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FREQUENCY AND TEMPERATURE CHARACTERIZATION OF A THREE AXIS ACCELEROMETER

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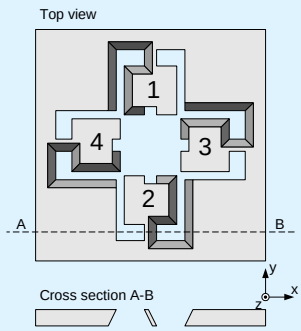
Introduction

- A monolithic three-axis accelerometer with…
  …four independent sensing elements.
  … each element sensitive in a (111) direction.
- Previously, theoretical studies have shown direction independent resolution and frequency response.
- Here, frequency and temperature characterisation are presented as well as resolution measurements.

Conclusions

- The resolution and frequency response are direction independent.
- The frequency response is virtually temperature independent.
- The offset stability can be reduced < 4 % of the measurement range for -40°C and 75°C with 2nd order compensation.
- Si stack is suggested for high performance.

Design, Modelling and Fabrication

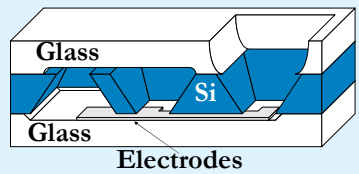


$$Out_x = \frac{Out_1 - Out_2}{2S\cos\alpha}$$

$$Out_y = \frac{Out_4 - Out_3}{2S\cos\alpha}$$

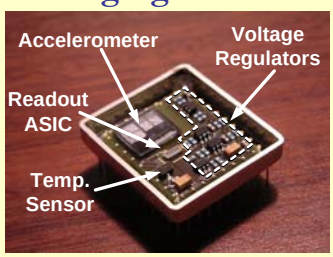
$$Out_z = \frac{-(Out_1 + Out_2 + Out_3 + Out_4)}{4S\sin\alpha}$$

S = sensitivity of each sensing element
α = inclination of the most sensitive axis



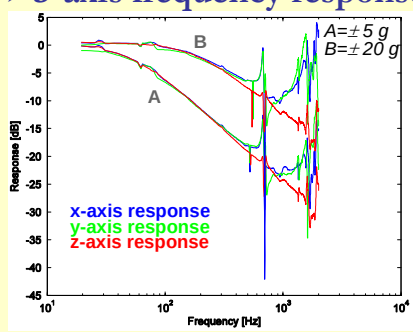
Characterisation

➢ Packaging for test



A 3-axis *accelerometer die Packaged with a four-channel capacitance readout circuit in a covar package.*

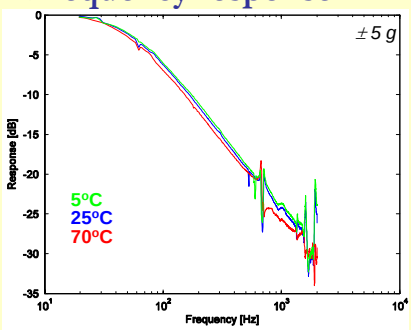
➢3-axis frequency response.



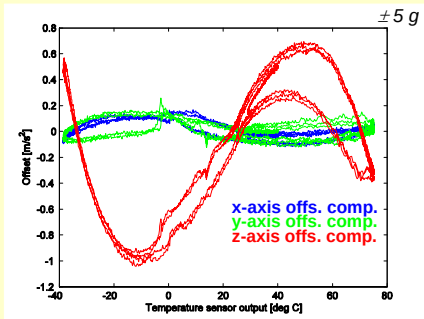
Frequency response of two devices with different range. (A=±5 g and B=±20 g)

The peaks >500 Hz are caused by shaker inaccuracy, lateral shaking that could not be picked up by the reference accelerometer.

➢ Frequency response



Frequency response at different temperatures.



Offset vs. temperature with 2nd order compensation.

	A	B
Range	±5 g	±20 g
Sensitivity	350 fF/g	66 fF/g
-3 dB freq.	55 Hz	250 Hz
Resonance freq.	850 Hz	2.0 kHz
Resolution (all axes)	0.1 mg/√Hz	0.4 mg/√Hz
Chip area	9x10 mm²	9x10 mm²

Properties of two characterized accelerometers.

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