2 General product description

2.1 Mechanical Design

The inertial sensor SMI230 is based upon a combined two-chip stacked concept. The accelerometer and gyroscope sensing parts consist of sensitive micro-mechanical sensing elements (MEMS) mounted side-by-side on the PCB. The read out ASICs are stacked on top of the respective sensing elements. All of these elements are packed in one LGA package.

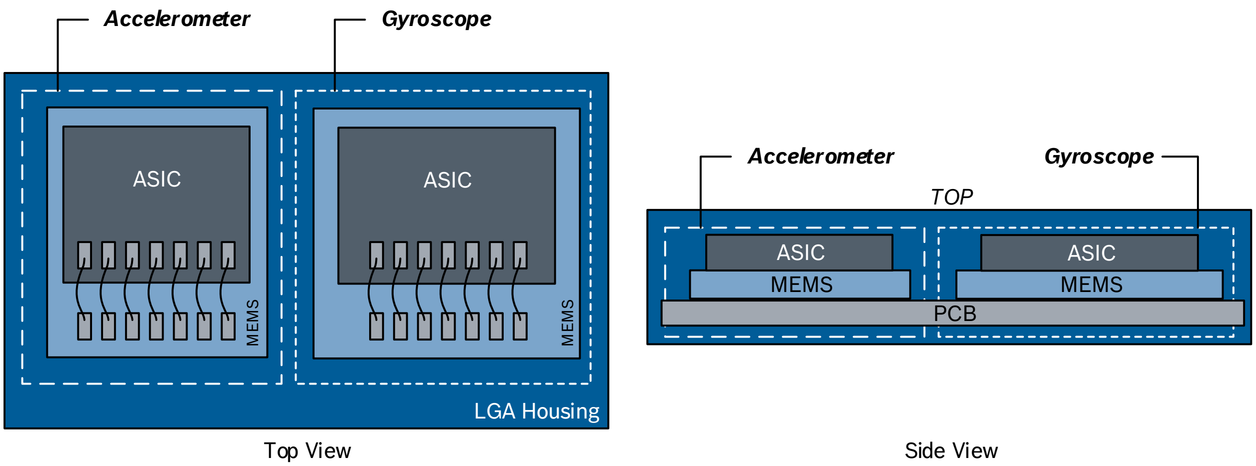

Figure 1 Schematics of the SMI230 mechanical design (left: top view; right: side view)

2.2 Sensor Data

The data width of the gyroscope and accelerometer sensor is 16 bits (11 bits for the temperature sensor) given in two´s complement representation.

The bits for each axis are split into an MSB upper part and an LSB lower part. Reading the sensor data registers always starts with the LSB part. In order to ensure the integrity of the sensor data, the content of the MSB register is locked by reading the corresponding LSB register (shadowing procedure).

The **burst read access** mechanism provides an efficient way to read out the angular rate or acceleration data in TWI or SPI mode. During a burst read access, the sensor automatically increments the starting read address after each byte. The burst read access allows data to be transferred over the TWI bus with an up to 50 % reduced data density. The sensor data (angular rate or acceleration data) in all read-out registers is locked as long as the burst read access is active. Reading the sensor data registers of each gyroscope and accelerometer part in burst read access mode ensures that the sensor values in all readout registers belong to the same time stamp.

2.3 Block Diagram

Figure 2 shows the basic building blocks of the SMI230. As stated in Figure 2, the accelerometer and the gyroscope MEMS elements are each evaluated by their own ASIC. Both sensing elements detect voltage (V) variations, feeding into the analog-digital converter (ADC). The digital signals are further processed and accessible via SPI or TWI.

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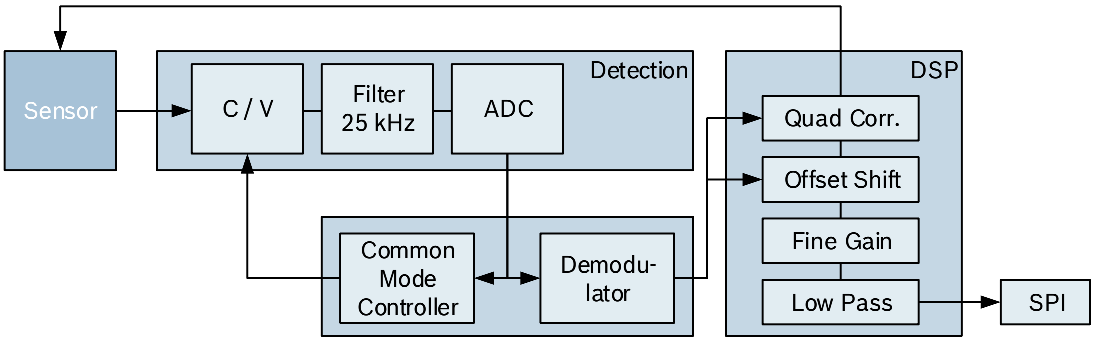

Figure 6 Path of the detection signal for one axis (gyroscope)

2.5 Orientation of the Sensing Axes

If the sensor is accelerated and/or rotated in the indicated directions, the corresponding channels of the device will deliver a positive acceleration and/or yaw rate signal (dynamic acceleration). If the sensor is at rest without any rotation, and the force of gravity is acting contrary to the indicated directions, the output of the corresponding acceleration channel will be positive and the output of the corresponding gyroscope channel will be ‘zero’ (static acceleration).

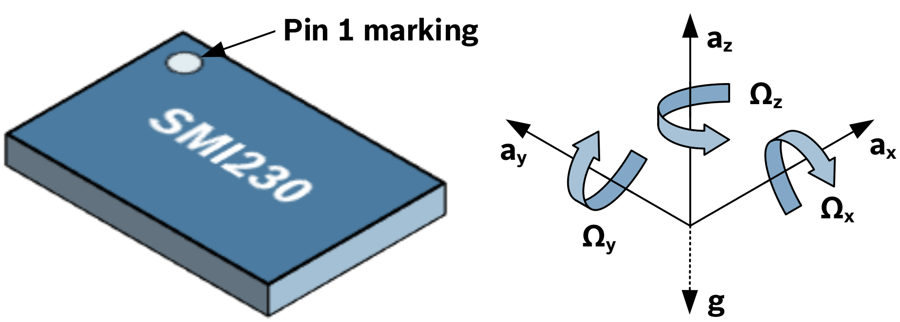

Figure 7 Sensing axis orientation

Example:
According to Figure 7, if the sensor is at rest, or at uniform motion in a gravity field, the output signals are:

- ±0 g for the ACC x-channel ±0 g for the GYR Ω_X-channel
- ±0 g for the ACC y-channel ±0 g for the GYR Ω_Y-channel
- +1 g for the ACC z-channel ±0 g for the GYR Ω_Z -channel

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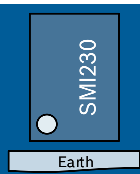
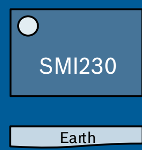
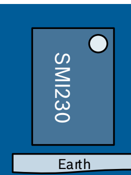
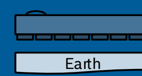
The table below lists all corresponding output signals of x, y, and z, and Ω_x, Ω_y, and Ω_z, while the sensor is at rest, or at uniform motion in a gravity field. This assumes a ±2 g accelerometer range setting and a top down gravity vector as shown above.

Sensor Orientation						
Output Signal x	0 0	+1 g +1024 LSB	0 0	-1 g -1024 LSB	0 0	0 0
Output Signal y	-1 g -1024 LSB	0 0	+1 g +1024 LSB	0 0	0 0	0 0
Output Signal z	0 0	0 0	0 0	0 0	+1 g +1024 LSB	-1 g -1024 LSB
Output Signal Ω_x	0 0	0 0	0 0	0 0	0 0	0 0
Output Signal Ω_y	0 0	0 0	0 0	0 0	0 0	0 0
Output Signal Ω_z	0 0	0 0	0 0	0 0	0 0	0 0

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3.2.4 Orientation within Reel

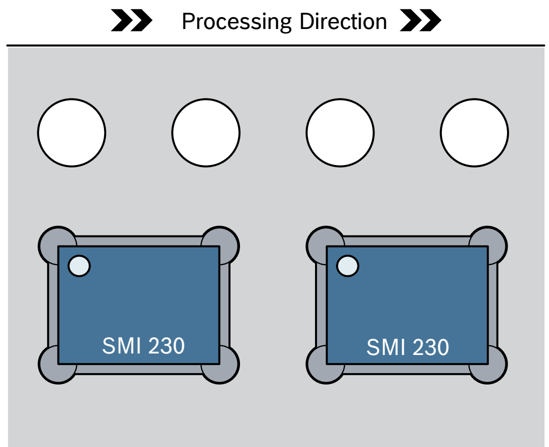

Figure 12 Orientation of the SMI230 devices relative to the tape

3.3 Labelling of the product

Labeling	Name	Symbol	Remark
	Product number	xxx	3 numeric digits, fixed to identify product type (“144”)
	Sub-con ID	A	1 alphanumeric digit, variable to identify sub-con
	Date code	YYWW	4 numeric digits, fixed to identify YY: “year”, WW: “working week”
	Counter ID	CCC	3 numeric digits, variable to generate trace-code
	Pin 1 identifier	●	--

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3.4 Pinning

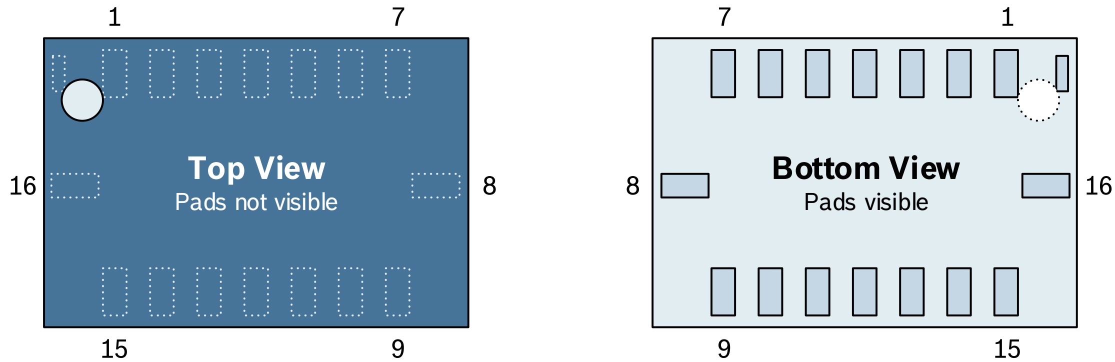

Figure 13 Pin-out top (left) and bottom (right) view

Pin	Name	I/O Type	Description	Connect to - SPI -	Connect to - TWI -
1	INT2	Digital I/O	Interrupt pin (ACC #2)	INT2 / DNC	INT2 / DNC
2	NC	--	--	GND	GND
3	VDD	Supply	Power supply analog & digital domain	VDD	VDD
4	GNDA	Ground	Ground for analog domain	GND	GND
5	CSB2	Digital in	SPI chip select GYR	CSB2	DNC (float)
6	GNDIO	Ground	Ground for I/O	GND	GND
7	PS	Digital in	Protocol select	GND	VDDIO
8	SCx	Digital in	Serial clock	SCK	SCL
9	SDx	Digital I/O	SPI: serial data in; TWI: serial data in/out	SDI	SDA
10	SDO2	Digital out	SPI: serial data out GYR	SDO2	SDO2
11	VDDIO	Supply	Digital I/O supply voltage	VDDIO	VDDIO
12	INT3	Digital I/O	Interrupt pin (GYR int #1)	INT3 / DNC	INT3 / DNC
13	INT4	Digital I/O	Interrupt pin (GYR int #2)	INT4 / DNC	INT4 / DNC
14	CSB1	Digital in	SPI chip select ACC	CSB1	DNC (float)
15	SDO1	Digital out	SPI: serial data out ACC	SDO1	SDO1
16	INT1	Digital I/O	Interrupt pin 1 (ACC int #1)	INT1 / DNC	INT1 / DNC

DNC: Do not connect
INTx: If not needed, DNC

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