2011 3rd International Conference on Signal Acquisition and Processing

ICSAP 2011

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General Information

Contents

Author Index

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CONTENTS

ICSAP 2011 Session 4

ICSAP 2011 Session 5

ICSAP 2011 Session 8

ICSAP 2011

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PREFACE

Dear Distinguished Delegates and Guests,

The Organizing Committee warmly welcomes our distinguished delegates and guests to the 2011 3rd International Conference on Signal Acquisition and Processing (ICSAP 2011) held during February 26-28, 2011 in Singapore.

ICSAP 2011 is co-sponsored by IACSIT and IEEE. If you have attended a conference sponsored by IACSIT before, you are aware that the conferences together report the results of research efforts in a broad range of computer science and Information Technology. These conferences are aimed at discussing with all of you the wide range of problems encountered in present and future high technologies. The ICSAP is organized to gather members of our international community scientists so that researchers from around the world can present their leading-edge work, expanding our community's knowledge and insight into the significant challenges currently being addressed in that research. The conference Program Committee is itself quite diverse and truly international, with membership from the Americas, Europe, Asia, Africa and Oceania.

This proceeding records the fully refereed papers presented at the conference. The main conference themes and tracks are Signal Acquisition and Processing. The main goal of these events is to provide international scientific forums for exchange of new ideas in a number of fields that interact in-depth through discussions with their peers from around the world. Both inward research; core areas of Signal Acquisition and Processing and outward research; multi-disciplinary, inter-disciplinary, and applications will be covered during these events.

The conference has solicited and gathered technical research submissions related to all aspects of major conference themes and tracks. All the submitted papers in the proceeding have been peer reviewed by the reviewers drawn from the scientific committee, external reviewers and editorial board depending on the subject matter of the paper. Reviewing and initial selection were undertaken electronically. After the rigorous peer-review process, the submitted papers were selected on the basis of originality, significance, and clarity for the purpose of the conference. The selected papers and additional late-breaking contributions to be presented as lectures will make an exiting technical program. The conference program is extremely rich, featuring high-impact presentations.

The high quality of the program – guaranteed by the presence of an unparalleled number of internationally recognized top experts – can be assessed when reading the contents of the program. The conference will therefore be a unique event, where attendees will be able to appreciate the latest results in their field of expertise, and to acquire additional knowledge in other fields. The program has been structured to favor interactions among attendees coming from many diverse horizons, scientifically, geographically, from academia and from industry. Included in this will to favor interactions are social events at prestigious sites.

We would like to thank the program chairs, organization staff, and the members of the program committee for their work. Thanks also go to Editors from International Association of Computer Science and Information Technology, for their wonderful editorial service to this proceeding.

We are grateful to all those who have contributed to the success of ICSAP 2011. We hope that all participants and other interested readers benefit scientifically from the proceedings and also find it stimulating in the process. Finally, we would like to wish you success in your technical presentations and social networking.

We hope you have a unique, rewarding and enjoyable week at ICSAP in Singapore.

With our warmest regards,

The Organizing Committees
February 26-28, 2011
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Voltage-Mode Universal Biquadratic Filters using OTA-*URC*

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***Abstract*— This paper present new universal biquad filter employing OTA and *URC* (Uniform Distributed RC). The features of the proposed circuit are that: the circuit topologies are very simple consisting of 2 OTA and 2 *URC*, where either one of the three filtering transfer function (LPF, HPF, BPF and BRF) can be achieved by this only one filter. In addition, higher filtering response frequency (ω_P) can be obtained through adjusting bias current of OTAs without affecting its quality factor (Q_P) stability. Characteristics of the proposed filter are simulated using PSpice and its results are in agreement with the theory.**

Keywords-universal biquad ; OTA; Uniform Distributed RC; Response Frequency (ω_P); Quality Factor(Q_P)

I. INTRODUCTION

Many current and voltage mode universal Biquadratic filter circuits employing operational transconductance amplifier (OTA) had been reported in the literature [1]–[7]. These designs of OTA-C filter circuit require no resistors. Therefore, they are suitable for monolithic integration than the other current conveyors. Moreover an OTA provides a highly linear electronic and a wide tunable range of the transconductance gain. Therefore, the filters based on OTAs are the attention for many researches. The characteristics of Uniform Distributed RC (*URC*) element have several advantages over lumped RC network. The structure of distributed RC elements in thin-film technology is built using smaller high frequency. Distributed RC elements may have many form structure. For instance, one capacitive layer, double capacitive layers and multi layer thin-film structure. The structure of the general *URC* consists of layers of conductors, resistive layer and dielectrics can be sandwiched together in many permutations. The resistive or conductive layers may be contacted at various points around their edges. Other advantages are applied to active filters. For instance single capacitive layer *URC*[8] in conjunction with amplifier in literatures respectively.

This paper introduces a voltage-mode universal biquad filter using two OTAs and two *URC* the filter can realize the low-pass (LPF), the high-pass (HPF), the band-pass (BPF) and band reject (BRF) transfer function by connecting the terminal V_a V_b and V_c to the ground or to the input voltage V_g. The characteristic parameters ω_P and Q_P can also be set orthogonally by adjusting the bias currents of the OTA. Some examples are given together with simulated results by PSpice.

II. CIRCUIT DESCRIPTION

A. Operational Transconductance Amplifier (OTA)

An operational transconductance amplifier (OTA) is widely used as an active element in analog signal processing circuit. It is a differential input voltage controlled current source (DVVCS) device. The port relation of OTA as shown in Fig. 1(a) and equivalent circuit of the ideal OTA is shown in Fig. 1(b).

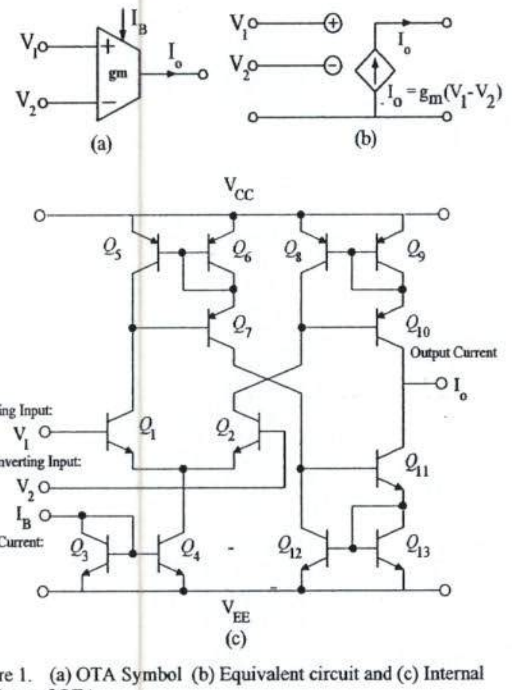

Figure 1. (a) OTA Symbol (b) Equivalent circuit and (c) Internal topology of OTA

The OTA element is given by the following equation:

$$I_O = g_m(V_1 - V_2) \tag{1}$$

where, V_1, V_2 is the differential input voltage, I_o is the OTA output current and g_m the transconductance gain is tunable through bias current I_B is given by $g_m = I_B/2V_T$ where, V_T is the thermal voltage (26mv). [9]

B. *Uniform Distributed RC*

It is know that the uniformly Distributed RC element (*URC*) have several advantage over lumped RC network. The structure of distributed RC element in thin-film or LSI technology is built using smaller substrate area, less isolation and parasitic problem at high frequency, Distributed RC elements may have many form structure.[10] The structure and circuit symbol of uniformly distributed RC elements (*URC*) is illustrated in Fig.2

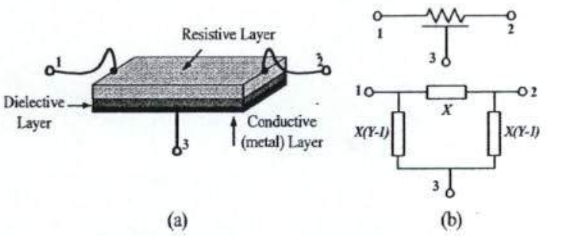

Figure 2. (a) A Uniformly Distributed RC section, (b) are symbolic and its equivalent lumped π network

The admittance parameter [Yij] of the two port network *URC* in Fig.2 is given as follows:

$$\begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = X \begin{bmatrix} Y & -1 & -(Y-1) \\ -1 & Y & -(Y-1) \\ -(Y-1) & -(Y-1) & 2(Y-1) \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} \quad (2)$$

when $X = \dfrac{P}{R\sinh P}$, $Y = \cosh p$ and $P = \sqrt{sRC}$

Where R and C are the value of the total resistance and capacitance of the capacitive *URC* respectively and *s* is the complex frequency variable.

III. OTA-*URC* PROPOSED CIRCUIT

A simple universal OTA-*URC* Biquad realized with only four element is shown in Fig.3 This Biquad can be used a lowpass, highpass and bandreject second-order filter section. The required transfer function is realized by connecting the terminal V_a, V_b and V_c to the ground or to the input voltage V_g. The output voltage is V_o.

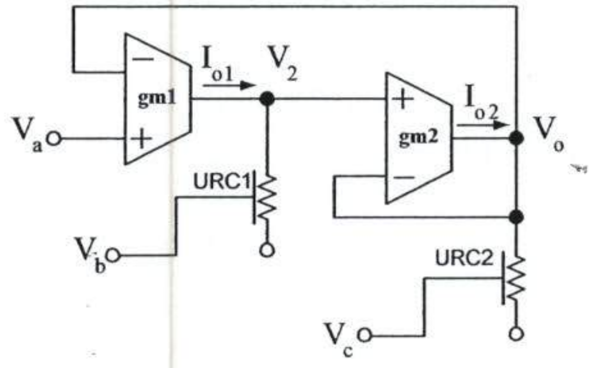

Figure 3. OTA-*DURC* Circuit Propose Universal Biquad Filter

Fig.3 shows a proposed OTA-*URC* circuit universal biquad filter. The transfer function of the circuit is given as follows:

$$T(s) = \frac{V_o}{V_g} = \frac{\delta\dfrac{V_a}{V_g} - g_{m2}R_2P_1\eta_3\sinh P_2\dfrac{V_b}{V_g} - P_1P_2\eta_1\eta_4\dfrac{V_c}{V_g}}{P_1P_2\eta_1\eta_2 + g_{m2}R_2P_1\eta_1\sinh P_2 + \delta} \quad (3)$$

Case low-pass is set $V_a=V_g$, $V_b=0$ and $V_c=0$. The transfer function $T_{LP}(s)$ of the circuit is given as follows:

$$T_{LP}(s) = \frac{\delta}{P_1P_2\eta_1\eta_2 + g_{m2}R_2P_1\eta_1\sinh P_2 + \delta} \quad (4)$$

Case high-pass is set $V_a=0$, $V_b=0$ and $V_c= V_g$. The transfer function $T_{HP}(s)$ of the circuit is given as follows:

$$T_{HP}(s) = \frac{-P_1P_2\eta_1\eta_4}{P_1P_2\eta_1\eta_2 + g_{m2}R_2\sinh P_2 + \delta} \quad (5)$$

Case band-pass is set $V_a=0$, $V_b= V_g$ and $V_c=0$. The transfer function $T_{BP}(s)$ of the circuit is given as follows:

$$T_{BP}(s) = \frac{-g_{m2}R_2P_1\eta_3\sinh P_2}{P_1P_2\eta_1\eta_2 + g_{m2}R_2P_1\sinh P_2 + \delta} \quad (6)$$

Case band-reject is set $V_a=V_g$, $V_b=0$ and $V_c=V_g$.The transfer function $T_{RP}(s)$ of the circuit is given as follows:

$$T_{RP}(s) = \frac{\delta - P_1P_2\eta_1\eta_4}{P_1P_2\eta_1\eta_2 + g_{m2}R_2P_1\eta_1\sinh P_2 - \delta} \quad (7)$$

where

$$\eta_1 = \cosh P_1 - 1, \quad \eta_2 = \cosh P_2 - 1, \quad \eta_3 = 2 - \cosh P_1,$$
$$\eta_4 = 2 - \cosh P_2, \quad \delta = g_{m1} g_{m2} R_1 R_2 \sinh P_1 \sinh P_2$$
$$P_1 = \sqrt{sR_1C_1}, \quad P_1 = \sqrt{sR_2C_2}$$

The pole magnitude (ω_P) and the pole Q-Factor (Q_P) are given by

$$\omega_P = \sqrt{\frac{g_{m1} g_{m2}}{C_1 C_2}}, \quad Q_P = \sqrt{\frac{g_{m1} C_2}{g_{m2} C_1}} \tag{8}$$

The Q-factor (Q_P) is determined by the capacitance ratio, C_2/C_1, and the transconductance ratio, g_{m1}/g_{m2}. The most sensitive parameter, ω_P, is a function of the transconductance-capacitance ratio, g_m/C.

IV. Simulation Results

To prove the performance of the propose circuit, a PSpice simulation was performed for examination. The PNP and NPN transistors employed in the proposed circuit were simulated by using the parameters of the PR200N and NR200N bipolar transistors of ALA400 transistor array from AT&T [11] with the parameters summarized in Table I. The frequency response and phase response is shown in Fig.4 and Fig.5 are respectively. The *URC* is approximated by the ladder lumped RC elements of 10 sections, and the operational transconductance amplifiers using (OTA).

The simulation results for different filter responses Fig.4.The transconductance gain g_{ms} of all OTAs were set VCC±12V, $I_{B1}=I_{B2}=100\mu A$. We selected the *URC* element value R1=100Ω, R2=2MΩ, C1=10nF and C2=300nF to obtain low-pass, high-pass, band-pass and band-reject in Fig. 3 at frequency response 25.878 kHz. The simulated and experimental results are in good agreement with each other.

TABLE I Individual Parameters of The Transistors

.MODEL PX2 PNP RB=163.5 IRB=0 RBM=12.27 RC=25 +RE=1.5 IS=147E-18 EG=1.206 XTI=1.7 XTB=1.866 +BF=110 IKF=4.718E-3 NF=1 VAF=51.8 ISE=50.2E-16 +NE=1.650 BR=0.4745 IKR=12.96E-3 NR=1 VAR=9.96 +ISC=0 NC=2 TF=0.610E-9 TR=0.610E-8 CJE=0.36E-12 +VJE=0.5 MJE=0.28 CJC=0.328E-12 VJC=0.8 MJC=0.4 +XCJC=0.074 CJS=1.39E-12 VJS=0.55 MJS=0.35 FC=0.5
.MODEL NX1 NPN RB=524.6 IRB=0 RBM=25 RC=50 +RE=1 IS=121E-18 EG=1.206 XTI=2 XTB=1.538 +BF=137.5 IKF=6.974E-3 NF=1 VAF=159.4 ISE=36E-16 +NE=1.713 BR=0.7258 IKR=2.198E-3 NR=1 VAR=10.73 +ISC=0 NC=2 TF=0.425E-9 TR=0.425E-8 CJE=0.214E-12 +VJE=0.5 MJE=0.28 CJC=0.983E-13 VJC=0.5 MJC=0.3 +XCJC=0.034 CJS=0.913E-12 VJS=0.64 MJS=0.4 FC=0.5

Fig.6 shows the gain response of the band-pass functions responses for different values of bias current where I_B is set 100µA, 150µA and 200µA respectively. This shows that the pole frequency can be adjusted without affecting the quality factor.

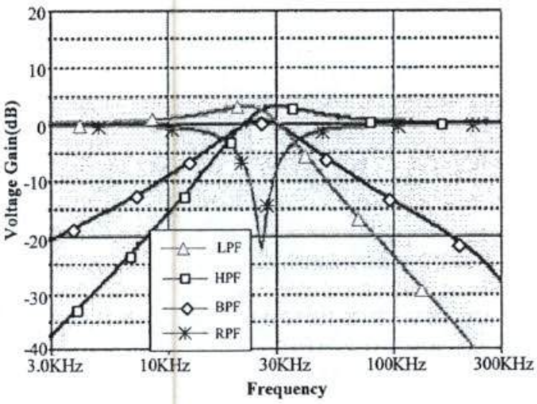

Figure 4. Gain responses of the proposed circuit working as universal biquad filter

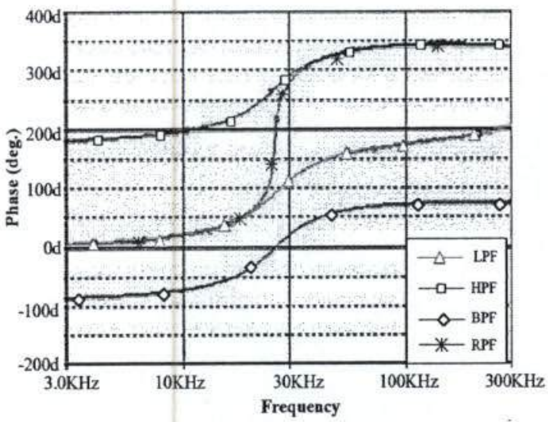

Figure 5. Phase Response of OTA-*URC* Circuit Propose Universal Biquad Filter

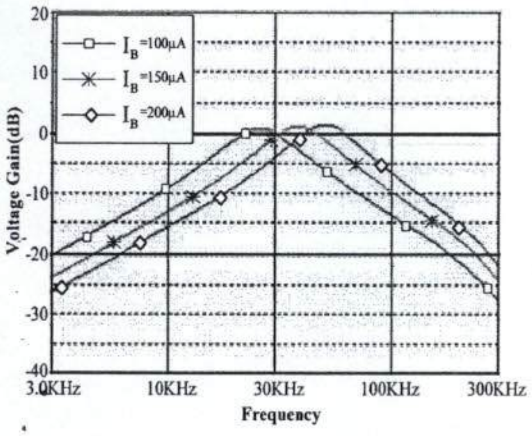

Figure 6. Band-Pass frequency responses for different values of bias current

V. CONCLUSION

We have proposed the OTA-*URC* circuit universal biquad filter. The proposed biquad can realize voltage-mode universal filtering responses (low-pass, high-pass, band-pass and band-reject) form the same topology. Filters using the simpler structure have the advantages of lower cost, chip area, power dissipation and noise. The circuit enjoys the advantage of high input impedance, amplitude responses for universal biquadratic filter. The cut off frequency (ω_P) and quality factor (Qp) are independently controlled. The experimental results are in reasonably good agreement with the theoretical. The proposed circuit can be suitable for fabrication by LSI process. It will be useful for universal biquad filter circuit.

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