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Design and Implementation of Frequency to Voltage Converter (FVC)

Madan Pal Singh[1], Ashish Kumar Gupta[2]
[1,2]Deptt. Of ECE, JBIT dehradun
1.madanchauhan2525@gmail.com
2.argashish2006@gmail.com

Abstract: this technique is used to convert accurately frequency to voltage, The goal of this conversion is to transform an oscillating signal frequency into a corresponding voltage that can be processed conveniently. this technique based on simple principle of differentiator integrator and divider the design converter provides an accurate output, its output response has input-amplitude independent characteristics

1 INTRODUCTION

To design and simulate the Frequency to Voltage Converter (FVC), from the available literature, using basic fundamental law, a relation was derived between the frequency and voltage for a sinusoidal signal. The complete circuit was designed using different active and passive components and was simulated using Microsim software. Here two very simple methods are proposed for frequency to voltage conversion.

(1) Based on rectification and filtering.

(2) Based on Sample and Hold technique.

Various waveforms and control signals were analyzed at different terminals within the circuit using the Microsim Design Lab 8 software for its performance in comparison to the existing techniques. Also circuit was tested for sinusoidal and digital waveforms.

2 CIRCUIT DESCRIPTION

2.1 Rectification and Filtering Technique:

Fig: (1) shows the bock diagram of proposed FVC which comprised an R-C series network, amplifier, squaring circuit, rectifier and filter circuit With the application of the Ohm's to a series R-C circuit, as frequency of sinusoidal signal increases, the resistance remains constant
and reactance of capacitor decreases. As a result the voltage across the resistance becomes the function of frequency of the applied signal. So the voltage across the series resistance can be written as:

(i)

Hence as a sinusoidal signal is fed to the circuit, the voltage drop across the resistor will vary. Each time, a change in input signal frequency, will result a change in the voltage drop across the resistance. The signal across the resistance is further amplified, rectified with the technique of analog multiplication and filtered with the help of filter circuit. Finally we get a voltage proportion to the frequency of input signal

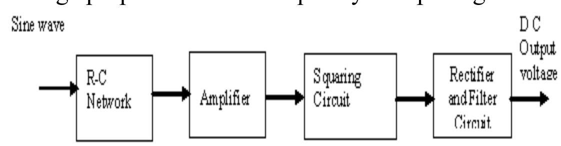

Fig: (1) Block diagram of Proposed FVC

The input to the squaring circuit is a sinusoidal signal. So at its output we get the squared signal. Which can be written as:-

(ii)

(iii)

This equation (3) gives a signal which has the frequency equal to the twice the input frequency and its amplitude is varying from '0' to peak value sinusoidally. At no instance its amplitude is becoming negative. In other words we can say it is the rectification of the input. Also we can say it becomes pulsating D.C. This signal further filtered with the help of a diode, R-C filter and L-R filter. Finally we get the desired output voltage.

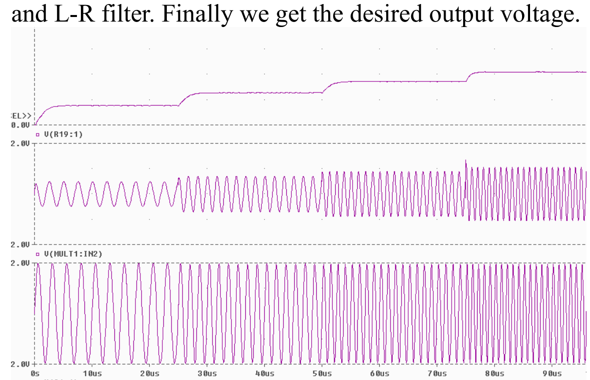

Fig :(2) Different waveform of proposed FVC

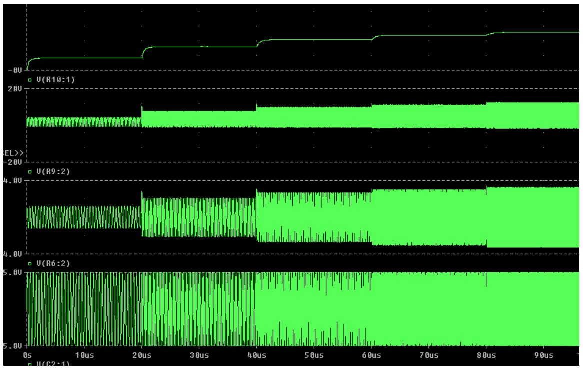

Fig :(3) Different waveform of proposed FVC upto 10MHz

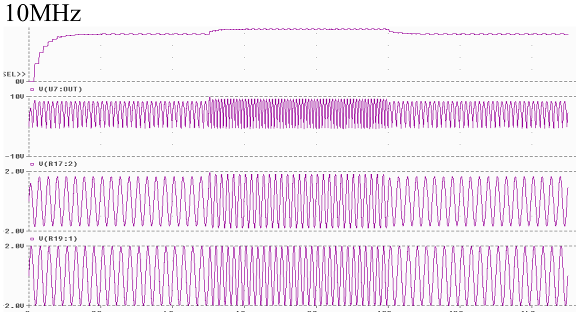

Fig :(4) Output & different waveform of proposed FVC Using S/H technique

3 BASED ON SAMPLE AND HOLD TECHNIQUE

The block diagram of proposed technique is given below in fig: (5). In this technique upto the stage of analog multiplication the circuit diagram is same as proposed by scheme (1), rectification and filtering technique. After that, as revealed from the equations (ii) and (iii), the R-C network and analog multiplier circuit does the amplitude modulation to the input signal proportional to change in frequency. So if samples are taken during each pulse at the output of multiplier circuit we can get the desired output. This is obtained by using the sample and hold circuit

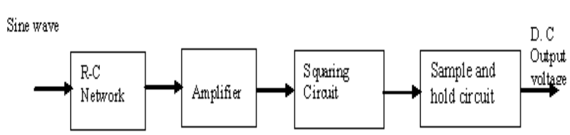

Fig: (5) Block diagram of Proposed FVC using S/H technique

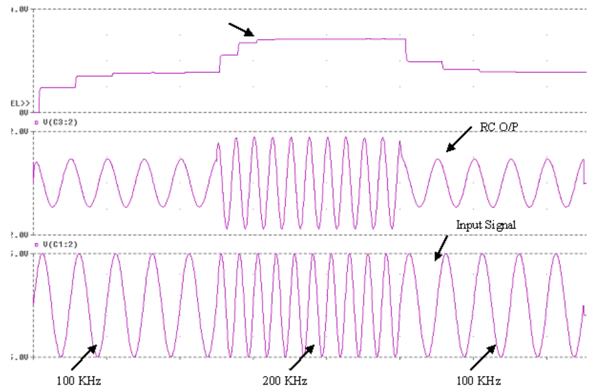

Fig :(6) Output & different waveform of proposed FVC Using integration S/H technique

4 PROPOSED FVC FOR DIGITAL INPUT SIGNALS:

The proposed circuit for FVC was tested on digital input and it reveals from the simulated waveforms that it function satisfactorily.

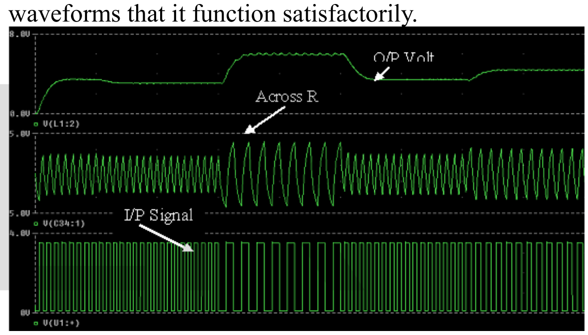

Fig: (7) Various signal for digital input signal for proposed FVC

Therefore from above three circuit diagram and waveforms, it reveals that our proposed FVC circuit is very simple and gives much better result with less rise time in compare to using existing integrator and counter types. Also operates on both digital and analog types of signals

5 CONCLUSION

The proposed FVC provides both accurate measurements and simple circuit configuration. Its performances using available commercial devices are tested by SPICE simulation. The simulation results are in significant agreement with the theoretical

6 REFERENCES

[1] T.L. Floyd and D. Buchla, *Basic Operational Amplifiers and Linear Integrated Circuits*. New Jersey: Prentice-Hall Inc., 1999, pp.450-457.

[2] A.B. Grebene, *Bipolar and MOS Analog Integrated Circuits Design*. New Jersey: John Wiley, 2003, pp.615-624.

[3] A.S. Hou, “Design of fast frequency-to-voltage converter using successive-approximation technique,” *Int. J. Electron*., vol. 92, pp. 635- 644, Nov. 2005.

[4] M.K. Mahmood and J.E. Allos, “Fast frequency detection of sinusoidal signals,” *Int. J. Electronics*., vol. 54, No. 6, pp. 825-832, 1983.

[5] M.K. Mahmood, J.E. Allos, and M.A.H. Abdul-karim, “Microprocessor implementation of a fast and simultaneous amplitude and frequency detector for sinusoidal signals,” *IEEE Trans. Instrum. Meas.*, vol. 34, no. 3, pp. 413-417, 1985.

[6] H.T. Bui and Y. Savaria, “High-speed differential frequency to voltage converter,” in *Proc. IEEE North East Workshop Circuits Syst.,* 2005, pp. 373-376.

[7] A. Djemouai, M.A. Sawan, and M. Slamani, “New frequency-locked loop based on CMOS frequency-to-voltage converter: Design and implementation,” *IEEE Trans. Circuits Syst. II Analog Digit. Signal Process,* vol. 48, pp. 441-449, 2001.

[8] W. Kiranon, P. Wardkein, and C. Loescharataramdee, “Simple frequency/voltage convertor with low output ripple,” *Electron. Lett.*, vol. 27, pp. 205-206, 1991.

[9] H.T. Bui and Y. Savaria, “Design of a high-speed differential frequency- to-voltage converter and its application in a 5-GHz frequency-locked loop,” *IEEE Trans. Circuits and Syst. I*, vol. 55, pp. 766-774, 2008.

[10]W.Surakampontorn,Y.Chonbodeechalermroong, and S. Bunjongjit, “An analog sinusoidal frequency-to-voltage converter,” *IEEE Trans. Instrum. Meas.*, vol. 40, pp. 925-929, Dec. 1991.

[11] T.Y. Lin, E.M. Drakakis, and A.J. Payne, “Architecture for frequency-to- current conversion,” *Electron. Lett*., vol. 37, pp. 1427-1428, Nov. 2001.

[12] A.S. Sedra and K.C. Smith, *Microelectronic Circuits*. New York: Oxford University Press, 1991.