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A Current-Switching and *gm*–Enhanced Colpitts Quadrature VCO

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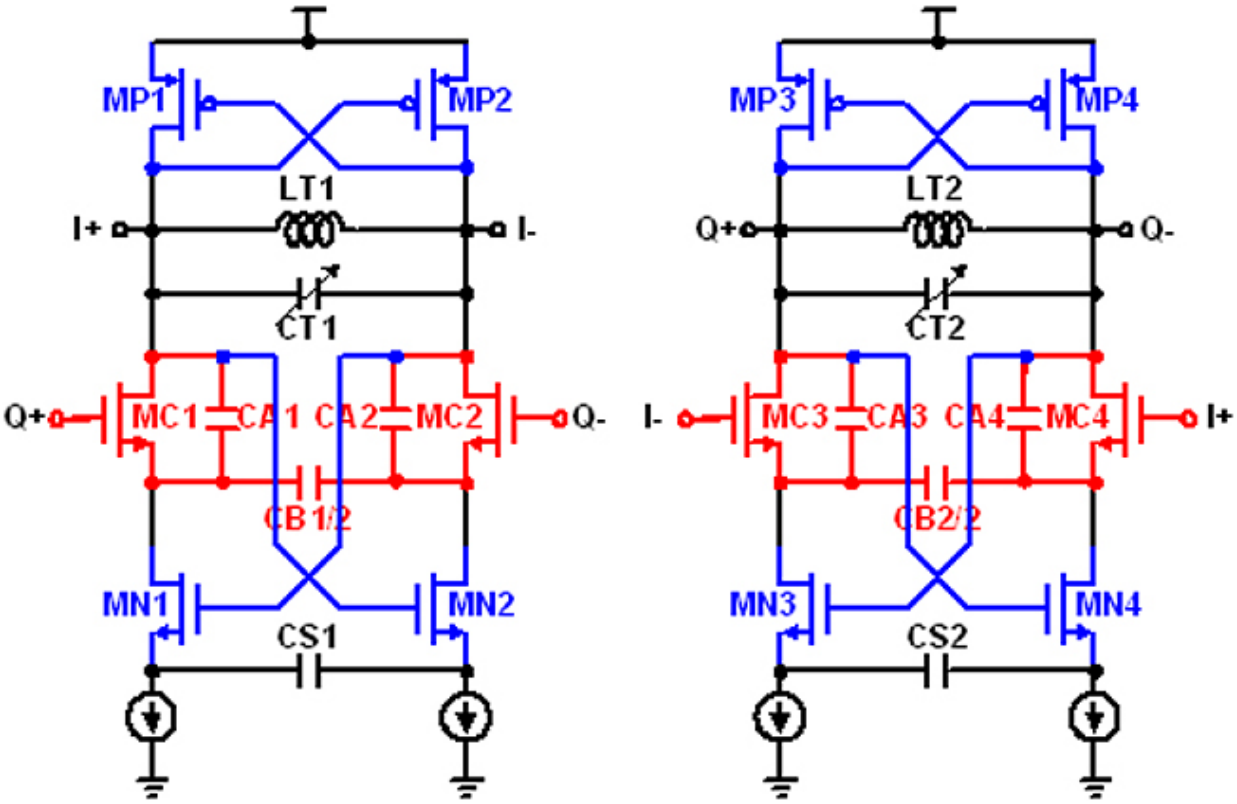
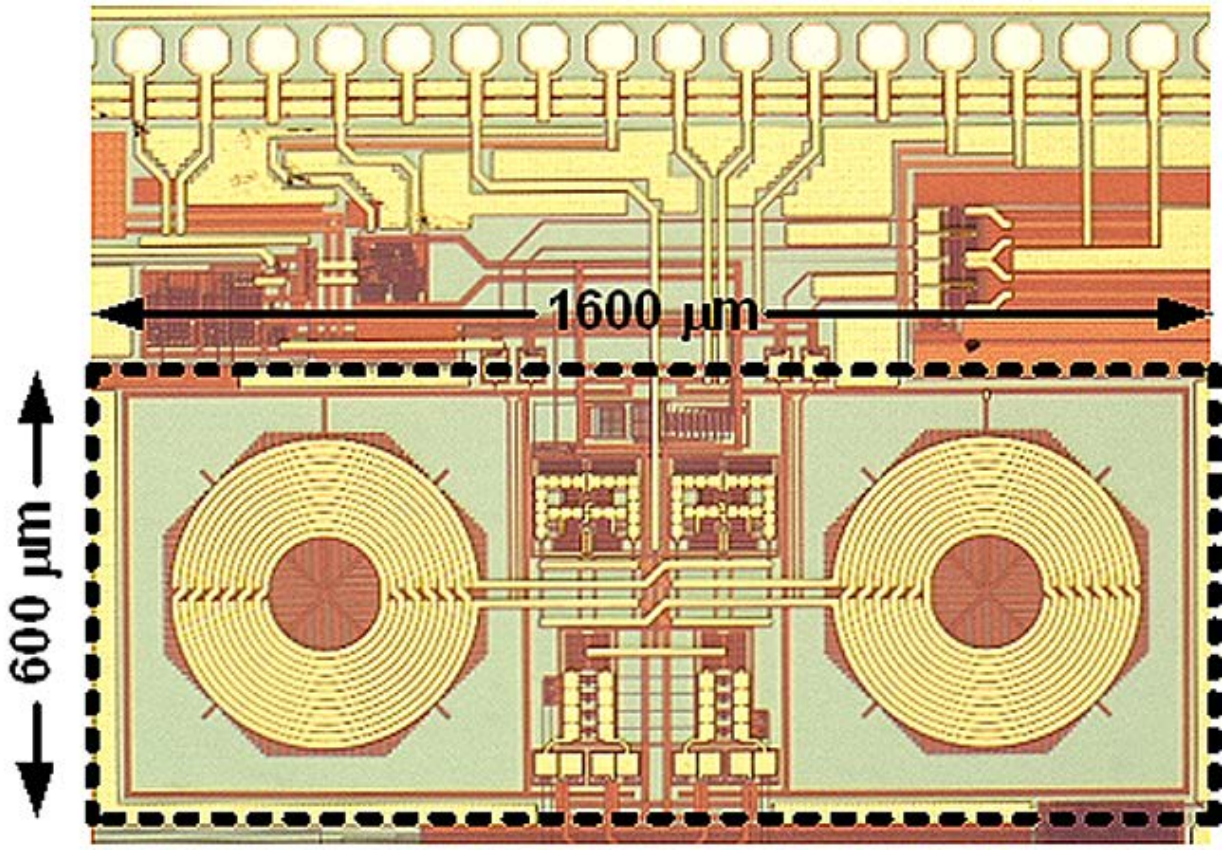
Power consumption is one of the most important concerns regarding radio transceivers in wireless medical devices for Medical Device Radio communications Service (MedRadio). For the coverage of broad MedRadio spectrum from 401 to 457 MHz in a single portable communication terminal, circuit designers are ever challenged by the unlimited reduction of transceiver power dissipation. In fully-integrated CMOS image-rejection, direct conversion, or low-IF receiver and transmitter architectures, quadrature voltage-controlled oscillators (QVCO) are essential circuit blocks for signal (de)modulations.

The aim of this project is to design and analysis a low-phase-noise and low-power quadrature voltage-controlled oscillator for MedRadio. Key challenging specifications are accurate quadrature phase and wide tuning range. Colpitts VCO is adopted in the proposed QVCO due to its low phase noise nature. By employing a current switching technique to improve the startup condition and reusing the core device to realize anti-phase injection locking, the proposed Colpitts QVCO has superior phase noise than the cross-coupled LC VCO and outperforms conventional QVCO in phase noise, quadrature phase accuracy, and tuning range. In addition, this project will use active devices compensation to mitigate the amplitude and quadrature phase error due to the component matching and process variation between the I/Q branches. What's more, by using high quality factor MEMS resonators will provide an aggressive attempt to achieve lower power consumption and lower phase noise.

A proposed Colpitts QVCO design is presented for low power, low phase noise, high quadrature phase accuracy, and large tuning range. The enhancement of effective transconductance leads to easier startup and reduced power consumption. The quadrature outputs are obtained by coupling two differential Colpitts VCOs with current switching via Colpitts oscillator core without extra coupling devices required. When operating at 488 MHz, the measurement shows the phase noise of –118 dBc/Hz @ 1-MHz offset, quadrature phase accuracy of 0.3˚, and tuning range of 20%, while consuming only 0.75 mW.



Schematic of QVCO



Chip photo of QVCO