A PARAMETRIC QUARTZ OSCILLATOR

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In its principle a Parametric Quartz Oscillator (PQO) is based on the use of a non-linear component characteristics, which works like a negative resistance.

The basic design of a PQO is first described. It is made of two selective loops related by the non-linear element, which is here a varactor. The main loop including a quartz resonator is able to oscillate at its resonant frequency provided that the pump frequency of the second loop signal is appropriate according to the conditions discussed in the paper. The expected advantage of the PQO in comparison with classical oscillator designs (Pierce, Colpitts, Clapp oscillators) is a low level of 1/f noise.

Then, a review of the PQO working is given. It is based on the famous Mathieu's equation and leads to the Manley-Rowe formulas which predict the power distribution between the various signal waveforms. Thus, it is shown that the energy supplied into the main loop is equivalent to the insertion of a negative resistance. As a consequence the PQO network seems to be a parametric generator.

A first calculation of the circuit behaviour in steady state is performed. It uses quasilinear analysis to determine the negative resistance value due to the pumping effect versus the bias voltage and the varicap parameters.

A second method is used to calculate the transient behaviour of the PQO circuit. The differential equations associated to the network are written in the Cauchy's form. This resulting system of differential equations is then solved by numerical methods.

Thus, currents and voltages in the PQO circuit are known in any case.

The results of computer simulation of the PQO circuit are in accordance with the first theoretical calculation and enable us to determine the circuit parameters at which self-oscillation can be achieved.

The PQO prototype developed in the Laboratoire de Chronométrie Electronique et Piézoélectricité (LCEP, Besancon France) is now on the stage of testing and optimization