

Geometry of the proposed antenna mounted on a ground plane (FR4, thickness of 2mm) of dimension 84×52 mm² is shown in Fig. 1, and it consists of two antenna elements. One is a folded planar monopole antenna for DVB-H operation and the other is a PIFA for GSM, DCS and PCS. The folded planar monopole antenna, which has been already proposed by [4], has a wideband characteristics and it is applied to DVB-H system in this work. As shown in Fig. 1, a meander line with three stripes is positioned at a corner of ground plane and its open end is located near to the feeding pad. The folded planar monopole antenna element is directly fed at the pad, which is connected to the feeding point (port 1) through an RF cable (50 ohms). The outer conductor at two ends of RF cable is only connected to the ground plane in the vicinity of the pad and feeding point (port 1). The length (105 mm) of RF cable is about quarter-wavelength of DVB-H band. To decrease the resonant frequency, the electrical length of an antenna element is only increased in common but practically the ground plane needs to be also increased since the whole structure including the antenna element and ground plane operates as a half wave dipole at the lowest resonance. The meander line plays the role to increase the electrical length of ground plane. For mobile communication of GSM, DCS and PCS, a PIFA is also designed and placed at an end of the ground plane opposite to the folded planar monopole antenna element. Position of these two antenna elements or distance between them mainly influences the isolation at the operating bands, the PIFA for GSM and DCS is placed away from the DVB-H band antenna element. The PIFA uses the first two resonant frequencies of a single resonant path for dual-frequency operation [5], and it is also fed by a feeding probe (port 2).

III. RESULTS

Fig. 2 shows the measured S-parameters for the proposed antenna. The measured bandwidth within 6:1 VSWR [6] is 421 MHz (419-840 MHz) for DVB-H band operation. At GSM, DCS and PCS band, it has a bandwidth (VSWR < 3) of 95 MHz (875-970 MHz) and 410 MHz (1600-2010 MHz), respectively. One can see that impedance bandwidth of the folded monopole antenna is wide enough to cover the DVB-H band and the PIFA also operates at GSM, DCS and PCS band. Isolation between two antenna elements is under -15dB over all frequency bands. Fig. 3 shows the measured dB magnitude of S₁₁ for the number of stripes of the meander line and length of RF cable at DVB-H band. As the number of stripes is increases, the meander line is extended to the area 'part A' in Fig. 1. The results of Fig. 3 shows that extending the ground plane is effective to decrease the resonant frequency of the antenna since there is no rapid bandwidth reduction. The measured radiation patterns are shown in Fig. 4, and peak gains are listed in Table 1. The gains at DVB-H band are well within the specified requirements of -10 to -7dBi (470-702MHz) [6]. From the measured results, it is shown that the performance of the proposed antenna can be suitable

for GSM, DCS and PCS band mobile terminals including DVB-H system.

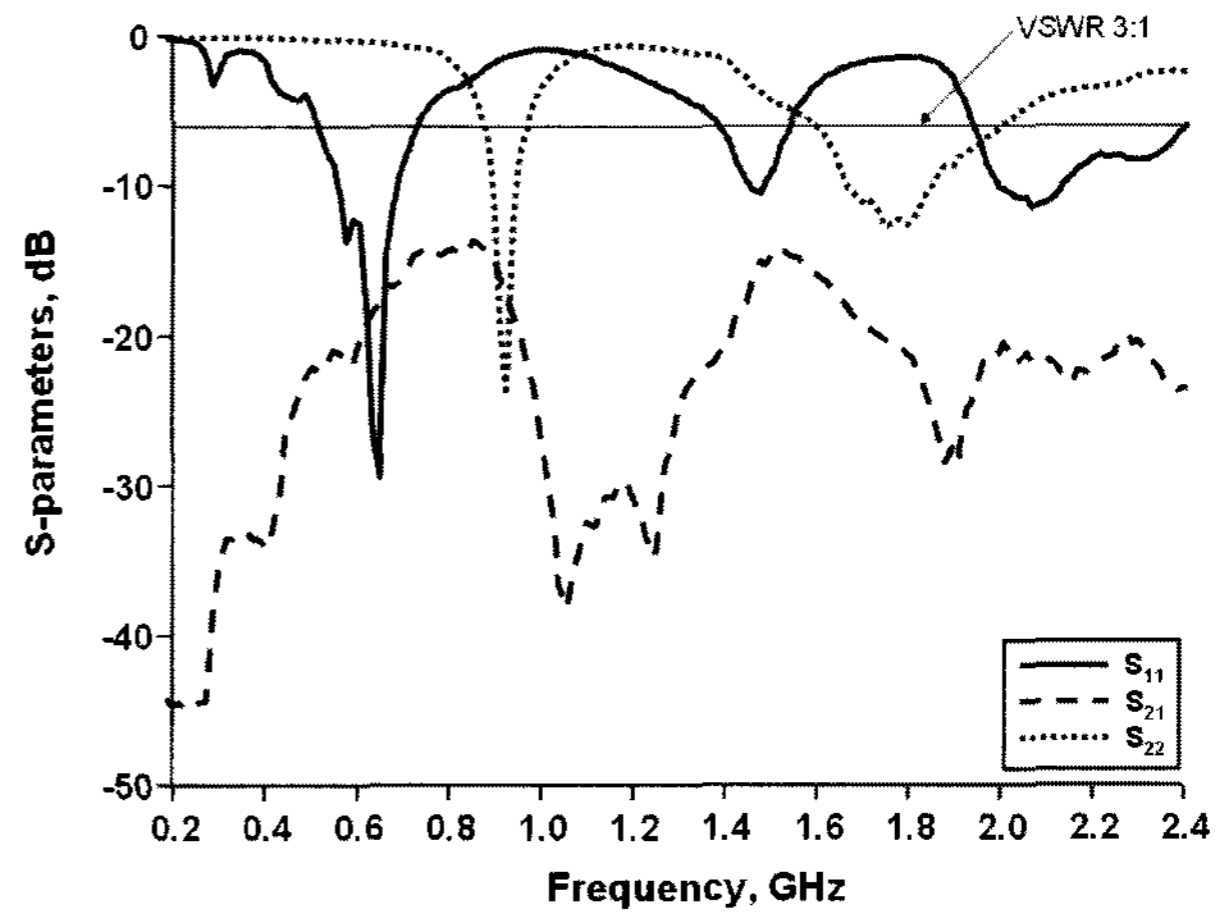
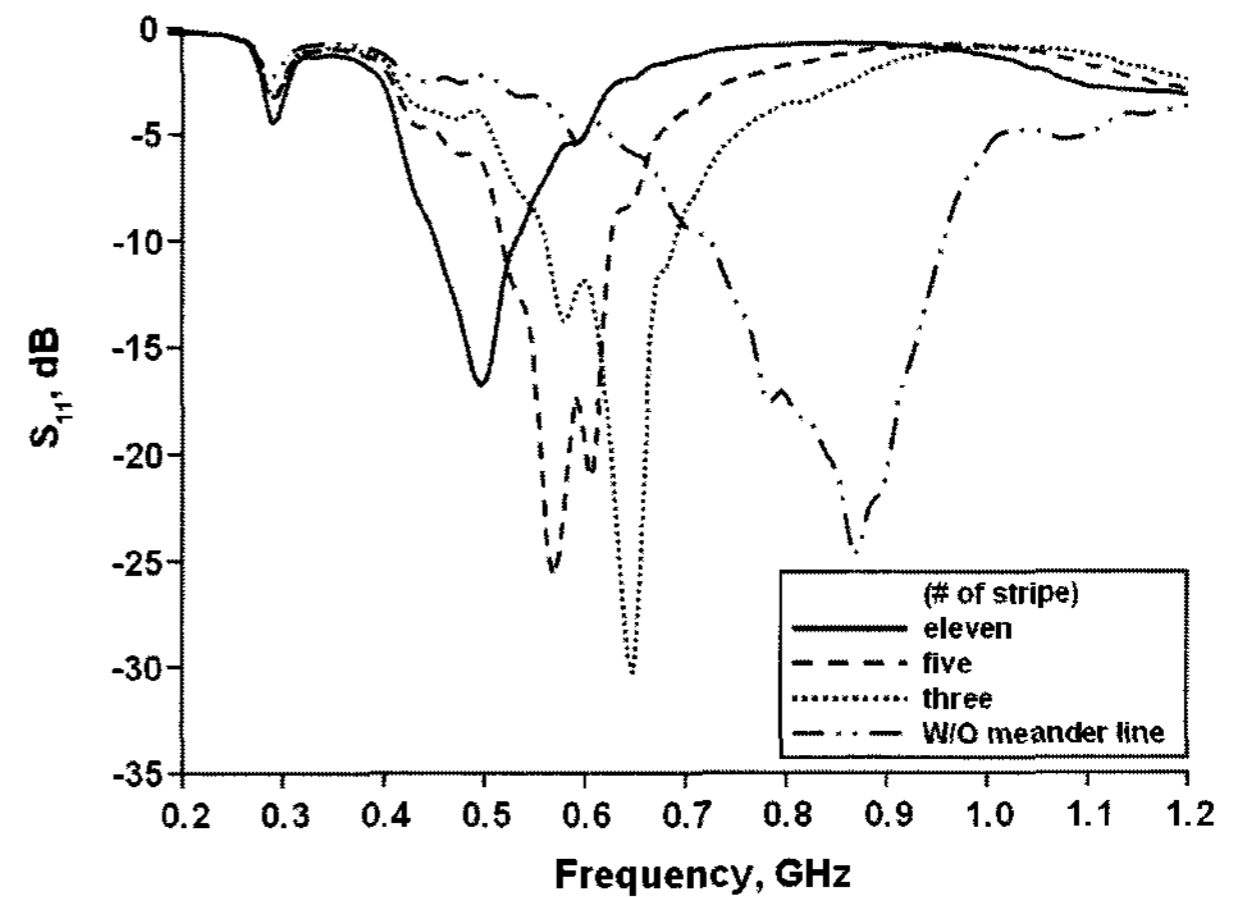
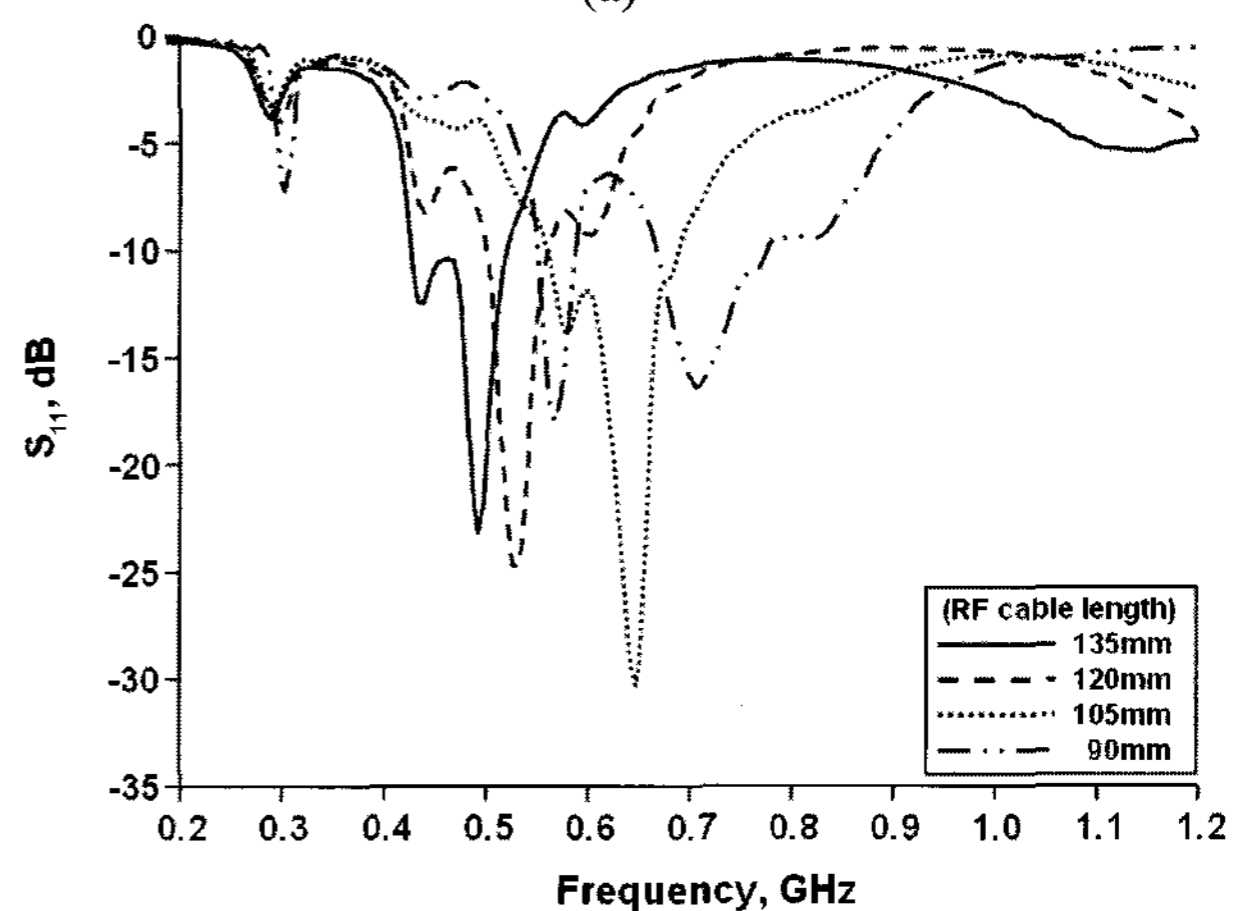


Fig. 2 Measured S-parameters for antenna



(a)



(b)

Fig. 3 Measured dB magnitude of S₁₁ for parameters

- (a) number of stripes
(b) length of RF cable

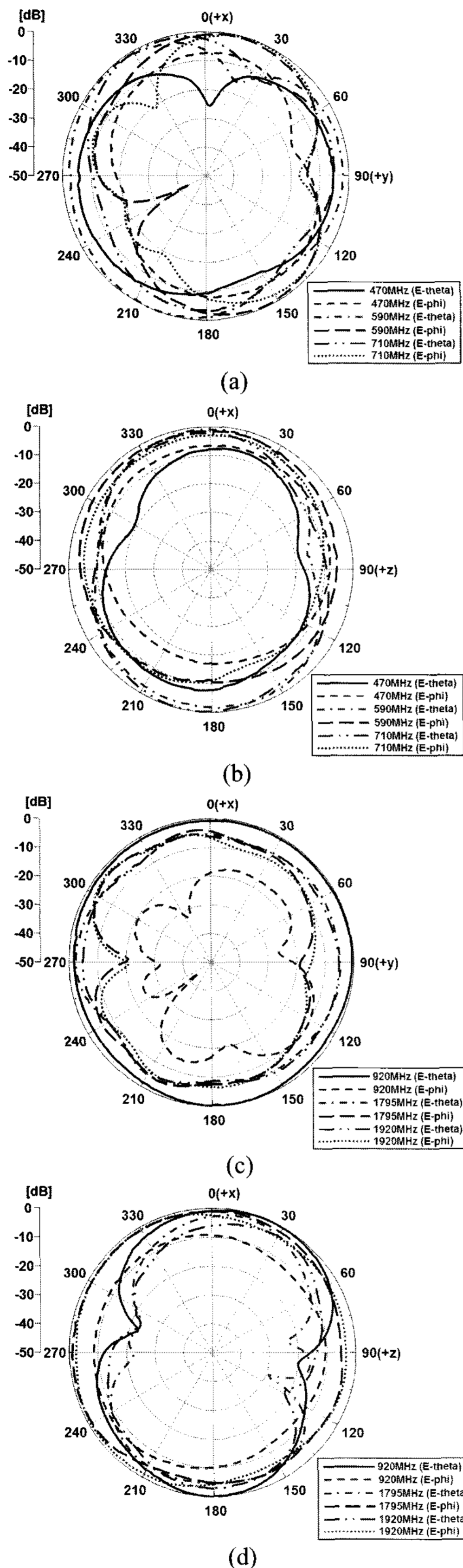


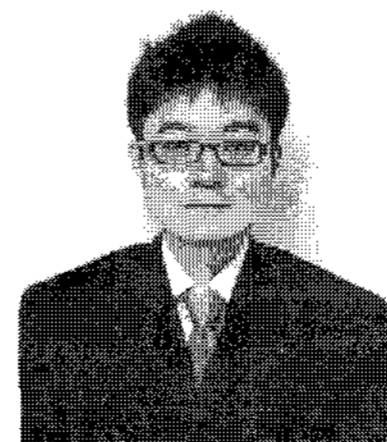
Fig. 4 Measured radiation patterns
 (a) x-y plane at DVB-H band
 (b) z-x plane at DVB-H band
 (c) x-y plane at GSM, DCS and PCS band
 (d) z-x plane at GSM, DCS and PCS band

Table 1 Measured peak gains

Band	Frequency [MHz]	Peak Gain [dBi]
DVB-H	470	-4.64
	530	-1.89
	590	0.37
	650	0.89
	710	0.26
GSM	880	0.14
	920	2.16
	960	3.25
DCS/PCS	1710	0.21
	1795	-0.27
	1850	-0.84
	1920	-0.22
	1990	-0.95

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