CPW-Fed UWB Antenna with Band-Notch by Hexagonal Shape Slot

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Abstract: **In this paper, a compact band-notch UWB antenna with CPW-fed is presented. A band notch antenna is designed by etching a band resonance hexagonal shape in the radiation element of the conventional UWB antenna. This antenna is capable of reducing the interference at the WLAN bands by eliminating the 5 -5.7 GHz band. The proposed antenna has compact size of 16 × 26 mm². This miniature size provides a good radiation patterns with mono-polar characteristics. In this designed antenna, the gain is suppressed very well in the desired WLAN bands.**

Keywords: **CPW-Fed UWB Antenna, band Notch antennas**.

1. Introduction

The need for high data rates wireless communication becomes more and more urgent and various solutions have been suggested. UWB (Ultra-Wide Band) techniques have been paid the most attention for many advantages, such as higher data rates, immunity to multi-path cancellation, increase of communication operational security and low interference to legacy systems [1]. Antennas are the particularly challenging aspect of UWB technology. However, the UWB communication systems use the 3.1– 10.6 GHz frequency band, which includes the IEEE802.11a frequency band (5.15–5.825 GHz). This UWB communication system may generate interference with IEEE802.11a and HIPERLAN systems. To overcome electromagnetic interference between UWB system and WLAN systems, various UWB antennas with multi notch function have been developed for UWB communication systems [2–7]. The advantage of using the proposed hexagonal slots is the desired peak at 5.5 GHz.

In this paper, the four hexagonal shapes are employed. This hexagonal shape is subtracted from the original radiation element of UWB antenna that does not have band notch. Furthermore, simulation results including return losses, input impedance, radiation patterns, gain variations and time domain analysis as well as branch angle variations are presented and discussed. The radiation element current distribution is changed by etching the hexagonal slot into the original element. Here, it is desired to design the dimensions of antenna including ground plane to be less than 16 × 26 mm^2. The 5 -5.7 GHz band ref to VSWR < 2 can be eliminated where the maximum VSWR in 5.4GHz is equal to 12 . The advantage of using hexagonal besides the desired peak at 5.4 GHz produces a second resonance at 10 GHz. This remains within the bandwidth of the UWB communication systems (i.e. 3.1-10.6 GHz). Even near upper frequency band. Antenna gain in WLAN bands can also be suppressed. Hence, with these modifications the desirable spatial-independent band-stop characteristics can be achieved.

2. Related Works

In [2-5] some multiple UWB band notch antennas are introduced. The [2] offers a new solution to develop high performance UWB antennas with multiple frequency notches. Instead of integrating the band notched element with the radiating element, the filter function part of the antenna in our design is combined with the feed line, which employs a half mode substrate integrated waveguide cavity to create multiple stop-bands.

In [3], they present a U-shaped aperture ultra-wideband antenna with band-notched characteristics. The antenna consists of a circular exciting stub on the front side and a U shaped aperture on the back ground plane. The extended band-notched characteristics are realized by attaching a slot and a parasitic strip to the antenna to suppress the potential interference. The parasitic strip on the bottom layer deals with the lower notched band while the C-shaped slot inserted in the circular exciting stub aims at the higher one. Details of the antenna design and measured results are given below. A conceptual circuit model, which is based on the measured impedance of the proposed antenna, is shown to enable discussion of the band-notched characteristics.

Authors in [4] investigated a new configuration of multiband/ultra wide-band (UWB) antenna the antenna is a V-shaped patch with unequal arms coupled electromagnetically to single feed isosceles triangular PIFA thorough two unequal slots. The six multiband operations are achieved due to the different lengths and widths of the V-shaped patch as well as the two coupling slots. Two more modes can be added by loading the triangular planar inverted F-antenna (PIFA) with V-shaped slot.

In [5], compact printed ultra-wideband monopole antenna with band-notched characteristics is proposed. By adjusting the size of the CSRR inserted in the radiating patch, we can easily obtain stop bands. This design uses a single CSRR instead of two and likewise realizes the band-notched characteristics.

In [6], a Fractal Binary Tree Slot employed on CPW-Ground-Fed UWB Antenna to introduced Band-Notch.

3. The antenna Design

The designed antenna geometry is shown in Fig. 1. W1 = 6 mm, W2 = 2.4 mm, L1= 5.3 mm L2= 7.1 mm, d1= 2.1mm, S1= 0.2 mm. The designed antenna geometry is shown in Fig 1. This antenna is constructed on Rogers RO4003 substrate with thickness ~1.5mm and relative dielectric constant of εr = 3.38 which has a dimension of 16×26mm^2 (i.e. $W_{sub} \times L_{sub}$).

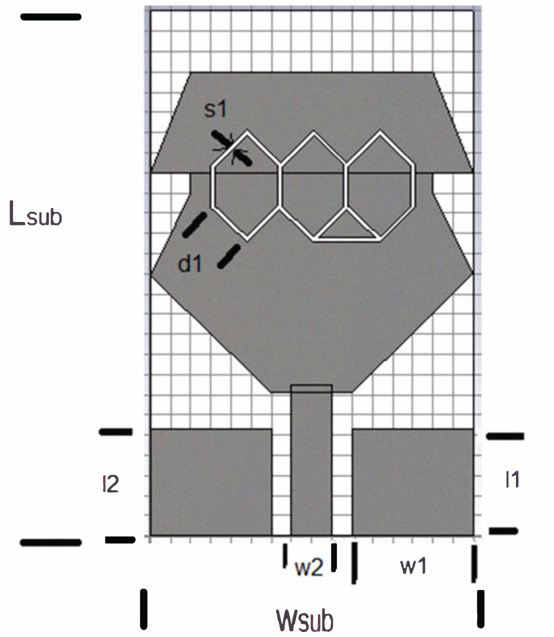

Fig.1 Geometrical parameters of proposed antenna.

4. Antenna Simulation results

The antennas with and without the resonance hexagonal slot is designed on the same substrate that are resented in pervious section. The simulated reflection coefficients are plotted and compared in Fig. 2 for both antennas.

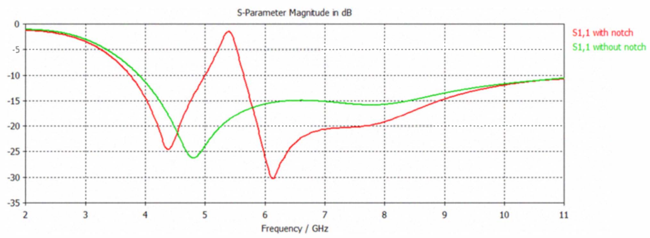

Fig 2. S11 Magnitude in dB

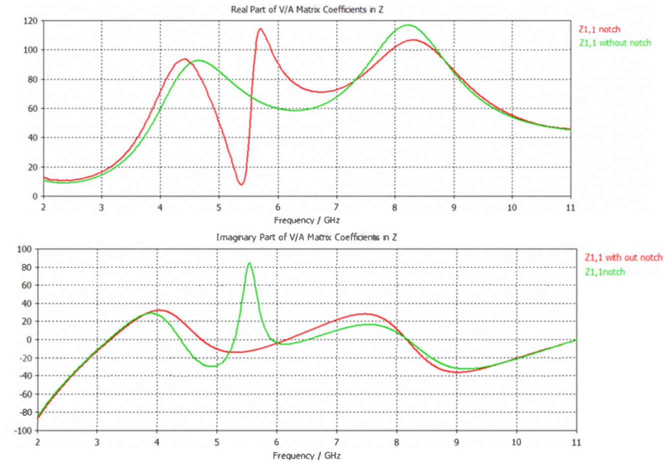

Fig 3 Input resistance (top) and reactance (bottom)

Fig. 3 shows the simulated input resistance (top plot) and reactance (bottom plot) of the proposed and conventional antennas in CST simulator. Input impedance of proposed antenna shows a very high input resistance (Real part) and reactance (Imaginary part) occurring near the desired notched frequency band.

Fig 4 shows the VSWR for the two proposed antennas. It is obvious that the VSWR in notch antenna increases from 2 to 12.

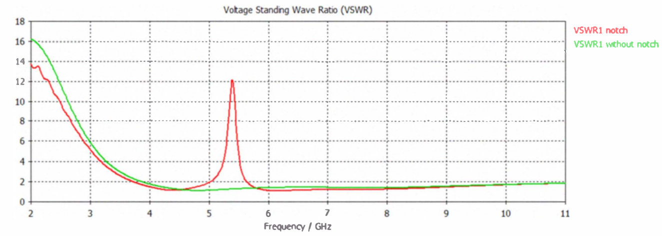

Fig 4. VSWR for proposed antenna

5. Analysis of Time Domain Antenna

As shown in the previous sections, the proposed antenna has a wide bandwidth. However, having a wide band in the frequency domain response does not necessarily ensure that the antenna behaves well in the time domain as well. This means that, the antenna does not widen a time-domain narrow pulse. Some multi resonant wide-band antennas such as log-periodic antennas, due to multiple reflections and large discontinuities within their structures widen narrow pulses in time domain [6-7]. Recalling Fig. 2, the dependence of radiation patterns on frequency clearly reveals that the antennas do not have a flat transfer function. Therefore, in order to ensure the usefulness of proposed antenna for time domain applications, the time domain responses of antennas must also be examined. The proposed antennas are assumed to be excited by the UWB signal to examine the time domain response of the proposed antennas. The input signals are the Gaussian pulse and its fifth derivative as shown in fig 5.

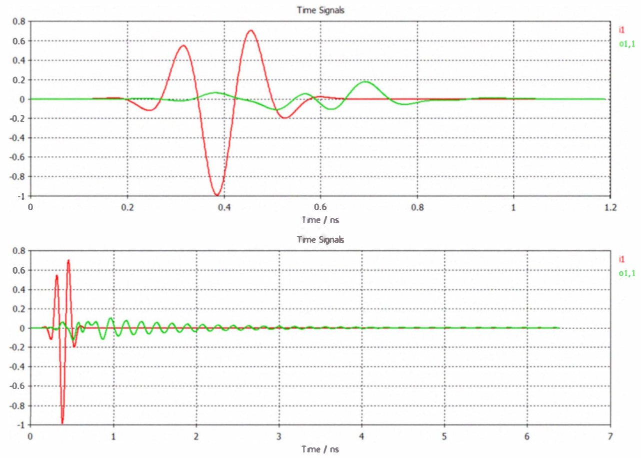

Fig 5. Time signal for input and output in two antenna proposed (top figure) and notch antenna (bottom figure)

6. Conclusions

In this paper, a compact CPW – Fed hexagonal shapes slot antenna with band-notched has been proposed and demonstrated for UWB radios. By etching a band notched resonance slot with three hexagonal shapes to the non-radiating part of the antenna, the interference to other occupied frequency bands can be reduced. In addition, the newly proposed configurations have proved to be capable of providing favorable spatial independent band-notched. The advantage of using fractal slots besides the desired peak at 5.5 GHz produces. This remains within the bandwidth of the UWB communication systems i.e. 3.1-10.6 GHz.

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