Automotive Electronics

# Product Information

# Angular Rate Sensor for Rollover Applications – SMG060 (digital output)

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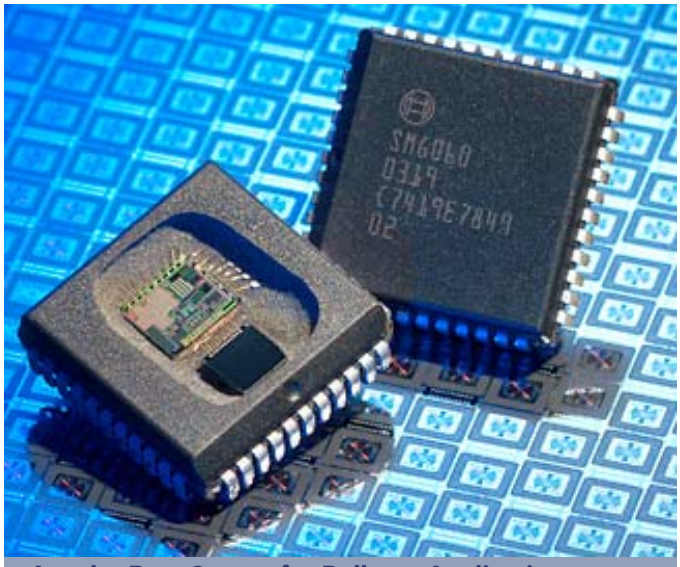
Preliminary




Angular Rate Sensor for Rollover Applications

## General Description

The Robert Bosch Angular Rate Sensor SMG060 is the second generation of gyroscopes for rollover applications.

The SMG060 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.

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.

## Customer Benefits

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

## Features

- Full scale (FS) measurement range: ±240°/s
- Temperature range -40°C...+105°C
- Digital output via SPI
- Digital interface for programming (SPI)
- Digital 10bit resolution
- Fast on-chip offset cancellation during power-on stage
- Slow on-chip offset cancellation (triggerable/continuous regulation)
- On-chip digital LP-filtering (approx. 3-pole-Bessel in pass band): 30Hz
- Non-Ratiometric output (independent of power supply voltage)
- Standard SMD-package (PLCC44)

## Working Principle

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

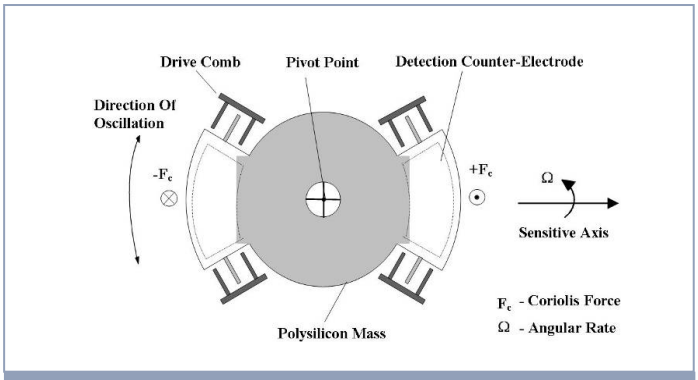



**Fig. 1: Basic layout of the sensing element of SMG060**

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.

| **Technical Data** | |
|---|---|
| Operating conditions | |
| Measurement range | ±240°/s |
| Supply voltage<br>Analog supply<br>Digital supply | <br>5.0V<br>5.0V or 3.3V |
| Supply current | 10mA |
| Operating temperature | -40°C...+105°C |
| Bandwidth (-3dB) | 27...33Hz |
| Cross axis sensitivity | <5.0% |
| Lifetime | >15000 hrs |
| Measurement and functional characteristics | |
| Sensitivity | 2 LSB/°/s |
| Sensitivity tolerance | ±7% |
| Non-linearity | ±0.5% 2FS |
| Noise | <1.5°/s rms |
| Absolute maximum ratings | |
| Power-on time | <1.0s |
| ESD (any pin) | 2.0kV |
| Shock impact | 1.2m |
| Temperature gradient | 20K/min |

## Contact

**Robert Bosch GmbH**
Component Sales
Postbox 13 42
72703 Reutlingen
**Germany**
Tel.: +49 7121 35-2179
Fax: +49 7121 35-2170

**Robert Bosch LLC**
Component Sales
15000 Haggerty Road
Plymouth, MI 48170
**USA**
Tel.: +1 734 979-3000
bosch.semiconductors@us.bosch.com

**Robert Bosch K.K.**
Component Sales
9-1, Ushikubo 3-chome
Tsuzuki-ku, Yokohama 224
**Japan**
Tel.: +81 45 9 12-83 01
Fax: +81 45 9 12-95 73

E-Mail: bosch.semiconductors@de.bosch.com
Internet: www.bosch-semiconductors.com