Automotive Electronics **Combined inertial sensors for VDC and RoSe SMI710 and SMI720**





Combined inertial sensors SMI710 and SMI720

Customer benefit / features:

SMI710: Designed for premium RSC, VDC, and RoSe functions

- 3 DoF Ωx-ay-az combined rotation and acceleration inertial sensor with SPI, PSI5, and CAN interface
- Excellent offset stability over temperature and life
- Applicable in systems up to ASIL D requirements

SMI720: Tailored for RoSe functions

- 2 DoF Ωx-az combined rotation and acceleration inertial sensor with SPI interface
- Applicable in systems up to ASIL C requirements
- Offset regulated sensor

Common Features

- Small standard SMD package: BGA 7 x 7 x 1.5 mm³ RoHS compliant
- Superior signal performance and implemented selftests enabling advanced system concepts for reliable safety relevant applications
- Fully digital signal processing
- On-chip self-monitoring based on Bosch VDC component experience
- 16 bit digital output via serial peripheral interface (SPI)
- > Two SPI versions selectable: in-frame or out-of-frame

Overview

The inertial sensors SMI710 and SMI720 are new compact inertial sensors with high accuracy and reliability. The SMI710 is especially designed for premium vehicle dynamics (VDC) functions such as roll-stability control (RSC), active damping systems (AD), and rollover sensing (RoSe). The SMI720 is tailored for RoSe systems.

The sensors consist of two micro-machined sensor elements and a signal processing ASIC mounted in a molded BGA housing (7 x 7 x 1.5 mm^3).

The concept of combining acceleration sensors and an angular rate sensor in one package aims to provide a costefficient one-chip solution for VDC applications without compromising on quality and standard system performance.

Product description

The SMI710 sensor contains an Ω_x angular rate sensor and a two-axis acceleration sensor (a_y/a_z). The SMI720 is sensitive for Ω_x angular rate and a_z acceleration. In addition, the SMI710 features mid-g output options with ±35 g range for a_y and ±10 g range for a_z.

Excellent durability with respect to mechanical and electrical interference is guaranteed by a fully digital signal processing of all sensor signals combined with a closed loop operation of the angular rate sensor. The digital output via SPI (SMI720) or via SPI, PSI5 or CAN (SMI710) interfaces ensures an optimal signal quality to the electronic control unit.

In combination with a multitude of customer specific signal monitoring options and an integrated safety controller, the sensor is particularly suitable for safety relevant applications. The sensors are applicable in systems with safety requirements according to ISO26262 up to ASIL D (SMI710) or up to ASIL C (SMI720) depending on the target application.

The sensors are RoHS compliant and qualified according to AEC-Q100.

Parameters	SMI710	SMI720
Measurement characteristics of the angular rate channel		
Measurement axis	Ωx	Ωx
Measurement range	±300 °/s	±300 °/s
Sensitivity (nominal)	100 LSB/°/s	100 LSB/°/s
Sensitivity variation 1)	±3 %	±5 %
Offset variation 1)	±3 °/s	±1 °/s regulated
Noise (rms) ²⁾	0.15 °/s	1.5 °/s
Measurement characteristics of the acceleration channels		
Measurement axis	ay, az	az
Measurement range	±5.0 g	±5.0 g
Sensitivity (nominal)	5000 LSB/g	5000 LSB/g
Sensitivity variation ¹⁾	±3 %	±6 %
Offset variation 1)	±50 mg (ay) ±70 mg (az)	±10 mg regulated
Noise (rms) ²⁾	6 mg (a _y); 7 mg (a _z)	12.5 mg
Functional characteristics		
Communication	SPI, PSI5, CAN	SPI
Bandwidth (-3dB) ³⁾	11, 18, 21 or 77 Hz	43 Hz
Start up time	max 400 ms ⁴⁾	500 ms
Operating conditions		
Supply voltage ⁵⁾	3.3 V / 5 V	3.3 V
Supply current ⁶⁾	< 29 mA	< 21 mA
Temperature range	-40 +125 °C	-40+105 °C
 ¹⁾ Over lifetime and temperature ²⁾ Noise is defined for filter settings SMI710: 77 Hz, SMI720: 43 Hz ³⁾ Nominal f_{·3dB} for the rate channel ⁴⁾ incl. up to 3 self-tests for 77.5 Hz setting ⁵⁾ digital ⁶⁾ SPI, PSI5 		

³⁾ Nominal f_{3dB} for the rate channel corresponding to programmable filter settings



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Working principle

The sensor elements of the SMI710 and SMI720 are manufactured utilizing state-of-the-art Bosch surface micromachining technology. The angular rate sensor is based on the coriolis vibratory gyroscope principle: High frequency electrostatic forces generate an oscillation of two seismic masses controlled by a closed loop drive system. When rotating around the nominal axis, the coriolis forces acting on the oscillators can be measured by capacity changes in the detection system.

The acceleration sensor consists of free movable comb-like seismic masses suspended from silicon spring bars and fixed counter-electrodes. As a result of external forces acting on the vehicle, deflections of the seismic masses along the sensitive axis generate changes in the capacity of the system.

The MEMS elements of SMI710 have been optimized for vibration robustness and ultra-robust offset stability. The SMI720 is optimized as cost effective RoSe sensor with an offset compensating signal path for Ω_x and a_z .

Portfolio

SMI710 and SMI720 are part of a larger sensor portfolio. The portfolio consists of acceleration sensors, angular rate sensors, pressure sensors, and combined inertial sensors for occupant safety systems, vehicle dynamics control VDC, active suspension systems, motor management, transmission control systems, and navigation.

Bosch has been active in the field of micro-electromechanical systems (MEMS) for more than 20 years, and is established as one of the pioneers of this technology. With more than 1000 MEMS patents, hundreds of engineers in this field, and more than 3 billion MEMS sensors shipped to date, Bosch is the global market leader for MEMS sensors.

For more information about automotive MEMS sensors, visit www.bosch-sensors.com.

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