Controlled Oscillator on the Base of MEMS-Structures

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Abstract – **the paper represents on-chip oscillator controlled by combined (analog and discrete) device controlling piezoresonance oscillating system on the MEMS structure base. This device can be used in telecommunication systems for generating high-stability signals.**

Keywords – **on-chip oscillator, the controlled MEMS – capacitor, niobate – lithium resonator.**

I. INTRODUCTION

The principally new technology producing microelectromechanical resonance units, inductors, controlled by voltage of capacitors and other on-chip units is compatible with standard integrated circuit (IC) technology and got strongly developed for the last years. This is microelectromechanical systems (MEMS) technology using integration process on poly-silicon surface [1-2].

MEMS technology gives new ways to develop communication devices by principal changing their architecture and improving such basic characteristics as quality factor, consumed power, noise level, filtration channel pass-band width.

II. OPERATION ALGORITHM

Controlling piezoresonance oscillating system (POS) by means of varicap is mostly used but has a range of disadvantages. The primary ones are: increasing phase noise, lowering quality factor (especially in high frequencies), appearing effect of self-modulation by high-frequency signal and worsening harmonic structure of the signal due to nonlinearity of oscillation system. Varicaps, used to adjust oscillators' frequency, significantly worsen signal/noise ratio because of low *Q* and self-modulation appearing when power level changes [3].

It's known [4], that adding to an oscillating circuit a varicap with back current level I_0 causes $\hat{E}_{noise}$ times increasing noise level:

$$\hat{E}_{noise} = 1 + \frac{qI_0 p^2 R_{ekv}}{2kT}, \qquad (1)$$

where q - electron charge; p - varicap turn-on coefficient in the oscillating circuit; $R_{экв}$ - circuit equivalent resistance; k - Boltzmann constant; T - absolute temperature.

When varicap quality factor is $Q \approx 100$, then

$$\hat{E}_{noise} = 1{,}2...1{,}5.$$

Many of these disadvantages could be avoided by using controlled oscillating systems (COS) with controlling interelectrode backlash.

Such type of control has the advantage that it doesn't worsen quality factor of oscillating system and doesn't input any additional phase noise, unlike it happens when using varicap.

A oscillator is in-process offered with a niobate – lithium resonator on a base MEMS structure**.** Oscillator is controlled by means of combined (analog and discrete) device controlling POS on MEMS-VCC base [5].

CONCLUSION

Using MEMS technology to control oscillator frequency gives possibility to improve its technical and technological characteristics and create new type high-stability oscillator. Thanks to using MEMS-capacitor as a control unit it's possible to provide exact reproducing of any control algorithm, which is set by the user.

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