Conical Monopole Type UWB Antenna with SRR to Tune out the Suppressed Dual Bands

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***Abstract* – In this paper, conical monopole type UWB antenna which suppress dual bands is proposed. The SSRs were arranged in such a way that the interaction of the magnetic field with them enables the UWB antenna to reject the dual bands using the resonance of SRRs. The proposed conical monopole antenna has a return loss less than -10dB and antenna gain greater than 5dB at 2GHz~11GHz frequency band, except the suppressed bands. The return loss and gain at WiMAX and WLAN bands is greater than -3dB and less than 0dB respectively.**

***Index Terms* — Conical monopole antenna, UWB, SRR, Band rejection, Dual bands.**

I. Introduction

Ever since the commercial use of UWB for local area mass storage wireless communication is permitted by FCC, many studies have been started to take off. Due to the overlapping of bands with WiMAX, WLAN and HYPERLAN/2 system, the sensitive receiver of local area wide band communication devices may be damaged by the transmitted signal of UWB communication device. Hence, some researches for UWB antenna with band rejection characteristic in UWB are introduced. UWB antenna using conical monopole antenna has high antenna gain and omni-directional radiation pattern. The recent results related to UWB antenna, with the shape of conical monopole antenna, is a UWB antenna design without band rejection method[1] and with a single band rejection using CSRR[2].

In this paper, a UWB antenna using conical monopole structure is introduced, and design method for rejecting two bands corresponding to WiMAX and WLAN is proposed. The UWB antenna satisfying 2GHz ~ 11GHz band is designed by tuning out the angle and length of conical structure. Additionally, the band rejection characteristic at WiMAX band(3.4GHz ~ 3.6GHz) and WLAN band(5.725GHz ~ 2.825GHz) is obtained by applying resonance characteristic of two SRRs of different sizes. The performance of the proposed antenna is verified through the simulation using commercial EM tool(HFSS) and a prototype is also designed to compare simulated and measured results.

II. Antenna Configuration

Monopole type conical antenna was popularized by Marconi in 1905[3]. Wideband character of the conical antenna has many applications. Characteristics of the antenna can be decided by adjusting length and angle of the conical monopole antenna. Fig 1 shows geometry and dimensions of the proposed UWB antenna design model by using these properties, characteristic impedance formula of conical transmission line is equation (1).

$$Z_o = 60\ln(\cot\frac{\theta}{2}) \tag{1}$$

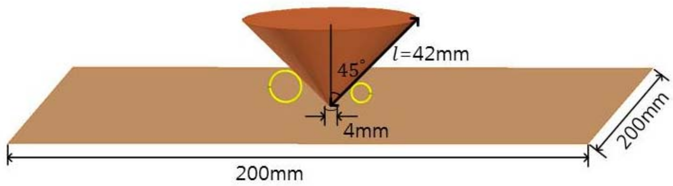

Fig. 1. dimension and geometry of the antenna.

The increment in the length of the cone increases the input impedance of the antenna close to characteristic impedance of the conical transmission line. Characteristic impedance of connector which is connected to the proposed antenna is 50 Ohm and input impedance of the cone's angle 45° starts to converge to 50ohm when the length of cone exceeds 34mm[4]. Table 1 presents parametric description of SRRs used for suppressing the bands. The SRR behaves as an LC resonator which was originally proposed by Pendry in 1999[5]. Resonance frequency of SRR can be tuned by adjusting its dimensions.

TABLE I
DIMENSIONS OF SINGLE SRRS

freq	Radius	diameter of wire	gap of ring
3.5GHz	5.4mm	1mm	0.3mm
5.775GHz	3.3mm	1mm	0.3mm

The SRRs were designed to operate at 3.5GHz and 5.77GHz. The SRRs were arranged, both in the sense of their positions and their dimensions, to interact with the magnetic field passing through them and to give arise to the resonance phenomenon as shown in Fig. 1.

III. SIMULATED AND MEASURED RESULT

Fig. 2 and Fig. 3 are the simulated current distributions. Both the SRRs resonate at frequencies 3.5GHz and 5.775GHz respectively.

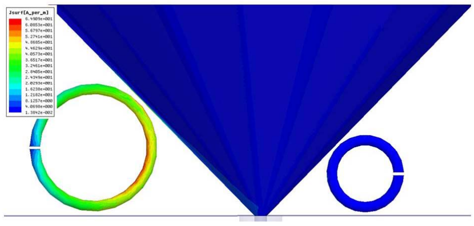

Fig. 2. Current distribution at 3.5GHz.

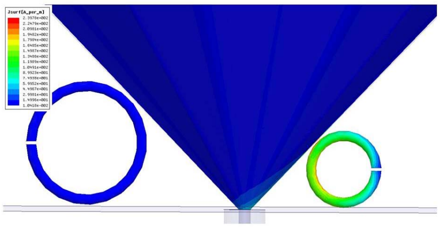

Fig. 3. Current distribution at 5.775GHz.

Fig 4 displays the simulated and measured return loss of the proposed antenna. Antritsu 37397C network analyzer was used for the measurement purposes. Measured results are close to the simulation results. Which confirms the dual bands rejection characteristic of the proposed antenna model.

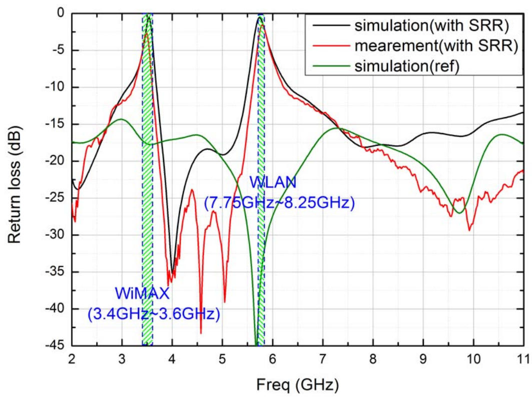

Fig. 4. Simulated and measured return loss of the antenna.

Fig 5 and fig 6 are the antenna gain simulation results. Gain of the proposed antenna is greater than 5dB in the UWB. But the Gain is less than 0dB at suppressed bands. The proposed antenna has omni-directional property as shown in Fig. 5 and Fig. 6.

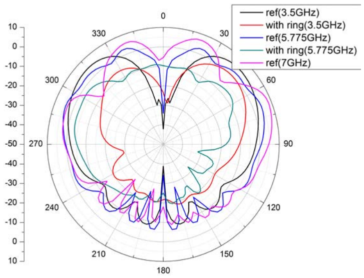

Fig. 5. E-plane radiation pattern.

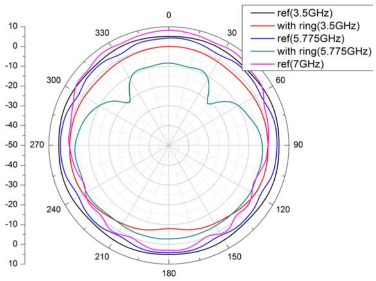

Fig. 6. H-plane radiation pattern.

IV. CONCLUSION

In this paper, An UWB antenna is proposed with band rejection characteristic at WiMAX band(3.4GHz ~ 3.6GHz) and WLAN band(5.725GHz ~ 2.825GHz) by using resonance characteristic of the single SRR and wide band characteristic of the conical monopole antenna. The antenna gain is over 5dB at pass band and under 0dB at rejection band. Therefore, the proposed antenna with more gain than that of conventional band rejecting UWB antenna may be useful for low power UWB system.

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