

BODAS Angle sensor AN3



- ▶ Angle determination at the tractor hitch control
- ▶ Measuring ranges $\pm 28^\circ$ to $\pm 60^\circ$
- ▶ Output signal proportional voltage
- ▶ Supply voltage 5 V
- ▶ Protection class IP67 / IP69K

Features

- ▶ Angle sensor element based on the Hall-effect principle
- ▶ Shaft can be mechanically rotated
- ▶ Integrated electronics with temperature compensation
- ▶ Output signal ratiometrically proportional to angle
- ▶ Precise compensation for zero point and sensitivity
- ▶ CE conformity

Contents

Product description	2
Type code	3
Technical data	4
Diagrams/characteristic curves	5
Electrical connection	5
Dimensions	6
Project planning information	7
Safety-related characteristics according to ISO 25119	8
Accessories	10
Safety Instructions	11

Product description

Description

The angle sensor AN3 is used for the angular measurement till $\pm 60^\circ$.

The sensor is supplying a ratio metric voltage, available with increasing curve (positive course) or inverted curve (negative course).

This sensor is a typical part of an electronic – hydraulic hitch control (EHC) and is supplied directly by a Rexroth EHC Controller or by a Rexroth SRC.

This sensor is destined for the use in agricultural applications.

Type code

01	02	03	04	05		06	07
AN3	V1			5	/	1	0

Type

01	Hall-effect angle sensor	AN3
----	--------------------------	------------

Version

02	Without pin	V1
----	-------------	-----------

Characteristic curve

03	Positive course	A
	Negative course	B

Angles

04	±28°	28
	±35°	35
	±41°	41
	±44°	44
	±60°	60

Supply voltage

05	5±0.5 V at signal voltage 10 ... 90% U_{sup}	5
----	--	----------

Series

06		1
----	--	----------

Index

07		0
----	--	----------

Available variants

Type	Material number
AN3 V1 B 28 5/10	R913029358
AN3 V1 A 28 5/10	R913029842
AN3 V1 B 35 5/10	R983055893
AN3 V1 A 35 5/10	R983055890
AN3 V1 B 41 5/10	R983055894
AN3 V1 A 41 5/10	R983055891
AN3 V1 B 44 5/10	R983055895
AN3 V1 A 44 5/10	R983055892
AN3 V1 B 60 5/10	R983095377

Further variants on request.

Technical data

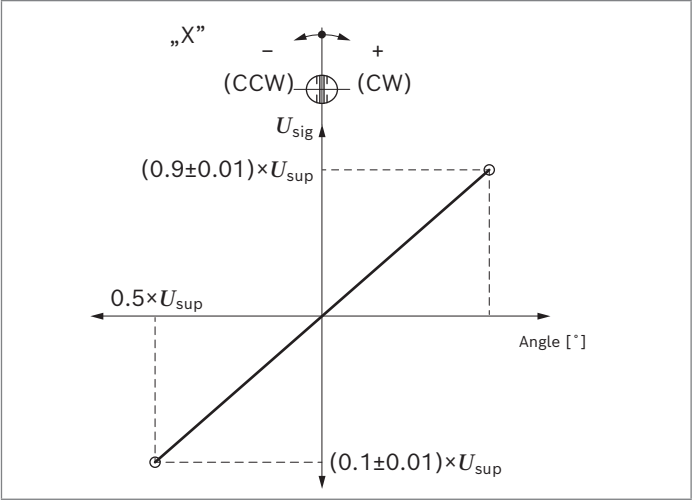
Type			AN3
Measurement principle			Hall-effect Maximum permissible external magnetic field: 25 mT
Nominal angular range			±28° ±35° ±41° ±44° ±60° Shaft can be mechanically rotated by 360°
Starting torque			≤5 Ncm
Shaft loading	radial		≤10 N
	axial		≤20 N
Supply voltage	U_{sup}		5±0.5 V DC
Supply current	I_{sup}		≤25 mA
Signal voltage	U_{sig}	ratiometric	10 ... 90% U_{sup}
Clamping voltage if nominal angular range is exceeded			6% U_{sup} when below range, 94% U_{sup} when above range
Load resistance			>10 kΩ
Linearity			< ±1%
Sensitivity of the end points			< ±1% of the supply voltage
Hysteresis			0.05°
Resolution			12 Bit / 0.025% U_{sup}
Temperature coefficient of zero point			±0.15% / 10 K
Temperature coefficient of sensitivity			±0.2% / 10 K
Operating temperature			−30 ... +80 °C
Storage time and storagetemperature			5 years at an average relative humidity of 60 % and a temperature between −10 °C and +30 °C. For short periods of up to 100 hours, a storagetemperature of −20 ... +40 °C is admissible.
Housing material			PA66 GF 30
Shaft material			X 5 CrNi 18-9
Type of protection with installed mating connector			IP67 and IP69K
Plug connection			3-pole TYCO AMP Superseal connector recommended
Electromagnetic compatibility (EMC)	1 MHz ... 1 GHz		100 V/m, no deviation >5% U_{sup} permissible
Electrostatic discharge (ESD)	Contact discharge		±8 kV
	Air discharge		±15 kV
Conformity according to	EMC directive 2014/30/EU with CE mark		Applied standards: ISO 14982:2009, 13766-1:2018, EN 12895:2015
	RoHS directive 2011/65/EU		
Overvoltage, reverse polarity, short-circuit resistance			Overvoltage: +16 V, reverse voltage: −16 V Short circuit monitoring
Dynamic tests	Broadband noise test	IEC 68-2-64	a_{eff} = 58 m/s ² , 20 ... 2000 Hz
	Transport shock	IEC 60068-2-27	Σ18 shocks; 6 directions; 6 ms; a_{max} = 400 m/s ²
	Continuous shock	IEC 60068-2-29	25 g, 6 ms, 1000 x each direction (positive/negative)
Signal delay time			< 400 μs

These values are valid R_{load} = 30 kΩ (against ground) and room temperature.

Diagrams/characteristic curves

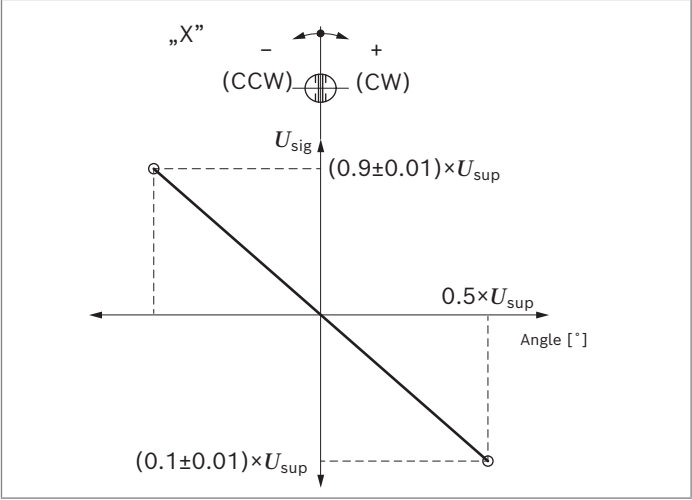
Characteristic curve A

Positive course



Characteristic curve B

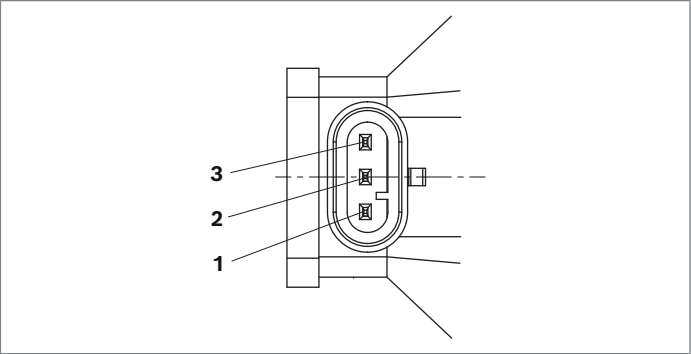
Negative course



Electrical connection

AMP Superseal connector

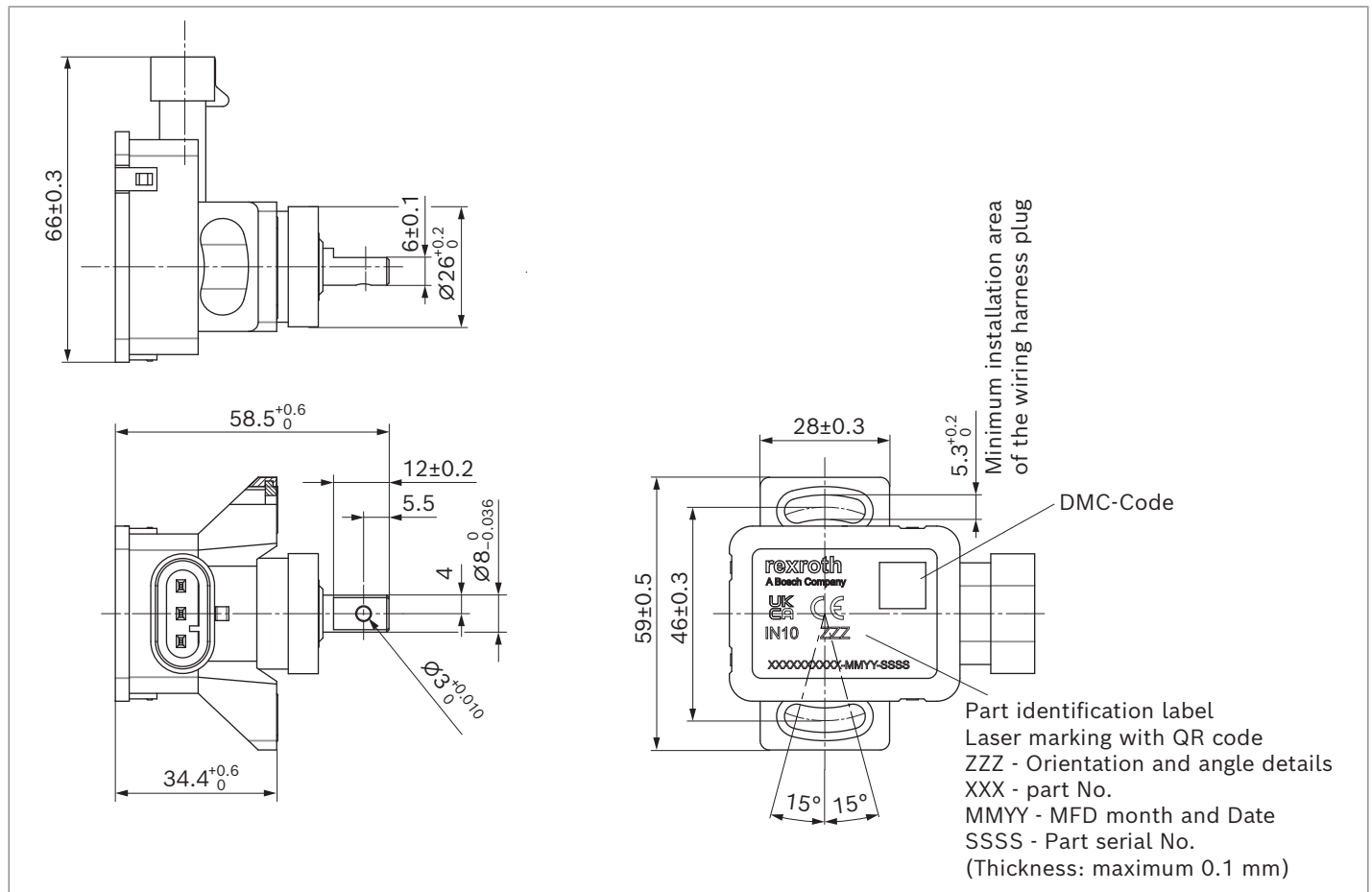
Pin Assignment



Pin	Connection	
1	GND	Signal ground
2	U_{sig}	Signal voltage
3	U_{sup}	Supply voltage

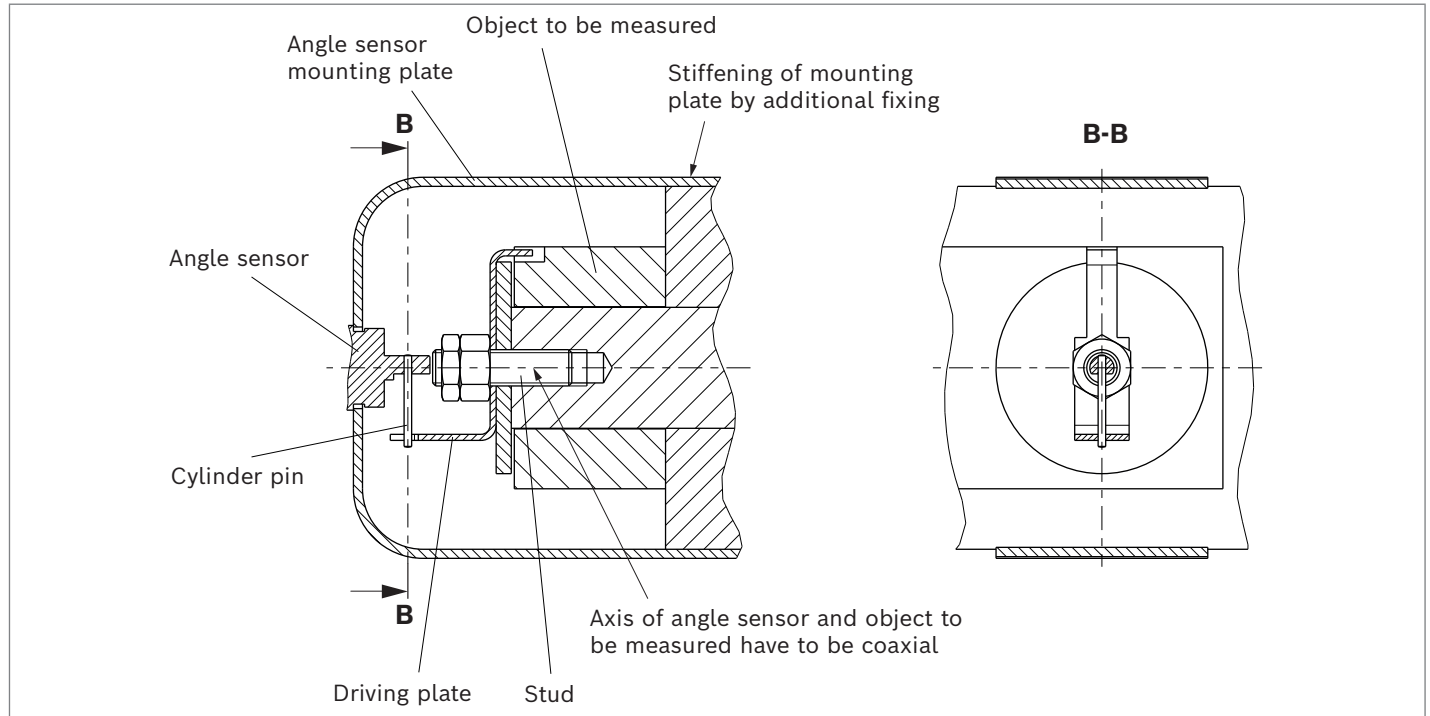
The mating connector is not included in the scope of delivery.
This can be supplied by Bosch Rexroth on request.

Dimensions



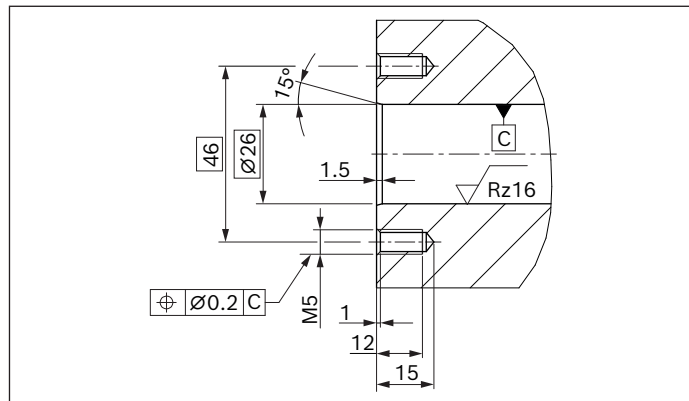
Project planning information

Coupling example



The angle sensor shaft is to be coupled to the measurement object as free of force and play as possible. It shall be ensured that maximum shaft loadings are not exceeded.

Assembly dimensions



Mounting bolts DIN 912-M5 x 12-8.8

Disc DIN 125-5.3-St

Shaft load: axial 20 N; radial 10 N

Starting torque ≤ 5 Ncm

Safety-related characteristics according to ISO 25119

The safety function of the sensor is defined as system integrity, i.e. the sensor shall sense and calculate the rotation of its shaft correctly and convert the angle into corresponding analog voltage output without failure.

- ▶ The sensor has a single channel architecture. All required diagnostic measures shall be provided by the ECU to reach the specified DC values can be found in the table “Diagnostic functions to be implemented by

the machine control unit” in this chapter. With the diagnostic measures on the ECU, the combination of sensor and ECU can be considered as single channel architecture with test equipment.

- ▶ The sensor meets the requirements of the basic and well-tried safety principles.
- ▶ The sensor contains no safety-related software.

Diagnostic functions to be implemented by the machine control unit

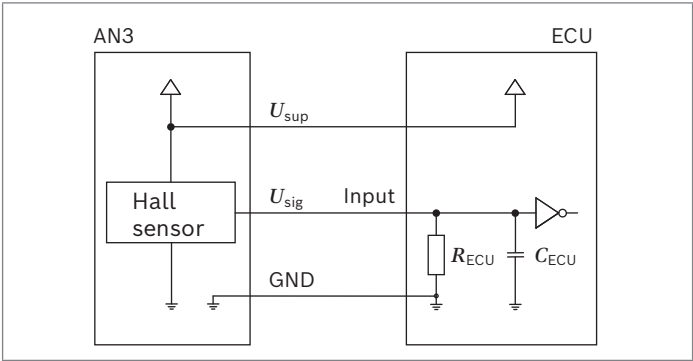
Following diagnostic functions shall be implemented by the machine control unit, in order to prevent damages to the sensor and to enable the sensor to reach the specified functional safety features.

Diagnostic functions	Frequency of monitoring	Failure reaction
Monitor the sensor power supply, and switch off the sensor in case of over- and undervoltage.	Periodically The exact frequency depends on the target reaction time.	Bring the system into a safe state.
React to the sensor out of range signal	Periodically The exact frequency depends on the target reaction time.	Bring the system into a safe state.

Temperature profile and corresponding MTTF_D and diagnostic coverage (DC)

Temperature [°C]	Self heating [°C]	Working hours [%]	MTTF _D [years]	DC ¹⁾ [%]
10	5	2	1305	67
20	5	2		
30	5	3		
40	5	3		
50	5	12.5		
60	5	12.5		
70	5	20		
80	5	25		
85	5	20		

Failure detection possibilities



In case of an open circuit failure of the GND cable, output U_{sig} of the AN3 is dependent of the ECU internal resistor R_{ECU} . During machine system integration, an open circuit failure of the GND cable shall be simulated and the corresponding output signal (U_{OC-GND}) of the AN3 shall be measured. Please make sure (e.g. by adding additional resistors) that $U_{OC-GND} > 95\% U_{sup}$.

1) It is assumed that the machine control unit will

- monitor the sensor supply voltage, and switch off the sensor in case of overcurrent, over- and undervoltage.

- react to the sensor out of range signal, and bring the machine into machine safe state

Failures of the AN3 that will cause out-of-range output signals and therefore detectable by the machine control system are listed in the following table:

Failure	Failure reaction	Failure response time
Connector/ wire break of U_{sig} , and/or AN3 internal failures that lead to the same effect	Sensor output out-of-range: $U_{sig} < 5 \% U_{sup}$	immediately
U_{sig} short circuit to U_{sup} and/or AN3 internal failures that lead to the same effect	Sensor output out-of-range: : $U_{sig} = U_{sup}$	immediately
U_{sig} short circuit to GND and/or AN3 internal failures that lead to the same effect	Sensor output out-of-range: $U_{sig} = 0 \text{ V}$	immediately
Connector/ wire break of U_{sup} , and/or AN3 internal failures that lead to the same effect	Sensor output out-of-range: $U_{sig} < 5 \% U_{sup}$	5 ms ¹⁾
Connector/ wire break of GND, and/or AN3 internal failures that lead to the same effect	Sensor output out-of-range: $U_{sig} > 95 \% U_{sup}$	5 ms ¹⁾
Hall IC internal failures	Sensor output out-of-range: $U_{sig} < 4 \% U_{sup}$	5 ms

¹⁾ Failure response time is valid for control unit with
 $R_{ECU} \geq 50 \text{ k}\Omega$ and $C_{ECU} = 100 \text{ nF}$

Accessories

Mating connector R902602132¹⁾

Designation	Ordering code	Quantity
Socket housing	AMP 282087-1	1
Socket contacts	AMP 183025-1	3
Single-wire seals	AMP 281934-2	3

¹⁾ The mating connector is not included in the scope of delivery.

Safety Instructions

General instructions

- ▶ Before finalizing your design, request a binding installation drawing.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ Opening the sensor or carrying out modifications to or repairs on the sensor is prohibited. Modifications or repairs to the wiring could lead to dangerous malfunctions.
- ▶ The sensor may only be assembled/disassembled in a deenergized state.
- ▶ Only trained and experienced specialists who are adequately familiar with both the components used and the complete system should implement system developments or install and commission electronic systems for controlling hydraulic drives.
- ▶ When commissioning the sensor, the machine may pose unforeseen hazards. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ Do not use defective components or components not in proper working order. If the sensor should fail or demonstrate faulty operation, it must be replaced.
- ▶ Despite every care being taken when compiling this document, it is not possible to consider all feasible applications. If instructions for your specific application are missing, you can contact Bosch Rexroth.
- ▶ The use of sensors by private users is not permitted, since these users do not typically have the required level of expertise.

Notes on the installation location and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g. exhaust).
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.
- ▶ A sufficient distance to radio systems must be maintained.
- ▶ Before electric welding and painting operations, the sensor must be disconnected from the power supply and the sensor connector must be removed.
- ▶ Cables/wires must be sealed individually to prevent water from entering the sensor.

Notes on transport and storage

- ▶ Please examine the sensor for any damage which may have occurred during transport. If there are obvious signs of damage, please inform the transport company and Bosch Rexroth immediately.
- ▶ If it is dropped, the sensor must not be used any longer, as invisible damage could have a negative impact on reliability.

Notes on wiring and circuitry

- ▶ Lines to the sensors must be designed in order to ensure sufficient signal quality: as short as possible and if necessary shielded. In case of shielding, shield must be connected to the electronics (chassis ground not signal ground) on one side or to the device or to vehicle ground via a low resistance connection.
- ▶ The sensor mating connector must only be plugged and unplugged when it is in a deenergized state.
- ▶ The sensor lines are sensitive to spurious interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor lines should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.
- ▶ Lines from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the sensor is installed (spacing < 150 mm). The wiring harness should be secured so that in-phase excitation with the sensor occurs (e.g. at the sensor mounting point).
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.

Intended use

- ▶ The sensor is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.

- ▶ Operation of the sensor must generally occur within the operating ranges specified and approved in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and approved boundary conditions may result in danger to life and/or cause damage to components which could result in sequential damage to the mobile working machine.
- ▶ Serious personal injury and/or damage to property may occur in case of non-compliance with the appropriate regulations.

Improper use

- ▶ Any use of the sensor other than that described in the chapter "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permitted.
- ▶ Damages which result from improper use and/or from unauthorized, unintended interventions in the device not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ Detailed information about functional safety metrics can be found in chapter "Safety-related characteristics according to ISO 25119"
- ▶ It is the responsibility of the customer to perform a risk analysis of the entire safety-relevant system on machine level and validate the suitability of the sensor for any determined safety functions of the mobile machine.
- ▶ An efficient field monitoring process must be setup by the customer. All field failures of the sensor must be reported to Bosch Rexroth immediately, even if they are not covered by the warranty.

Disposal

- ▶ Disposal of the sensor and packaging must be in accordance with the national environmental regulations of the country in which the sensor is used.

Further information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.

Bosch Rexroth AG
Glockeraustraße 2
89275 Elchingen
Germany
Tel. +49 7308 82-0
info.ma@boschrexroth.de
www.boschrexroth.com

© Bosch Rexroth AG 2023. All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights. The data specified within only serve to describe the product. As our products are constantly being further developed, no statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.