MINIATURISED ULTRA WIDE BAND(UWB) ANTENNA

Submitted By

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CONTENTS

Abstract

A new design of ultra-wideband (UWB) micro strip patch antenna with radar application is presented in this paper. The proposed antenna consists of a Circular patch with a partial ground plane that is fed by 50 Ω micro strip line. A wide band function is created by inserting overlapped one I-shape and two D-shape slots on the radiator patch, added slots in to the ground plane side or slits in truncated ground plane.

The proposed antenna potentially minimized frequency interference between UWB system. This antenna with the size of 16 mm × 24.3 mm (W×L) and the simulated results show that the antenna can operate over the frequency band between 2.95 and 9.56 GHz for voltage standing wave ratio (VSWR) > 2. Besides in the working band, the antenna shows good radiation pattern in the H-plane and the E-plane and has good time domain characteristic

Introduction

Ultra-wideband technology has become most promising technology since FCC (Federal Communication commission) approved the 2.95-9.56 GHz band for unlicensed radio frequency applications. It has the advantages of low power consumption, high data transmission, less complexity, low cost etc. However, the design of compact, low profile and efficient antennas for UWB applications is still a major challenge and micro strip antennas are mainly used in aircraft, spacecraft, satellite and missile applications where high performance, ease of installation, low cost and small size are major constraints.

In this paper, a notch band function is created by inserting overlapped one I-shape and two D-shape slots on the radiator patch, added slots in to the ground plane side or slit in truncated ground plane. With a compact size of 16 mm × 24.3 mm, the -10dB impedance bandwidth of the proposed antenna is sufficient to cover the entire ultra-wideband frequency for Radar Application.

Dimension:-

Parameter List

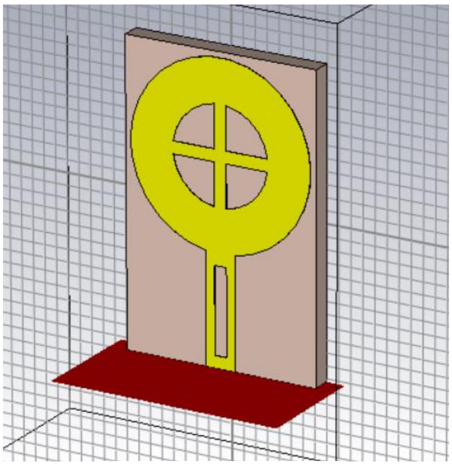
Name	Expression	Value
W	= 16	16
L	= 24.5	24.5
Ms	= 1.6	1.6
Lf	= 9	9
Ls	= 7	7
Mt	= 0.035	0.035
Wf	= 2.5	2.5
Lp	= 20	20
Wc	= 0.5	0.5
R	= 7.5	7.5
Lcut	= 1	1
Wcut	= Wf	2.5
LcutD	= 2.5	2.5
RpsO	= 4	4
x	= 1	1
Wcap	= 0.01	0.01
D	= 2	2
y	= 1	1
Lslot	= 7	7
Lpg	= 8	8
<new parameter>		

where it is clear that the proposed antenna has compact profile and desired notch band compare to others. In this paper, section 2 presents the geometry of the proposed antenna. Section 3 presents the result of some important features of proposed antenna such as return loss, VSWR and radiation patterns. Section 4 presents the conclusion.

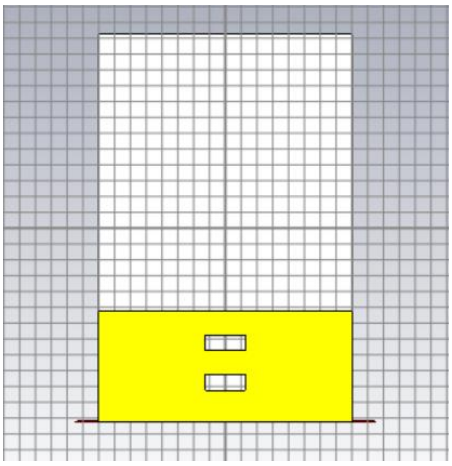
Antenna Design and Analysis

The proposed antenna is simulated using transient solver in Computer simulation technology (CST) microwave studio. Figure 1 shows the geometry and configuration of proposed notched band UWB antenna, which is designed on FR4 substrate with a thickness of 1.6 mm, relative permittivity of 4.3 and loss tangent of 0.03. The proposed antenna composed of a circular patch is fed by a micro strip line and printed on FR4 substrate having dimension of 16 mm × 24.3 mm. A notch band function is created by inserting overlapped one I-shape and two D-shape slots on the radiator patch, added slots in to the ground plane side or slit in truncated ground plane. To match 50Ω characteristic impedance micro strip feed line is designed and enhanced by adjusting the dimension of the feeding structure and patch size. The micro strip feed line is having fixed length (Lf) 9 mm and width (Wf) 2.5 mm and positioned at 1.25 mm far from symmetrical position.

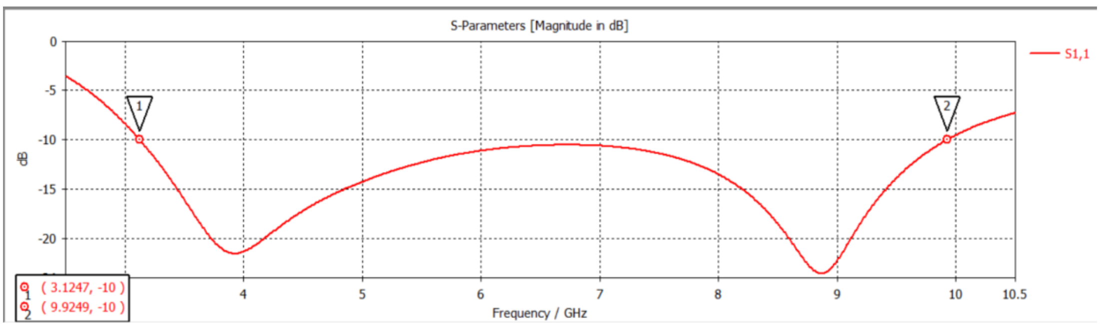
To design a micro strip patch over FR4 substrate, I-shaped and D-shaped slot in patch has done by the help of some changes as follows.



Front View

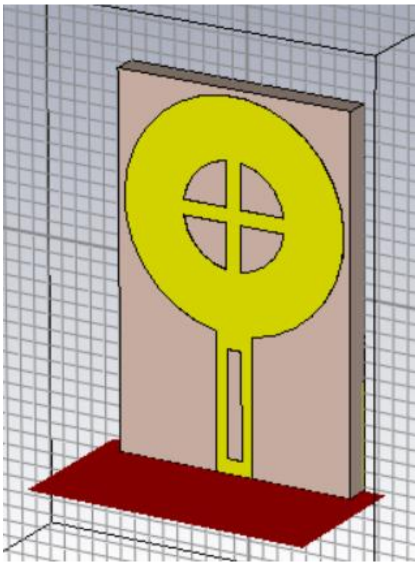


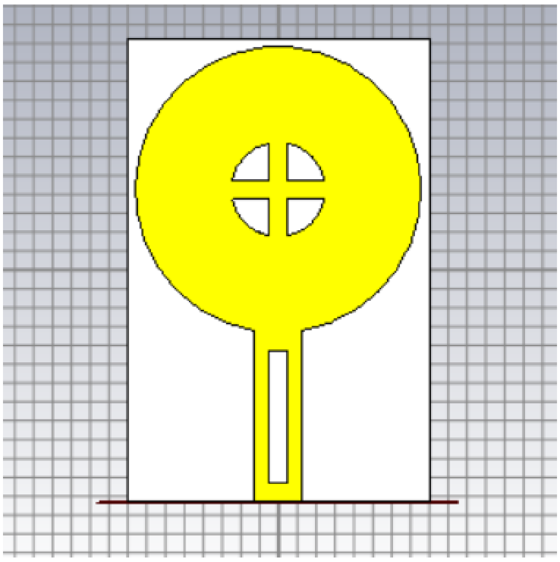
Back View

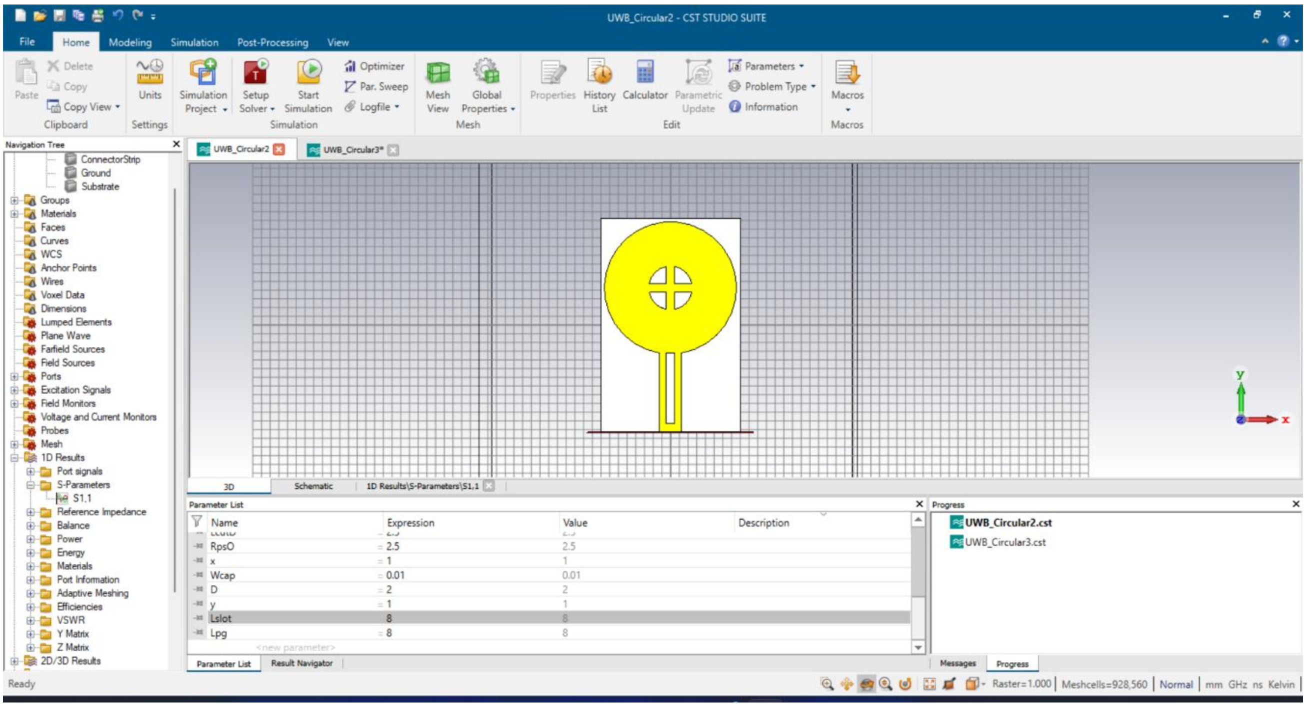


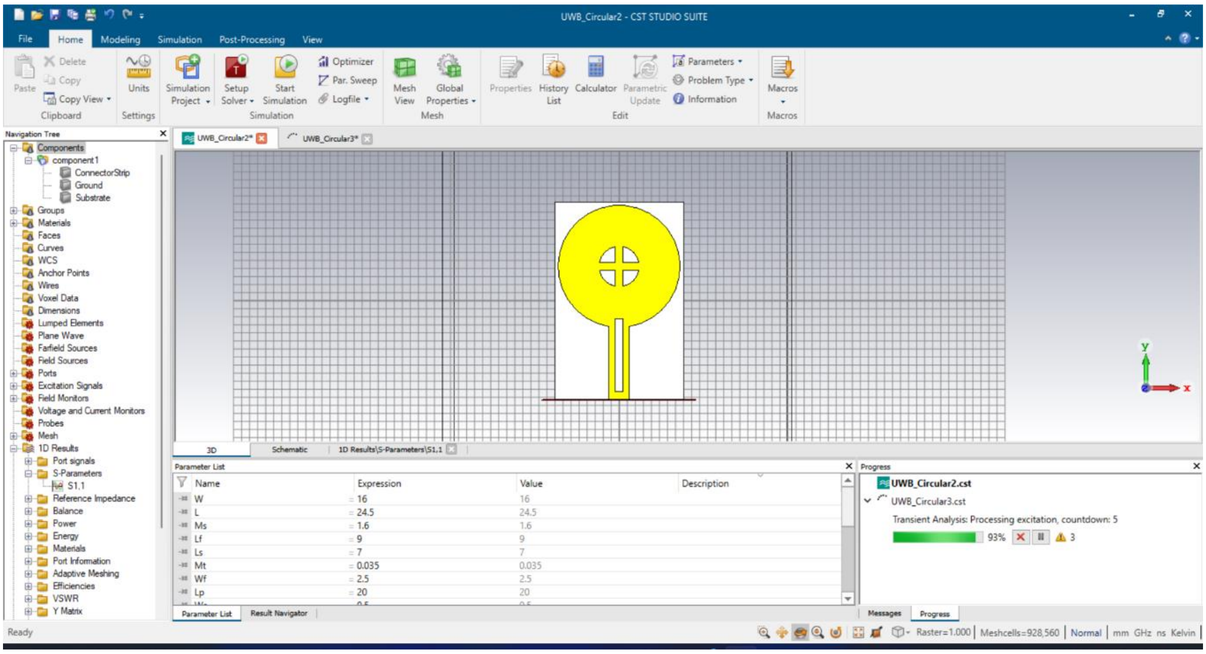
S parameter

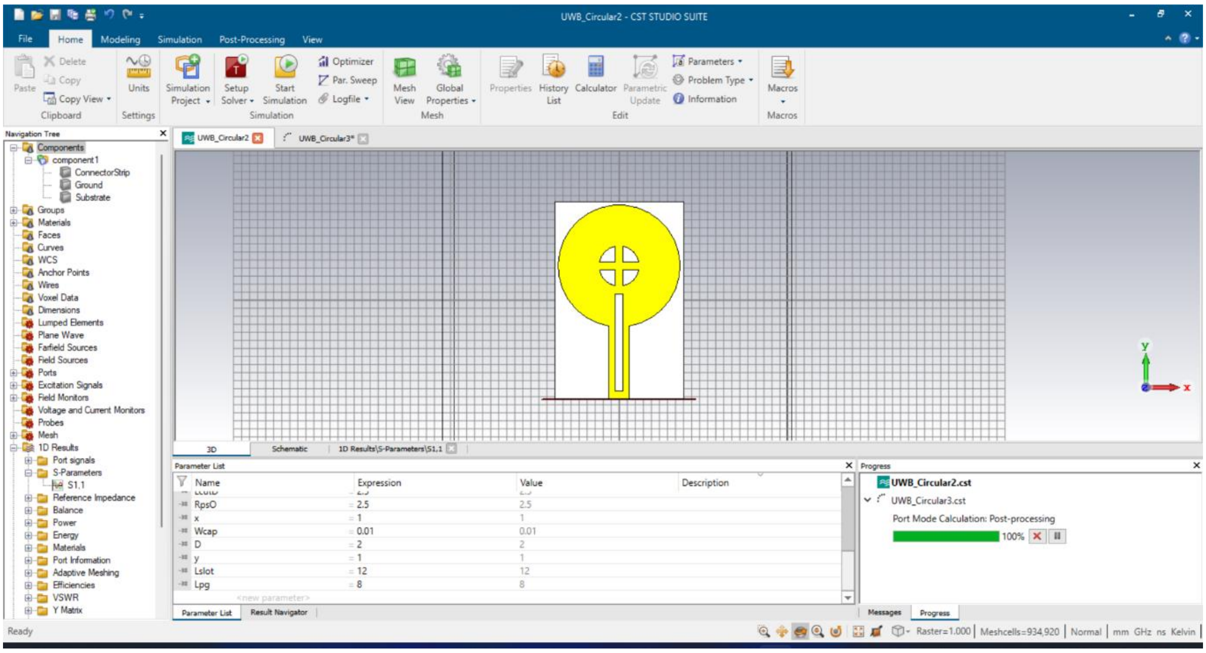
We Created this design after that we observe that as we change the inner radius of patch as well as we change the length of, I slot in feed so our S parameter graph shift down. Following figures show the variations



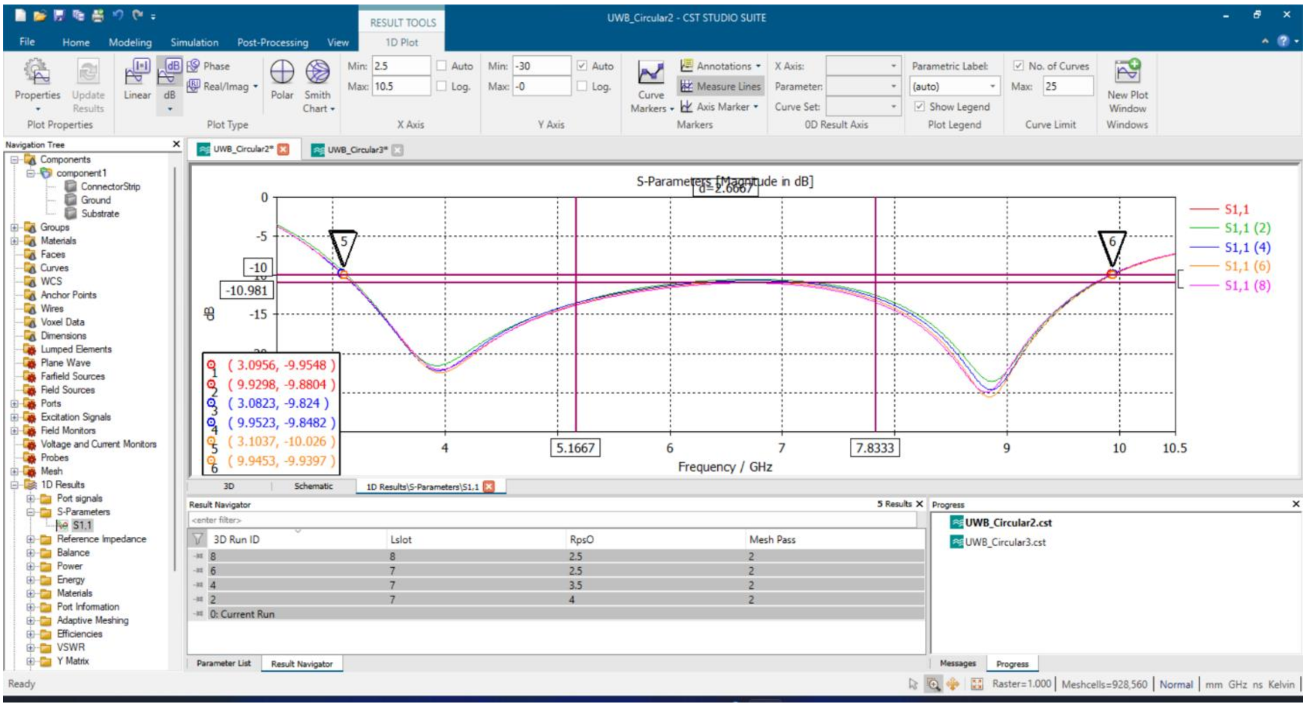




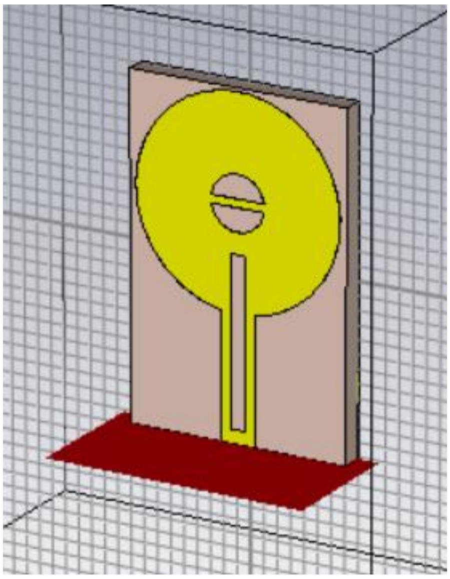

UWB_Circular2 - CST STUDIO SUITE
Parameter List
Name Expression Value Description
W 16 16
L 24.5 24.5
Ms 1.6 1.6
Lf 9 9
Ls 7 7
Mt 0.035 0.035
Wf 2.5 2.5
Lp 20 20
Progress
UWB_Circular2.cst
UWB_Circular3.cst
Transient Analysis: Processing excitation, countdown: 5
93%


UWB_Circular2 - CST STUDIO SUITE
Parameter List
Name Expression Value Description
RpsO 2.5 2.5
x 1 1
Wcap 0.01 0.01
D 2 2
y 1 1
Lslot 12 12
Lpg 8 8
Progress
UWB_Circular2.cst
UWB_Circular3.cst
Port Mode Calculation: Post-processing
100%

we get results as follow:



After multiple observation and changes we get our final design as follows



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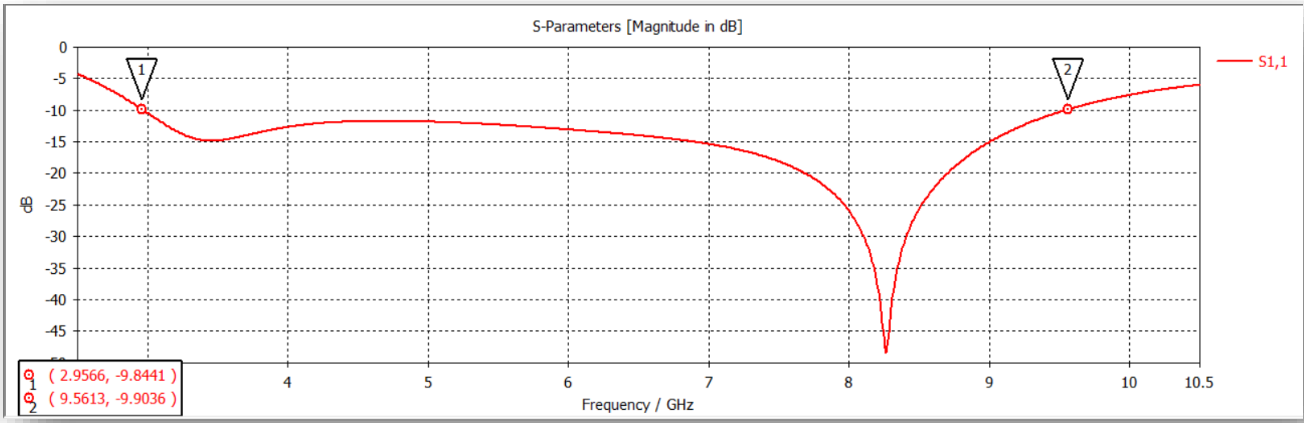
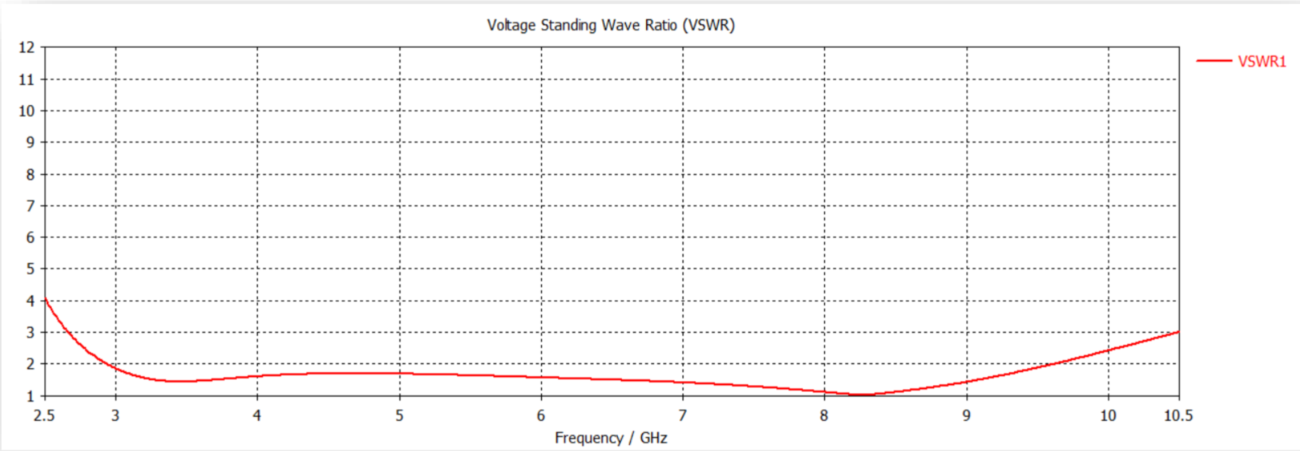
<new parameter>

Simulation Results

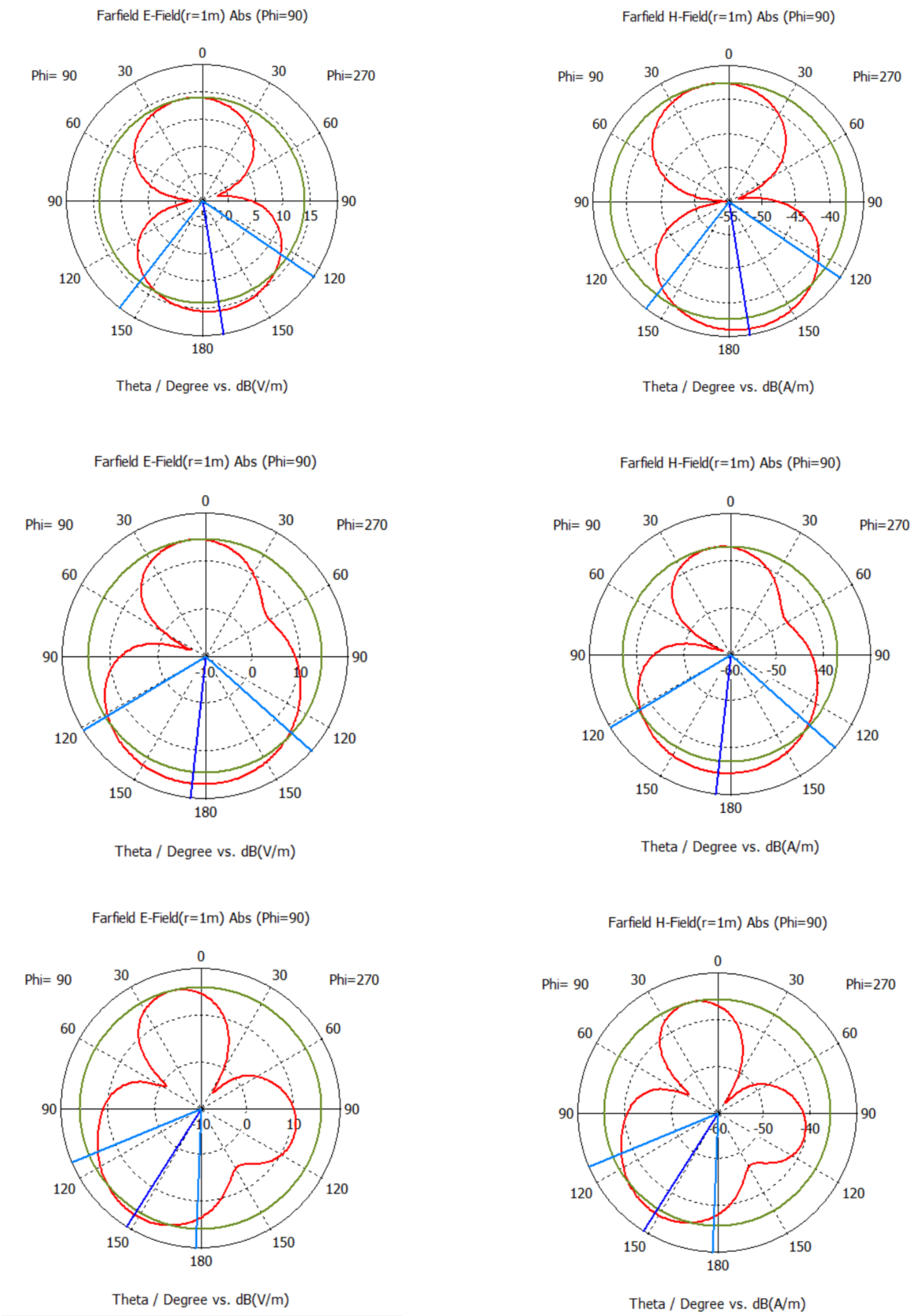
Following Figure shows the simulated return loss S1, 1 against frequency of the antenna with the help of CST microwave studio. As observed, the simulated impedance bandwidth with 10dB return loss for the proposed antenna is from 2.95-9.56 GHz.



Following Figure shows the simulated voltage standing wave ratio (VSWR) for the proposed antenna design. The UWB shows VSWR > 2 while it maintains good impedance matching at other frequencies in UWB band.



The simulated radiation patterns of proposed antenna for three different frequencies 3, 6.5 and 10GHz in the E-plane and H-plane are shown in fig. The radiation patterns in the H-plane are quite omnidirectional as expected and, in the E-plane like a small dipole leading to bidirectional patterns.



Conclusion

The simulations were carried out using CST microwave studio in time domain. This work presents a simple structure of an ultra-wideband microstrip patch antenna. The proposed antenna operates in 2.95- 9.56 GHz. Overlapping one I-shape and two D-shape slots on the radiator patch , slits in truncated ground plane in order to mitigate interferences between UWB system and make more efficient band UWB patch antenna. The applications of the proposed antenna are in the medical imaging, wireless communication, radars and special in ground penetrating radar (GPR). The proposed antenna is easily fabricated with RF/microwave circuits with low cost.

Reference

M. A. Sennouni, J. Zbitou, A. Tribak, A. Benaissa and M. Latrach, "Circular polarized square patch antenna array for wireless power transmission", *Proc. 2013 Int. Renew. Sustain. Energy Conf. IRSEC*, pp. 2013, 2013.

A. Afyf and L. Bellarbi, "A novel miniaturized UWB antenna for microwave imaging", *Int. Conf. Multimed. Comput. Syst. -Proceedings*, vol. 0, pp. 1475-1478, 2014.