Getting Optimal Power and Noise Performance in Accelerometers

Accelerometers provide motion-sensing capabilities and add value for numerous portable products that improve users' lives. Today, accelerometers are used for more than detecting the motion of the device for a game, screen rotation, or some other direct function. They provide context for the device's use and for handling the power modes of other parts of the system.

Satisfying the measurement requirements in all of the various operating modes and for all the system features requires careful consideration of two critical design parameters: power and noise.

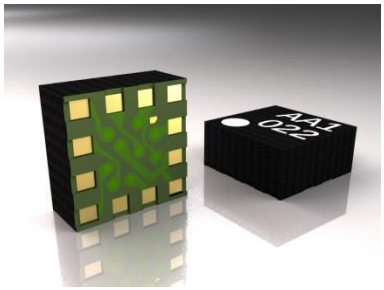
Current draw and the resulting power consumption is straightforward regarding its impact on battery life. Draw more current for any function and the battery life reduces between charges. However, minimizing the current draw under all situations is not easy to achieve, especially when each system's unique design requirements are taken into consideration.

In contrast, noise impacts the system's ability to properly discern and react to user and environmental inputs without false triggering. Optimal system design might require a greater sampling rate (oversampling), greater sample time, higher Output Data Rate (ODR) and other parametric changes that affect power consumption. The traditional accelerometer manufacturer's solution has been to make the decisions for power consumption and noise and provide a standard "one size fits all" solution. The alternative was a custom product that cost more and took more time to develop and more time to get into customers' hands.

A Built-in Power vs. Noise Tradeoff Solution

Based on extensive dealings with customers, Kionix engineers identified the need for a means of providing more insight and control of critical power and noise parameters to system designers. Built into the ASICs of Kionix's latest accelerometers, the KX022 (2x2mm) and KX023 (3x3mm), FlexSet™ provides the solution.

The FlexSet™ performance optimizer includes an online and downloadable graphical user interface as both a design tool and informational reference. The user interface allows those interested in investigating and especially system designers to understand the tradeoffs of specific switch settings and parametric value decisions.



Rather than settle for a standard process and set of parameters, the FlexSet™ optimizer allows system designers to set and then dynamically adjust power and noise values to meet their system's requirements. The user interface demonstrates the results of setting several parameters that impact current draw and noise, so system designers can customize the accelerometer for their application and obtain optimized power consumption and noise performance. With its powerful embedded functionality, FlexSet™ will become a cornerstone of

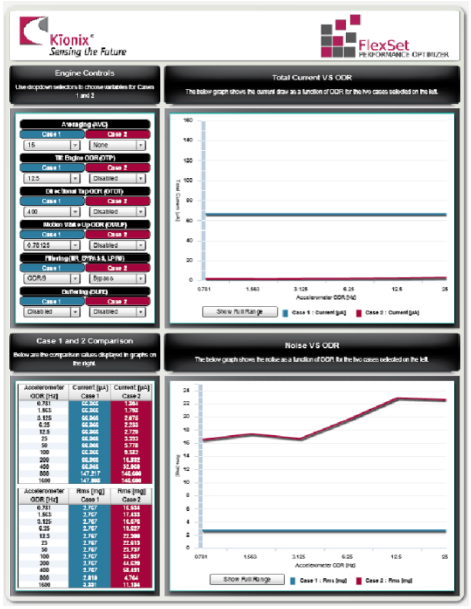
Kionix's low power-high performance products in the future.

What Can System Designers Do with the FlexSet™ Optimizer?

System designers typically want the lowest power as well as the lowest noise values, but the two are at opposite ends of the scale. Providing greater processing power to the interface circuit allows a greater number of samples to be taken in a given timeframe and increased averaging improves the accuracy. More complicated filtering and other steps taken to improve the accuracy of the readings and avoid noise-related inaccuracies increase the current draw. Application modes that can tolerate lower accuracy, allow lower power consumption.

Representative of the actual register selections that designers will have when customizing the accelerometer parameters, this tool allows system designers to tune the performance of their system through precise design parameter choices. Instead of a limited number of preset values, designers will have control of a wide range of switch selections and pull-down menus that provide a variety of operational configurations including ODR, sample averaging, operating modes, sample buffering, bandwidth, and more.

The FlexSet™ user interface demonstrates the resulting impact on power consumption and noise, so system designers can customize the accelerometer for their application and obtain optimized performance. It also includes a "Compare Cases" mode so designers can do side by side comparisons of various settings.



FlexSet™ optimizer allows system designers to determine the unique power and noise tradeoffs they want in their system through a series of precise design parameter selections.

The Output Data Rate pull down menu provides a selection of twelve exponentially increasing values from 0.78125 to 1600 Hz. With a lower ODR, portions of the chip are shut down. If the required number of measurements can be made in a small enough timeframe, additional portions of the circuitry can be shut off until the next series of measurements. This duty-cycling of the chip reduces current draw proportional to the off time.

Typical ODR values for providing output to an external circuit are 50 Hz and 100 Hz. At these values, the current can increase from 43 to 60 µA or 83 to 96 µA. At the same time, noise values from 5 to 10 mg levels for the three

axes, with no averaging filter, can be reduced to less than 1 mg levels by selecting an Averaging Filter number of 128 (the highest level) and increasing the power consumption.

Other system parameter selections include: digital engines settings, sample buffering, bandwidth selection, and more.

Programmable Performance

By building this functionality into an accelerometer, the FlexSet™ performance optimizer allows quicker implementation by system designers. Rather than waiting for the next iteration of new product or a custom implementation, a single product can serve a wider variety of applications and be optimized for those applications.

In addition, the programmability of integrated algorithms that allow system designers to easily implement other system capabilities, such as screen rotation, Tap/Double-Tap™ and motion wake-up functions. These intelligent embedded application algorithms are offered so a system designer does not have to obtain accelerometer data and decide if the screen needs to be rotated, or count and determine where the screen was tapped or determine if the device is moving. The system designer just decides the threshold values for these engines and the actions that they want the system to take, and the engines perform the computations and provide the appropriate decisions and outputs.

The engines do consume current, so system designers can disable them in situations where they are not required or applicable to save even more power. With FlexSet™ optimizer, they can evaluate the impact of the power savings to determine the individual data rate of each engine, providing even greater power savings possibilities.

System designers and others can get a first-hand experience of the simplicity, flexibility and effectiveness of the choices that FlexSet™ optimizer provides by visiting the Kionix website.