Philips announces a silicon-based BiCMOS technology for emerging microwave applications

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Royal Philips Electronics today introduced QUBiC4X, the latest addition to its highly successful QUBiC4 family of high-performance BiCMOS (Bipolar CMOS) process technologies. Based on silicon-germanium-carbon (SiGe:C) technology, this new process features bipolar transistors with fT figures in excess of 130 GHz, suiting it to microwave applications in the 10 GHz to 30 GHz range such as satellite TV receivers and automotive collision avoidance radars. Its ultra-low noise figure suits the process for use in sensitive RF receivers such as those required in high-performance mobile phones.

In terms of gain and noise figure, QUBiC4X's bipolar transistors rival gallium-arsenide performance, while at the same time the process allows the integration of CMOS logic, CMOS RF circuitry and high-performance high quality factor passive components. In addition to opening up new consumer-product oriented microwave applications that require the cost-benefits and volume manufacturing advantages of a silicon-based technology, QUBiC4X allows current hybrid solutions containing separate silicon and gallium-arsenide components to be replaced by much more highly integrated solutions.

"With the introduction of QUBiC4X, designers have the benefit of a high-performance, cost-effective, reliable process technology that meets the performance, volume manufacturing and integration density requirements of demanding consumer-product applications as well as

professional applications," said Patrice Gamand, Technology Manager for Philips Semiconductors' RF Innovation Center.

Applications for QUBiC4X range from mobile phone transceivers, where the combination of a low noise figure and low collector current provides more reliable reception and longer battery life, to 30-GHz automotive collision avoidance radars and short-range microwave links. Low-noise amplifiers such as those used in low-noise receivers for satellite TV, and RF power amplifiers are other obvious applications.

QUBiC4X Performance

QUBiC4X has been designed with real application requirements in mind rather than just a set of performance figures. The gain and cut-off frequency of its bipolar transistors have been co-optimized so that these transistors exhibit highly usable power gain at microwave frequencies well in excess of 30 GHz. Their fT x BVCEO figure is a record-breaking 245 GHz, offering RF circuit designers a unique combination of power gain and excellent dynamic range. The transistors have also been optimized so that their 0.4 dB noise figure applies at the low collector currents needed to conserve battery power in portable products. A process option that allows the integration of high breakdown-voltage power transistors enables the production of GSM (Global System for Mobile Communications) RF power amplifiers with 88% power-added efficiency.

QUBiC4X features the same extensive range of passive component integration capabilities as previous QUBiC4 generations, together with a set of newly developed 'elite-passives'. These enable the design of highly integrated solutions that combine improved RF performance with smaller size and weight, lower peripheral component count and cost, and easier design-in. The library of elite passives includes High-K MIM (High dielectric constant Metal-Insulator-Metal) capacitors for best-in-

class capacitance densities, SiCr thin-film resistors, and well-modelled high-Q inductors. The high-resistivity silicon substrate used in the QUBiC4X process has been chosen to minimize microwave losses, while an extensive armory of substrate isolation techniques reduces parasitic effects. QUBiC4X is fully supported by device models for its active and passive components and by integrated design flows.

Source: Philips