Volume 4, Issue 2, February 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Opertional Transresistance Amplifier Using Submicron Technology

Mr. Aniket R. Pawade
M.E. 2nd year
Dept. of Electronics and Telecommunication
PRPCET, Amravati, India

Prof. Rahul D. Ghongade
HOD and Professor
Dept. of Electronics and Telecommunication
PRPCET, Amravati, India

Abstract— ***Operational Transresistance Amplifier is important active element in Analog integrated circuits and system. The OTRA is receiving increasing attention as a basic building block in analog circuit design. It is relatively a new building block operating from low voltage supplies and overcomes the finite gain bandwidth product associated with traditional op-amp. The basic principle behind the design of OTRA is to provide amplification of high frequency signals with the using standard operational amplifier. In this work effort is made to study the role of OTRA as an active building block in analog circuits. Various CMOS realization of OTRA present in the literature are studied and these circuits are used to realize various signal processing and generating circuits. Based upon component sensitivity tendency and variation amount, just properly adjusting one or two resistances by a small difference, or giving approximate component values for achieving precise output responses is investigated and developed different OTRA realization.***

In many applications high speed and efficient power consumption is required is desired. For this purpose conventional transistor technique are usually chosen, but this results in lower power efficiency. So, the different sub-micron technologies are used. A sub-micron system integrates millions and millions of Electronic components in a small area .The main objective behind the use of this technology is to make the analog and digital system as compact as possible and more power efficient with the required functionality of OTRA and VLSI. The Low Power is the key contribution of the main processing blocks in OTRA system.

Keywords- OTRA, CMOS and VLSI.

I. INTRODUCTION

The operational Transresistance amplifier (OTRA) plays a very important role as an active element in analog integrated circuits due to their low input and output impedances which eliminates limitations of response time due to capacitive time constants. Both input terminals are internally grounded, thereby purge parasitic capacitances of the input. OTRA has the benefits of a high slew rate &extensive bandwidth. The Differential Operational Transresistance Amplifier (OTRA) is a four terminal analog building block, besides the power terminals.

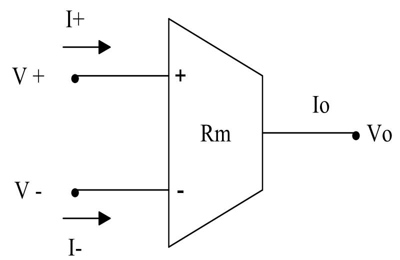

Fig 1.Block diagram of OTRA

The port relationship of OTRA may be characterized by the following matrix form:

$$\begin{bmatrix} V+ \\ V- \\ Vo \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ Rm & -Rm & 0 \end{bmatrix} \begin{bmatrix} I+ \\ I- \\ Io \end{bmatrix}$$

Where Rm is the Transresistance of the OTRA. Since input terminals of this element are internally grounded, most effects of parasitic capacitances at the input disappear. For ideal operation, the Transresistance (Rm) approaches infinity, forcing the input currents to be one and the same. Thus, OTRA must be used in a feedback configuration in a way that is similar classical operational amplifier.

II. *OTRA CMOS REALIZATION FOR SIGNAL PROCESSING AND GENERATING CIRCUIT.*

A. Differential Operational Transresistance Amplifier as signal processing system.

The Differential Operational Transresistance Amplifier (OTRA) is a four terminal analog building block, besides the power terminals, with a describing matrix in the form given by

$$\begin{bmatrix} V_1 \\ V_2 \\ V_{OA} \\ V_{OB} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ Rm & -Rm & 0 & 0 \\ -Rm & Rm & 0 & 0 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_{OA} \\ I_{OB} \end{bmatrix}$$

Circuit symbol of the differential OTRA.

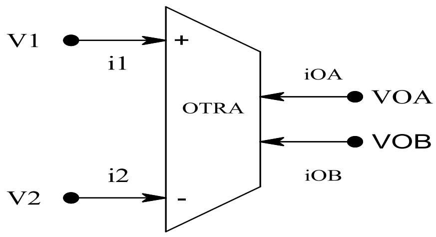

Fig.2. Block diagram of Differential OTRA

Input as well as output terminals are identified by low impedances. The input terminals are virtually grounded, leading to circuits that are inconsiderate to the stray capacitance. For ideal operation, the Transresistance gain, Rm approaches infinity forcing the input currents to be identical. Thus the OTRA must be used in a negative feedback configuration in a way that is similar to conventional opamp. OTRA has indistinguishable transmission belongings to the current-feedback op-amp, but with two low-impedance inputs and two low-impedance outputs for the Differential OTRA. Since the input terminals of these circuits are virtually grounded, they are suitable for cascade connection

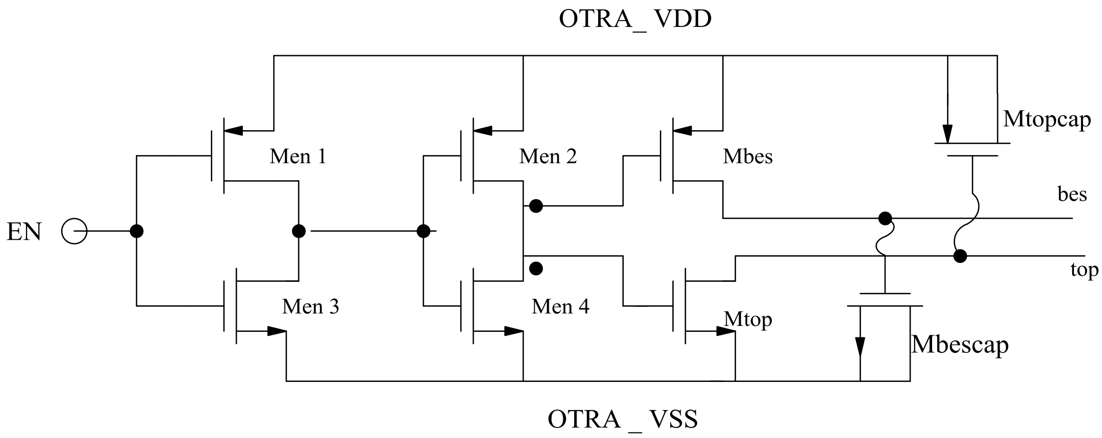

Fig. 3. CMOS realisation of Differential OTRA

The proposed CMOS differential OTRA is illustrated in Figure 3. This circuitry also includes the four power-down transistors which generates the enabled power-supplies named as bes and top. OTRA is active when the EN input is at the VSS voltage level. When the EN input is at the VDD voltage level, all the system is in the power-down mode. Mbes and Mtop transistors need to have high width values in order to have about the same power supply values for the bes and top power nodes as VDD and VSS. Mbescap and Mtopcap are MOS capacitances.

This basic input cell consists of four transistors which are illustrated in Figure 4. These four transistors generate two Class AB current mirror connection. In the static state I1 and I2 are biased automatically to the half of the power supply. For this design the initial value for I1 and I2 is 0V as virtually grounded. The input currents are directly connected to the I1 and I2 nodes. So the input current directly flow through the drain of the transistor. If one basic cell is used, the OTRA input will not be symmetrical. Because, for the given basic cell, the input I1 is formed by the use of two diode connected

NMOS (M9) and PMOS (M21) transistors, but at the input I2 there are no diode connections. For that reason, a second basic cell is placed into the design, by replacing the input pins, which input I2 is applied to the two diodes connected input part of the basic cell and input I1 is applied to the other input as given in Figure 4.

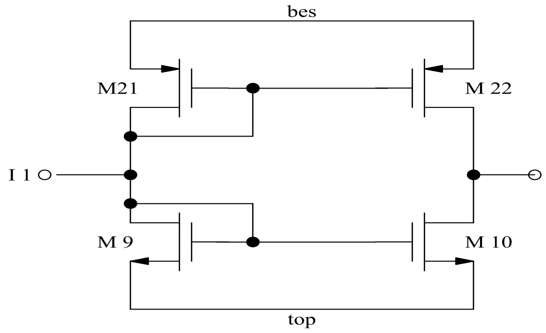

Fig.4. Basic input cell

B. *Operational Transresistance Amplifier as RC* sinusoidal signal generator

Sinusoidal oscillators have a wide range of application in telecommunications, control systems, signal processing & measurement systems. A variety of sinusoidal oscillators using the operational amplifier as the active element are available. The finite gain- bandwidth product of the op-amp affects both the condition and frequency of oscillation. To overcome this problem, several oscillators have been introduced using the current conveyor as the active element or the current feedback operational amplifier

Circuit description specific case of generalized circuit is shown in fig.5.

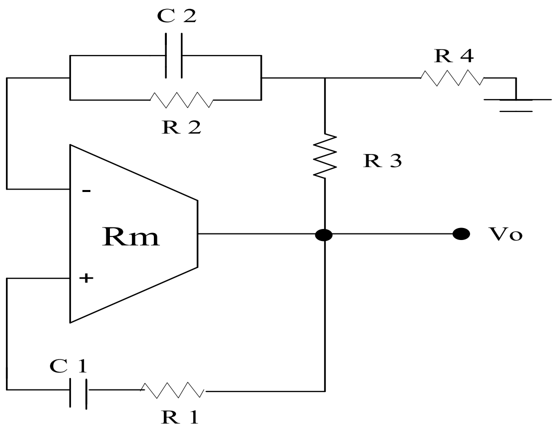

Fig.5. RC sinusoidal signal generator OTRA

The radian frequency of oscillation & condition of oscillation are given by:

$$\frac{R_1}{R_2} + \frac{C_2}{C_1} = 1$$

$$W_0 = \frac{1}{\sqrt{C_1 C_2 R_1 R_2}}$$

As is the case with all minimum component oscillator , the condition of oscillation and the frequency of oscillation cannot be independently controlled. It is seen that the W0 sensitivity to Ri or Ci (i = 1, 2) equal to -1/2. In order to achieve independent control on the condition of oscillation without affecting the frequency of oscillation, the circuit shown in Fig.5. For this circuit, the condition of oscillation is given by:

$$\frac{R1}{R2} + \frac{C2}{C1} = 1 + \frac{R3}{R2} + \frac{R3}{R4}$$

It is seen that the grounded resistor R4 controlls the condition of oscillation without affecting W0 which is given by:

$$W_0 = \frac{1}{\sqrt{R1\ R2\ C1\ C2\left(1 - \frac{R3}{R1}\right)}}$$

It should be noted that it is also possible to achieve independent control on the frequency of oscillation using OTRA.

III. RELEATED WORK

In 2012 Ashish Ranjan and Sajal K. Paul proposed Voltage-Mode Third Order Band Pass Filter Employing Operational Transresistance Amplifier[1].They proposed two third order voltage mode band pass filters having two types of asymmetric frequency responses. As the two types of asymmetric responses are found to be complementary in nature, hence cascading of these two filters will result a sixth order symmetric band pass filter.

In 2012 Fırat Kacar and Abdullah Yesil Proposed Complementry MOSFET Realization of Voltage Differencing Buffered Amplifier & Its Biquad Filter Applications [2]. They Proposed Fully Balanced Voltage Differencing Buffered Amplifier (FB- VDBA). In the circuit principle called VDBA (Voltage Differencing Buffered Amplifier) is proposed as substitute to the existing CDBA (Current Differencing Buffered Amplifier). The differences between VDBA and CDBA are that the VDBA inputs are voltage as for the CDBA inputs are current.

In 2005 Alper duru and Hakan Kuntman proposed Complementry MOSFET Differential OTRA Design for the Low Voltage Power Supplies in the Sub-Micron Technologies [3]. They proposed for the rail-to-rail input voltage operations, a new CMOS OPAMP has been designed. In this opamp, input Differential amplifier are used both in NMOS and PMOS combinations as in the OPAMP proposed in 1997. The rail-to-rail input stage, composed with the transistor.

Khaled N. Salamaa, Ahmed M. Soliman proposed Complementry MOSFET operational Transresistance [4] amplifier for analog signal processing with the OTRA impart a constant bandwidth virtually sovereign of the gain. The main benefit of the OTRA is the capability to implement various analog circuits without the demand of resistors, as it can be used to abandon both the odd & even non-linear terms as correlated with Metal oxide semiconductor transistors operating in the ohmic region.

Hung-Chun Chien proposed Realizations of Single OTRA-based Sinusoidal Oscillators [5] each circuit consists of a single OTRA with a few external passive components. The circuit features the least RC components design. The second also circuits provide independent control of the oscillation condition and oscillation frequency, respectively. The proposed circuits also exhibit low active and passive sensitivities to oscillation frequency, and most parasitic parameters in the proposed circuits disappear due to t he OTRA' s internal ground input terminals.

In 2008 Ahmed M.Soliman proposed modified CMOS differential operational Transresistance amplifier (OTRA) [6] in this he proposed modified CMOS realization of the differential operational Transresistance amplifier and its application. Simulation results and a fair comparison between the proposed modified differential OTRA and OTRA given in proved the strength of the proposed realization. Digitally controlled voltage-mode variable gain amplifier (VGA) based on the proposed realization is also introduced.

In 1999 K.N. Salamaa, A.M. Soliman proposed Novel oscillator using the operational Transresistance amplifier[7] Several active RC oscillator circuits using the OTRA (Operational transresistance amplifier) as the basic active building block. From which a minimum component oscillator is generated when general configuration using a single OTRA is introduced. For the best of author knowledge, these are the first active RC oscillators reported in the literature using the OTRA as the active building block.

IV. PROPOSED WORK

To achieve the proposed OTRA, different methodology and techniques can be used for research and design OTRA using CMOS technology for low power consumption.

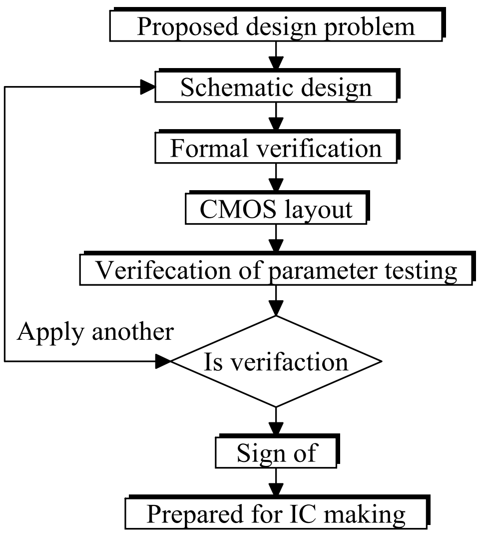

Fig.6. Flow chart of proposed work

V. CONCLUSION

This review paper presents a modified CMOS realization of the differential operational Transresistance amplifier and its application. In many applications high speed and efficient power consumption is required is desired. For this purpose conventional transistor technique are usually chosen, but this results in lower power efficiency. So, the different sub-micron technologies are used. A sub-micron system integrates millions and millions of Electronic components in a small area .The main objective behind the use of this technology is to make the analog and digital system as compact as possible and more power efficient with the required functionality of OTRA and VLSI. The Low Power is the key contribution of the main processing blocks in OTRA system.

REFERENCES

[1] Ashish Ranjan, Sajal K. Paul., "Voltage-Mode Third Order Band Pass Filter Employing Operational Transresistance Amplifier".*5th International conference on computer and devices (CODEC).*

[2] Fırat Kacar,Abdullah Yesil., " New CMOS Realization of Voltage Differencing Buffered Amplifier and Its Biquad Filter Applications," *Radioengineering*, VOL. 21, NO. 1, APRIL 2012.

[3] Alper duru, Hakan Kuntman, "CMOS Differential OTRA Design for the Low Voltage Power Supplies in the Sub-Micron Technologies," *Turk J Elec Engin*,VOL.13, NO.1 2005.

[4] Khaled N. Salamaa, Ahmed M. Soliman, "CMOS operational Transresistance," Microelectronics Journal 30 (1999) pp.235–245.

[5] Ahmed M.Soliman., "modified CMOS differential operational Transresistance amplifier (OTRA)," Int. J. Electron. Commun. (AEÜ) 63 (2009) pp.1067–1071,24 August 2008.

[6] K.N. Salamaa, A.M. Soliman,"Novel oscillator using the operational Transresistance amplifier," Microelectronics Journal 30 (1999) pp.235–245.

[7] K.N. Salama and A.M. Soliman,"Universal Filters Using the Operational Transresistance Amplifiers." AEÜ – Intl J. of Electronics and Communications, vol. 53, 1, 1999, pp. 49-52.

[8] S. KÕlÕnç and U. Çam,"Operational Transresistance Amplifier Based First- Order All Pass Filter with an Application Example." IEEE Intl Midwest Symp. Circuits and Systems, Hiroshima, Japan, vol. 1, 2004, pp. 65-68.

[9] F. Anday, "Realization of Norton Amplifier n-th Order Switched- Capacitor Networks." Int'l J.of Electronics, vol.53, no. 3, 1982, pp.289-292.

