위성 DMB 대역을 위한 수정된 폴디드 루프 안테나

논 문
61P-1-1

Design of Planar Modified Folded Loop Antennas for S-DMB band

이 현 진†
(Hyeonjin Lee)

Abstract – In this paper, the planar type modified folded loop antennas for S-DMB band is proposed. The proposed antenna consisted of opened center of a conventional closed loop and folded terminal of microstrip line to inside loop antenna. The sizes proposed antenna was minimized by folding the terminal of the loop. Also, It was minimized reactance value by increasing capacitances between coupled microstrip line. Therefore the proposed antennas compacted about 20% than a conventional loop antenna and increased efficiency of antenna. The proposed antennas got an omni-directional pattern, the antenna gain was 3.67 [dBi] and the bandwidth was 900 MHz (2.6-3.56 GHz) with VSWR≤ 2 from the simulated and the measured results. The frequency utilization coefficient was 29.9 %. These properties could satisfy the S-DMB band.

Key Words : Folded Loop Antenna, CPW(Coplanar waveguide), Broadband, Wideband, S-DMB

1. Introduction

These days, with the miniaturization and integration of personal mobile terminals, antennas likewise must be small, light, multi-functional, and capable of being mass produced. In today's mobile telecommunication, the antennas used most widely as terminal antennas are monopole and patch antennas. Because they are easy to manufacture, patch antennas are widely used as antenna elements but are problematic because of narrow bandwidth (approximately less than 10%). In addition, the size of the patch is approximately λ/2 in relation to the wavelength of resonance frequency, which makes these antennas difficult to mount on small portable telecommunication devices [1,2]. This also poses an obstacle to the manufacture of the diverse designs demanded by today's consumers. This paper proposed to minimize antenna size by folding the loop. The physical size of the antenna is minimized by opening and folding the center of microstrip loop into the radiator. The current at the terminal of opened and folded loop structure approximated zero due to the electromagnetic properties, and antenna efficiency is increased by generating capacitance between of folded microstip lines. The proposed antenna can be used the satellite DMB band.

† 교신저자, 정회원 : 동강대학교 전기전자과 교수・공박
E-mail : hyeonjin@dkc.ac.kr

접수일자 : 2011년 6월 18일
최종완료 : 2011년 12월 23일

2. Antenna design and Measurement

The proposed antennas used a coplanar waveguide (CPW) feeding method that can be realized through a single plane, thus allowing for an easy feeding method. Fig. 1 presented the design structure of the proposed antenna. Here, structure (a) of Fig. 1 was closed loop antennas. The proposed structure (b) of Fig. 1 that opened and folded the center of the loop antenna by reason of electromagnetic properties of the center loop antenna approximated zero. It folded inside the loop antenna to generate coupling between both coupled lines. As shown in the Fig. 1 planar square loop antennas consisting of a feeding part and a radiating part according to a CPW with a length of 50[Ω] designed[3]-[5]. Table 1 was shown parameters value of the designed antennas. Here,'H'is the height of the dielectric board and t is the thickness of the conductor. The proposed antenna was used a RF-4 substrate with relative dielectric constant 4.2 and a thickness 0.8 mm. The length of rectangular loop antenna optimized from λ/3 to λ/4 of operation frequency[6]. Fig. 2 is shown the reflection coefficient according to L2 change in structure (b) of Fig. 1. Here, the maximal resonance properties obtained at 6mm when L2 changed from 6 to 9 mm. According as the length of L2 increasing, the resonance frequency shifted to a lower band, It was agreement general antenna theories. Fig. 3 shown reflection coefficients in proportion to SG change in structure (b) of Fig. 1 that was the gap between folded microstrip of loop antenna. When SG changed from 0.4 to 1.2 mm, the resonance frequency didn't shift but the resonance properties changed. Because resonance conditions was satisfied in consequence of capacitance due to change the SG distance. Fig. 4 was shown impedance properties according to a simulation of structure (b) of Fig. 1. Here, when the imaginary value approximated zero, the effective resistance clearly expressed a characteristics impedance of 50 Ω. Fig. 5 was shown the reflection coefficients of comparison a closed loop antenna with the proposed antenna. From Fig. 5 the resonance frequency of closed and folded structures didn't change nearly, but the proposed loop antenna got a good characteristic of reflection coefficient then a closed loop antenna. The total size of both structures reduced approximately 20 % and obtained the good results, because the proposed antenna folded loop in side the antenna. Fig. 6 was shown reflection coefficients of the simulation and the measurement. As shown Fig. 6 reflection coefficients has nearly similar result, and was outstanding. Fig. 7 was shown the radiation pattern of the proposed antenna. Here, difference s in gain properties are extremely negligible; the radiation properties of the electric field and the magnetic field reflected the monopole antennas of omni-directionality. Fig. 8 was shown photographs of the manufactured antenna. The second photograph was small because the over all size decreased in comparison with closed loop antenna.

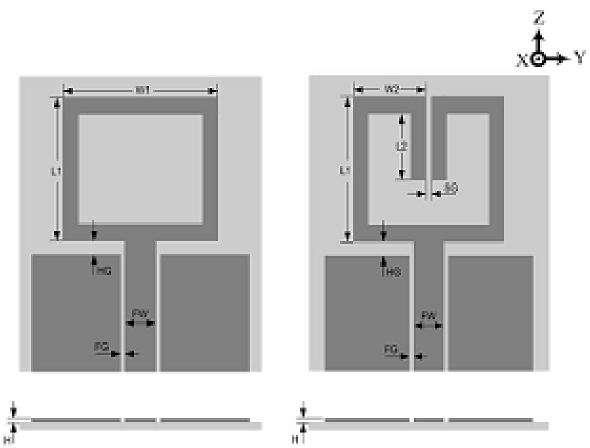


Fig. 1 Geometry of proposed antennas.
(a) A closed loop structure.
(b) The coupled loop structure.

Table 1 Optimal parameters of the design antennas.

(a) parameters of closed loop

parameter	Value	parameter	Value
L1	17[mm]	FW	5[mm]
W1	24[mm]	FG	0.4[mm]
HG	1.4[mm]		

(b) parameters of with coupled loop

parameter	Value	parameter	Value
L1	15[mm]	SG	0.4[mm]
W2	9.6[mm]	HG	1.4[mm]
L2	6[mm]	FW	5[mm]

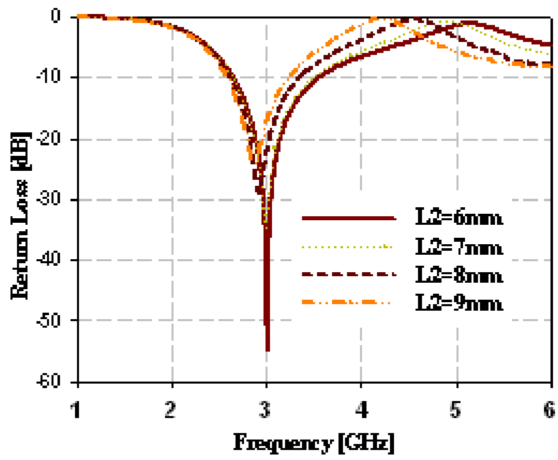


Fig. 2 Return loss against various L2 in (b) of Fig. 1.

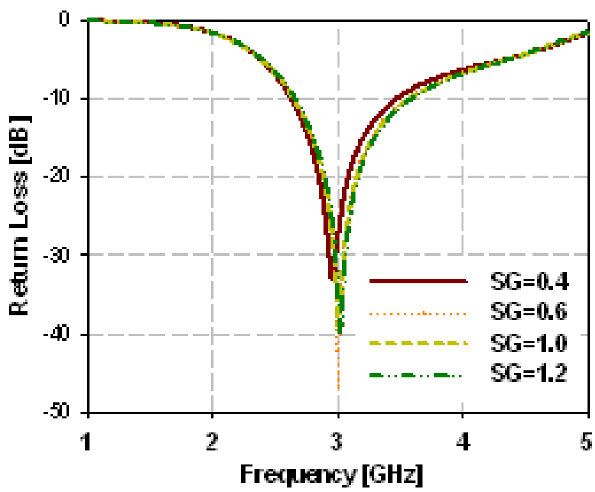


Fig. 3 Return loss against various SG in (b) of Fig. 1

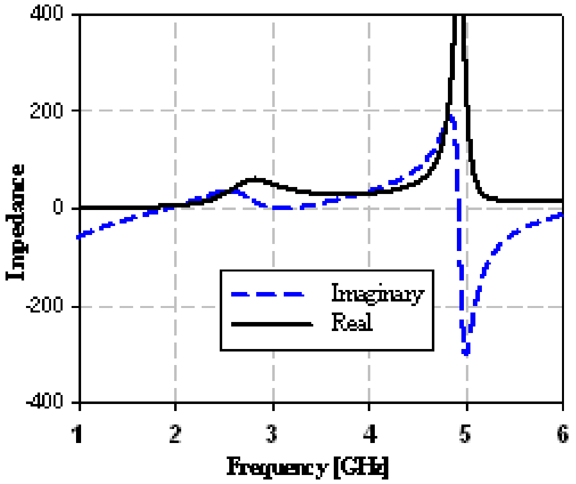


Fig. 4 Real and imaginary Impedance characteristic of proposed antenna.

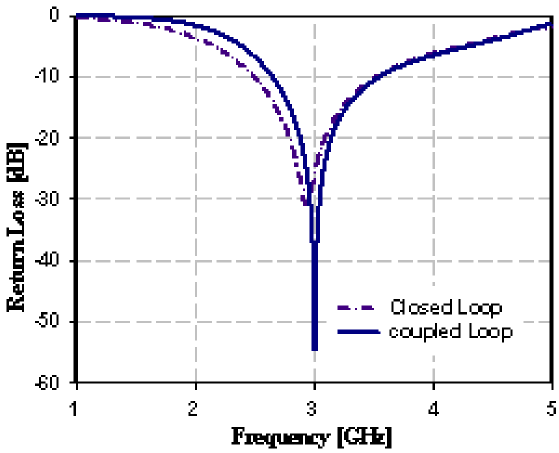


Fig. 5 Return loss of closed and coupled loop Fig. 1.

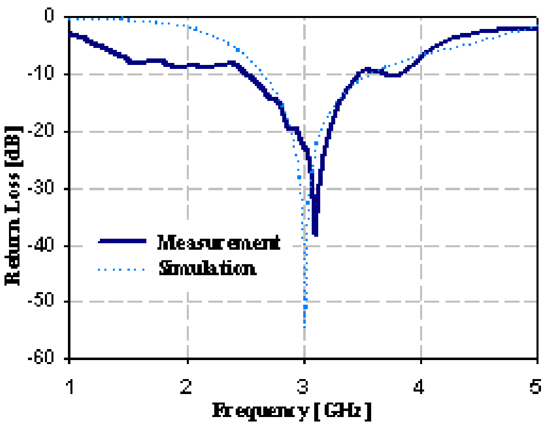


Fig. 6 Measurement and simulation return loss of proposed antenna.

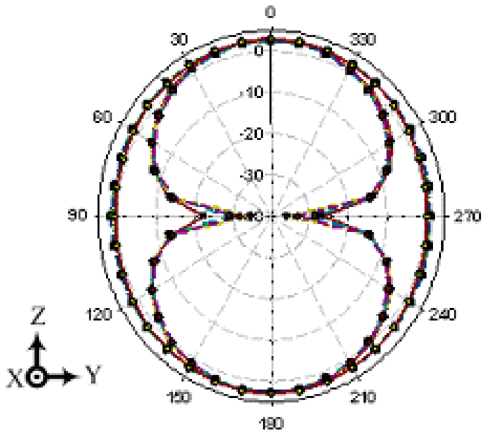
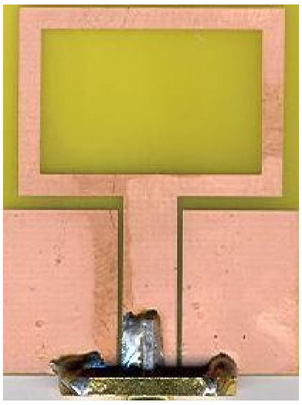
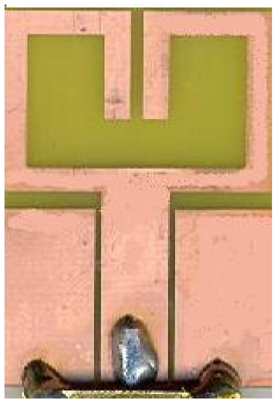


Fig. 7 Simulation radiation pattern of proposed antenna.



(a) Closed loop type



(b) Coupled loop type

Fig. 8 The photographs of manufactured antenna.

3. Conclusion

In this paper proposed printed modified folded loop antenna with CPW-fed. The proposed structure opened and folded the center of the loop antenna. It folded inside the loop antenna to generate coupling between both coupled lines. It analyzed their properties according to designing parameter values and manufactured. Antenna gain of 3.67 dBi obtained and from both of the simulation and the measurement results obtained a impedance bandwidth of 900 MHz (2.6 ~ 3.56 [GHz]) with VSWR≤2. It satisfied the frequency band of satellite DMB band (2.6 ~ 2.655 GHz).

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저 자 소 개

이 현 진 (李 玄 辰)

1958년 8월생. 1982년 조선대학교. 전기공학과 졸업. 1996년 전남대학교 대학원 전기동학과 졸업(공박). 1997.6 -1998. 7 펜실베니아 주립대학교 전기공학과 교환교수. 1992. 3 - 현재 동강대학교 전기전자과 교수.

Tel : 062) 520-2260

Fax : 062) 520-2356

E-mail : hyeonjin@dkc.ac.kr