



Low Phase Noise Ring-type Voltage Controlled Oscillator

IP Status: Issued US Patent; **Application #:** 09/624,929

Low Phase Noise VCO

A ring-type voltage controlled oscillator (VCO) with a delay stage minimizes phase noise and has an inverter, a memory element and tuning circuitry. The inverter receives a signal from and provides an output to other delay stages. The memory element is coupled to the inverter's output to delay the time before the output signal begins to switch states in response to switch of states of the received signal. The amount of this delay depends on the relative strengths of the inverter and the memory element. The tuning circuitry is coupled with the inverter and receives a control voltage to alter the inverter's strength, thereby altering the delay time without altering the strength of the memory element. Altering the strength of the tuning circuitry alters the delay of the delay stage, and hence the frequency of the VCO's operation. Because the memory element's strength is not altered, the speed at which the inverter's output switches remains substantially constant at all tuned frequencies. Furthermore, because phase noise is generated during the switching time, maintaining the increased switching speed reduces phase noise.

Technology ID

z00179

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Superior Phase Noise Performance

CMOS VCOs with low phase noise have attracted tremendous interest in recent years, but currently they tend to suffer from undesirable phase noise in most applications due to random fluctuations in the output phase of the oscillator. Ring oscillators, while easy to implement, usually have large phase noise, rendering them unsuitable for many applications. While phase noise models for ring oscillators have been built, none of them provide intuitive directions for low phase noise designs. This new model considers the nonlinear operation of a ring oscillator and analyzes the noise generation mechanism inside a ring oscillator. This design uses a small set of ring oscillator designs that provide superior phase noise performance compared to traditional ring oscillator designs. The circuit in this technology minimizes phase noise for both

device intrinsic noise and external noise coupled through power supply and silicon substrate. In addition, the oscillator operates in an all-digital CMOS technology and can therefore be fabricated on the same substrate with the rest of the digital circuitry, resulting in a more compact design, lower production cost and reduced power consumption.

BENEFITS AND FEATURES:

- Low phase noise: superior phase noise performance compared to traditional ring oscillator designs
- Oscillator operates in an all-digital CMOS technology; can be fabricated on the same substrate with the rest of the digital circuitry
- More compact design
- Lower production cost
- Reduced power consumption

APPLICATIONS:

- Communications
- Wireless communications systems
- VCO applications
- Frequency synthesizers
- Clock recovery circuits

Phase of Development - Proof of Concept

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