MEMS magnetic field sensor for high accuracy applications

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Abstract

Novel MEMS based current and magnetic field sensor based on low stress silicon nitride cantilevers is presented. The Si_xN_y cantilever has an embedded coil carrying a predetermined bias current for sensing an external field. The objective was to develop robust, reliable, high accuracy revenue metering quality current sensing based industrial application with a 10-year product lifetime.

The devices were fabricated, and tested in large quantities. The process was later transitioned to a foundry for production; engineering runs of 9 wafers / 5000 devices to demonstrate reliable operation and yield. The sensor was tested for an operating range of 0.1A to 250A with a linearity of 0.5% of reading. The novelty in the approach includes optimized design for temperature, shock, position sensitivity and cross-sensitivity to noise; novel high yield process for die singulation using a protective coating; an automated wafer level magnetic test scheme; a novel synchronous device for acceleration compensation. These results constitute the 1st time a resonant MEMS device with swept-frequency bias current operation for DC & AC current sensing. This novel approach is robust to frequency drift; it removes the need to lock to the resonant frequency, and leads to higher reliability. These devices were also operated in parametric resonance modes that provide significant and unique benefits.

The applications of this sensor are very broad and span current sensing from automotive applications to high accuracy sensing for revenue quality metering.