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Implementation of Oscillator Using Current Controlled Current Conveyor at 120nm Technology

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Abstract—**Current Conveyors have been used as a basic building block in a variety of electronic circuit in instrumentation andcommunication systems. Today they replace the conventional OPAMP in so many applications such as active filters, oscillators, analogsignal processing and A/D, D/Convertors. Current conveyor is a high performance analog circuit design block based on currentmode and voltage mode approach. It is basically a unity gain element that exhibits high linearity, wide dynamic range, highbandwidth and better high frequency performance. The current conveyor is a combination of voltage as well as current follower.Current conveyor has the advantages of a wide current and voltage bandwidths. We use a translinear configuration for first,second and third generation current conveyor. Here, Sinusoidal oscillator by using CCI CCII and CCIII perform good accuracy andfrequency response at 1.5V supply voltage. The current conveyor is simulated in terms of voltage offset, current offset, currentbandwidth and voltage bandwidth in 120nm CMOS technology using TANNER Tools.**

Keywords—**Voltage Mode Circuits (VMC), CMOS Current Conveyor, CCII, and Miscellaneous symbolic representation of CCII**

1. Introduction

A current conveyor is a four (possibly five) terminal device which arranged with other electronics elements in a specific circuit configuration can perform several analog processing functions like traditional op – amp. This stems from the fact that the CC offers an alternative way of abstracting complex circuit function, thus aiding in the creation of new and useful implementations. Moreover likewise op – amp the terminal behaviour of op – amp approaches its ideal behaviour quite closely. Hence the circuit designed with CC matched the predicted theoretical values. The concept of current conveyor was first presented in 1968[1] and further developed to a second generation current conveyor in 1970[2].The current conveyor is intended as a general building block as with the operational amplifier. Because of the operational amplifier concept has been current since the late 1940's, it is difficult to get any other similar concept widely accepted. However, operational amplifiers do not perform well in application field for current conveyor circuits. Since current conveyors operate without any global feedback, different high frequency behaviour compared to operational amplifier circuits results. Specifically a CC can provide a higher voltage gain over a large signal bandwidth under small or large signal conditioning than a corresponding op – ampcircuit in effect a higher GBW product. In addition, CCs have been extremely successful in the development of an instrumentation amplifier which doesn't depend critically on the matching of external components, instead depends only on the absolute value of signal component.

2. Voltage Mode Circuits (VMC)

The current mode design technique is a good alternative for the high performance analog circuit design as it offers voltage independent high bandwidth. In current-mode design, the stress is more on the current levels for the operation of the circuits and the voltage levels at various nodes are immaterial. In voltage-mode circuits (VMCs), such as operational amplifiers (op amp), the performance of the circuit is determined in terms of voltage levels at various nodes including the input and the output nodes. Therefore, VMCs are not suitable for high frequency applications. When signals are widely distributed as voltages, the parasitic capacitances are charged and discharged with the full voltage swing, which limits the speed and increases the power consumption of voltage mode circuits. Current-mode circuits cannot avoid nodes with high voltage swing either but these are usually local nodes with less parasitic capacitances [5].

Therefore, it is possible to achieve higher speed and lower dynamic power consumption with current-mode circuit techniques. When the signal is conveyed as a current, the voltages in MOS transistor circuits are proportional to the square root of the signal, if the devices are assumed to be operating in saturation region. Therefore, a compression of voltage signal swing and a reduction of supply voltage are possible. This feature is utilized in log domain filters, switched current filters and in non-linear current-mode circuits [6]. However, as a result of the device mismatches, this non-linear operation may generate an excessive amount of distortion and cannot be used for the applications where high linearity is required. Thus, linearization techniques are utilized in current-mode circuits to reduce the nonlinearity of the transistor trans-conductance and in this case the voltage signal swing is also not reduced.

3. Basic Principle of Sinusoidal Oscillator

The basic structure of a sinusoidal oscillator consists of anamplifier and a frequency selective network connected inpositive-feedback loop. Although in an actual oscillatorcircuit, no input signal will be present, we include an inputsignal here to explain the principle of operation. Withexception such as relaxation oscillator, the operation ofoscillator is based on principle of positive feedback whereportion of the output signal is feedback into input withoutphase change. Thus, it reinforces the input and sustainsthe continuous sinusoidal output. Beside

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this, the phaseshift of feedback signal must be either 0o or 360o. Thelast requirement is the loop gain T of amplifier must beequal to one, which is also named as Barkhausencriterion. Thus mathematically, the loop gain T is

$$T = AV\beta = 1$$

Where AV is the voltage gain of the amplifier and betais the feedback at output voltage. An oscillator enjoys thesame status in the domain of electrical and electronicsengineering as do wheels in the mechanical engineering.Sinusoidal Oscillators of variable frequency find widerange of applications in instrumentation & measuringsystems, communication, control systems and signalprocessing. For the implementation of RC (resistancecapacitance)sinusoidal oscillator. As we Compared thesinusoidal oscillator by using first, Second and thirdgeneration of current conveyor then second generationcurrent conveyor iis the best among these.

4. Sinusoidal Oscillator by using CCII

Sinusoidal oscillator by using Second generation currentconveyor is the best one as compared with first and thirdgeneration of current conveyors. A second generation currentconveyor (CCII) based resistance-capacitance (RC)sinusoidal oscillator operating over wide range. Theoscillation condition and oscillation frequency can beadjusted independently by two control resistors. The leakagepower consumed by CMOS based Second generation currentconveyor (CCII) is 9.5mW.Sustained oscillation obtained at3MHz. The circuit proposed makes use of groundedcapacitors the circuit enjoys low sensitivities and suitable forintegration. Sinusoidal oscillator of variable frequency finedextensive applications in communication systems,instrumentation and measurement. The simplicity of thedesign approach turns into a disadvantage when it is desiredto change the frequency of oscillation independent of thenecessary and sufficient condition required to sustain theoscillations. Here, the sinusoidal oscillator by using CCII isdesign by the miscellaneous symbol of CCII, which isgenerated by the schematic of CCII as shown in fig.1 and

fig.2 below:

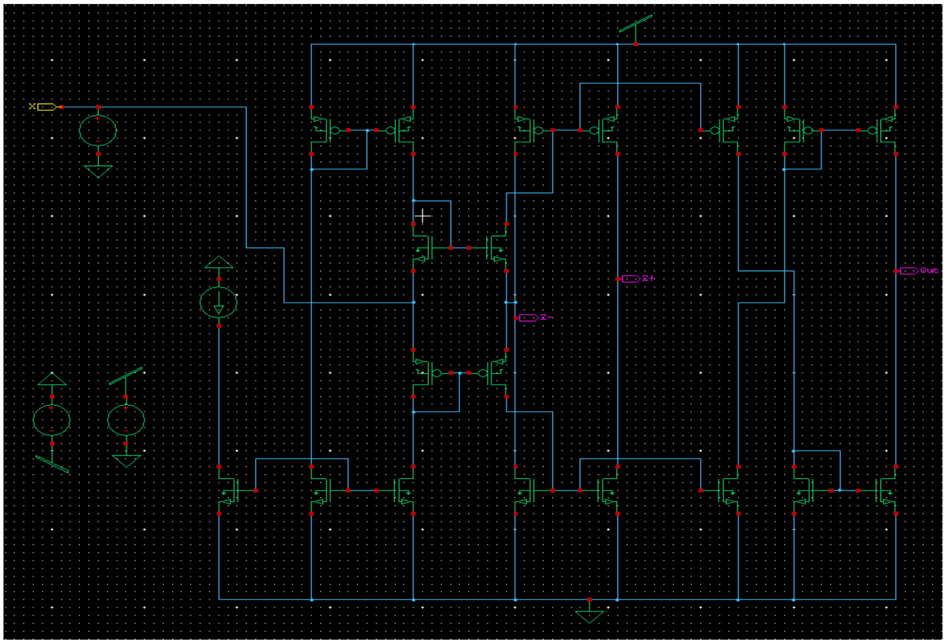

Figure 1: Schematic designing of CCII

After the designing of Second-generation current conveyor(CCII) its symbol is designed by selecting the whole circuitby using the Mentor Graphics tools and coping it in thenew schematic by a new name and in miscellaneous pressthe option of generate symbol then first generation currentconveyor miscellaneous symbol will be generated asshown in fig.2

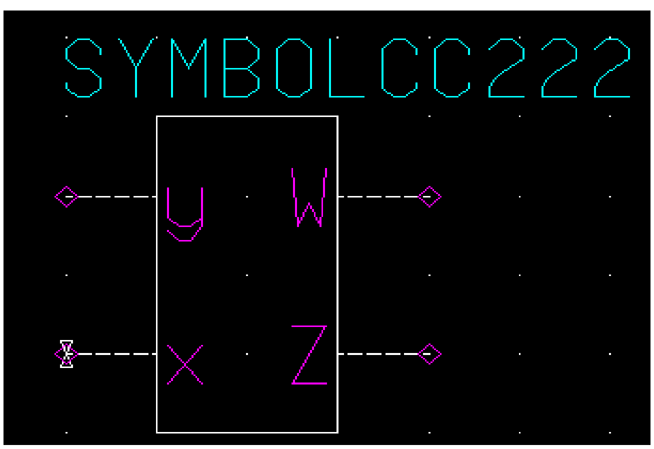

Figure 2: Miscellaneous symbolic representation of CCII

output (DO-CCII). After the miscellaneous symbolicrepresentation of CCII, that symbol is also called as the blackblock representation. Here, by this symbol we will designsinusoidal oscillator as shown in fig.3. The secondgeneration current conveyor (CCII) is sometimes claimed asthe standard building block of current mode operation whichstems largely from the fact that the CCII offers a useful wayof realizing complex circuit functions. In the recent years,their applications and advantages in the RC sinusoidaloscillators with the salient features of controlling thefrequency of oscillation without affecting the condition foroscillation have received considerable attention [3]. Theproposed RC sinusoidal oscillator using second generationcurrent conveyor (CCII) with grounded capacitor is as shownbelowFigure 3:

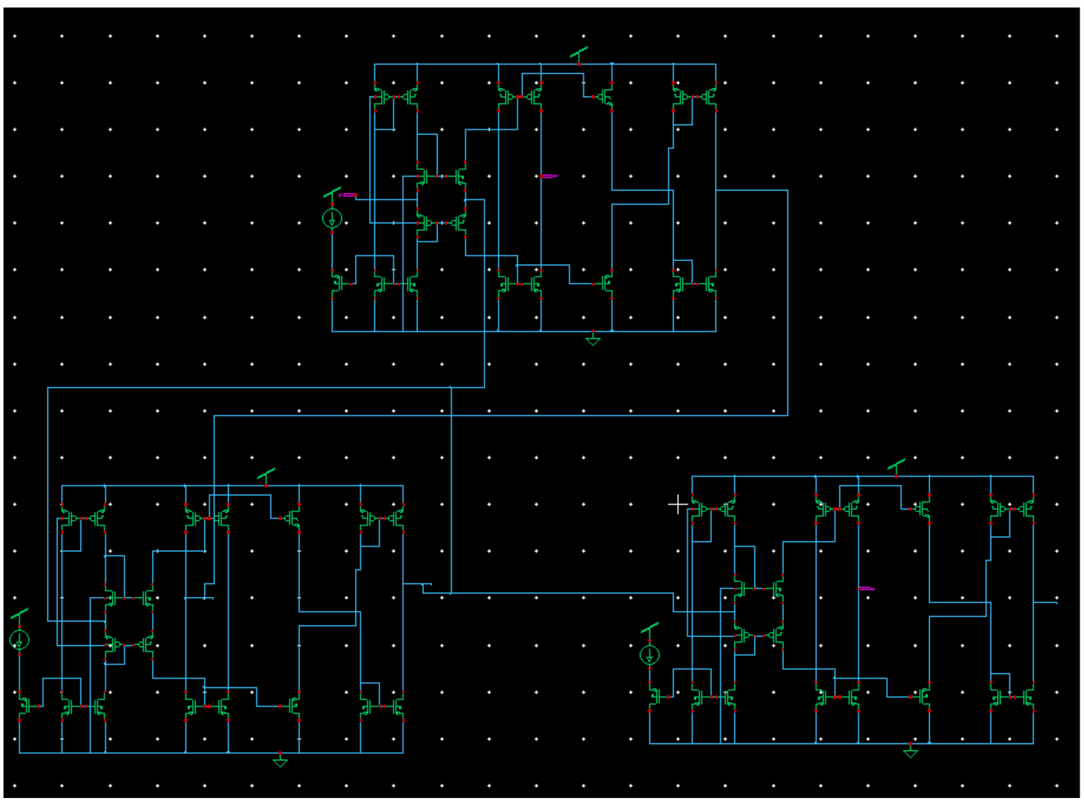

Figure 3 schematic of oscillator using CCII

The output waveforms presented and the results discussed inthis are simulated outcomes of the proposed circuit carriedout by use of mentor graphic 0.18um technology. Delay inthe start of oscillation=40ns, Frequencyachieved=3MHz and Amplitude achieved-664.13mV.Simulation result of sinusoidal oscillator by using CCII is asin fig.4

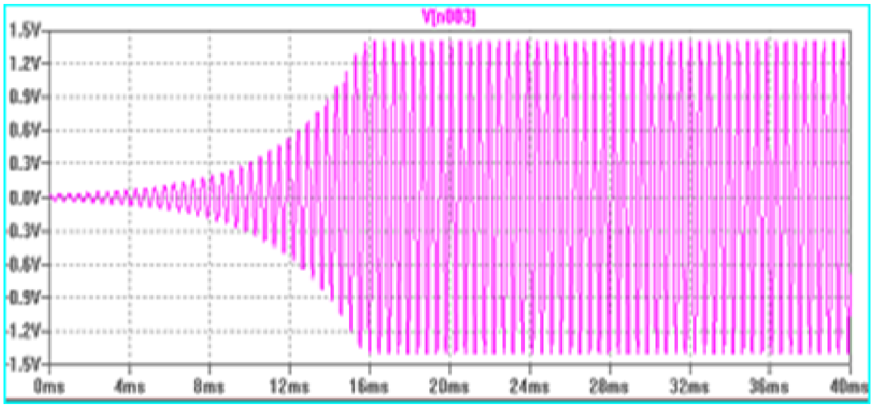

Figure 4: Waveform of Sinusoidal oscillator by using CCII

CONCLUSION

We presented a CMOS implementation current conveyor based oscillator circuit in 120nm CMOS technology. The design, based on a ±1.5V DC supply and developed using TANNAR tool, achieves good linearity, low power dissipation and high bandwidth in the device.

A proposed CMOS second generation basedsinusoidal oscillator has been described and simulate up to a maximum frequency of 3MHz.The circuit follow theinput-output characteristics of second generation currentconveyor(CCII).R1=R2=R=9.2KΩ,C1=C2=C=120PF andRf=3.2 KΩ under the condition Rc=5.2 KΩ.

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