COMPOSITE EQUIVALENT SC RESISTORS AND THEIR STUDY

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ABSTRACT

The recent developments of switched capacitor (SC) the field of network analysis and synthesis. In the present study the equivalent resistors have been produced by SC networks. The study of such resisters is made implemented with op-amp. The characteristics of the network is compared with that of conventional one. Precession high order filters are widely used in various types of electronic. Precession high order filters are widely used in various types of electronic equipment such as telecommunication and other voice band systems. Monolithic implementation of these low frequency filters requires the realization of long time constants in small silicon area; and the realization of transfer functions that are insensitive to parameter variations

Keyword: - *SC, Filters, Electronic, Op-amp etc.*

1. INTRODUCTION

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat, may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within integrated circuits.

The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance falls within the manufacturing tolerance, indicated on the component.

A composite material (also called a composition material or shortened to composite, which is the common name) is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure, differentiating composites from mixtures and solid solutions.[1] The new material may be preferred for many reasons: common examples include materials which are stronger, lighter, or less expensive when compared to traditional materials.

The discovery of new idea of SC networks which have 'special characteristics of long time constant and insensitive to component variations have attracted many scientists working in the field of circuit theory. Precession high order filters are widely used in various types of electronic

equipment such as telecommunication and other voice band systems. Monolithic implementation of these low frequency filters requires the realization of long time constants in small silicon area; and the realization of transfer functions that are insensitive to parameter variations [1]. The conventional active filters implemented with thin films or hybrid techniques do not meet these requirements. Therefore they are not suitable for many application [2]. In past decades Op-amp. has been a building block of active resistance capacitance (RC) networks, such as active filters, integrator and differentiators etc. The resisters to be used with active networks may be implemented with SC networks [3]. The SC networks implemented with implemented with SC networks [3]. The SC networks i implemented with op amp. has brought a revolutionary change in network technology and research work [4][5][6]. Moreover the parasitics presented by input capacitance to op amps. induce errors and considerably complicate the design procedures. Intensive study shows that composite SC networks have overcame these difficulties of circuit designer to a great extent [7].

2. EQUIVALENT SC NETWORK OF DIFFERENTIAL

The circuit diagram of RC active network known as differential RC integrator is shown in fig (1).

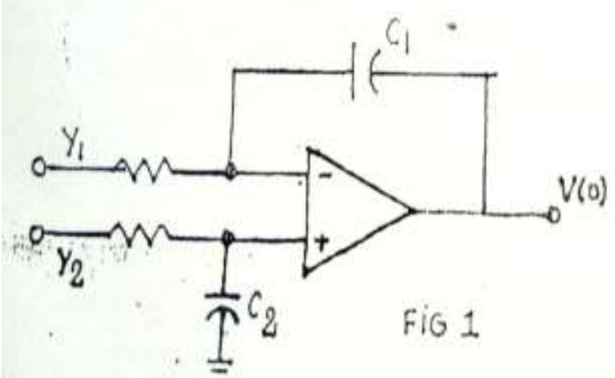


FIG 1

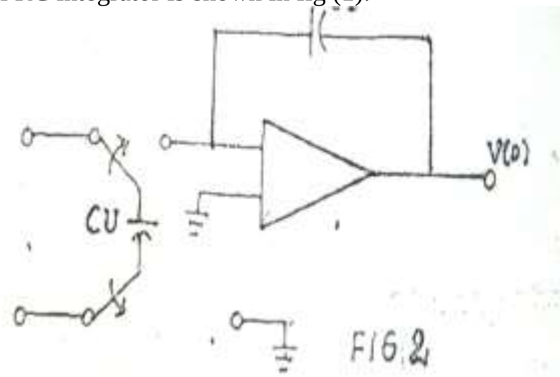


FIG 2

The output of the differential integrator may be obtained by applying simple network theorems. Applying Kirchhoffs Current law (LCL) at node (A)

$$V_1Y_1 - V_A(\gamma_1 + j\omega C_1) + V_0 j\omega C_1 = 0$$

Or, $$V_A = \frac{\gamma_1 v_1 + v_0 j\omega C_1}{\gamma_1 + j\omega C_1} \qquad - \quad - \quad - \quad 1$$

Again Applying KCL at node B one gets

$$(v_2 - V_\beta)\gamma_2 + (0 - v_\beta)\, r\omega C_2 = 0$$

Or, $$V_B = \frac{v_2\gamma_2}{\gamma_2 + mC_2} \qquad - \quad - \quad - \quad 2$$

Applying ideal op amp. $V_A=V_B$ - - - 3

Therefore, from equations (1), (2), (3)

$$V_0 = \frac{\gamma_1 + j\omega C_1}{j\omega C_1}\left[\frac{v_2\gamma_2}{\gamma_2 + j\omega C_2} - \frac{v_1\gamma_1}{\gamma_1 + j\omega C_1}\right] \qquad - \quad - \quad - \quad 4$$

To make the network suitable for diffractions integrator $y_1=y_2$

$$j\omega C_1 = j\omega C_2 \qquad - \quad - \quad - \quad 5$$

This yields

$$V_o = \frac{\gamma}{j\omega C}(V_2 - V_1) \qquad \text{since } \gamma = 1/R$$

So $$V_o = \frac{1}{j\omega CR}(V_{o2} - V_{o1})e^{j\omega t}$$

Or, $$V_o = \frac{1}{RC}\int (V_{o2} - V_{o1})e^{j\omega t}dt \qquad \text{since } RC = T$$

Or, $$V_o(t) = \frac{1}{T}\int_0^T (V_{o2} - V_{o1})e^{j\omega t}dt \qquad - \quad - \quad - \quad 6$$

The network is Known as differential integrator
The differential gain may be written as

$$A_d = \frac{-j}{RC\omega} = \frac{-j}{\omega T} \qquad - \quad - \quad 7$$

Where T − RC - - - 8

$$A_d = \frac{1}{\omega T} \qquad - \quad - \quad - \quad 9$$

$$A_d = \frac{1}{RC\omega} = \frac{1}{T\omega} \qquad - \quad - \quad - \quad 10$$

The numerical value of R=5K ohm,C=1 nF the differential gain is given in the table

ω	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
A_d	2×10^6	10^6	$.66\times10^6$	$.5\times10^6$	4×10^5	3×10^5	2.8×10^5	2.5×10^5	2.2×10^5	2×10^5

It is found that the differential integrator serves as low pass filter.

3. SC NETWORK

The circuit diagram of SC integrator is shown in the figure No.(2). It is operated with two phase non overlapping Clocks. sample phase the switched are thrown to left and the difference between Voltage Vi and V2 is coupled and stored on Cu. During integration phase the switches are thrown to right and difference of Voltages is sealed and stored on C. By switching Cu at high clock rate relative to pass band
frequencies an equivalent resistance is obtained [9].

$R_{eq} = 1/f_c$ Cu - - - 11

Where f_c = Clock Frequency

The integrator gain constant of frequency given by

$w=1/R_{eq} f_c C_1 = f_c$ (Cu/C_1) - - - 12

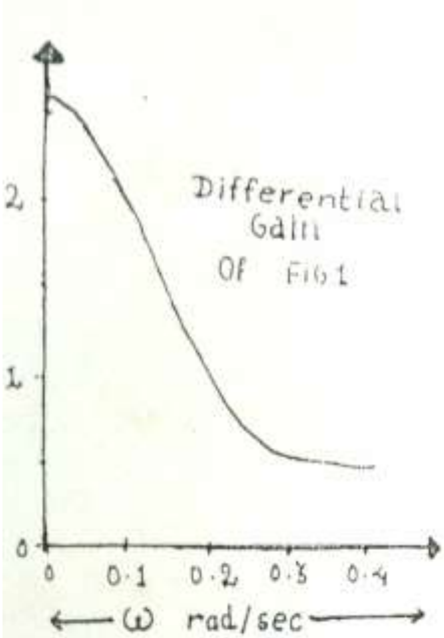
The switched capacitor realizes a very large resistance in very small chip . From eqn. (11) it can be seen that by switching a IP-F Capacitor at 100 KHZ an equivalent resistance of 10 M ohm is realized in an area of only about 5 mil^2 for Cu plus a few additional square mils for the minimum geometry.

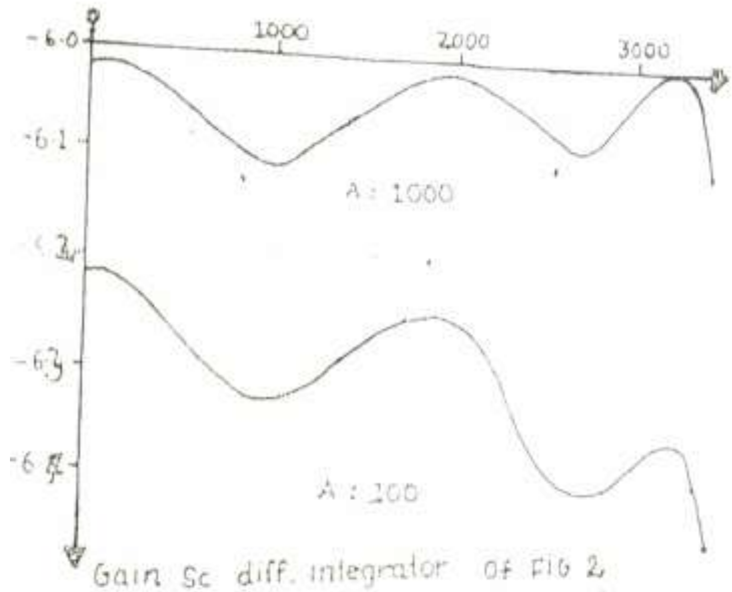
MOSFET SWITCH Transistor. If this equivalent resistor is used in Conjunction with C_1 to Cu a gain constant of 10^4 rad/see is obtained. Since the gain constant in (12) is determined by a ratio of monolithic
capacitors, high matching accuracy and excellent temperature stability are obtained in monolithic MOS implementation . [8, 9,10,11,12,13].

The gain of the switched capacitor integrator with op-amp is given in fig. 3.

The ploting is performed by PSPICE Program.

From the graph it is evident that nature of low pass filter is modified switched capacitor resistor implemented with op-amp.





4. CONCLUSIONS

In this paper a simple method has been adopted to present the SC resistor and their implementation with op-amp.This approach for realizing MOS Switched Capacitor integrators with gain constants determined by capacitor ratio achieves excellent temperature stability. The SC networks implemented with active filter network produces precise frequency response. The intensive study of response curve shows that the circuit is insensitive to its component variations. This approach may also be applicable to band pass filter. By using weighted integration capacitor arrays programmable networks may be designed . it can be seen that by switching a IP-F Capacitor at 100 KHZ an equivalent resistance of 10 M ohm is realized in an area of only about 5 mil^2 for Cu plus a few additional square mils for the minimum geometry.

5. REFERENCES

[1]. Harder, Douglas Wilhelm. "Resistors: A Motor with a Constant Force (Force Source)". Department of Electrical and Computer Engineering, University of Waterloo. Retrieved 9 November 2014.
[2]. HVR International (ed.): "SR Series: Surge Resistors for PCB Mounting." (PDF; 252 kB), 26. May 2005, retrieved 24. January 2017.
[3]. "Carbon Film Resistor". The Resistorguide. Retrieved 10 March 2013.
[4]. "Thick Film and Thin Film" (PDF). Digi-Key (SEI). Retrieved 23 July 2011.
[5]. "Thin and Thick film". resisitorguide.com. resistor guide. Retrieved 3 December 2017.
[6]. Kuhn, Kenneth A. "Measuring the Temperature Coefficient of a Resistor" (PDF). Retrieved 2010-03-18.
[7]. Westinghouse Electric Company, Westinghouse AP1000 Design Control Document Rev. 17, Cranberry Township, PA, 2008. http://pbadupws.nrc.gov/docs/ML0832/ML083230868.html (accessed May 07, 2013).
[8]. Mitsubishi Heavy Industries, Design Control Document for the US-APWR, Tokyo, Japan, 2011. http://pbadupws.nrc.gov/docs/ML1109/ML110980211.pdf (accessed May 07, 2013).

[9]. W. Johnson, J. Bruhl, D. Reigles, J. Li, A. Varma, Missile Impact on SC Walls: Global Response, in: Struct. Congr. 2014, American Society of Civil Engineers, Reston, VA, 2014: pp. 1403–1414. doi:10.1061/9780784413357.124.

[10]. J.C. Bruhl, A.H. Varma, W.H. Johnson, Design of composite SC walls to prevent perforation from missile impact, Int. J. Impact Eng. 75 (2015) 75–87. doi:10.1016/j.ijimpeng.2014.07.015.

[11]. 6. J.C. Bruhl, A.H. Varma, J.M. Kim, Dynamic Global Response of SC Walls Subject to Missile Impact, Nucl. Eng. Des. (2015). Elsevier Science. Accepted for publication.

[12]. Obayes, Saif Aldeen Saad, Ibtesam R. K. Al-Saedi, and Basil Jabir Shanshool, " Microstrip Grid Antenna Array for 5G Mobile Devices," Journal of Communications, vol. 13, no. 5, pp. 225-229, 2018. Doi: 10.12720/jcm.13.5.225- 229.

BILOGARAPHY

1. **R.A. Friedenson, R.W. Daniels, R. J. Dow and P.H. Mc Donald,** "RC active filters for 3D channel bank", Bell Syst. Tech. J. Volume 54, pp. 507-529, Mar. 1975.
2. **W.E. Heinlein and W. Harvey Holmes**, "Active filters for Integrated circuits", Vol. Sc - 10, pp. 371-379, Dec. 1975.
3. **B.J. Hosticka, R.W. Broadersen and P.K. Gray**, "MOŞ sampled data recursive filters using state variable techniques". In proc. int. system, Circuits and Systems (Phoenix, Az, Apr. 1977), pp. 525-529.
4. ---- "MOS sampled data recursive filters using switched capacitor integrators", IEEE J; Solid state circuits volume SC-12, pp. 600-608, Dec. 1977.
5. **J.T. Caves, M.A. Copeland, C.F. Rahim and S.D. Rosenbaum,** "Sampled analog filtering using switchedcapacitors as resistor equivalent", IEEE J; Solid Circuits, Vol. Sc 12, pp. 592-599, Dec. 1977.
6. **D.J. Allstot, R.W. Brodersen and P.R. Gray**, "Fully integrated high order MOS sampled data ladder filters", Indigest, int. solid state ciruits Conf. (San Francisco, C.A., Feb. 1978), pp. 82-83.
7. **G.M. Jacobs, D.J. Allstot, R.W., Broaderson and P.R. Gray**. "Design techniques for MOS switched capacitor ladder filters". IEEE Trans. Ciruits and Systems Vol. CAS - 25, pp. 1014-1021, Dec. 1978.
8. **H. Jokinen and M. Valtonen**, "small signal analysis of non-ideal switched capacitor circuits", IEEE International symposium on circuits and system, Vol. 1, pp. 395-398, London, 1994.
9. **David J. Allstot, member, IEEE, Robert W Broadersm, member, IEEE and Paul R. Gray, senior member IEEE**. "MOS Switched capacitor Ladder filters", IEEE J; Solid state circuit, Vol. Sc 13, No. 6, Dec. 1978, pp. 806-814.
10. **Hannu Jokinen and Martti Valtonen**, "Steady state small signal analysis of switched capacitor circuits. Conference paper Midwest symposium on circuits and systems, Ames. 18.8 - 21 - 8, 1996.
11. **J. Roos and M. Valtonen**. "Self generating look up table models combined with DC Analysis", Proceedings of BEC '96, Tallinn, October, 1996.
12. **L. Costa, M. Honkala, A. Kivikero A. Lehto Vuori and M. Valtonen**, "Non monotone Norm-Reduction Method in Numerical Circuit Analysis, June 2002,

BOGRAPHIES

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