

Compact Low Phase Noise 3.8GHz Oscillator

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This paper describes the theory and design of a compact low noise dielectric resonator oscillator operating at 3.8GHz. The oscillator demonstrates a phase noise performance of -150 dBc/Hz at 10kHz offset with a tuning range of 200kHz and a vibration sensitivity between 10^{-8} and 10^{-9} g $^{-1}$. The power supply requirements are 6V without a regulator or 8V regulated at 160mA. The box dimensions are 11 x 11 x 5 cm.

The oscillator is based on a feedback configuration consisting of a medium power amplifier, multi-section single layer 10dB output coupler, tunable electronic phase shifter, fixed phase shifter and a dielectric resonator with printed probes. The initial prototype is shown in Figure 1. Printed probes are used for coupling to the resonator which produces an unloaded Q of 19,000. Unloaded Qs up to 30,000 can be obtained for less robust configurations.

The oscillator was built such that most of the individual elements could be measured independently. Design curves for varying coupling line shapes and lengths were developed to achieve the required Q_L/Q_0 and hence insertion loss for the resonator. Two of these oscillators were built to enable the phase noise to be measured as the noise is below that of most measurement equipment.

Finally, vibration measurements were done at spot frequencies using a loud speaker and DC vibration motor at the University of York and full vibration measurements were performed at Selex-ES. The vibration sensitivity varied from 10^{-8} to 10^{-9} per g depending on the axes.

A more modular compact design is currently under investigation where the individual elements can be measured and thereby optimised separately and then linked directly with each other to form the oscillator. A manual tuning phase shifter has also been designed so that the coaxial cables which are sensitive to vibrations can be removed. The open loop phase shift is required to be accurate to $<\pm 1$ mm ($10^\circ/\text{mm}$) to achieve the required phase noise performance. Improvements in phase noise performance of around 8dB are predicted and expected.

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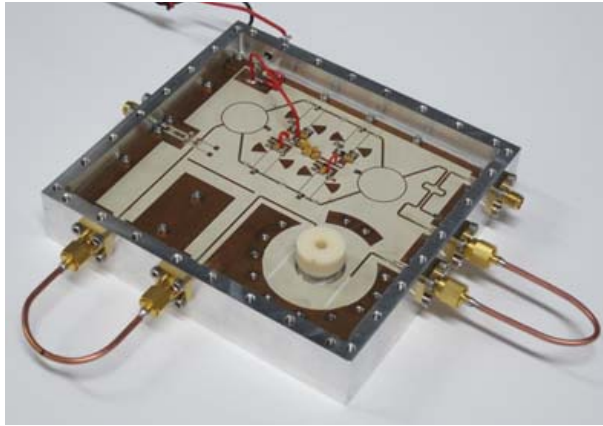


Fig. 1: Dielectric Resonator Oscillator with lid removed. The lid contains the resonator enclosure.