Inertial sensor
MM5.10-EOL

RE 95177
Edition: 02.2017

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
- Configuration of baud rate, CAN ID etc. possible

Inhalt

Description

The purpose of the inertial sensor MM5.10-EOL 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 MM5.10-EOL 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 MM5.10-EOL via the power supply we recommend powering the inertial sensor MM5.10-EOL 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 MM5.10-EOL 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 MM5.10-EOL:

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

Material number for MM5.10-EOL
F037000401

Technical data

Ambient conditions

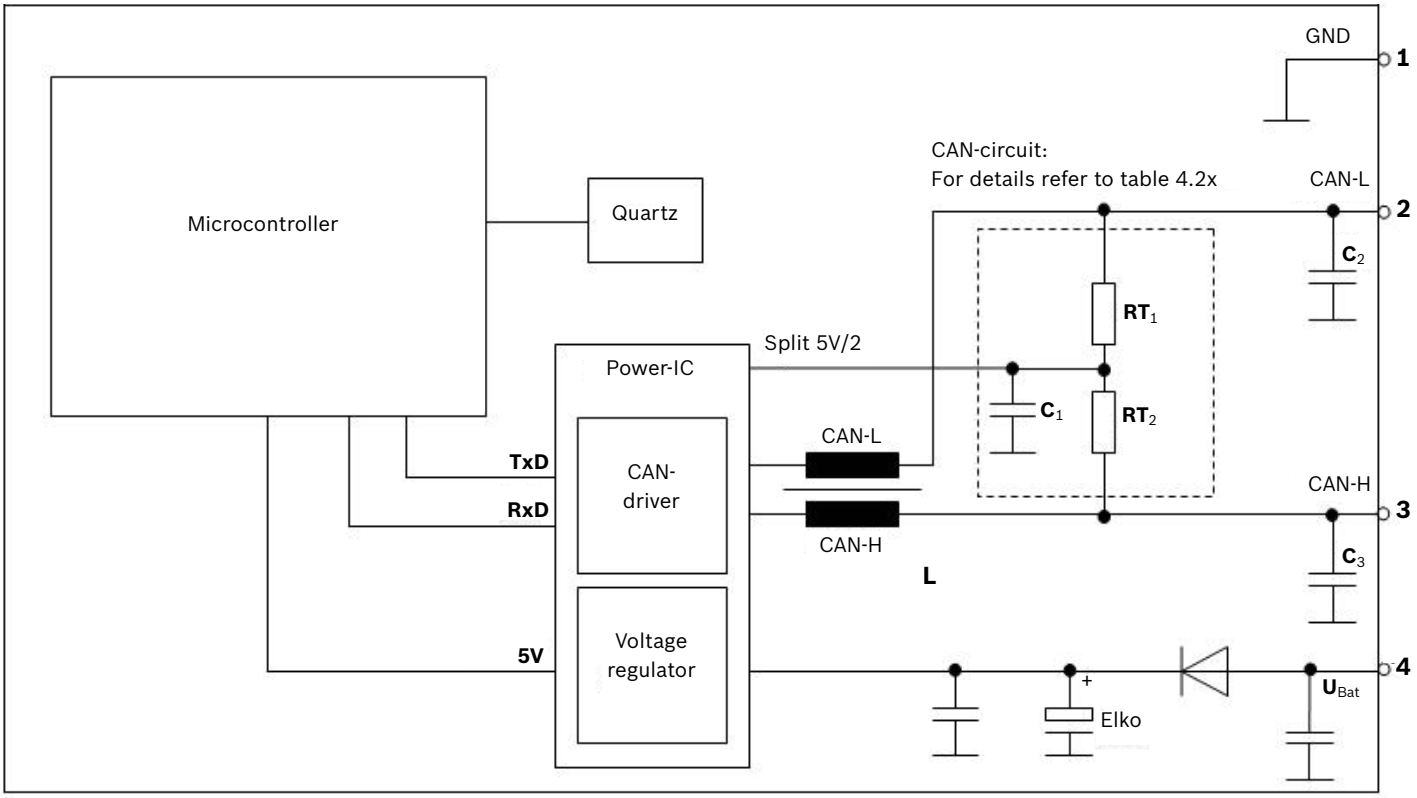
Position		Minimum	Typical	Maximum
Storage time				5 a
Storage temperature		–40 °C		+85 °C
Humidity φ_{max}	at 40 °C			95 %r.h.
	at 55 °C			65 %r.h.
Operating temperature range		–40 °C		+85 °C
Temperature gradient				3.0 K/min
Atmospheric pressure		860 mbar		1060 mbar

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 µH
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 offset	(t<3 min after U_{batt} on)	–0.6 °/s/min	±0.2 °/s/min	+0.6 °/s/min
	(t>3 min after U_{batt} on)	–0.2 °/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)

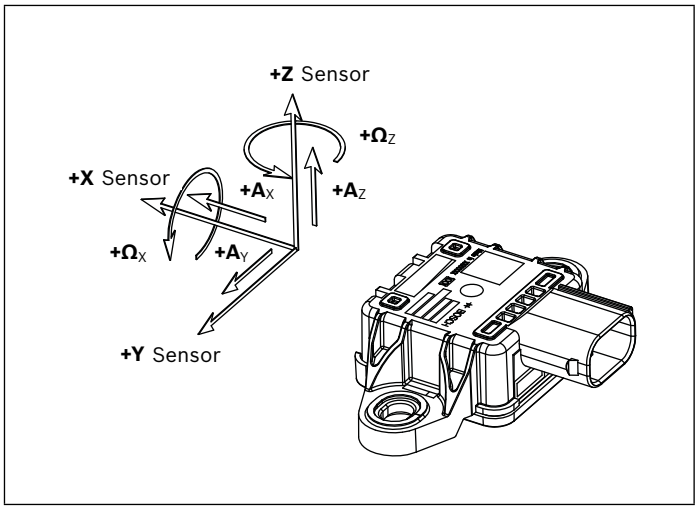
Antenna measurement according to	CISPR 25-13	0.15 to 1000 MHz

Sensor configuration

The sensor can be reconfigured with regard to baud rate, CAN ID, deactivation of CAN messages, CAN update rate, big/little endianess format, bandwidth signal filter and sign output signals with the help of an ASCII file.

A CAN tool that can interpret ASCII files is required for transmission of the data to the sensor. CAN tools from Vector were tested. On request, the ASCII file can be made available by Rexroth.

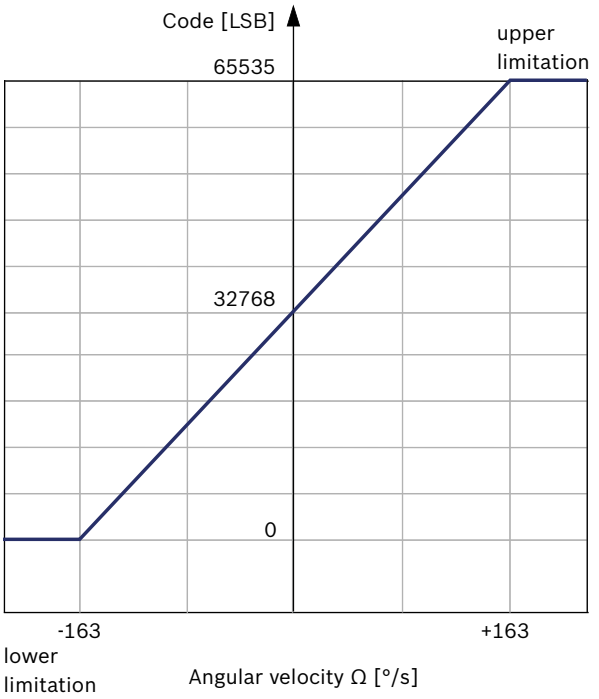
Vehicle axis system



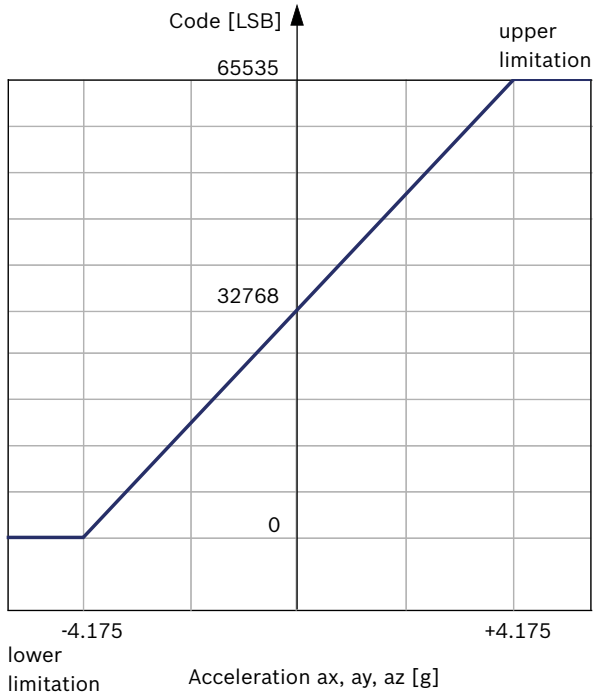
Vehicle axis system according to DIN 70000 respectively ISO 8855:
$+X_{vehicle}$ points to the front of the vehicle
$+Y_{vehicle}$ points to the left side of the vehicle
$+Z_{vehicle}$ points to the top of the vehicle

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.:
$+X_{vehicle} = +X_{Sensor}$
$+Y_{vehicle} = +Y_{Sensor}$
$+Z_{vehicle} = +Z_{Sensor}$

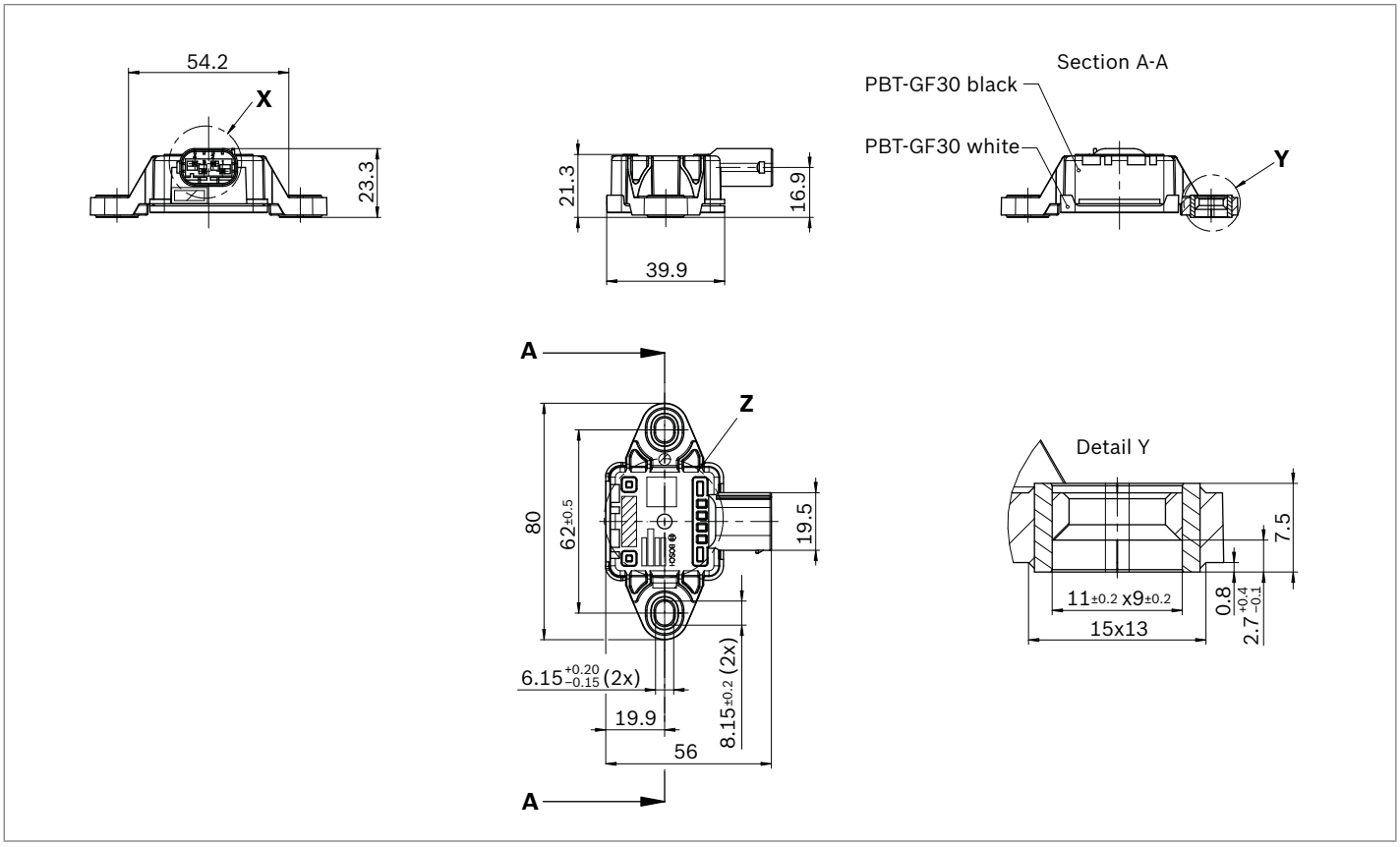
▼ **Yaw and roll rate**



▼ **Acceleration (nominal)**

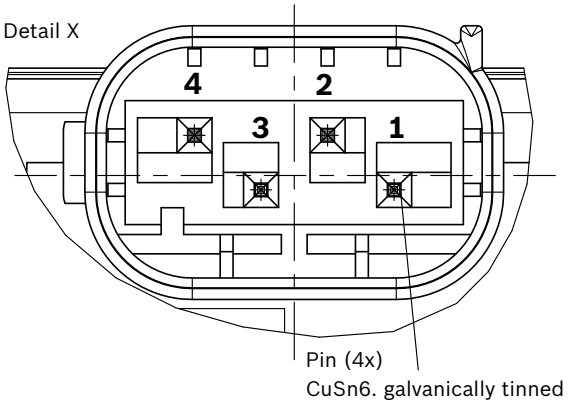


Dimensions



Connector AMP-MQS Superseal

▼ **Pin assignment**



1 Ground GND
2 CANL
3 CANH
4 Supply voltage U_{sup}

▼ **Mating connector**

Designation	Quantity	AMP-MQS material number
Housing	1	1-967640-1
Contacts (DGB 0.75 mm²)	4	965906-1
Single-wire seal (for ø1.4 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).

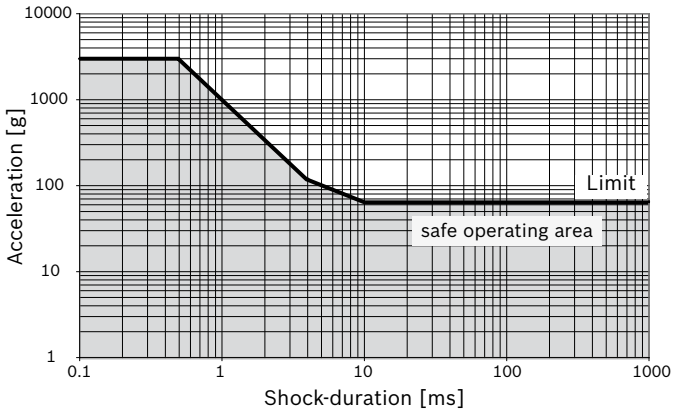
Assembly into the vehicle

The mounting location of the inertial sensor MM5.10-EOL 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 MM5.10-EOL 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 MM5.10-EOL 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**



Manufacturer Confirmation of MTTF and $MTTF_d$-Values

The following information was determined in accordance with DIN EN ISO 13849-1:2008 directive using the parts count method:

Product	**MTTF** years	**$MTTF_d$** years	**Diagnostic coverage**
Inertial sensor MM5.10-EOL	261	522	Low (79%)

For the use of sensors in safety-related structures in accordance with ISO 13849-1:2008, the requirements stated there (e.g. for software, system errors) are to be taken into consideration by the machinery/system manufacturer.

The sensor provides the following monitoring functions:

- Evaluation of the error bit status in the CAN telegram (watchdog signal) as indirect monitoring of the sensor elements (input), as well as simple temporal program run monitoring in the built-in microprocessor (logic).
- Cyclic redundancy check (CRC process in accordance with SAE J1850)
- CAN message counter in synchronous mode
- For serious errors in the sensor, a safe condition of the sensor is ensured **without** CAN communication.

The basic and proven safety principles of electronic and mechanical engineering are therefore properly adhered to. The reliability measures specified do not represent any commitment regarding liability for material defects or a guarantee.

Chapter	Basic safety principles (SP)	Remarks	Technology	Areas of use	Implemented in the project
A.1.1	Use of suitable materials and manufacturing processes	Selection of the materials, manufacturing and treatment processes taking into consideration e.g. tension, durability, elasticity, friction, wear, corrosion, temperature, conductivity, mechanical strength of the insulating materials.	Mechanical system	Components	Ensured by selecting materials and manufacturing processes as for Platform DRS-MM5.x and 5E.x. Materials and manufacturing processes have been used in sufficient number since the platform has been in the field and are “proven in use”.
D.1.1	Use of suitable materials and manufacturing processes	Selection of the materials, manufacturing and treatment processes taking into consideration e.g. tension, durability, elasticity, friction, wear, corrosion, temperature, conductivity, mechanical strength of the insulating materials.	Electrical system	Components	Ensured by selecting BE and manufacturing processes as for Platform DRS-MM5.x and 5E.x. Testing approval, cyclic quality test Materials and manufacturing processes have been used in sufficient number since the platform has been in the field and are “proven in use”.
A.1.2	Correct dimensioning and forming	Consideration e.g. of tension, expansion, fatigue, surface roughness, tolerances, manufacturing processes.	Mechanical system	Components	Ensured by selecting BE and manufacturing processes as for Platform DRS-MM5.x and 5E.x. Testing approval, cyclic quality test Materials and manufacturing processes have been used in sufficient number since the platform has been in the field and are “proven in use”.
D.1.2	Correct dimensioning and forming	Consideration e.g. of tension, expansion, fatigue, surface roughness, tolerances, manufacturing processes.	Electrical system	Components	Ensured by selecting BE and manufacturing processes as for Platform DRS-MM5.x and 5E.x. Testing approval, cyclic quality test Materials and manufacturing processes have been used in sufficient number since the platform has been in the field and are “proven in use”.
A.1.3	Suitable selection, combination, arrangement, assembly and installation of the components/system	Consideration of the manufacturer's application instructions, e.g. catalog sheets, installation instructions, specifications, as well as experiences with similar components/systems.	Mechanical system	Components	See TCI and drawing.
D.1.3	Suitable selection, combination, arrangement, assembly and installation of the components/system	Consideration of the manufacturer's application instructions, e.g. catalog sheets, installation instructions, specifications, as well as experiences with similar components/systems.	Electrical system	Components	Ensured by selecting BE and manufacturing processes as for Platform DRS-MM5.x and 5E.x. Testing approval, cyclic quality test Materials and manufacturing processes have been used in sufficient number since the platform has been in the field and are “proven in use”.

Chapter	Basic safety principles (SP)	Remarks	Technology	Areas of use	Implemented in the project
A.1.4	Application of the principle of energy separation (closed circuit principle, return spring)	A safe condition is achieved by separating all important fixtures from the energy source. See primary measures for stopping in EN 292-2:1991 (ISO/TR 12100-2:1992), 3.7.1. Energy is required to start movement in a mechanism. See primary measures for starting in EN 292-2:1991 (ISO/TR 12100-2:1992), 3.7.1. Different operating modes should be taken into consideration, e.g. operating mode, maintenance mode. This principle may not be used for some applications, e.g. if energy must be maintained for tensioning devices.	Mechanical system	Components	The sensor does not return any signal in the absence of power.
A.1.5	Adequate mounting	Manufacturer's application instructions must be observed when using screw locks. Overstraining can be avoided by using a suitable torque limitation procedure.	Mechanical system	Components	See TCI and drawing.
D.1.6	Application of the principle of energy separation (GS-BGIA-M13: off-load current principle, spring, return spring)	A safe condition is achieved by separating all important equipment from the energy source, e.g. by using a normally closed (NC) contact for inputs (contact and position switches) and a normally open (NO) contact for relays [see also EN 292-2:1991 (ISO/TR 12100-2:1992), 3.7.1]. There can be exceptions in some cases, e.g. if a failure of the electrical supply represents an additional hazard. Time-delaying functions may be necessary to ensure that a safe status of the system is achieved [see EN 60204-1:1997 (IEC 60204-1:1997), 9.2.2].	Electrical system	Components	If the energy supply is disconnected, the sensor does not deliver any more values. There is no substantial capacity, which means that shut-off is below 1 ms. The higher-level system must detect a cable break. A fault in the electronic system that leads to a plausible value is not detected.
A.1.7	Limitation of the environmental parameters range	Temperature, humidity and contamination at the installation location are examples of these parameters. See Section 8 and **the manufacturer's application instructions**.	Mechanical system	Components	See TCI and drawing.
D.1.7	Suppression of voltage peaks	A set up for suppressing voltage peaks (an RC element, a diode or a varistor) must be used parallel to the applied load but not parallel to the contacts. NOTE: A diode increases the switching off time.	Electrical system	Components	See TCI and drawing.
D.1.8	Reduction in response time	Minimization of delay when switching off components used for switching.	Electrical system	Components	There is no substantial capacity, which means that shut-off is below 1 ms.
A.1.9	Adequate reaction time	Consideration of e.g. reduction of spring force, friction, lubrication, temperature, inertia during acceleration and deceleration, combination of tolerances.	Mechanical system	Components	See TCI and drawing.

Chapter	Basic safety principles (SP)	Remarks	Technology	Areas of use	Implemented in the project
D.1.9	Compatibility	Use of components that are suitable for the voltages and currents used (power supply unit).	Electrical system	Components	See TCI and drawing.
D.1.10	Resistance to environmental stresses	Design of fixtures so that they can function in all expected operational environments and under unfavorable conditions, e.g. temperature, humidity, vibration and electromagnetic interference (EMI). See Section 8 and the manufacturer's application instructions / specifications.	Electrical system	Components	See TCI and drawing. Testing approval carried out in accordance with testing plan.
A.1.11	Simplification	Reduction in the number of components in safety-related systems.	Mechanical system	Components	Not relevant for the sensor
D.1.11	Safe mounting of the input devices	The input devices are to be secured (e.g. with lock switches, position switches, marginal switches, proximity switches), so that the position, orientation and switch tolerances are adhered to under all expected conditions, e.g. vibration, standard wear, intrusion of foreign particles, temperature. See EN 1088:1995 (ISO 14119:1998), Section 5.	Electrical system	Components	Not relevant for the sensor
D.1.12	Protection from unexpected restarting after restoring the energy supply	Avoiding unexpected start-up, e.g. after restoring the energy supply [see EN 292-2:1991 (ISO/TR 12100-2:1992), 3.7.2, EN 1037 (ISO 14118), EN 60204-1 (IEC 60204-1)]. Special applications, e.g. maintaining the energy for clamping devices or securing a position, need to be considered separately.	Electrical system	Components	Not relevant for the sensor
A.1.13	Adequate lubrication	-	Mechanical system	Components	Not relevant for the sensor
D.1.13	Protection of the control circuit	The control circuit should be protected in accordance with EN 60204-1:1997 (IEC 60204-1:1997), 7.2 and 9.1.1 .	Electrical system	Components	Not relevant for the sensor
A.1.14	Adequate protection to keep out fluids and dust	IP protection type observance [see EN 60529 (IEC 60529)].	Mechanical system	Components	Protection class IP69K and IP 67 adhered to in accordance with DIN 40050-9.

Chapter	Well-tried safety principles (SP)	Remarks	Technology	Areas of use	Implemented in the project
A.2.1	Use of carefully selected materials and manufacturing processes	Selection of suitable materials for the respective application, as well as appropriate manufacturing and treatment processes.	Mechanical system	Components	Ensured by selecting materials and manufacturing processes as for Platform DRS-MM5.x and 5E.x. Materials and manufacturing processes have been used in sufficient number since the platform has been in the field and are “proven in use”
A.2.2	Using components with a defined failure behavior	The most frequent failure behavior of a component is known in advance and is always the same, see EN 292-2:1991 (ISO/TR 12100-2:1992), 3.7.4.	Mechanical system	Components	Ensured by selecting materials and manufacturing processes as for Platform DRS-MM5.x and 5E.x. Materials and manufacturing processes have been used in sufficient number since the platform has been in the field and are “proven in use”. Internal sensor monitoring concept available, FMEAs and FTA carried out.
D.3.2	Avoidance of errors in cables	To avoid short circuits between adjacent lines: a) use cables with shielding that is connected to the protective conductor system on every single line, or b) use a protective conductor between all signal lines in flat cables.	Electrical system	Components	Coded unsealed connectors, cable strands are individually insulated.
A.2.3	Oversizing / safety factor	The safety factors are specified in standards or are taken from experience with safety-related applications.	Mechanical system	Components	See TCI and drawing.
D.3.3	Distances between electrical conductors	Ensure that sufficient distance is used to prevent any unintentional connections between terminals, components and lines.	Electrical system	Components	LVL 8.3, RD75PBF, AE-KFL layout requirements adhered to.
A.2.4	Secured position	The mobile element of the component is held mechanically in one of the possible positions (friction alone is not sufficient). To change the position, force must be applied.	Mechanical system	Components	Not relevant for the sensor
D.3.4	Energy limitation	A capacitor must be used to supply a limited amount of energy, e.g. when using a time cycle control.	Electrical system	Components	See TCI and drawing.
A.2.5	Increased OUT force	A safe position / a safe condition is achieved by increasing the OUT force in relation to the IN force.	Mechanical system	Components	Not applicable.
D.3.5	Limiting electrical parameters	Limiting of the voltage, current, energy or frequency to avoid an unsafe status, e.g. by torque limitation, offset/time-limited running and reduced speed.	Electrical system	Components	See TCI and drawing.

Chapter	Well-tried safety principles (SP)	Remarks	Technology	Areas of use	Implemented in the project
D.3.6	Prevention of undefined conditions	Undefined conditions in the control system should be avoided. The control system must have a structural design that enables the condition of the control system to be predetermined during standard operation under all expected operating conditions, e.g. output/outputs.	Electrical system	Components	See TCI and drawing.
D.3.7	Positive actuation mode	A direct action is transferred by form fit (not by traction) without elastic elements, i.e. no use of springs between the actuator and contacts [see EN 1088:1995 (ISO 14119:1998), 5.1].	Electrical system	Components	Not relevant.
A.2.8	Forced mechanical effect / actuation	The dependent operation (e.g. parallel operation) of multiple components is achieved with a form-fit mechanical connecting element (or more than one). The connecting element(s) should not contain any springs or other “flexible” elements [see EN 292-2:1991 (ISO/TR 12100-2:1992), 3.5].	Mechanical system	Components	Not relevant.
D.3.8	Status orientation in the case of failures	If possible, all equipment / circuits should enter a safe condition or be safe to operate.	Electrical system	Components	See TCI and drawing. Internal sensor monitoring concept available, FMEAs and FTA carried out. Error display via CAN messages.
A.2.9	Multiplication of parts	Reduction in the impact of defects by using several parts of the same type; in this connection, for example, a fault that occurs on one spring (of many) does not lead to a dangerous condition.	Mechanical system	Components	Not relevant.
D.3.9	Directed failure	If it is possible to implement, components or systems should be used whose types of failure are known in advance [see EN 292-2:1991 (ISO/TR 12100-.2:1992), 3.7.4].	Electrical system	Components	See TCI and drawing. Internal sensor monitoring concept available, FMEAs and FTA carried out. Error display via CAN messages.
A.2.10	Use of proven springs (see also Table A.3)	A proven spring requires: ▶ the use of carefully selected materials, manufacturing processes (e.g. before the application of static and dynamic setting) and treatment processes (e.g. rollers and shotblasting); ▶ a sufficient guide for the spring and ▶ a sufficient safety factor during extended use (i.e. a high probability of no breakage occurring). Proven compression springs can also be designed with: ▶ the use of carefully selected materials, manufacturing processes (e.g. before the application of static and dynamic setting) and treatment processes (e.g. rollers and shotblasting); ▶ a sufficient guide for the spring and ▶ a space between the coils for unloaded springs that is smaller than the wire diameter, and ▶ sufficient force after a breakage or after several breakages (i.e. a breakage/breakages do(es) not lead to a dangerous condition).	Mechanical system	Components	Not relevant as there is no spring.

Chapter	Well-tried safety principles (SP)	Remarks	Technology	Areas of use	Implemented in the project
D.3.10	Oversizing / safety factor	Components that are used in protection circuits should be underloaded, e.g. by: ▶ the current that runs through the switch contact, and which should be less than half of the current nominal value; ▶ the switching frequency of the components, which should be less than half of the switch frequency nominal value and ▶ the total number of circuits expected, which is ten times smaller than the number of circuits for which this electrical fixture is designed. ▶ NOTE underloading can depend on sensible design.	Electrical system	Components	See TCI and drawing. Internal sensor monitoring concept available, FMEAs and FTA carried out. Error display via CAN messages.
D.3.11	Reduction of possible faults/separation	Separation of safety-related functions from other ones.	Electrical system	Components	Not relevant.
D.3.12	Balance between complexity / simplification	A balance should be attained between: ▶ the complexity of the fixtures, in order to achieve better control and ▶ the simplification of the fixtures, in order to improve their reliability.	Electrical system	Components	Ensured by selecting materials and manufacturing processes as for Platform DRS-MM5.x and 5E.x. Materials and manufacturing processes have been used in sufficient number since the platform has been in the field and are “proven in use”.
A.2.14	Reduced range of reaction time, hysteresis limitation	Determining the necessary limitations. Consideration of e.g. reduction of spring force, friction, lubrication, temperature, inertia during acceleration and deceleration, combination of tolerances.	Mechanical system	Components	See TCI and drawing. Internal sensor monitoring concept available, FMEAs and FTA carried out. Error display via CAN messages.

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 MM5.10-EOL to be tested within the framework of application release.

Additional tests

It has to be tested whether vehicle components near the inertial sensor MM5.10-EOL 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.
- Sensors do not fall under the scope of EMC-RL 2004/108/EC or 2014/30/EU. A declaration of conformity and the CE marking for individually sold sensors is not required, since the sensors are only sold to machine manufacturers (OEM) or to companies with the necessary expertise (i.e. certified Bosch Rexroth partners or companies with trained and qualified service personnel). Furthermore, the responsibility of the above mentioned companies for machine EMC testing remains unaffected in principle.
- The use of sensors by private users is not permissible, 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 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