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Current Feedback Operational Amplifier (CFOA) Based High Speed Notch Filter Using THS3202 IC

Vijay laxmi Kalyani, Surbhi Pokharna

Vijay laxmi Kalyani, Assistant Professor, Electronics and Communication Department, Govt. Women Engineering College Ajmer, India, (vijaylaxmikalyani@yahool.com).
Surbhi Pokharna, B.Tech, 2nd year, Electronics and Communication Department, Govt. Women Engineering College Ajmer, India, (jainsurbhi99.sp.sj@ gmail.com).

ABSTRACT: In this paper a high speed notch filter has been designed on a 50MHz frequency range using a CFOA IC -THS3202. The THS3202 IC is a 2GHz dual current Feedback Amplifier having higher slew rate of 9000 V/µs. The proposed circuit can be used to eliminate the interference signal between a particular frequency band at 50 MHz. This type of circuitry can be useful for high frequency range of application such as coax stub that is used on high frequency to minimize interstation interference,dual band antennas, HF transreceivers etc. Simulation results and analysis have been carried out using NI-multisim software. Ultiboard results and 3D layout are also shown of the proposed circuit to make a complete PCB circuit.

Keywords: Current feedback operational amplifier (CFOA), Notch filters, NI Multisim 12.0 software, Ultiboard, IC-THS3202

I. INTRODUCTION

Notch filters are used in many applications like audio signal, tone- signaling, power line, hearing aid feedback where to eliminate the undesired signal on a particular band. Using conventional op-amp these filters does not work at a very high frequency. To design the high speed notch filter CFOA based ICs are more preferable. Many types of notch filter designs have been investigated over a last decade [1-4]. In [1] a novel tunable miniature active notch filter based on short circuited quarter-wavelength resonator were presented and used tunable Active Capacitance (AC) circuit and serves for trial purposes. In [2] Analog and Digital Notch Filter Implementation were proposed which proposed a few methods for rapidly obtaining accurate notch filters. In [3] the article presented high speed notch filter on different frequencies. In [4] 50 MHz notch filter with coax cable were presented.

In this paper the author(s) have made an effort to design a high speed notch filter on a 50MHz frequency range using a CFOA IC -THS3202. Design of notch filter using THS3202 IC provides a good result at 50 MHz frequency range. The THS3202 IC is a 2GHz current Feedback Amplifier developed with BiCOM-II technology. It is designed for low distortion with a high slew rate of 9000 V/µs [5].

II. CFOA BASED ICS

The current feedback operational amplifier is a type of electronic amplifier whose inverting input is sensitive to current. The CFOA was invented by David Nelson at Comlinear Corporation, and first sold in 1982 as a hybrid amplifier, the CLC103. CFOA are widely used in analog signal processing applications such as analog to digital convertors, filters and many other building blocks of communication. CFOA has many advantages such as It provides faster slew rate, higher speed with low distortion, excellent high frequency performance, larger dynamic range, constant gain bandwidth product and low noise characteristic, this is increasingly needed in analog signal processing. Many CFOA ICs have been introduced over the last decade by several manufacturers such as such as AD844 from Analog Devices, Intersil HFA1130, NCS2511 from ON Semiconductor, THS3201 and THS3202 from Texas Instruments and so on.

II.I. THS3202 IC: The THS3202 IC is a 2GHz dual current Feedback Amplifier developed with BiCOM-II technology. It is designed for low distortion with a high slew rate. This IC provides well-regulated AC performance with power supplies ranging from single-supply of 6.6V up to a 15V. The high unity-gain bandwidth of up to 2GHz is a major contributor to the excellent distortion performance. The THS3202 offers an output current drive of ±115mA and a low differential gain and phase error that makes it suitable for applications such as video line drivers. Further, the THS320x family is ideally suited for applications such as driving loads sensitive to distortion at high frequencies. Hence it is a high-speed operational amplifier configured in a current-feedback architecture. This device is built using Texas Instruments BiCOM-II process, a 15-V, dielectrically isolated, complementary bipolar process with NPN and PNP transistors possessing of several GHz. This configuration implements an exceptionally high-performance amplifier and

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wide bandwidth, high slew rate, fast settling time, and low distortion. It is useful in Signal Processing, Test & Measurement, Imaging, Video & Vision. Hence, This IC has many features such as Unity-Gain Bandwidth: 2 GHz, High Slew Rate: 9000 V/µs, Power-Supply Voltage Range: 6.6 V to 15 V, Unity-gain bandwidth, ±115mA High output current [5].

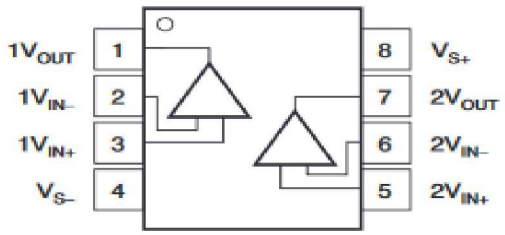

Fig. 1. THS3202 IC from Texas Instruments

II. Design of high speed notch filter using CFOA IC (THS3202)

The proposed circuit uses THS3202 IC to design the high speed notch filter at 50 MHz with minimum component requirement. The THS3202 IC is a dual current feedback amplifier. Therefore using only single IC the proposed circuit (in fig.-2) provides a good results at 50 MHz frequency range with minimum component requirement. Notch filters are widely used to reject the particular band of frequency. The center frequency is determined by $f_o = 1/2\pi RC$. Where $f = f_{Notch}$, Here f_{Notch} is the maximum notch out frequency on which maximum attenuation occur.

To design this filter first select the center frequency f_o=50MHz (Where $f_o = 1/2\pi RC$)

1. Choose the value of C_1=C_3=.1pF, C_2 =.2pF and R_1= R_2=32KΩ, R_4=R_5=10KΩ, R_3=16 KΩ,
The –3dB bandwidth (B.W.) can be determined by the following calculations. B.W. = f_{Notch}/Q, where, B.W. = $f_H - f_L$ =31.601-81.79= -50.189 MHz.

The filter Q can be determined by:

$Q = (f_H - f_L)/f_o$ =-50.189/50=–1.00378

+

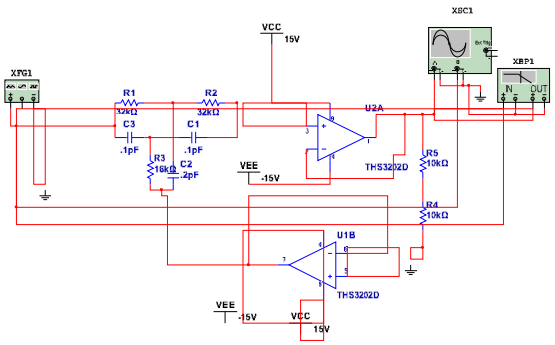

Fig.2. circuit diagram of notch filter using THS3202 IC

Fig.3. Output result of notch filter using THS3202 IC

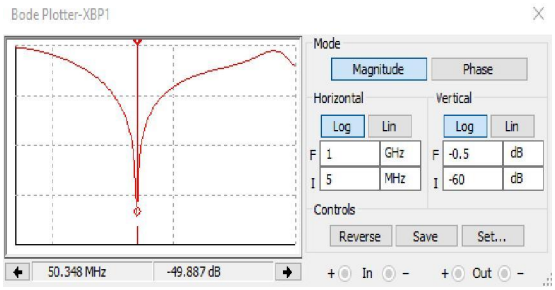

Fig.4 frequency response curve shows the center frequency at 50.3448 MHz

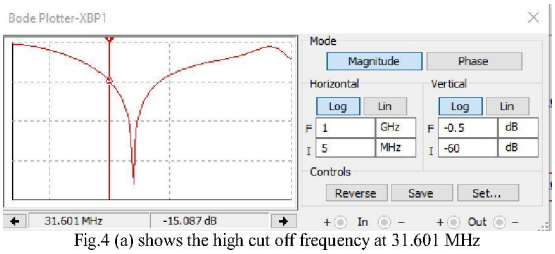

Fig.4 (a) shows the high cut off frequency at 31.601 MHz

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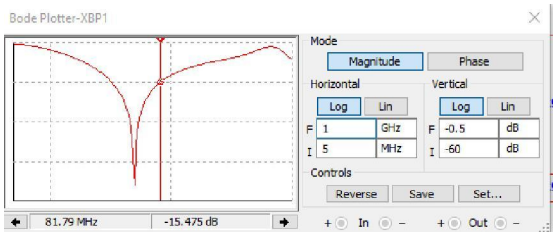

Fig.4 (b) shows the low cut off frequency at 81.79 MHz

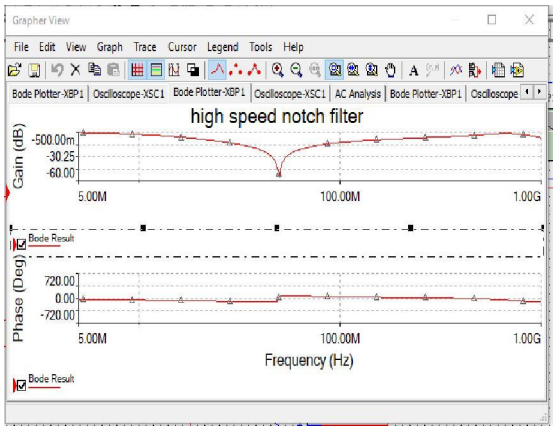

Fig.5 grapher view represents the gain and phase response

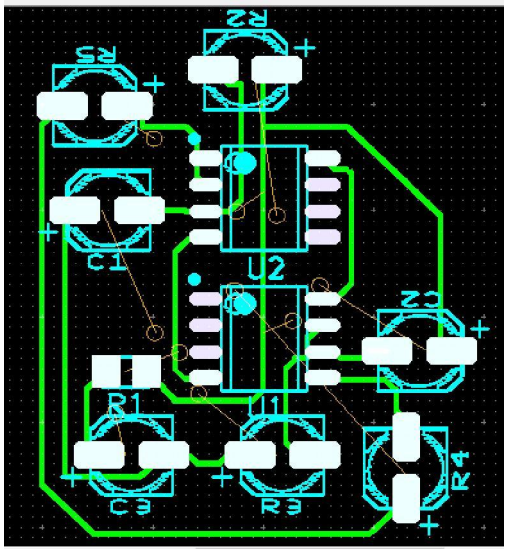

Fig.6. ultiboard design of high speed notch filter

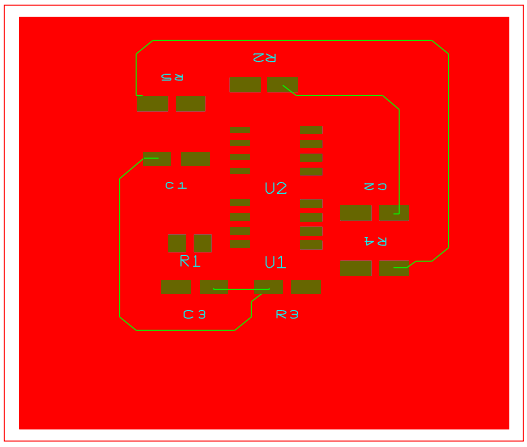

Fig.7 PCB layout of high speed notch filter

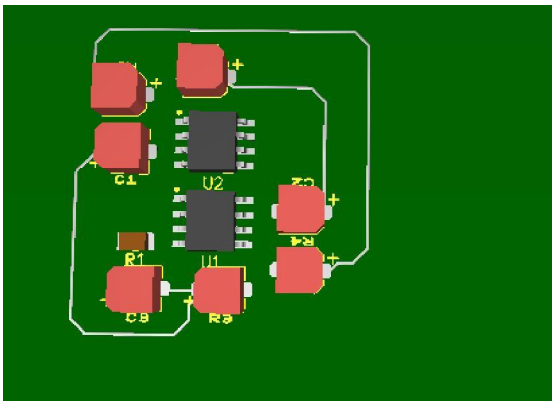

Fig.8. 3D of high speed notch filter

III. RESULT

The result shows that when the input frequency of 50 MHz applied at input then the output results obtain in form of sine wave (shown in fig.3) and the frequency response curve also determined with accurate results (fig.4). The maximum elimination is occur at the center frequency 50.348 MHz which is near to the theoretical value. The gain obtain at this frequency is -49.887 dB. Frequency response curve shows that there is the band reject frequency between two bands: F_H and F_L. Therefore the bandwidth between two bands (as shown in fig.4a and 4b) are B.W.= F_H-F_L=31.601-81.79=-50.189 MHz. and Q =-1.00378 have been determined.

IV. CONCLUSION

The new design of high speed notch filter based on CFOA has been introduced in this paper. The proposed circuit used the dual current feedback amplifier with minimum component so it also concluded that this type of circuitry required only single op-amp and work on a very high frequency range. The results shows that it can eliminate the

interference signal at 50 MHz. With the help of ultiboard and PCB design layout we can use this circuitry for hardware implementation. 3D view of the circuitry are also shown for better understanding.

REFERENCES

[1]. Lintignat, B. Jarry, B. Barelaud ,"Varactor-Tuned Active Miniature Notch Filter ,Conference Paper · June 2012, DOI: 10.1109/NEWCAS.2012.6328958

[2] Mircea S , us ,c˘a, Petru Dobra ,"Analog and Digital Notch Filter Implementation", Conference Paper · May 2016

[3] Bruce carter, "High-speed Notch Filters", high performance analog products, analog applications journal, Copyright© 2006, Texas Instruments Incorporated

[4] https://www.dh8bqa.de/building-a-50-mhz-notch-filter-with-coax-cable/

[5] http://www.ti.com/lit/ds/slos242f/slos242f.pdf

Authors Detail:

1. Vijay Laxmi Kalyani, Assistant professor, HOD from Electronics and Communication Engineering Department, Govt. Women Engineering College, Ajmer.

2. Surbhi Pokharna, B.Tech 2nd year, Electronics and communication, Govt. Women Engineering College, Ajmer.