

MEMS Sensor Terminology

Accelerometers/Inclinometers

Bandwidth – Bandwidth is the frequency range in which the MEMS sensor operates. Kionix sensors respond from DC to a user-defineable upper cutoff frequency. The maximum bandwidth is determined by the mechanical resonant frequency (-3dB) of the sensor.

Cross-axis Sensitivity – The output induced on a sense axis from the application of acceleration on a perpendicular axis, expressed as a percentage of the sensitivity. There are multiple cross-axis sensitivities: S_{xy} , S_{xz} , S_{yx} , S_{yz} , S_{zx} , S_{zy} , where the first subscript is the sense axis and the second subscript is the off-axis direction. For example, the calculation of the cross-axis sensitivity for the x-axis sensor of a tri-axis accelerometer is shown below:

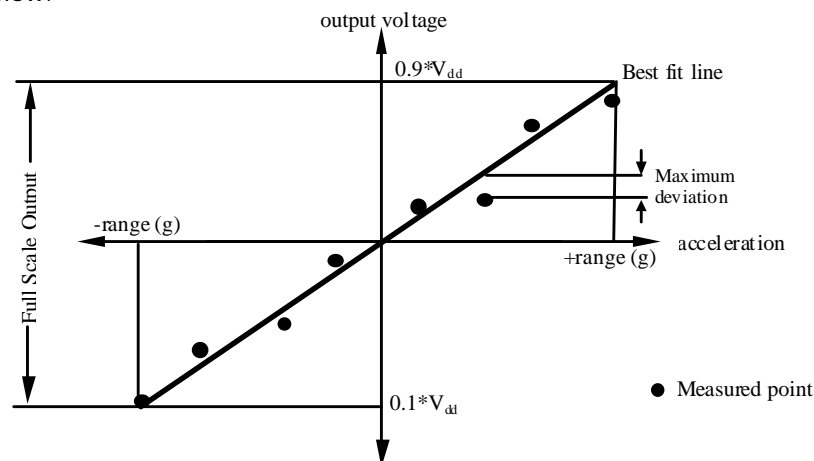
$$S_{x_{cross}} = \left(\frac{\sqrt{(S_{xy}^2 + S_{xz}^2)}}{S_x} \right) * 100\%$$

ESD Tolerance – The device will continue to meet specifications after an electrostatic shock that is less than or equal to the ESD tolerance. Kionix parts are specced to the Human Body Model (HBM), where an ESD pulse is similar to that produced by a person who is electrically charged.

Mechanical Shock – The maximum mechanical shock applied in any direction at which the part will not be damaged when nominal V_{dd} is applied to the device.

Noise Density – When multiplied by the square root of the measurement bandwidth, this value will give the rms acceleration noise of the sensor at nominal V_{dd} and temperature. Accelerations below this value will not be resolvable.

Non-linearity – Sensors do not demonstrate a perfectly linear relationship between input acceleration and output voltage. This non-linearity is the maximum deviation of output voltage from the "best fit line", the straight line defined by sensitivity, expressed in percentage of Full-Scale Output (FSO). The method for calculating non-linearity is shown below:



$$Non - linearity = \frac{Maximum\ deviation(V)}{Full\ Scale\ Output(V)} \times 100\%$$



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Offset vs. Temperature — The maximum change in the nominal zero-g output over the full operating temperature range.

Operating Temperature — The temperature range in which the device will meet performance specifications.

Range — The input acceleration that causes the output to reach span voltage.

Resolution — Resolution is the minimum detectible change in acceleration. To be detectible, the signal must be greater than the noise of the sensor.

Sensitivity — The output voltage change per unit of input acceleration at nominal V_{dd} and temperature, measured in mV/g.

Ratiometric Error — Ideally, the sensor is ratiometric – the output scales by the same ratio that V_{dd} increases or decreases. For example, a 5% increase in V_{dd} results in a 5% increase in 0g offset. Ratiometric error is defined as the difference between the ratio that 0g offset or sensitivity changed and the ratio that V_{dd} changed, expressed as a percentage. For our specifications, ratiometric error is calculated for a +/-5% change in V_{dd} from nominal and can be calculated using the below equations.

Offset Ratiometric Error

$$ORE(1.05V_{dd}) = \left(\left(\frac{0gOffset(@1.05V_{dd})}{0gOffset(@V_{dd})} \right) - \left(\frac{1.05V_{dd}}{V_{dd}} \right) \right) * 100$$

$$ORE(0.95V_{dd}) = \left(\left(\frac{0gOffset(@0.95V_{dd})}{0gOffset(@V_{dd})} \right) - \left(\frac{0.95V_{dd}}{V_{dd}} \right) \right) * 100$$

Sensitivity Ratiometric Error

$$SRE(1.05V_{dd}) = \left(\left(\frac{Sensitivity(@1.05V_{dd})}{Sensitivity(@V_{dd})} \right) - \left(\frac{1.05V_{dd}}{V_{dd}} \right) \right) * 100$$

$$SRE(0.95V_{dd}) = \left(\left(\frac{Sensitivity(@0.95V_{dd})}{Sensitivity(@V_{dd})} \right) - \left(\frac{0.95V_{dd}}{V_{dd}} \right) \right) * 100$$

Span — Span is the output voltage relative to zero-g offset voltage for full scale \pm input acceleration at nominal V_{dd} and temperature.

Storage Temperature — The temperature at which the device can be stored unpowered and still meet performance specifications when powered within the operating temperature.

Zero-g Offset — The output voltage for zero-g input acceleration at nominal V_{dd} and temperature.

