

# BODAS inertial sensor

**MM7.10**



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The data specified within only serves to describe the product. 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.

The cover shows an example application. The product delivered may differ from the image on the cover.

The original instruction manual was created in German.

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# 1 About this documentation

## 1.1 Validity of the documentation

This documentation is valid for the following product:


- BODAS inertial sensor MM7.10

This documentation is intended for machine/system manufacturers, assemblers and service engineers.




This documentation contains important information on the safe and proper transport, installation, commissioning, operation, maintenance, disassembly and simple troubleshooting of the product.

- ▶ Read this documentation completely, in particular chapter 2 "Safety instructions" on page 7 and chapter 3 "General instructions on property damage and product damage" on page 11 before you start working with the product.

## 1.2 Required and supplementary documentation

- ▶ Only commission the product if the documentation marked with the book symbol  is available to you and you have understood and observed it.

**Table 1: Required and supplementary documentation**

| Title  | Document number  | Document type         |
|--|--|-----------------------|
| <b>Offer drawing</b>   | RA90896310<br>Please request the offer drawing from your contact at Bosch Rexroth. | Offer drawing         |
|  <b>Inertial sensor MM7.10</b><br>Contains the permissible technical data, connections, main dimensions and circuit diagrams of standard versions. | 95178  | Data sheet            |
|  <b>Inertial Measurement Unit MM7.10<br/>Technical Customer Documentation</b>  | 95178_TCD_MM7.10   | Technical information |
|  <b>Inertial Measurement Unit MM7.10<br/>Mounting guideline</b>  | 95178_MG_MM7.10  | Technical information |

## 1.3 Representation of information

Uniform safety instructions, symbols, terms and abbreviations are used throughout this documentation to ensure safe and proper use of the product. For clarification, they are explained in the sections below.

**1.3.1 Safety instructions**




This documentation contains safety instructions in chapter 2.6 "Product-specific safety instructions" on page 10 and in chapter 3 "General instructions on property damage and product damage" on page 11, as well as before a sequence of actions or an instruction for action involving a risk of personal injury and property damage. Always follow the measures for danger prevention associated with the use of this product.

Safety instructions are set out as follows:

|  <b>SIGNAL WORD</b>   |
|--|
| <p><b>Type and source of danger!</b><br/>                     Consequences of non-compliance<br/>                     ► Danger prevention measures</p> |

- **Warning sign:** draws attention to the danger
- **Signal word:** identifies the degree of the danger
- **Type and source of danger:** indicates the type and source of the danger
- **Consequences:** describes the consequences of non-compliance
- **Precautions:** states how the danger can be avoided


**Table 2: Hazard classes as defined in ANSI Z535.6**

| Warning sign, signal word  | Meaning  |
|--|--|
|  <b>DANGER</b>  | Identifies a dangerous situation that will result in death or serious injury if it is not avoided. |
|  <b>WARNING</b> | Identifies a dangerous situation that may result in death or serious injury if it is not avoided.  |
|  <b>CAUTION</b> | Identifies a dangerous situation that may result in minor to moderate injury if it is not avoided. |
| <b>NOTICE</b>  | Property damage: The product or surrounding area may be damaged.                                   |

**1.3.2 Symbols**

The following symbols indicate notices that are not safety-relevant but increase understanding of the documentation.

**Table 3: Meaning of symbols**

| Symbol  | Meaning  |
|---|--|
|  | If this information is disregarded, the product cannot be used and/or operated to its full extent. |
| ►   | Single, independent action   |
| 1.<br>2.<br>3.  | Numbered instruction:<br>The numbers indicate that the actions must be completed in order.         |

### 1.3.3 Designations

This documentation uses the following designations:

**Table 4: Designations**

| Designation | Meaning               |
|-------------|-----------------------|
| MM7.10      | BODAS inertial sensor |

As a generic term for the "Inertial sensor", the designation "product" or "sensor" will be used in the following.

### 1.3.4 Abbreviations

This documentation uses the following abbreviations:

**Table 5: Abbreviations**

| Abbreviation | Meaning   |
|--------------|---|
| ANSI         | <b>A</b> merican <b>N</b> ational <b>S</b> tandards <b>I</b> nstitute is an organization that coordinates the development of voluntary standards in the United States |
| CAN          | <b>C</b> ontroller <b>A</b> rea <b>N</b> etwork   |
| DIN          | <b>D</b> eutsches <b>I</b> nstitut für <b>N</b> ormung (German Institute for Standardization)   |
| ECU          | <b>E</b> lectronic <b>C</b> ontrol <b>U</b> nit   |
| EMC          | <b>E</b> lectromagnetic <b>c</b> ompatibility   |
| EN           | <b>E</b> uropean <b>N</b> orm (standard)  |
| ISO          | <b>I</b> nternational <b>O</b> rganization for <b>S</b> tandardization  |
| PCB          | <b>P</b> rinted <b>C</b> ircuit <b>B</b> oard   |
| RE           | <b>R</b> exroth document in the <b>E</b> nglish language  |
| TCD          | <b>T</b> echnical <b>C</b> ustomer <b>D</b> ocumentation  |

## 2 Safety instructions

### 2.1 About this chapter

The product has been manufactured in accordance with generally accepted engineering standards. There is still, however, a danger of personal injury or property damage if this chapter and the safety instructions in this documentation are not observed.

- ▶ Read this documentation completely and thoroughly before working with the product.
- ▶ Keep this documentation in a location where it is accessible to all users at all times.
- ▶ Always include the required documentation when passing the product on to third parties.

### 2.2 Intended use

The sensor is intended as a component for application in mobile working machines. The sensor may only be commissioned after it has been installed in the machine/system for which it is intended and the safety of the entire system has been established in accordance with the Machinery Directive.

The purpose of the MM7.10 inertial sensor is to measure the physical effects of the yaw rate, rate of roll, and of transverse, longitudinal and vertical acceleration.

- ▶ Generally, the sensor must be operated within the operating ranges specified and approved in the data sheet 95178, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Its use outside of these 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.
- ▶ Observe the corresponding IP protection class.

The product is intended only for professional use and not for private use. Intended use includes having fully read and understood this documentation, especially chapter 2 "Safety instructions" on page 7.

### 2.3 Improper use

Any use other than that described as intended use is considered improper. Bosch Rexroth AG is not liable for damage resulting from improper use. The user is solely responsible for any risks arising from improper use.

The following foreseeable forms of faulty usage are also considered improper (this list is not exhaustive):

- Use outside the operating parameters approved in the data sheet (unless customer-specific approval has been granted)
- Application of the sensor in explosive environments

## 2.4 Personnel qualifications

The activities described in this documentation require basic knowledge of mechanics and electronics/electrics, as well as knowledge of technical terms associated with those fields. In order to ensure safe use, these activities should only be performed by skilled personnel or an instructed person under the direction and supervision of skilled personnel.

Skilled personnel refers to persons who possess the professional training, knowledge and experience, as well as the understanding of the regulations relevant to the work to be done that are necessary to recognize possible dangers and take the appropriate safety measures. Skilled personnel must follow the rules relevant to their field and have the necessary expert knowledge of mechatronics and electronics.

Expert knowledge means, for instance:

- Being able to read and fully understand electric circuit diagrams,
- in particular, fully understanding the relationships with regard to safety devices,
- as well as to carry out the wiring of electronic components correctly and
- regarding the function and interaction of electronic and mechanical components.

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.



Bosch Rexroth offers you measures supporting training in specific areas.

You can find an overview of the training contents on the Internet at:

[www.boschrexroth.com/training](http://www.boschrexroth.com/training).

## 2.5 General safety instructions

- Observe the country-specific accident prevention and environmental protection regulations.
- Observe the safety regulations of the country in which the product is used/operated.
- Use Rexroth products only when they are in good working order.
- Do not install, operate, disassemble or maintain Rexroth products if under the influence of alcohol, drugs or medication that may affect your reaction time.
- Only use approved accessories and original spare parts from Rexroth in order to exclude hazards to persons due to unsuitable spare parts.
- Observe the technical data and ambient conditions specified in the product documentation.
- If unsuitable products are installed or used in applications that are of relevance to safety, unexpected operating conditions may occur in the application, which could result in personal injury or property damage. For this reason, only use the product in safety-relevant applications if this use is expressly indicated and approved in the product documentation, e.g. in safety-related parts of a control system (functional safety).
- Due to the sensor's sensitivity to acceleration across the entire frequency range, it is necessary to test the MM7.10 inertial sensor during the application approval process.



- Only commission the product if it has been determined that the end product (e.g. machinery/system) in which the Rexroth products are installed corresponds to the country-specific provisions, safety regulations and standards for the application.
- Use tools appropriate for the work being performed and wear appropriate protective clothing to prevent punctures and cuts (e.g. when removing protective covers, disassembly).
- The sensor contains electronic components and may thus be damaged by electrostatic discharge. Observe the handling instructions for electrostatically endangered components, see data sheet 95178.
- The proposed circuits do not imply any technical liability for the system or the machine on the part of Bosch Rexroth.
- Opening the sensor or carrying out modifications to or repairs on the sensor is prohibited. Modifications to or repairs on the wiring can lead to dangerous malfunctions.
- The sensor may only be assembled/disassembled in a de-energized condition.
- Make sure that nobody is in the machine's danger zone.
- Do not use defective components or components which are not in a proper working order. If the sensor fails or demonstrates a faulty operation, it must be replaced.
- Protect the sensor during transport, processing and/or assembly against the ingress of humidity, paints or other substances into the connector chamber.
- Despite the greatest care being taken when compiling this document, it is impossible to consider all feasible applications. If information on your specific application is missing, please contact Bosch Rexroth.
- If other or more specifications apply to the marketing of the product or if there is marketing outside the specified target markets, you must demand compliance with the target market-specific regulations from Bosch Rexroth or ensure their compliance yourself.

## 2.6 Product-specific safety instructions

The following safety instructions apply to chapters 6 to 14.

### CAUTION

#### **Danger due to malfunctions!**

Risk of injury and property damage as well as machine damage due to malfunctions of the sensor!

- ▶ Carry out a risk assessment of your machine and determine the possible safety-relevant functions.
- ▶ Take suitable measures to ensure safety in applications relevant to safety, e.g. sensor redundancy, plausibility check, emergency switch, etc.
- ▶ Product data that is required for the safety assessment of the machine is included in data sheet 95178.

#### **Improper cable and line routing!**

Risk of stumbling and property damage! Improper routing of cables and lines can cause a risk of stumbling as well as damage to equipment and components, e.g. due to lines and connectors being torn off.

- ▶ Always install cables and lines in a way that nobody can fall over them, that they are not bent or twisted, do not chafe on edges and are not guided through ducts with sharp edges without sufficient protection.

## 2.7 Personal protective equipment

The personal protective equipment is the responsibility of the user of the product.

Observe the safety regulations in your country.

All pieces of personal protective equipment must be intact.

### 3 General instructions on property damage and product damage

The following information applies to chapters 6 to 14.

#### **NOTICE**

##### **Environmental pollution due to incorrect disposal!**

Careless disposal of the product and the packaging material could lead to environmental pollution!

- ▶ Dispose of the product and packaging in accordance with the national regulations in your country.

##### **Electrical voltage!**

Property damage due to electrical voltage!

- ▶ Always disconnect the voltage supply to the relevant machine/system part before installing the product and/or connecting or disconnecting the connector. Protect the machine/system against reactivation.

The warranty exclusively applies to the delivered configuration.

The warranty will be voided if the product is incorrectly installed, commissioned or operated, or if it is used or handled improperly.

## 4 Scope of delivery



**Fig. 1: Inertial sensor MM7.10**

Included in the scope of delivery:

- Inertial sensor MM7.10 (1)

## 5 About this product

### 5.1 Product description

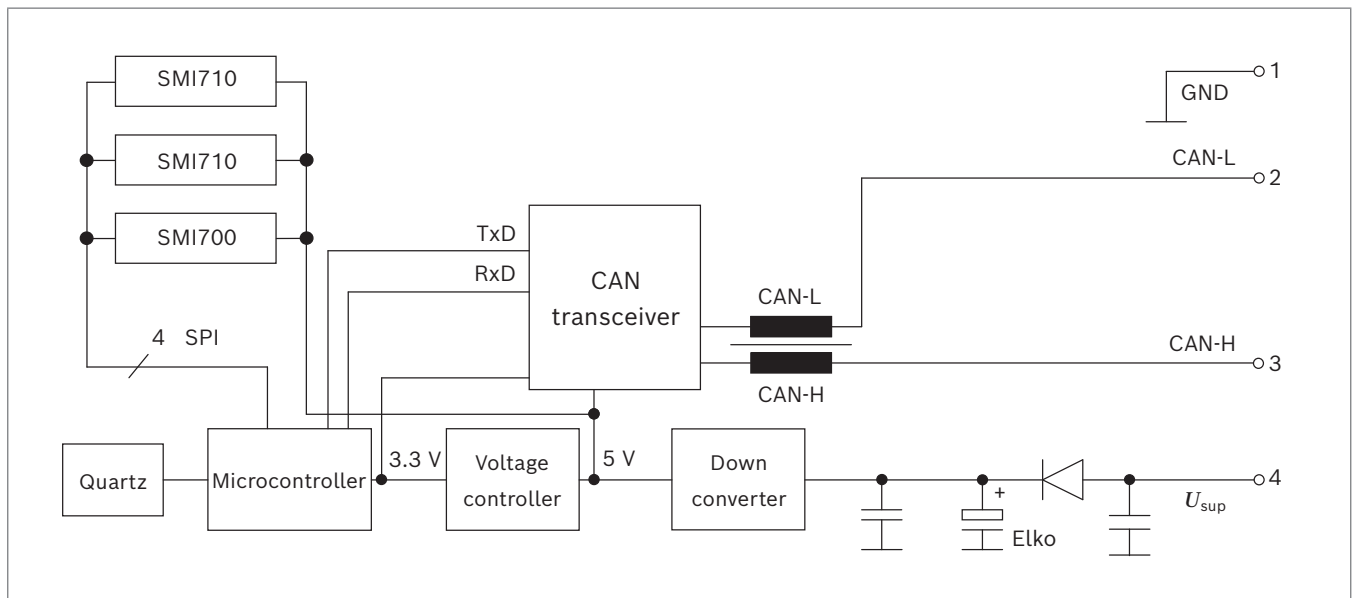
The purpose of the MM7.10 inertial sensor is to measure the physical effects of the yaw rate, rate of roll, and of transverse, longitudinal and vertical acceleration. When mounted appropriately (i.e. according to the offer drawing), the MM7.10 measures the yaw and roll rates as well as the lateral, longitudinal and vertical acceleration of the vehicle.

In order to prevent signal interference or negative power supply impacts on the MM7.10, we recommend the supply of the MM7.10 via the control unit or terminal 15 with separate ground connection.

**Vibration** Due to the sensor's sensitivity to acceleration across the entire frequency range, it is necessary to test the MM7.10 during the application approval process. Please also observe the data shown in the offer drawing.

**Angle output** The MM7.10 in combination with the software library ASlib-IMU and a control unit – can realize an angle output in Euler format. The ASlib-IMU must be integrated into the control unit. The sensor signals are read in via the control unit, offset to angle values by the software library and made available on the CAN bus. The ASlib-IMU can be found on the Bosch Rexroth website in the area MyRexroth under ME Partner Download Space.

#### 5.1.1 Block diagram



**Fig. 2: Block diagram MM7.10**

For compliance with Load Dump 5a according to ISO 16750-2, it is required to install a load dump diode in the vehicle electrical system of the higher-level system (machine).

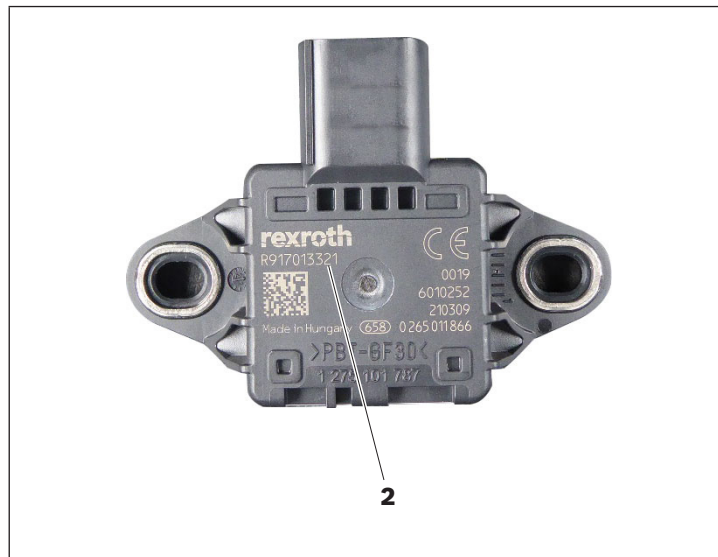
## 5.2 Product identification

The product can be identified using the material number (1) on the label of the packaging unit.



**Fig. 3: Material number on sticker MM7.10**

The product is to be identified by means of the material number (2) on the connector of the sensor.



**Fig. 4: Material number on sensor connector MM7.10**

## 6 Transport and storage

Check the sensor for transport damage. If there are obvious signs of damage, please inform the transport company and Bosch Rexroth immediately.

If the sensor is dropped, it is not permissible to use it any longer, as invisible damage could have a negative impact on reliability.

### 6.1 Storing the inertial sensor

**Table 6: Requirements**

| Storage conditions                                       |         |
|--|---------|
| Storage time at -40 ... +85 °C and 60% relative humidity | 5 years |

## 7 Installation

Prior to installation, the following documents should be to hand:

- Data sheet of the product (contains the permissible technical data, main dimensions and circuit diagrams of standard versions)

### 7.1 Unpacking

**NOTICE!** Danger due to electrostatic discharge!

When unpacking the sensor, there is a danger of damage to the electronic components of the sensor due to electrostatic discharge.

- ▶ When unpacking, protect the sensor against electrostatic discharge; information on the protection of the sensor against electrostatic discharge (ESD) can be found in the respective data sheet 95178.
- ▶ Remove the packaging from the inertial sensor.
- ▶ Check the sensor for transport damage and completeness, see chapter 4 "Scope of delivery" on page 12.
- ▶ Dispose of the packaging in accordance with the regulations in your country.

### 7.2 Installation conditions

The installation position and location of the inertial sensor essentially determine the procedures for installation and commissioning.

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g. exhaust system).
- ▶ 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.

### 7.3 Mounting the inertial sensor

#### 7.3.1 Preparation

1. Use the material number on the sticker of the packaging unit or directly on the sensor to check whether the correct inertial sensor is available, see chapter 5.2 "Product identification" on page 14.
2. Compare the material number with the details in the order confirmation.



If the material number of the inertial sensor does not match the one in the order confirmation, contact your local contact person for clarification.

You can find their contact information at

<https://addresses.boschrexroth.com>



### 7.3.2 Installation

The MM7.10 must be fastened with two screws prior to operation.

The appropriate size can be found in the offer drawing.

Tighten the M6 nut with a tightening torque of  $6^{+2}_{-1}$  Nm.

The screws must not be tightened with impact screwdrivers, as the high impact force of the screwdriver and the resulting acceleration can damage the silicone micromachines inside the MM7.10.

Bosch Rexroth recommends the use of electronically controlled screwdrivers (torque and angle of rotation) for mounting.

It is also not permitted to subject the area near the mounted MM7.10 to excessive shock loads, as this would result in accelerations outside the safe operating range. High accelerations can be caused, for example, by hammer blows, the stopping of workpiece carriers, and the use of automatic screwdrivers for screwing, etc. Exceptions are possible during repair work, e.g. in the service.

The MM7.10 must be mounted without exerting force on the MM7.10 housing or deforming the mounting location.

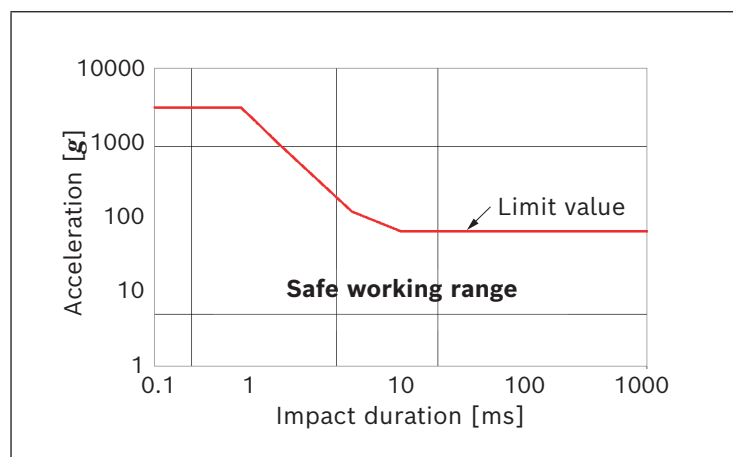
The use of tools such as a hammer or crowbar may cause tension and damage on the MM7.10. An MM7.10 that has been damaged during installation on the vehicle is detected by a specific MM7.10 internal function and communicated to the ECU by the CAN.

The MM7.10 connector must not be connected/disconnected while supply voltage is applied to the wiring harness.

Do not install or use the MM7.10 if the housing is deformed or damaged.

#### Spectrum during mounting

During the mounting on the vehicle, the housing of the MM7.10 is exposed to various influences, e.g. due to the fixing and the tools. These values, which are determined by a triaxial accelerometer mounted on the PCB of the MM7.10, must not exceed the specified range.



**Fig. 5: Spectrum**

### 7.3.3 Information on wiring and circuitry

- Lines to the sensors must be designed so that they are as short as possible and shielded. The shielding must be connected to the electronics on one side or to the device or vehicle ground via a low resistance connection.
- The sensor mating connector must only be plugged and unplugged when it is in a de-energized state.
- The sensor lines are sensitive to spurious interference. For this reason, the following measure should be taken when operating the sensor:  
Sensor lines should be laid as far as possible to large electrical machines (e.g. alternator, motor generator) and not in vicinity of other power lines in the device or vehicle.
- The wiring harness should be mechanically secured in the area in which the sensor is installed (distance < 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 machine interior. If the lines are routed outside of the machine, their secure mounting is to be ensured.
- Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.

### 7.3.4 Connecting the inertial sensor

1. Make sure that the connector of the sensor and the mating connector of the wiring harness match; the pin assignment can be found in data sheet 95178.
2. Make sure that the mating connector of the wiring harness is in de-energized condition.
3. Connect the mating connector of the wiring harness to the sensor connector until it engages noticeably and observe the correct plug-in position.

## 8 Commissioning



During all work for commissioning the inertial sensor, observe the general safety instructions and intended use detailed in chapter 2 "Safety instructions" from page 7 on.

- ▶ 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.
- ▶ Commission the machine and check the correct functioning of the sensor.

## 9 Operation

This product is a component which requires no settings or changes during operation. For this reason, this chapter of the manual does not contain any information on adjustment options. Use the product only within the performance range specified in the technical data.

## 10 Maintenance and repair

### 10.1 Cleaning and care

#### **NOTICE**

##### **Damage to seals and electronics/electrics due to mechanical effects!**

A water jet may damage the seals and electronics/electrics of the sensor!

- ▶ When cleaning with a water jet, the IP protection class must be observed; depending on this, the water jet may not be directed at the sensor.

For cleaning and care of the sensor, observe the following:

- ▶ Check whether all the seals and fittings on the plug-in connections are securely seated to ensure that no moisture can penetrate into the sensor and the installation space during cleaning.
- ▶ Use only water and, if necessary, a mild cleaning agent to clean the sensor. Never use solvents or aggressive cleaning agents.

## 10.2 Inspection and maintenance

No special activities are necessary.

## 10.3 Repair

The sensor cannot be repaired.

When replacing the sensor, make sure that no contamination can penetrate the hydraulic system and that the sealing surface of the sensor is not damaged.

- ▶ Only use original spare sensor from Rexroth, otherwise the functional reliability cannot be guaranteed, and the warranty will be voided.
- ▶ Spare parts can be found online at [www.boschrexroth.com/eshop](http://www.boschrexroth.com/eshop)

Address all questions regarding repair to your responsible Bosch Rexroth service.

# 11 Removal and replacement

- ▶ Only disassemble the inertial sensor when de-energized.

# 12 Disposal

Careless disposal of the inertial sensor can lead to environmental pollution.

- ▶ Dispose of the inertial sensor and the packaging material in accordance with the national regulations in your country.

# 13 Extension and conversion

You must not convert the inertial sensor.



The warranty from Bosch Rexroth only applies to the configuration as delivered. Entitlement to warranty cover will be rendered void in case of conversion, upgrade or a software modification.

# 14 Troubleshooting



A control unit to which the sensor is connected can often detect errors by means of the sensor signal. What type of errors are detected depends on the hardware of the control unit used and the software running on the controller. The indication or display of an error, e.g. via a display or a diagnostic tool, depends on the machine concept. Observe the control unit manufacturer’s instruction manual, if applicable.

## 14.1 Malfunction table for MM7.10

The Table 7 is intended to support troubleshooting. This table is not exhaustive. Problems may occur in practice that are not listed here.

**Table 7: MM7.10 error reactions**

| Error type  | Error reaction  | Error reaction time in the worst case |
|---|---|---------------------------------------|
| Error detected at start-up                            | No transmission of CAN messages   | –                                     |
| Error inertial sensor module (sensor unit, bus, etc.) | Transmission of CAN messages with error signal status                                 | 100 ms                                |
| µC error (memory, program execution, etc.)            | No transmission of CAN messages   | 100 ms                                |
| CAN error   | See chapter 4.1.3 of the "Technical customer documentation" MM7.10 (95178_TCD_MM7.10) |                                       |

## 15 Technical data

The permissible technical data of the inertial sensor can be found in data sheet 95178.



The data sheet can be found in the online product catalog at [www.boschrexroth.com/p-MM7-10](http://www.boschrexroth.com/p-MM7-10)



For more information, see [www.boschrexroth.com/mobile-electronics](http://www.boschrexroth.com/mobile-electronics)

# 16 Alphabetical index

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