
6.1 Mounting advice

Mounting of the sensors must be done to correspond with the "Mounting instructions for displacement sensors".

Sensors for non-contacting displacement measurement should preferably not be secured to parts of the machine which because of their own vibrations will falsify the measurement results.

6.2 Free space and minimum distances for non-contacting displacement sensors

Non-contacting displacement sensors operating according to the eddy-current principle create a high-frequency electro-magnetic field. If any electrically-conducting material apart from the measured object enters this field, the measurement results will be falsified; therefore during the installation of non-contacting displacement sensors, the following free space and minimum distances must be maintained:

	Probe tip projecting		Distance to shaft shoulder
	Probe tip flush		Required minimum diameter to shaft
	Distance to shaft end > 100 % coverage		Required minimum diameter of the shaft for two sensors
	Distance to the shaft shoulder sensor, parallel to electrically conductive material		Sensors mounted parallel



HINT!

If the free space and minimum distances cannot be observed due to constructional restrictions, the manufacturer must be consulted.



6.3 Wiring of the intrinsically safe current circuit

The wiring must be carried out according to the wiring diagrams.

The wiring diagram associated with the INA - 08x ATEX has the drawing number: C102 233.001

6.3.1 Signal cable

For the signal cable between sensor and safety barriers a 3-core cable must be provided. If a 4-core cable is laid two of the wires must be connected to COM.

A 4-core cable is required between the safety barriers and the electronics.

The signal cable shield must be connected to the shield terminals on the mounting rail.

Signal cables must only be laid on a separate cableway for measuring cables.

The distance to the energy supply and control lines must be 1 m. Necessary intersections with such lines must be rectangular and within shortest possible distance.

The wire cross section must not be below 0.5 mm². Unused wires must be earthed on one side. The wires ends must be provided with cable connector sleeves.

Signal cables for intrinsically-safe circuits must be identified in colour (bright blue. Cable and connection components identified in this way may not be used for other purposes within the EX-area.

Technical safety limit values

When erecting an intrinsically safe current circuit with only one working stock, it must be determined that - including cable and connection components - the maximum permissible values of inductance, capacitance and temperature for the current circuit are not exceeded.

6.4 Mounting and Installation advice

A prerequisite for operationally safe equipment is a „correct“ installation. The sensor should be protected against:

- Mechanical damage (e.g. pinching or crushing the cable)
- Damage to the cable from vibration (e.g. rubbing through the insulation)
- Electrical immission (EMC)
- Environmental influence (e.g. humidity)

When putting up electric systems in potentially explosive surroundings, not only the general installation instructions for electric systems have to be observed, but also standard IEC 60079-14 resp. the relevant country-specific regulations for explosion-protected systems.

The sensor mounting torque is 4,5 Nm.



6.5 Sensor mounting

Before mounting check:

1 Sensor

- For completeness
 - All components are available
 - No damage is visible

2 Mounting accessories

- Complete availability (when required)
 - Nuts
 - Threaded parts, securing clips,
- All components fit to each other
 - Same thread on the sensor as the threaded mounting locations at the measurement points?

3 Cable ways

- Cable ways from sensors to terminal housings
 - Can damage to the cable be excluded?

4 Tools

- Mounting
 - Open-end wrenches
 - Screwdrivers

6.5.1 Cables and protective conduit

Sensor cables and any extension cables must be electrically and mechanically protected. Here the local circumstances must be observed.

Cable and terminal identification

The importance of identification of cables and terminals from the measuring point to the monitoring electronics should not be underestimated. This is imperative for the documentation, commissioning and service personnel and must be carried out by the operators of the plant.



Ex ib IIIC (dust)							
Maximum values				Maximum values			
Ui	=	30	V	Ui	=	30	V
Ii	=	100	mA	Ii	=	100	mA
Pi	=	500	mW	Pi	=	600	mW
Li	=	0,6	mH	Li	=	0,6	mH
Ci	=	38	nF	Ci	=	38	nF
Temperature class		permitted surface temperature		Temperature class		permitted surface temperature	
T6		85 °C		T6		85 °C	
T5		100 °C		T5		100 °C	
T4		135 °C		T4		135 °C	

7.2 Supply current circuit

Supply current circuit in spark-protection type, intrinsically safe Ex ib IIC only for connection to an intrinsically-safe, certified current circuit.



HINT!

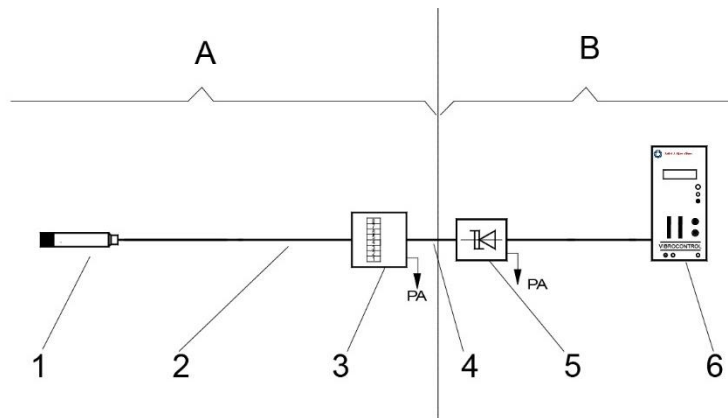
It is to be noted that the overall capacity C_i increases by attaching different cable length to the INA-08x. The appropriate value is to be inferred from the following table.

INA-08x	Type	Length [m]	C_{iges} [nF] (Sensor + Cable)
	INA-.../050/...	5	24
	INA-.../100/...	10	24
	INA-.../200/...	20	28
	INA-.../300/...	30	31
	INA-.../400/...	40	34
	INA-.../500/...	50	38

Table 7-1) C_{iges} G Total capacities INA-08x + Cable



7.2.1 Principle structure of the measuring chain



A = Hazardous Area

B = Safe Area

1. INA-08x
2. Sensor cable
3. Terminal protective housing
4. Signal cable
5. Safety barrier
6. Monitoring electronics

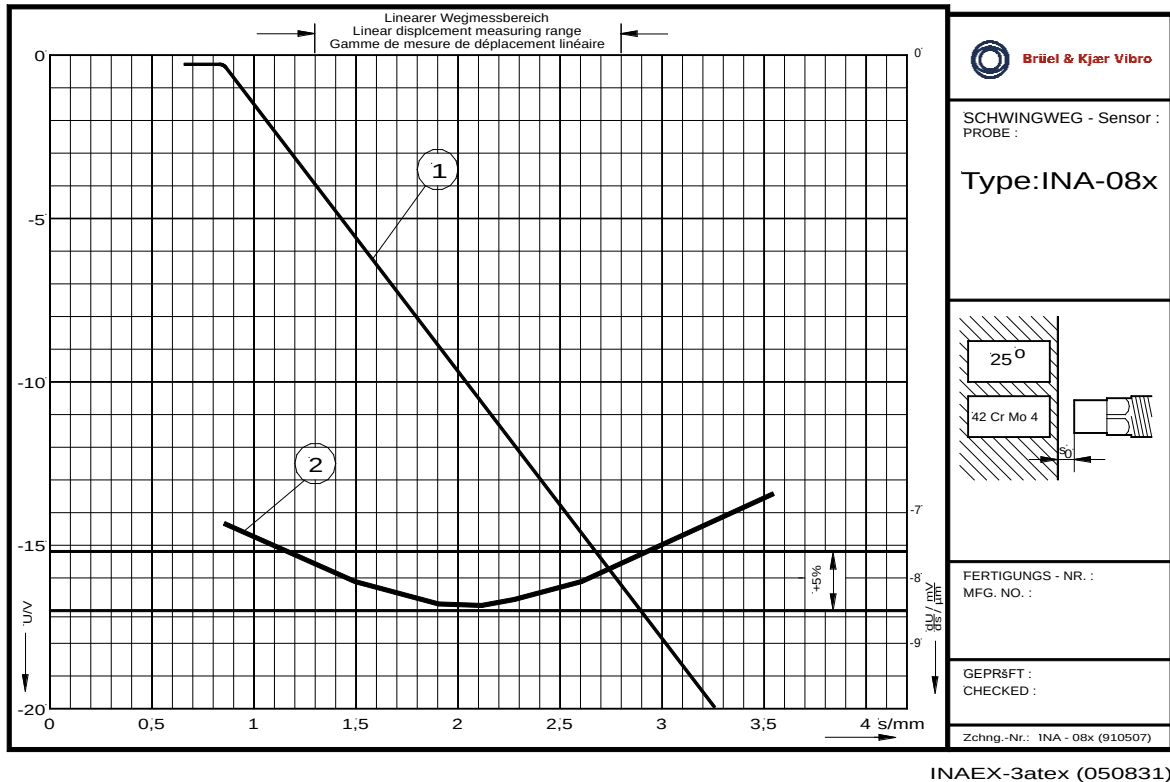


8 Technical Data

Technical measurement data of the displacement sensors	
Measurement type	relative shaft vibration relative shaft displacement
Measurement principle	eddy-current principle
Frequency range	0 ... 2 600 Hz (-3 dB)
Transmission factor	-8 mV/μm (material 42CrMo4) other materials see table, page 10
Linear measuring range	1,5 mm
Transmission factor error limits	< ± 5 % at room temperature (+ 22 °C) < ± 10 % in operating temperature range
Deviation from reference line	± 2 % at room temperature (+ 22 °C) ± 10 % in operating temperature range
Measuring range with additional measurement deviation of 5 %	2,4 mm
Mean operating point	At a gap voltage of -9 V
Temperatures	
Storage temperature range (in original packaging)	-20 °C ... + 70 °C
Working temperature	0 °C ... + 110 °C Note Temperature class
Power requirement	
Supply voltage U_B	-18 V ... -30 V DC not polarized
Current consumption	max. 20 mA
Supply voltage penetration coefficient	≤ 46 dB ($f = 100$ Hz) ≤ 27 dB ($f \leq 10$ kHz)
Insulation resistance between housing and 0 V	$R_{IS} > 20$ MΩ
Protection class acc. to EN 60529	IP 54
Output	
Signal voltage	$U_{SIG} = U_B + 2$ V
Signal current	$I_{max} = 15$ mA
Noise	< 1 mV _{ss} (... 10 kHz)
Dynamic int. source resistance	< 5 Ω
R_{Laod}	> 1 kΩ



8.1 Characteristics curve of the displacement sensors



- Sensor temperature, constant ($t = 25\text{ °C}$). Supply voltage -24 V.
Test material 42CrMo4 AISI 4140
- Typical transmission characteristics curve (Pos. 1)
- Typical sensitivity characteristics curve (Pos. 2)

Transmission characteristics curve $U = f(s)$ (Pos. 1)

This describes the relationship between gap voltage and the distance between the sensor tip and the measurement surface.

Characteristic curve of sensitivity $\frac{dU}{ds} = U'(s)$ (Pos. 2)

This describes the incremental gradient (sensitivity factor) as a function of the gap between sensor tip and the measurement surface.

Nominal measuring sensitivity

-8 mV/μm (-200 mV/mil)

(with standard shaft material Material no.: 1.7225 acc. to IN 17 200 with composition 42CrMo4)

8.2 EMC

EN 61326-1

Through electro-magnetic stray fields influences on the measured values may arise. In case of disturbing influences of this type a grounded protective conduit is recommended for the signal cable.

9 Service and repair

The sensors of the series INA-08x are service free.



IMPORTANT SERVICE NOTE:

A defective sensor may not be opened and in case of a fault must be completely exchanged.

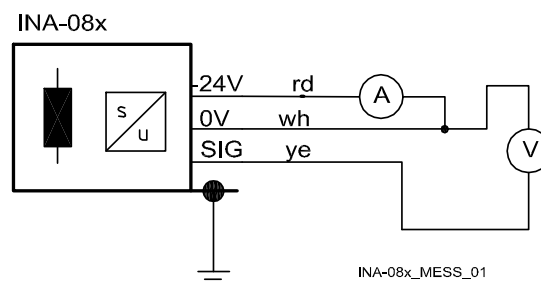
If there is a defect with the integral cable the sensor must be exchanged.

9.1 Fault identification / Short test

A test of the rest potential is sufficient for fault identification. This rest potential can be checked outside the Ex-area after the safety barriers. A commercially-available digital multi-meter is sufficient for this test.

The measurement function can only be checked with a suitable vibration measuring instrument.

9.1.1 Measuring circuit structure



NOTE!

The measurements may be carried out only by authorized technical personnel outside the explosion protected area.

If the sensor is located in the explosion hazardous area the relevant and valid standards and guidelines must be observed at the time of the inspection.



9.1.2 Measurement table

Status	Supply voltage	Signal voltage / current
Sensor unloaded (undamped)	$U_B = -24 \text{ V}$	$U_{SIG} = -22 \text{ V} \pm 0,5 \text{ V} /$ $I_{SIG} = -4,7 \text{ mA} \pm 0,2 \text{ mA}$
Sensor damped	$U_B = -24 \text{ V}$	$U_{SIG} = -0,6 \text{ V} \pm 0,5 \text{ V} /$ $I_{SIG} = -3,2 \text{ mA} \pm 0,2 \text{ mA}$

Tabelle 9-1) Messtabelle

9.2 Accessories

The following accessories are recommended for the series INA-08x sensors:

- Safety barrier set AC-294
- Signal cable AC-1114
- Terminal protective housing AC-2105

9.3 Calibration

The sensor can be exchanged without requiring re-calibration of the instrumentation. It fulfils the essential points of the accuracy requirements of the API-670 standard and DIN-45670.

10 Disposal



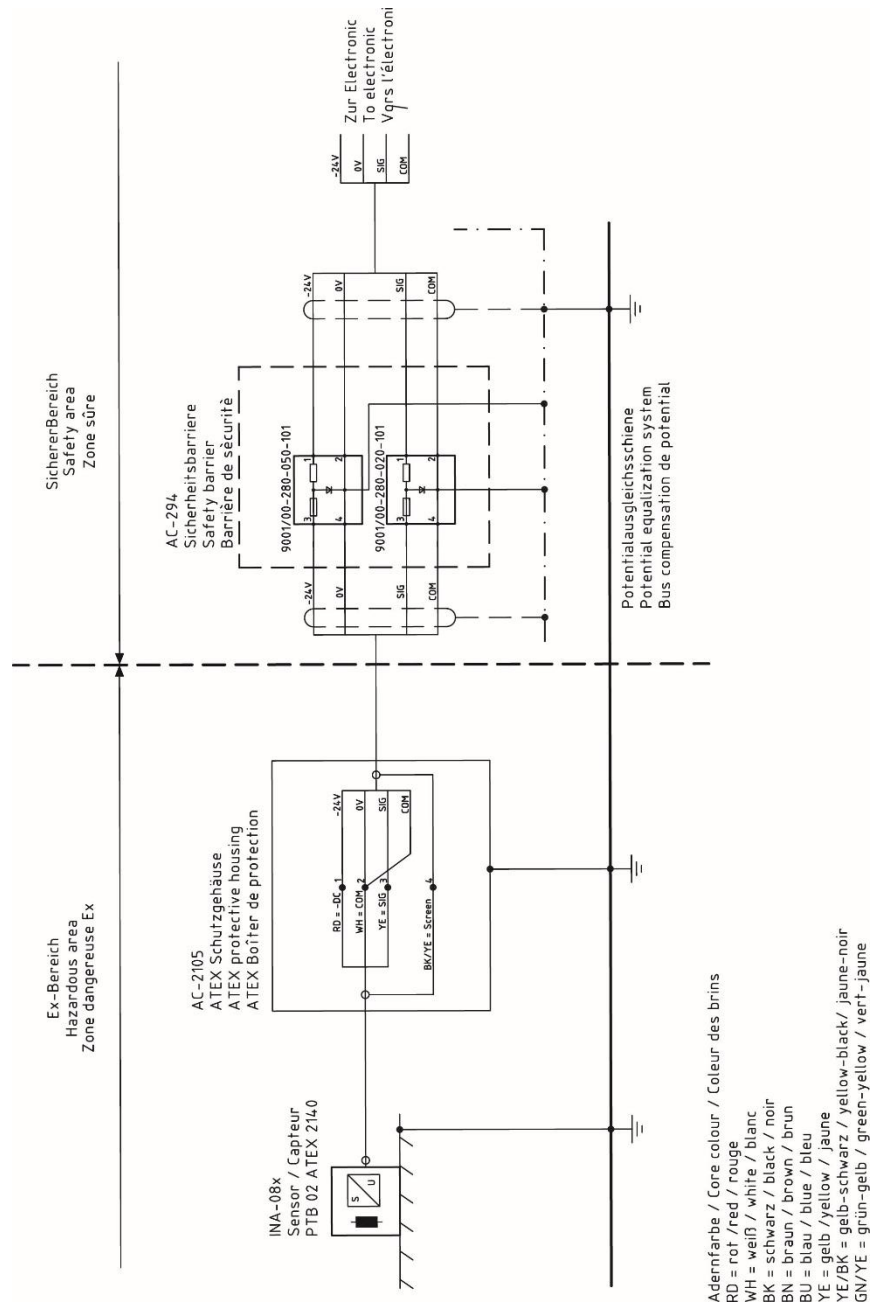
After use, dispose of the systems, cables and sensors in an environmentally friendly manner, in accordance with the applicable national provisions.

WEEE-Reg.-No. DE 69572330



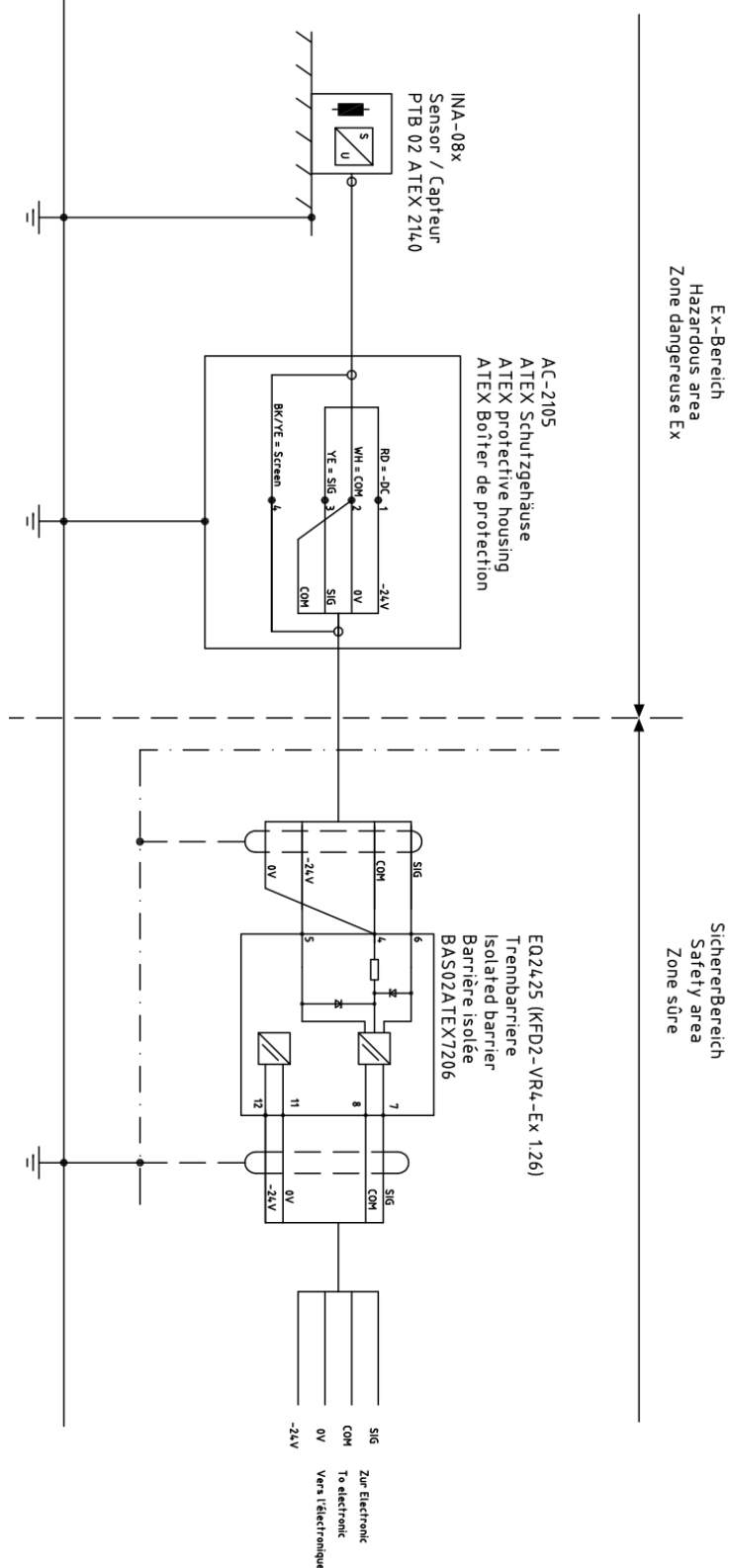
11 Connection diagram

11.1 INA-08x on AC-294





11.2 INA-08x on EQ2425



12 Declaration of conformity



EU-Konformitätserklärung / *EU- Declaration of conformity*

Hiermit bescheinigt das Unternehmen / *The company*

Brüel & Kjær Vibro GmbH
Leydheckerstraße 10
D-64293 Darmstadt



die Konformität des Produkts / *herewith declares conformity of the product*

Berührungsloser Wegsensor / *Non-contacting Displacement Sensor*
Typ / *Type*

INA-08x

mit folgenden einschlägigen Bestimmungen / *with applicable regulations below*
EU-Richtlinie / *EU-directive*

2014/30/EU EMV-Richtlinie / *EMC-Directive*

2014/34/EU ATEX-Richtlinie / *ATEX-Directive*

2011/65/EU + (EU) 2015/863 Richtlinie zur Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten / *EU Directive for the restriction of the use of certain hazardous substances in electrical and electronic equipment*

Angewendete harmonisierte Normen / *Harmonized standards applied*

EN 61326-1: 2013

EN IEC 60079-0:2018; EN 60079-11:2012

EN IEC 63000:2018

EG-Baumusterprüfung / *EC-Type-Examination Certificate*

PTB 02 ATEX 2140 Ausgabe 1 / *Issue 1*

Bereich / *Division*
Brüel & Kjær Vibro GmbH

Unterschrift / *Signature*
CE-Beauftragter / *CE-Coordinator*

Ort / *Place* **Darmstadt**
Datum / *Date* **24.08.2021**


(Niels Karg)

UNRESTRICTED DOCUMENT

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