Title: MEMS-Oscillators Revolutionizing the Precision Timing Market

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Abstract: Frequency references are the heartbeat of most electronic systems. Over the last decade, MEMS-based frequency references have revolutionized the timing market by outperforming quartz-crystal oscillators in many applications, where they can offer lower power, smaller size, better stability, programmability, and higher reliability. In this paper, a MEMS-based frequency reference is presented which achieves a frequency stability of < ±100 parts per billion (ppb) in the temperature range from −45°C to 105°C, and an Allan Deviation (ADEV) of <2e−11 over 1 s averaging time. The result of an improved version of this device is also presented where the frequency stability over temperature is improved by 10 folds, to better than < ±10 ppb, which matches the performance of entry-level quartz-based OCXOs. Such oscillators are key building blocks in telecom, networking, and precision timekeeping systems. To enable such performance, SiTime's Dual-MEMSTM technology is used for temperature-to-digital conversion (TDC). This technology enables the design of high-precision temperature-compensated MEMS-based oscillators with superior performance for applications in breezy conditions and harsh environments. The TDC circuit is realized in a 0.18-µm CMOS process and achieves a resolution of 20 µK over a bandwidth of 100 Hz while consuming 19 mW of power, leading to a resolution FOM of 40 fJK2. Measurement results supporting the applications in harsh environments are presented, while a comparison with the high-performance quartz-crystal TCXO solutions will be also provided.

Author / Presenter BIO:

- M.Sc. and Ph.D. from TU-Delft
- Joined SiTime Corp. in Santa Clara, USA in 2014
- Started SiTime's branch in The Netherlands in 2017
- Presently, Sr. Director of Circuit Design focused on designing MEMS-based oscillators
- Has authored or co-authored over 20 peer-reviewed scientific papers, one book, and holds several U.S. patents