Design and Development of Low Cost, Compact, High Frequency Microwave Signal Source

[1]Ashwini.S.B, [2]Mahalakshmi.B.S, [3]Poojashree.C.P, [4]Shashikala.B.N, [5]Bhuvaneswari.P

[1,2,3,4,5]Dept of ECE, RRCE, Bengaluru
Email: [4]shashibn1994@gmail.com, [5]bhuvanasamuel@gmail.com

Abstract-Wireless Communication is gaining vast importance in recent years. Microwave signal should travel for a long distance without any connectivity between transmitting and receiving antenna The existing sources include Klystron supply, BNC model, Magnetron etc are of high cost and bulky. The most effective parameters in designing source include the cost, size and transmission frequency. The biggest threat in the existing sources is the high cost and size. In this paper we are concentrating on the designing of microwave source with the above mentioned parameters. The main aim of this paper is to design a low cost, compact, high frequency (S-Band) microwave source for communication.

Keywords-Voltage Controlled Oscillator (VCO), PIC Microcontroller, S-Band Modulation.

I. INTRODUCTION

Microwave and Radio frequency field has undergone a big growth in recent years. From being a technology that had its utilization mainly in Telecommunication and Radar applications. It is today the forefront technology for range of wireless applications. The market for wireless applications is expanding and this in turn is constantly driving the demand for plethora of RF products with increased functionality and integration. The satellite communication established a worldwide communication network proving communication from one point of the world to any part of the world. Thus the scope of RF design techniques and technology which until a decade or so ago was confined to HF and UHF frequency bands. Looking at wide range of EM spectrum, frequencies from 300 MHz to 100 GHz and above falls in range of RF field.

RF field has gained considerable importance in recent years due to its wide variety of applications. This trend is enabling the use of increasingly higher RF frequencies with their inherent advantages of smaller component, size and larger bandwidth. Presently RF sources are imported from advanced countries like USA, Germany, Japan, Israel which are very expensive. Microwave field has vast scope and trained manpower in this field will cater to demands of Telecom and Defense industries in India. Microwave generation is based on heterodyne of two phase correlated wavelength. It is generated in optical domain which is complicated and costly [1].

The microwave signal generation uses monolithic quantum dot passively mode locked laser. These are promising for microwave generation because of their compact size, low power consumption, efficiency etc. [6]. Also using self-heterodyning of a single wavelength tunable SG-DBR laser for microwave signal generation is explained by Michael A. Bernacil et al..[2].Two single mode laser diodes are injection locked to +1 and -1 diffracted orders of 4.6GHz acousto-optical modulator to generate microwave signal[4].The utilization of optical technology in microwave signal generation offers new features and improved performance like wider tuning range ,lower noise, synchronization etc.[7].The concept of transmitting power as microwaves from one place to another in order to reduce cost and distribution losses [8].

To create interest in this field, we focused in the development of low cost Microwave signal source in the extended S-Band frequency range of 2 GHz to 4 GHz using Voltage Controlled Oscillator (VCO)whose output power is in the range of 5mW,which can be amplified to higher level using RF amplifiers at a lower stage. Since VCO is a integrated unit of various features it has been selected for our fabrication. On successful fabrication of microwave signal source, we can develop signal source to transmit the microwave signal with Antennas and conduct measurement techniques. The paper is organized like this. In Section II the issues of present system is described ,the solution for the existing system can be solved by our proposed system is explained in Section III, the implementation of hardware is briefly explained in Section IV, Section V explains software requirements, finally the paper is concluded in Section VI.

II. ISSUES OF PRESENT SYSTEM

The present sources which are used to generate a microwave signal are BNC model, Reflex Klystron supply, VCO based sources etc….., but these sources have some demerits. The BNC model microwave source has issues over the Noise and Switching speed.

The Klystron supply which is widely used is based on Velocity Modulation. It has the major disadvantage of high cost ,low power and heavy weight. To design a more compact source is suggested by P.D. Smith and S.R. Cloude [11].In this Paper, we mainly concentrate in eliminating noise , switching speed, high cost ,low power and heavy weight.

III. PROPOSED SYSTEM

In this paper, The main aim is designing the source of compact size and low cost , high frequency microwave signal. Further can be used in various communication applications.

The design block diagram is shown in the Fig.1. The system includes the Power supply unit, PIC-Microcontroller, 2x16 LCD display, Voltage Controlled Oscillator (VCO) and a Modulator (LM 324).

The Rectification, Regulation and Filtering processes are carried out in the power supply unit. Voltage Controlled Oscillator is the heart of the model which generates a high frequency in the S Band (2GHz to 4 GHz) microwave signal.

The PIC microcontroller is programmed in such a way to display the voltages and frequencies which are varied using Potentiometer. The message signal from LM 324 and the carrier from VCO are modulated and the generated microwave signal is transmitted.

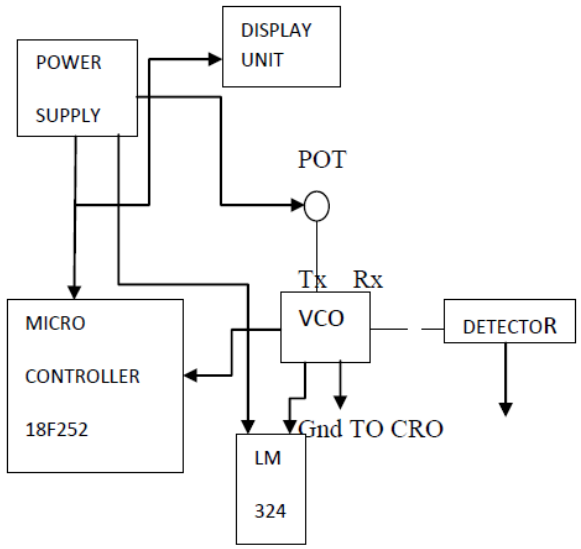

Fig 1. Block diagram of Microwave Signal Source

By using the transmitting and receiving antennas, the generated signal is transmitted and detected.

IV.HARDWAREREQUIREMENTS

The hardware includes 2x16 LCD display, Voltage Controlled Oscillator, PIC Microcontroller 18F252, Modulator LM 324, Power Supply Unit Potentiometer. Where the VCO plays a major role in the model which generates a high frequency microwave signal. Using the Modulator, the signal is modulated and then detected.

V. SOFTWARE REQUIREMENTS

The Software includes Kiel software and Embedded C. Embedded C is a set of language extensions for the C programming language. It includes the special features like fixed point arithmetic, name address spaces and basic I/O hardware addressing. The syntax of Embedded C is same as C compared to assembly language C code written is more reliable and scalable and more portable between different platforms. Kiel software is an industry standard development tools for 8051 microcontroller family. Here in the development of our model, we have programmed the PIC Microcontroller in such a way to display the variation of voltage and frequency.

VI.CONCLUSION AND FUTURE WORK

The contribution of the proposed system is to design a microwave source. In this paper we are concentrating on the existing system disadvantages. The main aim of this paper is to make the Microwave signal source available for low cost and to make it portable. The future work on this approach is to make the microwave signal generated from the source should travel longer distance by using the intermediate amplifier

ACKNOWLEDGEMENT

Our Sincere thanks to our Chairman Sri.A.C. Shanmugam ,Principal Dr.M.S.Bhagya Shekar for their constant encouragement & support towards thiswork. Also we thank our Faculties and family members for their support.

REFERENCES

[1] Jianping Yao " Microwave Photonics: Photonic Generation of Microwave and Millimeter-wavesignals. University of Ottava, ON K1N 6N5 VOL.5 No.1 JAN-2010.

[2] Michael A. Bernacil, Shane O, Connor and Ben Maher, Eds "Microwave signal generation using self heterodyning of a fast wavelength switching SG-DBR laser" California Polytechnic State University, 1 Grand Avenue, San luis Obispo USA-IEEE 2008.

[3] P. Bouyer, T. L. Gustavson, K.G. Haritos, and M. A. Kasevich "Microwave signal generation with optical injection locking". Optical Letters/Vol. 21, No.18/September 15 -1996

[4] Antennas and Propagation by John .D. Krauss 4th Edition , Mc Graw-Hill international edition 2010..

[5] Microwave engineering by Annapurna Das , Sisir K Das TMH publication,2nd ,2010.

[6] C. Y. Lin, J.H. Kim, L.F. Lester, Y. C. Xin "Compact optical generation of microwave signal using monolithic quantum dot passively mode-locked laser".DOL:10.1109/JPHOT.2009.2035523 1943-0655/$26.00 IEEE-2009

[7] Tibor Berceli "Optical processes for the generation of microwave signals" Mikrotalasna revija June-2004.

[8] M. Venkateswara Reddy, K. Sai Hemanth, CH . Venkat Mohan "Microwave power transmission-A next generation power transmission system." IOSR Journal of Electronics and Electrical Engineering 1676 Volume 4 Issue-5(IOSR-JEEE) Feb 2013.

[9] E. Schamiloglu "High power Microwave sources and applications". Paper presented atIEEE-2004 MTTS, Forth Worth, Texas.

[10] E. A. Avrutin, J. H. Marsh and E. L. Portnoi "Generation of ultrastable Microwave via Optical frequency" division. Vol. 147, No. 4. August IEEE-2011.

[11] P.D.Smith and S.R. Clouds. Eds."Ultra wide band. short-pulse Electromagnetic 5. Netyayork: kluwer academic/plenum publishers.2002.

[12] Samuel.Y.Liao" Microwave Solid State devices and circuits" Pearson India publishers.2003.