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Design and Performance Analysis of Oscillator Circuit for High-Impedance Quartz Vibrating Beam

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In this paper, the design, analysis and experimental results of the multiple common-emitter series oscillator circuit with negative feedback for a high-impedance quartz vibrating beam, which is used in a recently designed accelerometer, are presented. The equivalent circuit parameters of the quartz vibrating beam are introduced and the impedance characteristic is analyzed. For the oscillation loop analysis based on the small-signal model analysis method, the model of the oscillation loop is established and analyzed. Using the analytical results, the multiple common-emitter series oscillator circuit parameters are designed and the expected loop performance is characterized by simulations. Then the resonant system is practically implemented using the high-impedance vibrating beam and the multiple common-emitter series oscillator circuit. The resonant system performance is evaluated using the Agilent frequency meter 53132A. The experimental results show that the high-impedance quartz vibrating beam vibrates stably with the multiple common-emitter series oscillator circuit, and the vibrating frequency bias stability of the system is less than 8 mHz.

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