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Peregrine Semiconductor Invents DuNE™ Technology for Mobile Antenna Tuning

Digitally Tunable Capacitors enable high-performance RF tuning for GSM cellular, mobile TV

San Diego, California, and Munich, Germany, November 10, 2008 -- Peregrine Semiconductor Corporation, a leading supplier of high-performance RF CMOS and mixed-signal communications ICs, today announced a breakthrough in the highly sought-after solution to mobile antenna tuning. The Company's new DuNE™ Technology, a patent-pending design methodology made possible by Peregrine's UltraCMOS™ process and HaRP™ design innovation, has enabled a single-die tunable capacitor circuit – referred to as a Digitally Tunable Capacitor (DTC) – which meets the high-performance demands for antenna tuning in leading-edge cellular and mobile applications. These demands include superb power handling and linearity; low power consumption; and highly integrated in a small form factor. For more than 20 years, the RF researchers have attempted to address these challenges with a variety of micro-electromechanical systems and ferroelectric materials technologies, each having its own merit yet unable to integrate the features and functionality enabled by Peregrine's DuNE Technology.

What Is Antenna Tuning?

Because of the increase in new features, functionality and industrial design requirements, the space available for the mobile system antenna is shrinking at a rapid rate. As antennas are wrapped and repathed, they lose efficiency. Some of this lost performance can be recovered with antenna tuning, in which the system uses dynamic impedance tuning techniques to optimize the antenna performance for both the frequency of operation and the environmental conditions.

"One of the most significant challenges facing the mobile handset designers is the poor antenna performance for multi-band multi-mode handsets. Dynamically tuning the antenna to compensate for the increasing bandwidth requirements and environmental effects will significantly improve the antenna performance," stated Tero Ranta, Manager for Advanced Technology at Peregrine. "Further, as the market demands new wideband services in the

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handset, such DVB-H and ISDB-T for mobile TV, the use of antenna tuning becomes a necessity. Until now, no tunable element met the needs of the mobile products industry in power handling, reliability, high volume production and integration. Peregrine's DuNE Technology is the key to unlocking the future of digital tunability in mobile RF systems," he added.

The first devices in the DuNE DTC portfolio are designed to meet the stringent broadband requirements for DVB-H and ISDB-T mobile TV; multi-mode, multi-band GSM/WCDMA cellular handsets; and the power handling requirements for interoperability between the two applications.

DuNE Technology for Cellular Applications

In addition to traditional cellular frequencies, today's mobile phones may need to support frequencies from 0.7 GHz up to 2.7 GHz, for cellular bands as well as non-cellular services such as mobile TV, Bluetooth, WLAN and GPS. The RF transceiver of the mobile phone is designed for 50 Ohm impedance. Ideally, the antenna would match that impedance across the entire frequency band. However, small handsets have inherently narrow antenna bandwidth, poor antenna matching and low radiation efficiency, and, without antenna tuning, ultimately are prone to antenna mismatch. To date, several first generation open-loop antenna tuning systems are being used in handsets, and development teams are beginning to design adaptive closed-loop antenna tuning systems. Micro-electromechanical systems (MEMS) and ferroelectric materials technologies (such as BST) have been used to implement tunable antennas and filters, however they are not yet proven for high-volume production and both typically require a high bias voltage (up to 30V or higher) to tune, requiring a separate CMOS charge pump and controller chip. Because UltraCMOS technology enables monolithic integration of RF, analog and digital circuitry, Peregrine's single-die DuNE DTCs integrate high-Q tunable capacitors (Q=40 to 80 at 1-2 GHz) with a built-in low-voltage serial interface, in a chip-scale package offering a footprint that is 5 times smaller than competing technologies. Typical capacitance values range from 0.5pF to 10pF, with typical tuning ratios ranging from 3:1 to 6:1 with 5 bits or 32 states of resolution. In addition to >+38 dBm of power handling in 50 Ohm, DuNE DTCs feature high linearity (IP3 > +65 dBm) and switching speed of better than 5µs.

DuNE Technology for Mobile TV

Mobile TV applications such as DVB-H and ISDB-T also require very broadband reception and delivering good coverage to an already complex system, all in a small space. Achieving broadband reception is directly related to the physical size of the antenna and the handset; any antenna mismatch degrades range and reception quality. To date, designers have typically had only two antenna choices: a passive internal antenna with poor performance, or the external whip antenna. The embedded, internal antenna is demanded by the market, yet poor performance is not accepted. As a result, interest in "tunable" internal antennas – those which cover a narrow section of the bandwidth and can be "retuned" as the receive channel changes – is increasing.

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When the DVB-H antenna is embedded in the GSM handset, the tunable element for DVB-H antenna tuning needs to be able to handle high levels of coupled GSM power without shift in capacitance or causing nonlinearities. Typically better than +26dBm of linear power handling is required to meet GSM/DVB-H interoperability requirements. The existing design options for mobile TV antenna tuning (such as varactor diodes or bulk-CMOS switched capacitor banks) do not meet these power handling requirements. Using a high-linearity switch (e.g. SP4T) to implement switchable tuning network can meet interoperability requirements, but results in very rough tuning.

Peregrine's new DuNE DTCs have been designed for 5 bits of resolution or 32 tuning states, which provides the level of fine resolution that is required to tune the antenna across the entire mobile TV band. As well, DuNE Technology enables a Q = 40–70 at 470 to 862 MHz for a 1.36 to 6.3pF (4.6:1) tunable capacitor. The current consumption is only 11 µA at +2.75 V, while meeting the stringent power handling requirements of better than +28dBm and IIP3 > +62dBm.

Individual DTC devices are planned for release during 2009, beginning with the DTCs for mobile TV which will be offered in the tiny 2x2mm 8-pin DFN package. Pricing will be volume dependent and is available by contacting Peregrine at sales@psemi.com.

Today's news reflects the growing demand for Peregrine's UltraCMOS SOS RFICs. Peregrine has brought to market a variety of innovative products throughout the recent years – devices which deliver performance objectives set by market leaders with highly stringent RF design requirements. These companies include global cellular powerhouses, navigation/communications experts, as well as CATV/DTV leaders. Peregrine's UltraCMOS devices are becoming increasingly critical in high-performance RF designs. Continued enhancements to the fundamental design technology, such as the HaRP™ and DuNE technology innovations, combined with the perfectly insulating sapphire substrate, results in extremely linear FET with exceptional RF performance. The ability to integrate high-performance RF, analog, digital, passive elements and nonvolatile memory on a single, standard CMOS IC sets UltraCMOS devices apart from compound semiconductor and other mixed-signal processes.

Further details about the DuNE Technology invention may be found on the Peregrine website at www.psemi.com.

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About UltraCMOS™ Technology

UltraCMOS™ mixed-signal process technology is a proprietary, patented variation of silicon-on-insulator (SOI) technology on a sapphire substrate providing with high yields and competitive costs. It combines the RF, mixed-signal, and digital capabilities of any other CMOS process, yet tolerates the high power required for high-performance wireless applications. The Company's revolutionary HaRP™ and DuNE™ design innovations enable dramatic improvements in harmonic results, linearity and overall RF performance; specifications required by the 3GPP standards body for GSM/WCDMA applications which are unmatched in the industry. These significant performance advantages exist over competing processes such as GaAs, SiGe, BiCMOS and bulk silicon CMOS in applications where RF performance, low power and integration are paramount.

About Peregrine Semiconductor

Peregrine Semiconductor Corporation designs, manufactures, and markets high-performance communications RF ICs for the wireless infrastructure and mobile wireless; broadband CATV/DTV; communications infrastructure; and space and avionics markets. Manufactured on the Company's proprietary UltraCMOS™ mixed-signal process technology, Peregrine products are uniquely poised to meet the needs of a global RF design community in high-growth applications such as WCDMA, EDGE and GSM digital cellular, broadband, DTV, DVR and rad-hard space and defense programs. The Company, headquartered in San Diego, California, maintains global sales support and manufacturing operations and a worldwide technical distribution network. Additional information is available on the web at psemi.com.

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