Asian Journal of Convergence in Technology **Volume V Issue I**
ISSN NO: 2350-1146 I.F-5.11

UWB filter with DMS for Wi-Fi Applications

Raasi Chenna , Vijayadithya Doddi, Sumanth Gurram,Vinay Sharma, Madhur Deo Upadhayay

Electrical Engineering Department
Shiv Nadar University
Greater Noida, India
rc936@snu.edu.in , vd875@snu.edu.in , sg864@snu.edu.in , mu689@snu.edu.in.

***Abstract*—Inthis paper a planar ultra-wideband bandpass filter is designed. The filter is designed using Defected microstrip structure (DMS) and coupled lines. The measured range of pass band is1.5GHz to 7GHzwith a notch at 5.2GHz WLAN frequency.**

Keywords— Planar filter,UWB, Coupling, DMS, Notch

I. INTRODUCTION

In a receiver, a Band Pass Filter allows signals within a preferred range of frequencies to be decoded, while avoiding signals at redundant frequencies from getting through. A wide Band Pass Filter allows higher frequencies ranging in Giga Hertz, which are deployed in numerous communication applications like in low power consumption wireless networks, Wi-Fi, WLAN, Bluetooth, etc. which achieve high bandwidth connections. UWB finds usage in major communication fields like Satellite Communication, Wireless printing, Wireless High Definition Interface, File transfers without PC.The main objective of this filter in a transmitter is to limit the bandwidth of the o/p signal to the required level and to convey data at the preferred speed and in the preferred form. In [1], a design making use of aperture coupling to integrate two bandpass filteris implemented. A millimetre-wave BPF operating at 2.4 GHz and 30 GHz was implemented by using the air filled substrate-integrated waveguide circular cavities with low frequency cut offs.In [2] proposed MMR (Multimode Resonator) is categorized as stepped impedance resonator since it contains λ/2 low impedance line section in the centre and two λ/4 high impedance line sections at two sides.In [3] filter consisting of three parallel coupled lines. In paper [4], UWB based on transversal signal interference principle was implemented.In [5] shorting lines are used.Two different designs combining a bandpass and a notch filter are developed [12].Quarter wavelength spaced shunt stub transmission lines [8].In [9], a Novel Band stop filter is discussed which employs a new technique of dual U-shape DMS(Defected Microstrip Structure).DMS circuits are more immune than DGS(Defected Ground Structure) from crosstalk and ground plane interference. Besides, the DMS is advantageous in high frequency designs. Resonant characteristics of the proposed structure were controlled by adjusting the dimension of dual-U shape slot unit.Stopband characteristics were closely related to slot shape and size which is similar to DGS. DMS circuits are more immune than DGS from crosstalk and ground plane interference.A compact filter which has frequency and passband characteristics well-suited for WiMAX applications is discussed in [11]. In the proposed design, by adjusting the length of the DMS structure, we can adjust the center frequency of the stop-band. For our convenience we blocked the 5.2GHz frequency in our design and allowed the other signals to pass through The DMS structure offers a stop-band width of 0.8 GHz. For the high pass, we need coupling or via to short the low frequency signals.

II. DESIGN OF UWB

The filter is designed on a FR4 substrate with dielectric permittivity is 4.3 and substrate thickness 1.6mm. The design employs the concepts of edge coupling and end coupling in order to create the Band pass behaviour. In general, lower the end coupling gap, higher the transmission. There is a shift to Pass band higher frequency with lesser coupling length. As impedance increases, the sharpness of the transmission graph improves. Stubs with higher impedance and minimum possible distance are preferred. Resonance in substrate can cause flickers in the output. The performance of the design also varies with the port size.

In all the graphs showing S parameters, S11 is the reflection coefficient and S21 or S12 is the transmission coefficient.

A. Design

The dimensions of design are as shown in the above figure. All the coupling gaps are all 0.1mm. This design exhibits UWB behavior between 1.5GHz – 7GHz, with a notch stop band at 5.2 GHz. This notch behavior is due to the special band stop design incorporated in the center impedance line.

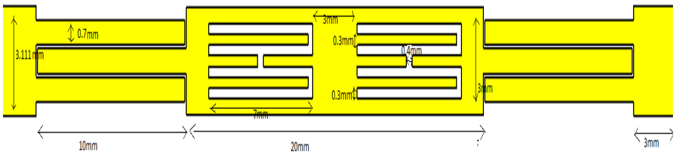

Figure1. Dimensions of the proposed design

TABLE IIMPEDANCE LINE WIDTHS

Line Impedance	**Line Width**
35.61 Ω	5.25mm
50.02Ω	3.111mm
100.02Ω	0.698mm

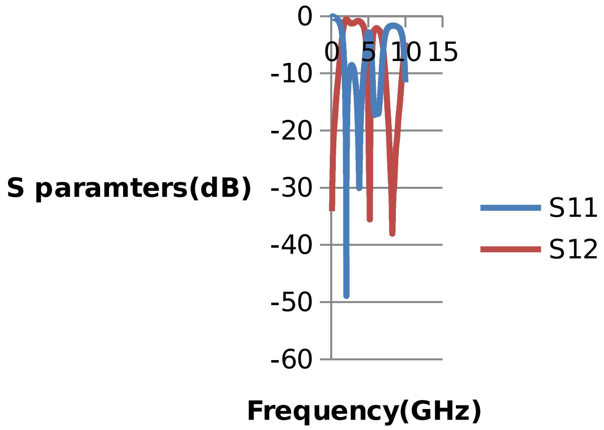

Figure 2. S parameters of the proposed design

B. *Parameters*

Increase in horizontal coupling length decreases the bandwidth. Length of the center impedance line has no significant effect on the output. A decrease in bandwidth is observed with increasing centerline width(lessening impedance).When the end-coupling gap is increased, a slight increase in BW is noted.

C. *DMS Structure*

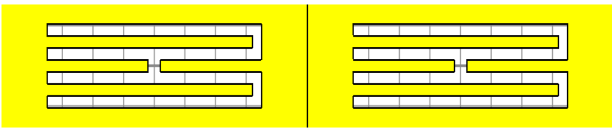

Figure 3. DMS structure responsible for notch

DGS has been widely used in microwave circuit design such as power divider. DGS combined with microstrip line causes a resonant character of the structure transmission with a resonant frequency controllable by changing the shape and size of slot. On the basis of DGS, DMS is introduced in filter design. Slot on the strip can create resonant characteristics in the frequency response, so DMS has stopband characteristics in specific frequency. Stopband characteristics are closely related to slot shape and size which is similar to DGS. DMS circuits are more immune than DGS from crosstalk and ground plane interference. Besides, the DMS is advantageous in high frequency designs. Resonant characteristics of the structure are controlled by adjusting the dimension of dual-U shape slot unit.

III. RESULTS AND DISCUSSIONS

A. *Fabrication Results*

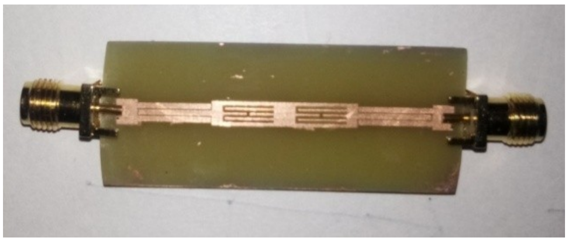

Figure 4. Fabricated design

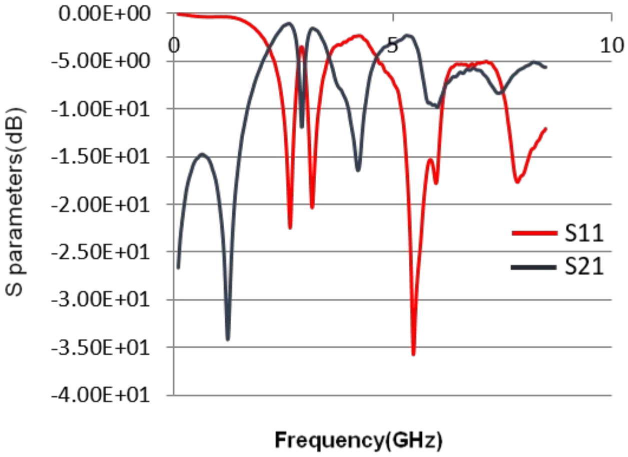

Figure 5. S –Paramters of the fabricated design

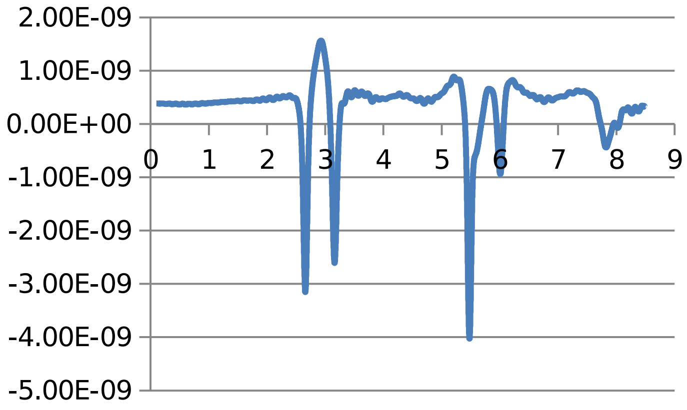

Figure 6. Group Delay of the fabricated design

The results show the fabricated filter exhibits Ultra wide band between 1.5GHz to 7GHz, with a magnitude above -10dB. Two notched are observed one at 2.5GHz and the other at 5.2GHz, both being the ranges of WLAN, BLE, Wi-Fi. This can be noted in Figure 6 where the change in group delay is observed at the two respective frequency ranges. Results are observed using the Vector Network Analyzer.

IV. CONCLUSIONS

This design sized 46mm x 3mm exhibits good UWB behaviour with less reflection between 1.5GHz – 7GHz andwith a notch at 5.2GHz. At 5.2GHz, the WLAN signals travel and since this design shows a small stop band behaviour in the respective range, the WLAN signals are thus avoided interfering with microwave signals travelling. The existing UWB filter size which is currently deployed in UWB systems is around 25mm x 28mm. Hence, this a highly size optimized design. The fabricated design showed two notches at 2.5GHz and 5.2GHz which imply that the signals of Wi-Fi, BLE, WLAN. It passes 3.5GHz which is the citizen Band in United States and hence is useful. In a way, this acts like a 3G signal. It also allows GSM signals.

REFERENCES

[1] Shao Yong Zheng , Zhi Li Su, Yong Mei Pan, ZeeshanQamar , and Derek Ho "New Dual-/Tri-Band Bandpass Filters and Diplexer With Large Frequency Ratio", *IEEE transactions on microwave theory and techniques*, vol.66, no.6, june 2018.

[2] Lei Zhu, Sheng Sun, Wolfgang Menzel "Ultra-Wideband Bandpass Filters using Multiple-Mode Resonator", *IEEE Microwave and Wireless Components Letters*, vol.15, no.11, novemeber 2005.

[3] Yechou Lachen, Tribak Abdelwahed, Kacim Mohamed, Zbitou Jamal and Angel Mediavilla Sanchez "A Novel Low-cost Microstrip Bandpass Filter for Ultra Wideband RF Applications", *International Journal of Microwave and Optical Technology*, vol.11, no.2, March2016.

[4] S.VinothKumar, M.Ganesh Madhan, Kaushik R "A simple UWB Bandpass Filter Design based on signal Interference Approach", *CAE-ISSN:2394-4714, FCA-Newyork, International conference on computing, communication and sensor network, CCSN 2015.*

[5] Subodh Kumar Singhal, Deepak Sharma, Ram Mehar Singh Dhariwal "Design of 1.3GHzMicrostrip Highpass Filter Using Optimum Disturbed Short Circuited Stubs", *First International Conference on Computational Intelligence, Communication Systems and Network*,2005.

[6] Anthony Bruster , Zahriladha Zakaria , Eliyana Ruslan , Ariffin Mutalib "A Review of Bandpass with Tunable NotchMicrowave Filter in Wideband Application" *International journal of Engineering and Technology,* vol.7, no.3, Jun-Jul 2015.

[7] Shao Ying Huang, Yee Hui Lee "Development of Ultra-wideband (UWB) Filters" Research Gate Publication, Nanyang Technological University, January 2008.

[8] Cansever, Cem,"Design of a Microstrip Bandpass Filter for 3.1-10.6 GHz Uwb Systems" May 2013. *Electrical Engineering and Computer Science – Thesis.* Paper 1.

[9] Dongsheng La, Yinghua Lu, and Siyang Sun "Novel Bandstop Filter Using Dual-U Shape Defected Microstrip Structure", *Proceedings of International Symposium on Signals, SystemsandElectronics,*ISSSE2010.

[10] David Mohammed Pozar, "Microwave Engineering", John Wiley and Sons, Inc.2nd Ed.

[11] Mahmoud A. Abdalla, Ashraf Y. Hassan, Ahmed A. Ibrahim "Building a Zero Order BPF with CLRH Transmission Lines", *Microwaves & RF Maganzine*, August 2018.

[12] Silas Christensen, Vitaliy Zhurbenko and Tom K. Johansen "Compact Microstrip bandpass filter with tunable notch" *International Conference on Microwave, Radar, and Wireless Communications*, IEEE 2014.