Automotive Electronics

Product Information
Angular Rate Sensor for Rollover Applications – SMG061 (analog output)

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Preliminary

Angular Rate Sensor for Rollover Applications

General Description

The Robert Bosch Angular Rate Sensor SMG061 is the second generation of gyroscopes for rollover applications.

The SMG061 is a micromachined gyroscope for the detection of angular rates in car safety applications such as rollover control units. It is a device with considerable relevance for the correct performance of such passenger safety systems.

Working Principle

In detail, the sensor is based upon a two-chip concept – the micromachined sensing element and a separate evaluation ASIC. The sensing element is an oscillating polysilicon mass sealed under vacuum on wafer level with the sensitive axis lying in the chip plane. The signal evaluation is fully digital and for the communication with the µC an ADC converts the digital signals to an analog output.

Customer Benefits

- Full self-test capability
- Continuous on-chip monitoring
- Increased driving and detection frequencies (5kHz/6kHz) for easier mechanical design of the ECU
- Five external components needed for EMC and low pass filter
- Bosch VDC experience based on millions of sensors in the field
- Bosch as reliable business partner in the automotive industry

Features

- Analog output ratiometric with respect to VDDA
- Full scale (FS) measurement range: ±240°/s
- Temperature range -40°C...+105°C
- Fast on-chip offset adjustment during power-on stage
- Slow on-chip offset cancellation (triggerable)
- On-chip digital LP-filtering (approx. 3-pole-Bessel in pass band): 30Hz
- Ratiometric output (dependent of power supply voltage)
- Standard SMD-package (PLCC44)

Figure 1 shows that the sensing element has a symmetrical layout with only one suspension at the pivot point. By applying electrostatic forces to comb structures, the mass is forced to a rotational oscillation around this pivot point in the center of the mass. This oscillation (in-plane movement, drive movement) is stabilized by an electronic control loop (drive control loop) in the evaluation ASIC of the sensor.

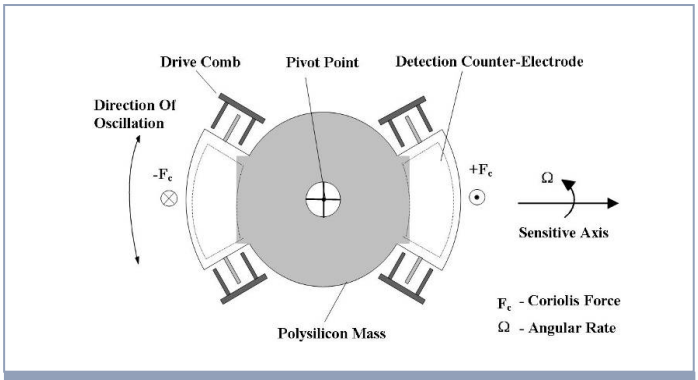

Fig. 1: Basic layout of the sensing element of SMG061

Due to the conservation of the angular momentum, an applied angular rate in chip plane will cause a rocking motion of the mass in an out-of-plane direction. Embedded electrodes (detection counter electrodes) under the mass allow a capacitive detection of this out-of-plane motion. The mechanical oscillator symbolizes the sensing mass and its in-plane movement. The "± Coriolis Force" comprises the deflection of the two capacitors formed by the sensing mass and the counter electrodes in the substrate. The signals at those detection electrodes are modulated onto the frequency of the drive oscillation.
After amplification and subtraction the signal proportional to the angular rate is discriminated by a synchronous demodulation. A PLL derives the correct demodulation phase.

Package Details

Sensor chip and read-out ASIC are packaged in a standard PLCC44 package, which is as well available as RoHS compliant version.

Self-test

Complete testing of the mechanics and ASIC is done via the self-test. The self-test of the sensor is triggered by applying a logic low level to the BITEB. A correct working sensor will respond with a nominal value of 60 % full-scale (FS) rate signal at the DAC pin. All other signals indicate a defect of either the sensing element or the evaluation circuit.

Technical Data	
Operating conditions	
Measurement range	±240°/s
Supply voltage analog supply digital supply	 5.0V 5.0V or 3.3V
Supply current 3.3V digital supply 5.0V digital supply	 <12mA <20mA
Operating temperature	-40°C...+105°C
Bandwidth (-3dB)	27...33Hz
Cross axis sensitivity	<5.0%
Lifetime	>15000 hrs
Measurement and functional characteristics	
Sensitivity	7mV/°/s
Sensitivity tolerance	±7%
Non-linearity	±0.5% 2FS
Noise	<1.5°/s
Absolute maximum ratings	
Power-on time	<1.0s
ESD (any pin)	2.0kV
Shock impact	1.2m
Temperature gradient	20K/min

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