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Design of Low Power Pierce Crystal Oscillator Using CMOS Technology

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***Abstract*—** Crystal Oscillators are key parts employed in several electronic circuits, similar to in portable applications, digital and microprocessor-based devices. so as to save lots of power, low-power consuming circuit is commonly desired. A high demand of oscillator in portable instruments leads to high performance crystal oscillators to implement in silicon chip. A 20 MHz Pierce crystal oscillator is designed in a 0.13m CMOS process using Mentor Graphics with 1V supply. This exhibits approximately a section noise of -60dB/Hz at one megahertz offset. This employed in communication system similar to Electronic Warfare system.

***Keywords*—**CMOS,LowPower,CrystalOscillator,PierceOscillator

I. INTRODUCTION

Oscillators essentially measure ac signal generator generates sine wave of wanted magnitude, at wanted frequency. Material like quartz exhibits a singular property referred to as piezo electrical property. It states that if mechanical forces applied to quartz then it generates electrical potential. If we tend to apply mechanical vibrations to quartz then below the correct operative conditions we are able to acquire electrical oscillations from it. [3]

A crystal oscillator has fascinating characteristics for tuned oscillator circuit applications as a result of the natural oscillation frequency of the crystal is extremely stable with changes in temperature, power offer voltage, or mechanical vibration. The oscillation frequency of a oscillator may be approximated by the subsequent equation:

$$f_{osc} = \frac{1}{2\Pi\sqrt{L_1 + C_1}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

High frequency stability is the biggest advantage of employing a oscillator. The frequency of a oscillator remains stable in spite of changes in temperature, voltage, wetness or different parameters. Thanks to high demand in transportable instrument, high performance oscillator is required to be enforced on chip. It offers blessings similar to low power and correct in frequency.

Types of crystal oscillator:

1. Pierce crystal oscillator
2. Miller crystal oscillator

Pierce oscillator circuit has been accustomed maintain the synchronization and organize the periodic awaken systems. To operate over a long period of time the low power consumption is required for wireless applications. [1]

It is not easy to reduce power consumption in any electronic device; Trade-off exists between totally different parameters of generator. Balancing of that trade of we have to achieve a design for low power oscillator.[10] Phase noise, oscillation frequency, offer voltage, power dissipation, and CMOS feature size are measure factors to touch upon while styling Oscillator.

II. RELATED WORK

Mohammad Marufuzzaman,et.al.[1 Propose to design crystal oscillator with low power consuming differential structure which is approximately 515.4W. With a small dimensions place it offered 20 MHz operating frequency. Mentor graphics tool is used for simulation process.

Kin Keung [2], Presents UWB break up RFID systems need top quality clock signals and oscillator is one among the few candidates. A study of a low-power parallel-mode oscillator for such applications is given. A 7.8125 megahertz Pierce oscillator is realized in a TSMC ninety nm CMOS method. Achieved frequency stability is high but more power dissipation as well as phase noise.

Akshy behal [4], one among the foremost necessary options of any generator is its frequency stability, or in different words its ability to produce a relentless frequency output below variable load conditions. a number of the factors that have associate degree effect on the frequency stability of an oscillator usually include: variations in temperature, variations within the load yet as changes to its DC power offer voltage to call a couple of Frequency stability of the output may be improved by the correct choice of the parts used for the resonant electric circuit as well as the electronic equipment however there's a limit to the steadiness which will be obtained from traditional LC and RC tank circuits.
To obtain a really high level of generator stability quartz is mostly used because the frequency crucial device to supply different varieties of generator circuit celebrated generally as a quartz generator, (XO).
Zeng Xianwen.[5], A 37.5 megahertz crystal differential generator providing at the same time quick start-up and low-power consumption is given for digital radio broadcasting DRM and DAB receiver. it absolutely was made-up with a regular zero.18 um CMOS technology, and no external parts square measure required except a thirty seven.5 megahertz crystal. The start-up time is regarding 250 United States of America.

Zeng Xianwen.[5], A 37.5 MHz crystal differential oscillator offering simultaneously fast start-up and low-power consumption is presented for digital radio broadcasting DRM and DAB receiver. It was fabricated with a standard 0.18 um CMOS technology, and no external components are needed except a 37.5 MHz crystal. The start-up time is about 250 us.

III. METHODOLOGY

The crystal oscillator design using Mentor Graphics tool kit based on 0.13µm technology. Schematic layout has 6 PMOS and 7 NMOS transistors. There is negative and positive two output are existed which represents the differential structure of the circuit. The supply voltage is V_{DD} which is 1.2V and AC signal input is 1V. [1]

Table 1: Parameters in Crystal Oscillator Design

PARAMETER	VALUE
Voltage supply	1.2V
Vin	1V
Width	(0.5µm)PMOS (0.25µm)NMOS
Length	(0.13µm)PMOS & NMOS

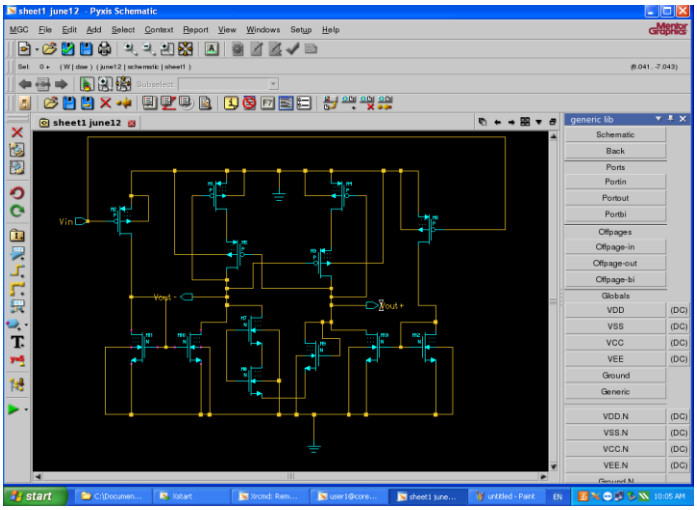

FIG 1: The crystal oscillator design in 0.13µm standard CMOS process using Mentor Graphics.

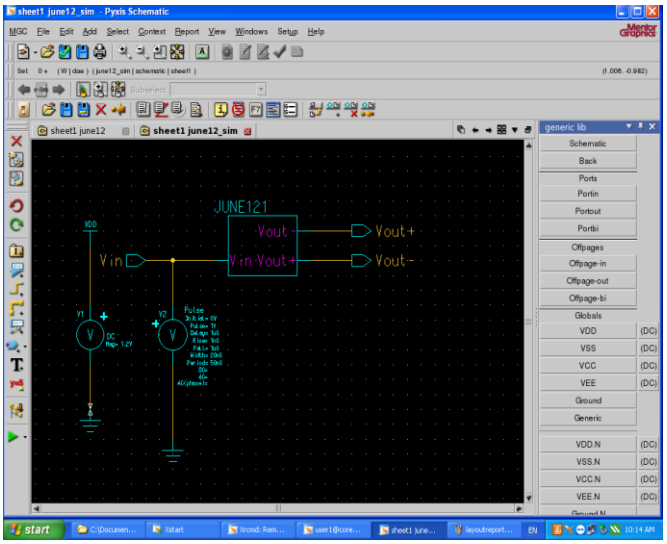

FIG 2: Symbol design for crystal oscillator circuit

Above fig shows the symbol design for pierce crystal oscillator. Symbol designed according to the parameters given in Table 1.

IV. RESULTS AND DISCUSSION

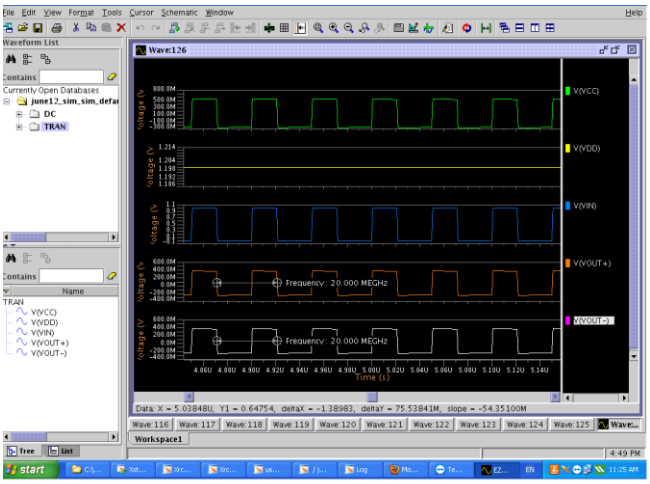

FIG 3: The results of Transient Analysis

Above Fig. showing transient analysis for a designed crystal oscillator using EZwave tool. As per the required result we get the 20MHz oscillator frequency within minimum power consumption which is 1V. There are two output present Vout+ and Vout- because of the differential behaviour of the pierce crystal oscillator.

V. CONCLUSION and Future Scope

The differential structure crystal oscillator is successfully designed with the aim of minimum power dissipation, less phase noise and more stable frequency. The designed work carried out using 0.13um CMOS process technology using mentor Graphics tool. For further improvement we again reduce the feature size and power consumption considering the trade-off between crystal oscillator parameters.

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