

APPLICATION NOTE

Optimizing DROs for Low Phase Noise

Introduction

The circuit method described in this Application Note provides a fast qualitative indicator of the best resonator position.

Optimization

Designers of free-running Dielectric Resonator Oscillators (DROs) ultimately face the task of fine tuning the best DRO “puck” position adjacent to the microstrip. Frequently, the goal is to minimize phase noise at a specified offset from the carrier. Through trial and error and many observations on a spectrum analyzer, it is possible to strike a compromise between low phase noise and good power output. Low phase noise is dependent upon the choice of:

- An active device
- Operating bias point
- Supporting circuit components
- Unloaded quality factor of the resonator

All the above contribute to the Loaded Quality Factor (QL) of the oscillator unit.

Although QL has been measured by load-pull or injection-locking techniques, QL is not the bottom line. The technique described in this Application Note minimizes noise and simultaneously monitors relative power output. Because the pushing figure or the sensitivity of the oscillating frequency to changes in supply voltage are also tied to QL, pushing as a qualitative indicator of the puck position provides the optimum QL and good phase noise.

Instead of manually varying the supply voltage, if the supply is modulated, set the voltage to approximately $0.5 V_{p-p}$ at a low audio rate. If the bench supply cannot be programmed to do this directly, insert the secondary of a miniature audio transformer between the supply and the circuit—after the voltage regulator, if any—and drive the transformer primary from an audio source such as a function generator. Non-linearity in the active device causes a conversion from the amplitude modulation to the frequency modulation (fm). Adjust the spectrum analyzer to view the fm. Experiment with the x, y, and z position of the DRO puck and supply voltage (or active device current).

As a high QL point is approached, the fm deviation minimizes, and the dB amplitude (power output) change can be observed. Turn off the modulation to make a few correlations of the minimum fm deviation puck position with close in-phase noise, and then help is provided to discover the best DRO placement.

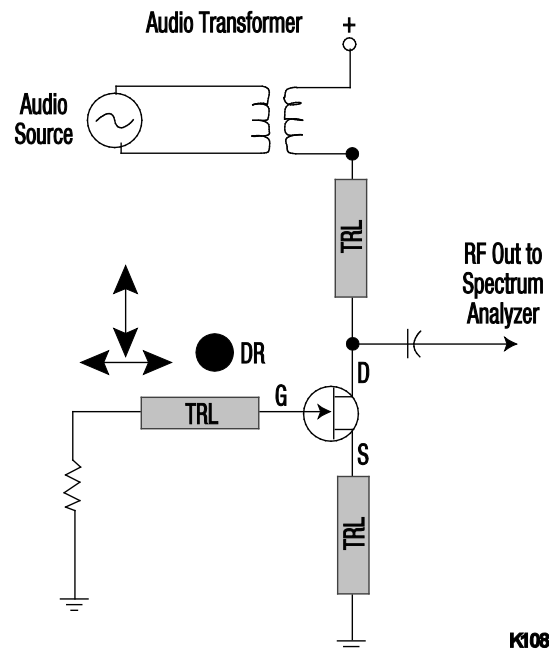


Figure 1. Apply Amplitude Modulation for Phase Noise Optimization

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