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Mobius Microsystems, Inc

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Corporate Backgrounder

Market Overview:

Frequency generation is one of the fundamental elements of electronics design. Whether you're building a simple garage door opener or a sophisticated space navigation system, you need a component in your design which generates high frequency timing signals to synchronize the communications among ICs, PCBs, and eventually complete systems. Today, almost without exception, the task of frequency generation is carried out by piezoelectric materials such as quartz crystals or ceramic resonators. With a steady growth rate for decades, billions of crystals and oscillators are now produced worldwide each year.

For decades, the makeup of electronic devices underwent continuous transformation - from tubes to transistors and from analog to digital processing - but dependence on quartz crystals as frequency generators remained virtually unchanged. In fact, in most systems quartz crystals are the only remaining non-semiconductor component on the board. Recent trends however, reveal weaknesses and limitations of quartz crystals. The shrinking dimensions of many CE products make the large, bulky packaging required for crystals unacceptable; as high definition and personal multimedia applications drive up the amount of bandwidth required by consumer electronics and storage devices, standard reference frequencies are increasing beyond the capabilities of low cost, fundamental mode crystals.

Fortunately, the recent emergence of RF-capable CMOS processes, and innovations in precision analog CMOS design, allow for building a frequency source monolithically in silicon eliminating the limitations imposed by quartz frequency sources. With its patented CMOS Harmonic Oscillator (CHO™) technology, Mobius Microsystems champions the path to removing all mechanical resonators and ushering in a new era of fully integrated electronics.

CMOS finally breaks quartz tradition:

By implementing the frequency reference on a monolithic CMOS IC, Mobius allows the industry to finally move beyond quartz-based crystals, or other mechanical resonators, and explore the many benefits of integration made possible only by an all-CMOS solution. The CHO technology removes the high frequency limitation of low cost, fundamental mode crystals and accommodates the thinnest IC packaging available to system designers. The integrated and space-saving design eliminates the common frequency drift problems associated with crystal's load capacitors, and it offers excellent shock and vibration immunity. In addition to size and reliability advantages over quartz crystals, CHO products significantly shorten the manufacturing cycle time to best respond to the fluctuating demands of the consumer electronics market.

This is the first CMOS oscillator to achieve very low frequency drift over all environmental conditions including temperature, voltage and process variations. It offers system designers a frequency source with excellent phase noise and jitter performance.

The foundation of this patented CHO design is a harmonic (LC) resonator circuit which, unlike common LC resonators that have long been used in low jitter PLLs, is designed to maintain its frequency accuracy in an open-loop configuration. The key innovation that Mobius brings to market is a complex analog control circuitry that compensates for process, voltage and temperature variations to stabilize the oscillating frequency with sufficient accuracy in the open-loop configuration. The technology enables CHO to support many common consumer electronics and storage system interfaces. The company offers a broad selection of output frequency and package options to fit the needs of various applications.

Mobius History:

Mobius Microsystems was established in April 2004 leveraging years of extensive CMOS and mechanical oscillator research at the University of Michigan, Ann Arbor. The team's research solidified the conviction that an all-CMOS approach is a more compact, more reliable, better performing, and more scalable solution to the problem than any other proposed alternative. After verifying fundamental concepts within the research environment, the company moved on to commercialize the technology. Upon receiving seed funding, the company expanded its engineering resources and refined the all-CMOS oscillator technology. The first customers of Mobius were leading semiconductor companies that noticed the compelling value of an integrated CMOS oscillator. Consequently, the company signed up with a leading semiconductor company to implement the CHO technology in IP form as part of a larger ASIC. The project was successfully completed and released to mass production in early 2006. With the release, CHO became the first technology to replace quartz crystals in a commercial application.

After receiving Series A funding from leading venture capital firms – Foundation Capital, Menlo Ventures and RPM Ventures - Mobius relocated its headquarters to Sunnyvale, CA to attract the experienced engineering and management talent in Silicon Valley. Today, the company maintains design centers in both Sunnyvale and Detroit, MI.

Mobius accomplishments:

The design team at Mobius Microsystems has a long list of outstanding technical achievements:

- First commercial replacement of quartz crystals in a USB 1.0 Full-Speed interface link
- First CMOS oscillator to match the accuracy, phase noise and jitter performance of quartz-based crystal oscillators
- An all-CMOS, integrated microprocessor clock with the fastest start-up time
- First, fully-integrated Spread Spectrum Clock Generator that eliminates the need for both quartz crystals and PLL ICs

The company is recognized in many business forums in Michigan and California, and it was named in 2006 as an "FSA Start-up to Watch" nominee.

The company's patented CHO technology has been published in detail in the most respected peer-reviewed scientific journals, and presented in leading conferences, including ISSCC '08, JSSC '07, ISCS '06 and ICICC '05.

Mobius Microsystems maintains a large portfolio of US and international patents in the field of all-CMOS clock generation. Currently, the company has 7 issued patents, and 18 pending applications that apply to various aspects of CMOS clock generation.

Business model:

Mobius Microsystems is a fabless semiconductor company with funding from leading venture capital firms in Silicon Valley and Michigan. The company offers its patented CHO technology both in component and, in very select cases, in IP form. The first products to utilize the CHO technology are CMOS oscillators

which are targeted to replace quartz-based oscillators, and SSCG ICs which will replace both the quartz crystal and the PLL ICs that are used to multiply the quartz frequency and implement Spread Spectrum Clocking.

Integrating Time:

Mobius' CHO technology will launch a new era in timing generation for the electronics industry, benefiting consumer electronic appliances, storage devices, peripherals and automotive applications. Using standard CMOS to integrate frequency references represents the final breakthrough in the path to complete integration of key system functions.