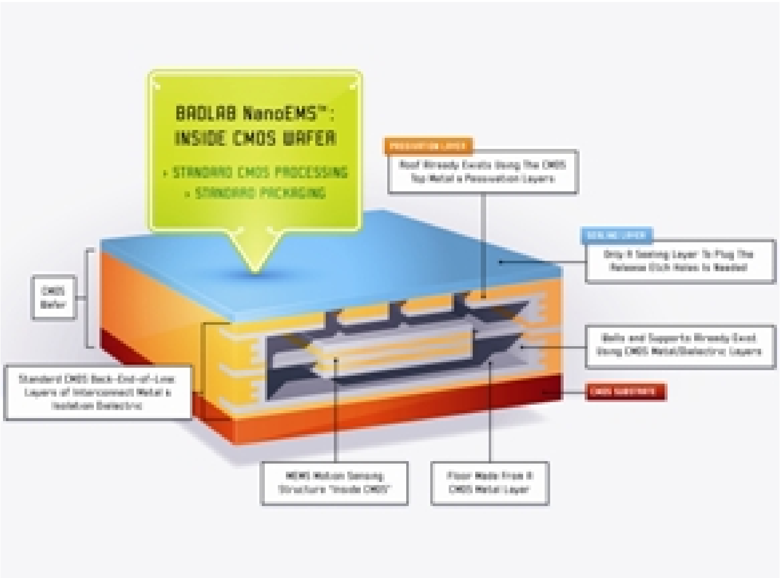
Auto-calibrating CMOS 3D Digital MEMS Compasses Offer Cost-Effective Performance



Until now, 3D Compasses have typically used non-standard technologies such as magneto-resistive materials or Hall-effect structures combined with magnetic field concentrators to detect the direction of the Earth’s magnetic field. Baolab Microsystems is first to design a pure CMOS Lorentz force MEMS sensor and, as a result, its new ***3D Digital NanoCompass*** matches performance benchmarks for sensitivity, power consumption and package size, but at a dramatically lower cost. An additional unique feature resulting from this integration is that the device auto-calibrates to maintain consistent accuracy.

The ***BLBC3-D NanoCompass*** is the first product that will be made using Baolab’s breakthrough ***NanoEMS*** technology. NanoEMS enables nanoscale MEMS (Micro Electro Mechanical Systems) to be built using standard high-volume CMOS lines and fully integrated monolithically with the analogue and digital electronics. The MEMS elements are defined during the normal CMOS production process within the existing metal interconnect layers of the wafer.

“As the market for 3D Compasses grows for smartphones and other mobile devices, the ASP will be rapidly driven down from around a dollar to 50 cents and lower,” explained Dave Doyle, Baolab’s CEO. “Allowing for the fixed costs of testing, tape & reel, pick and place, packaging, etc., the only way to hit this target price and still have a margin for profit is to use our NanoEMS technology, as traditional approaches are several times more expensive. When several devices are integrated onto a single chip to create a multi-sensor device using NanoEMS, the cost savings compared to conventional MEMS become even more significant especially as different sensors require different production processes, unlike NanoEMS.”

Baolab's innovative design uses Lorentz force sensors to detect the Earth's magnetic field. The MEMS structure, a moveable aluminium plate suspended by springs, is constructed using the metal interconnect layers of the CMOS chip by etching away the Inter Metal Dielectric (IMD) using vHF (vapour HF). When a current passes through the plate, it experiences a force (the Lorentz force) proportional to the surrounding Earth's magnetic field. The resulting displacement is measured using capacitive detection between the moveable plate and fixed electrodes around it, sensing the magnetic field in the x, y and z directions with a single NanoEMS chip.

Hall effect sensors work well for magnetic field perpendicular to the chip (z direction) but less so in the x and y planes, and are not pure CMOS solutions as they require post processing to deposit some magnetic material on top of the wafer to increase their sensitivity (Integrated Magnetic Concentrator). This adds to the cost of manufacture, as does the additional processing required to realise compass devices from magneto-resistive technologies such as AMR and GMR (Anisotropic Magnetoresistance and Giant Magnetoresistance). Other benefits of Lorentz over Hall include lower power consumption due to the use of metallic conductors to carry the current, increased sensitivity using mechanical resonance and no magnetic saturation issues.

Until now, the Lorentz force approach has not been used extensively due to the cost of manufacture using conventional MEMS techniques, but it is perfectly suited to the mechanical structures supported by Baolab's NanoEMS. Built in a standard CMOS process flow, NanoEMS makes it possible to manufacture the devices at a fraction of the cost, opening the market for a new generation of mobile devices that take advantage of Baolab's lower cost 3D NanoCompasses.

Engineering samples of the *BLBC3-D NanoCompass* will be available in 2012 along with a comprehensive evaluation kit. It provides 5 degree heading resolution and 13-bits per axis. Commercial product will have an I2C or SPI digital serial interface and a choice of either a 3x3x0.9mm 10 pin DFN/0.5mm pitch package, which provides drop in compatibility with existing solutions, or a 2x2x0.75mm BGA package. Full details are at www.baolab.com/compass.htm [1]

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