

Inertial sensor AC1

RE 95175

Edition: 11.2014

Replaces: 10.2013

**Feature**

- ▶ 5-Axis (5D) inertial sensor, 3 accelerations, 2 rotation rates
- ▶ All signals via CAN interface (ISO 11898)
- ▶ 7 to 16 V supply
- ▶ Type of protection IP6K7
- ▶ Operating temperature: -40 to +85 °C
- ▶ Small size
- ▶ Bosch Automotive Quality

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Description

The purpose of the inertial sensor AC1 is to measure the physical effects of yaw rate, roll rate and of lateral, longitudinal and vertical acceleration. If mounted appropriately (i.e. according to the offer drawing), the inertial sensor AC1 is measuring the yaw and roll rate and lateral, longitudinal and vertical acceleration of the vehicle.

To avoid signal disturbances or negative influences on the inertial sensor AC1 via the power supply we recommend powering the inertial sensor AC1 via the ECU or clamp 15 with a separate ground connection.

Vibration

As a result of the acceleration sensitivity of the sensors over the entire frequency range, it is necessary for the sensor unit AC1 to be tested within the framework of application release. Please also consider data shown in the offer drawing.

Mounting position

Normal position of inertial sensor AC1:

- ▶ Connector opposite to driving direction
- ▶ Definition of axes see offer drawing

Material number for AC1

R917009129

Technical data

Ambient conditions

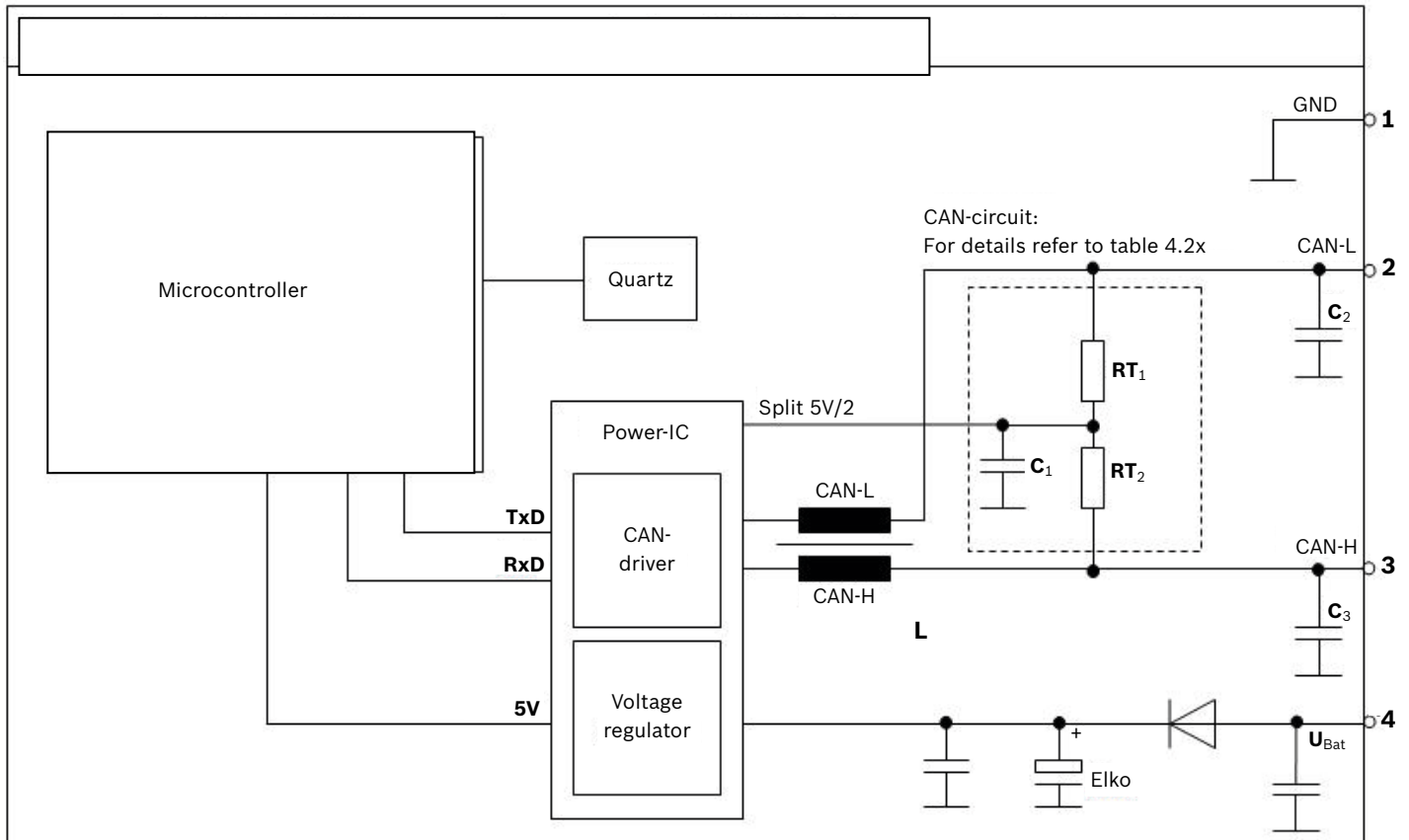
Position	Minimum	Typical	Maximum
Storage time			5 a
Storage temperature	-40 °C		+85 °C
Humidity φ_{\max}	at 40 °C		95 %r.h.
	at 55 °C		65 %r.h.
Operating temperature range	-40 °C		+85 °C
Temperature gradient			3.0 K/min
Atmospheric pressure	860 mbar		1060 mbar

Electrical data

Position	Minimum	Typical	Maximum
Nominal supply voltage		14 V	
Supply voltage range	7 V		16 V
Non-destructive supply voltage range	(within t_{life} , δ_{op})	-16 V	+16 V
	(within t_{life} , δ_{room}); $t < 5$ min	-18 V	+18 V
Supply current		65 mA	90 mA
Output short circuit protection	0 V		+18 V
Signal output (CAN)		Compatible to ISO 11898	
Type of protection according to EN 60529		IP6K7	

Electrical data (CAN-Interface)

Position	Value
EMC capacitor	100 pF
	100 pF
EMI filter	51 μ H
Microcontroller	Renesas R8C/23
Power-IC	Bosch CA510
(Voltage regulator, watchdog, CAN transceiver)	Split termination resistors integrated (1k33 Ohm)
Microcontroller memory	flash
Baudrate	500 kBaud



Yaw and roll rate output

Position	Minimum	Typical	Maximum
Nominal measuring range	-163 °/s		+163 °/s
Overrange limit	-1000 °/s		+1000 °/s
Nominal sensitivity		200 LSB/°/s	
Sensitivity error at δ_{Op} within t_{life} (referred to SF)	-4 %	±2.5 %	+4 %
Non-linearity	-1 °/s	±0.5 °/s	+1 °/s
Differential non-linearity (in steps of 5 °/s)	-4 %		+4 %
Offset, absolute (within t_{life} , measured at δ_{Op})	-3 °/s	±1.5 °/s	+3 °/s
Offset drift run to run (within t_{life} , measured at δ_{Op})	-1.25 °/s	±0.6 °/s	+1.25 °/s
Rate of change of off- set	(t<3 min after U_{batt} on) (t>3 min after U_{batt} on)	±0.2 °/s/min	+0.6 °/s/min +0.2 °/s/min
Resolution, absolute (quantisation)			0.1 °/s
Time until availability		0.3 s	0.35 s
Cross axis sensitivity	-4 %	±2 %	+4 %
Cut-off frequency (-3dB)		15 Hz	
Output noise		0.1 °/s	0.2 °/s
g-sensitivity	-0.25 °/s/g		+0.25 °/s/g

Acceleration output (lateral (y), longitudinal (x) and vertical (z))

Position	Minimum	Typical	Maximum
Nominal measuring range	-4.2 g		+4.2 g
Overrange limit	-10 g		+10 g
Nominal sensitivity		7845 LSB/g	
Sensitivity error at δ_{Op} within t_{life} (referred to SF)	-3 %	±2.0 %	+3 %
Non-linearity	-0.072 g	±0.036 g	+0.072 g
Offset (within t_{life} , measured at δ_{Op})	-0.1 g	±0.05 g	+0.1 g
Offset drift run to run (within t_{life} , measured at δ_{Op})	-0.04 g	±0.03 g	+0.04 g
Rate of change of offset	-0.03 g/min	±0.2 g/min	+0.03 g/min
Resolution, absolute (quantisation)			0.1 g
Time until availability		0.3 s	0.35 s
Cross axis sensitivity	-4 %	±2.5 %	+4 %
Cut-off frequency (-3dB)		15 Hz	
Output noise		0.004 g_{rms}	0.005 g_{rms}

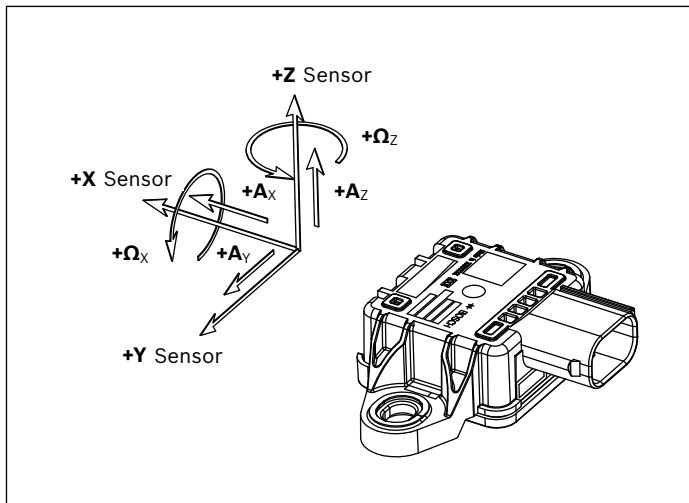
Radiated susceptibility (radiated immunity)

	Norm	Range	Value
Strip line test according to	ISO 11452-5	1 to 400 MHz	200 V/m
BCI- test according to	ISO 11452-4	1 to 400 MHz	100 mA
Absorber-lined chamber test according to	ISO 11452-2	200 to 2000 MHz	150 V/m
Mobile phone test according to	ISO 11452-9		

Radiated susceptibility (radiated emission)

Antenna measurement according to	CISPR 25-13	0.15 to 1000 MHz	
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Vehicle axis system



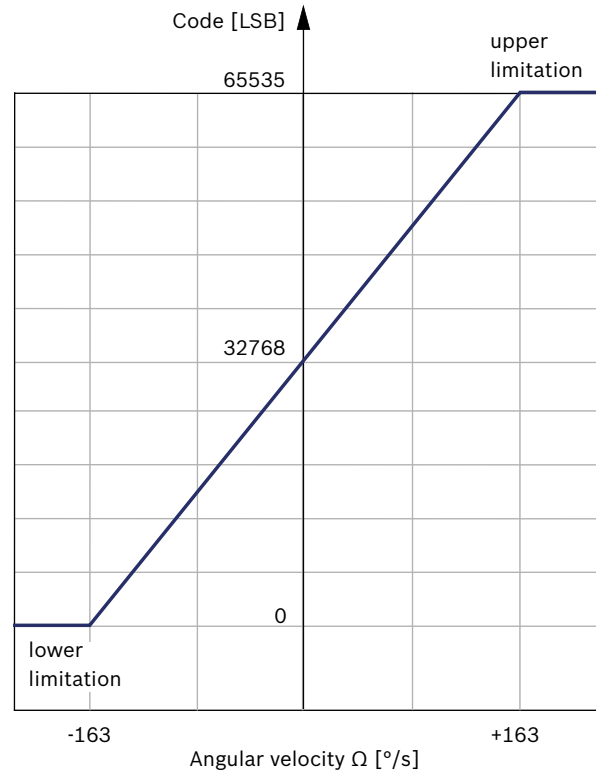
Vehicle axis system according to DIN 70000 respectively ISO 8855:

- +X_{vehicle} points to the front of the vehicle
- +Y_{vehicle} points to the left side of the vehicle
- +Z_{vehicle} points to the top of the vehicle

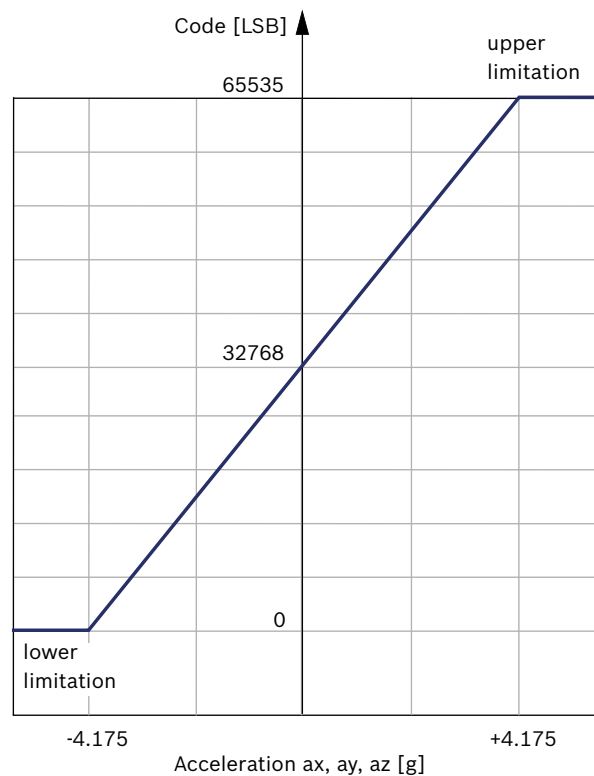
If the sensor is placed in the vehicle as shown on the offer drawing, the sensor axis and the vehicle axis are identical, i.e.:

- +X_{vehicle} = +X_{sensor}
- +Y_{vehicle} = +Y_{sensor}
- +Z_{vehicle} = +Z_{sensor}

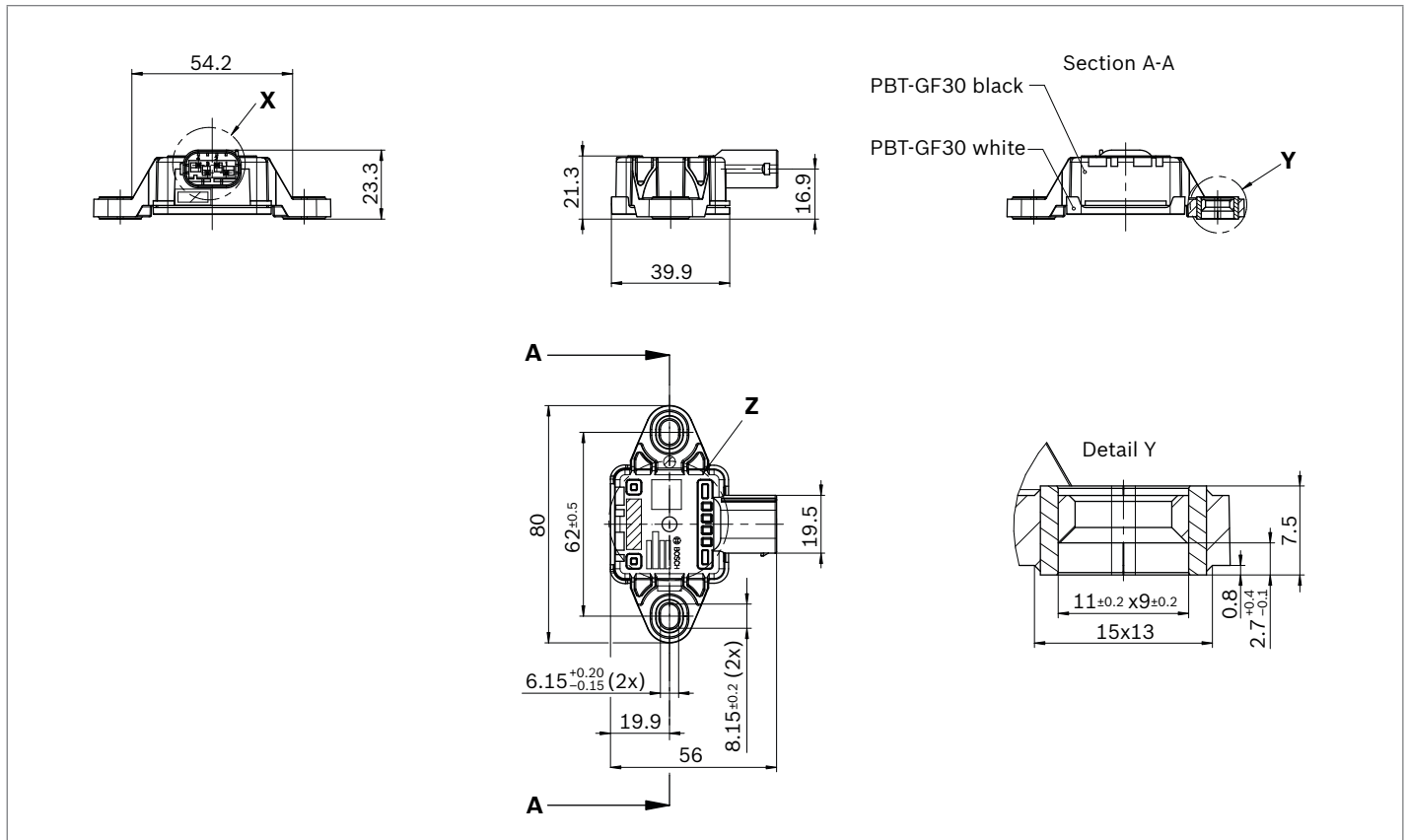
▼ Yaw and roll rate



▼ Acceleration (nominal)

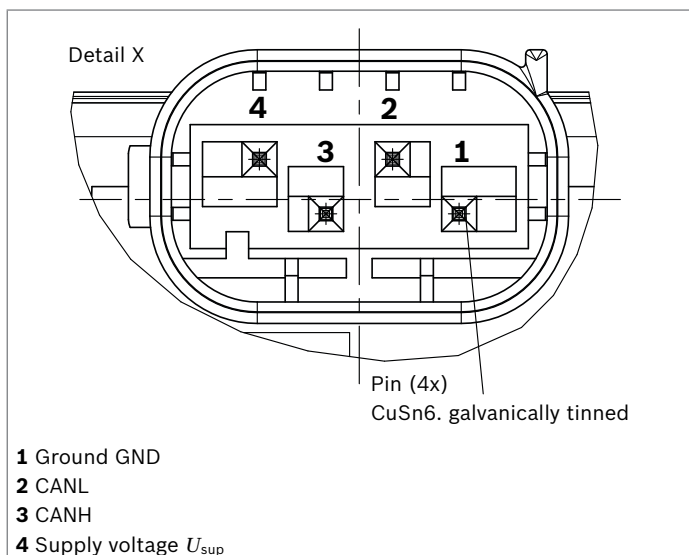


Dimensions



Connector AMP-MQS Superseal

▼ Pin assignment



▼ Mating connector

Designation	Quantity	AMP-MQS material number
Housing	1	1-967640-1
Contacts (DGB 0.75 mm ²)	4	965906-1
Single-wire seal (for $\varnothing 1.4$ bis 1.9 mm)	4	967067-1

The mating connector is not included in the scope of supply. This can be supplied by Bosch Rexroth on request (material number R917009162).

Assembly into the vehicle

The mounting location of the inertial sensor AC1 is to be chosen in such a way, that only vehicle-dynamic related motions occur at the location.

Bosch Rexroth will give support to find suitable location.

The inertial sensor AC1 must be fixed with two bolts before operation. The corresponding size is contained in the offer drawing. Tightening torque for the M6 nut is defined in the offer drawing.

A mounting bolt with ordinal impact wrench is not allowed as the rattling vibration of the impact wrench may lead damage of the sensor. Bosch Rexroth recommends to use electronically controlled wrenches (torque and angle of rotation) for fixation process.

It is also to pay attention that no unallowable shock, e.g. hammer etc. is applied in the area of the sensor during mounting.

Large accelerations may occur from e.g. hammer blow, stopping of work piece carriers, screw-on with automatic screwdriver, etc. Exceptions are possible during repair work, for example in service.

The inertial sensor AC1 is to be assembled without application of force. Using tools like a hammer or crowbar may lead to tensions and damage of the sensor.

In the vehicle, no force must be applied to the sensor. No parts (e.g. passenger seat) must be placed on the sensor, nor must anybody step onto the sensor (e.g. assembly personnel).

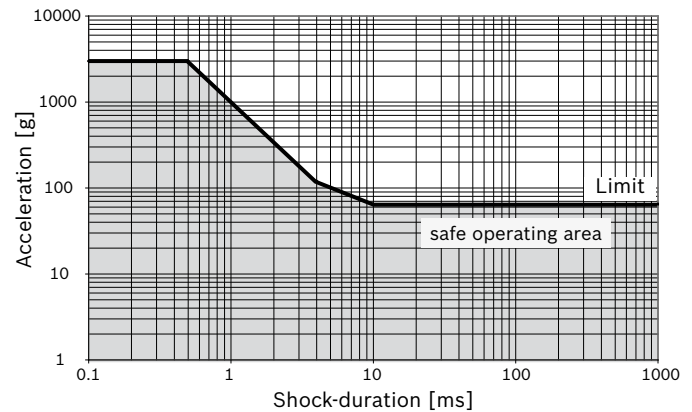
The sensor must not be connected / disconnected with supply voltage being applied.

No deformation or damage of the sensor is allowed.

Spectrum during mounting

During the sensor's attachment to the vehicle the sensor is exposed to various impacts of the housing by mounting and tooling. These values quantified by a tri-axial accelerometer mounted on the sensor's PCB must not exceed the specified area.

▼ Specification for acceleration during mounting



Guidelines for application

General information

As a result of the acceleration sensitivity of the sensors over the entire frequency range, it is necessary for the inertial sensor AC1 to be tested within the framework of application release.

Additional tests

It has to be tested whether vehicle components near the inertial sensor AC1 create signal disturbances. This can be caused by the following:

- ▶ Complete engine speed range, minimum speed to maximum speed with 3500 min⁻¹
- ▶ Actuating the shift lever

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.
- ▶ It is not permissible to open the sensor or to modify or repair the sensor. Modifications or repairs to the wiring could result in dangerous malfunctions.
- ▶ The sensor may only be assembled/disassembled in deenergized state.
- ▶ System developments, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and with the complete system.
- ▶ While commissioning the sensor, the machine may pose unforeseen dangers. 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.
- ▶ No defective or incorrectly functioning components may be used. 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 take into account all feasible applications. If instructions for your specific application are missing, you can contact Bosch Rexroth.

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 sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the sensor is to be unplugged during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.

Notes on transport and storage

- ▶ Please inspect the device for any damages which may have occurred during transport. If there are obvious signs of damage, please immediately inform the transport company and Bosch Rexroth.
- ▶ 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 as short as possible and be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The sensor should only be plugged and unplugged when it is in a de-energized state.
- ▶ The sensor lines are sensitive to radiation 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 fixated so that in-phase excitation with the sensor occurs (e.g. at the sensor mounting points).
- ▶ 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 released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

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

Use in safety-related functions

- ▶ The customer is responsible for performing a risk analysis of the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

Further information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The sensor must be disposed according the national regulations of your country.

Bosch Rexroth AG

Mobile Applications
Robert-Bosch-Straße 2
71701 Schwieberdingen, Germany
Service Tel. +49 9352 40 50 60
info.bodas@boschrexroth.de
www.boschrexroth.com

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