Antennas for Compact Communication Systems

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Abstract— The most important problems of nowadays compact communication systems are not only for the higher total radiation power (TRP), but also for the higher total isotropic sensitivity (TIS). The TIS of communication systems will be degraded by the electromagnetic interference (EMI) from other active parts of print circuit board (PCB). The smaller the size of compact communication system is, the serious problem of EMI will happen at receiver. Due to the EMI problem, the sensitivity of communication system will be degraded. In this paper, various kinds of small antennas are designed and developed for the compact size of communication systems. The antenna design should consider the compact size of communication system. The simulation tool for designing the antenna inside the compact size of communication system is by using commercial available General Electromagnetic Simulation (GEMS) [1]. The measurement results of TRP and TIS for various kinds of antenna and developed antenna for the compact communication system are compared.

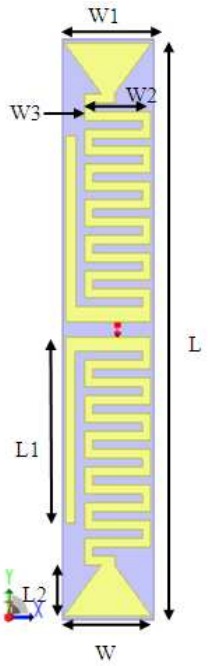
1. INTRODUCTION

The paper designed the multi-band antennas applying to GSM communication systems. By using multiple-band dipole concept, the special meander line antenna is developed with frequency band including 850 MHz/900 MHz/1800 MHz/1900 MHz. Except for the passive antenna performances with or without size of communication are measured, the performances of TRP and TIS for GSM is also measured.

The simulated and measured results of the return loss and radiation patterns are in good agreements for applications in a communication system.

2. ANTENNA DESIGN

The proposed antenna is designed for operation at GSM850/900/1800/1900 bands for wireless security systems applications with return loss $S_{11} < -10$ dB. Fig. 1 shows the simulation model structure of the multiband dipole antenna and main structure is made of copper.



名稱	數量	單位
L	78	mm
L1	23	mm
L2	6.8	mm
W	14	mm
W1	10	mm
W2	6	mm
W3	1.2	mm

Figure 1: Simulation model of the multiband dipole antenna.

The multiband dipole antenna comprises of a meandering line and bow-Tie. The purpose of bow-tie is for bandwidth improvement at lower band. This structure is easily constructed by printing on a dielectric (FR4) substrate. Fig. 2 shows the prototype of fabricated multiband dipole antenna.

3. RESULTS OF SIMULATION AND MEASUREMENT

The antenna is mounted inside the case communication system is shown in Fig. 3. The return loss of multiband dipole antenna with and without compact communication systems are shown in Fig. 4. The worst case of return loss is 10 dB. The measured return loss with communication system will shift to higher frequency.

The radiation efficiency of multiband dipole antenna and antennas for compact communication systems are shown in Fig. 5. The measured radiation efficiency of antenna itself is about 70% for lower band and higher band. If with the communication case, the measured radiation efficiency degraded to 45% and 65% for lower and higher frequency.

The peak gain of multiband dipole antenna and antennas inside compact communication system are shown in Fig. 6. The multiband dipole antenna measured maximum antenna gain for operating frequencies across the 824 MHz $\sim$ 960 MHz GHz band and 1710 MHz $\sim$ 1990 MHz band are 0 dBi $\sim$ 2 dBi.

The TRP and TIS are important for the GSM system. Except for the developed antenna, other market available antennas for the communication system are also measured and compared. The TRP and TIS are measured at the Communication Research Center of Oriental Institute of Technology. Figs. 7, 8, 9, and 10 are the TRP and TIS for frequency at 850 MHs, 900 MHz, 1800 MHz, and 1900 MHz respectively. The TRP and TIS of developed antenna with the communication sys-

Figure 2: Prototype of the multiband dipole antenna.

Figure 3: Developed antenna for compact communication system.

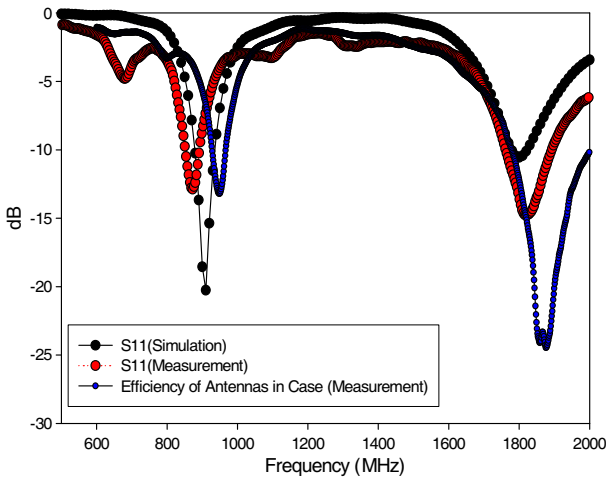


Figure 4: S_{11} of multiband dipole antenna.

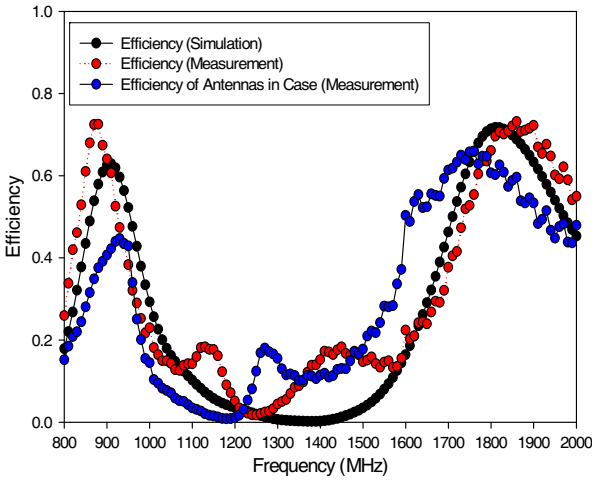


Figure 5: Radiation efficiency of multiband dipole antenna.

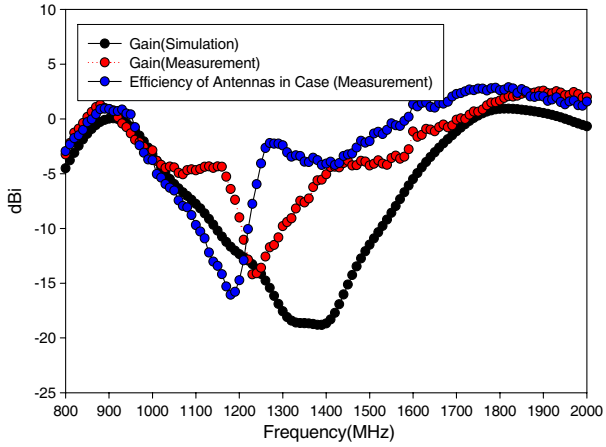


Figure 6: Peak gain of multiband dipole antenna.

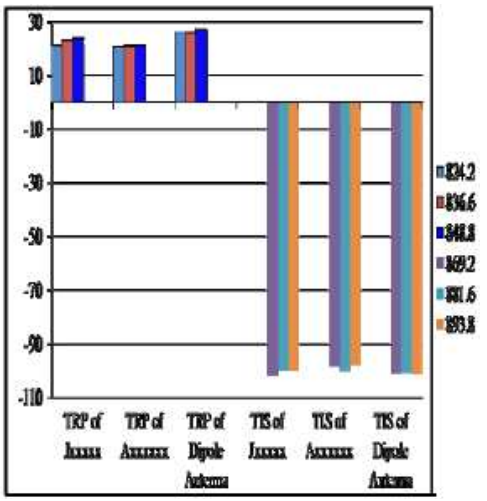


Figure 7: TRP and TIS of GSM850.

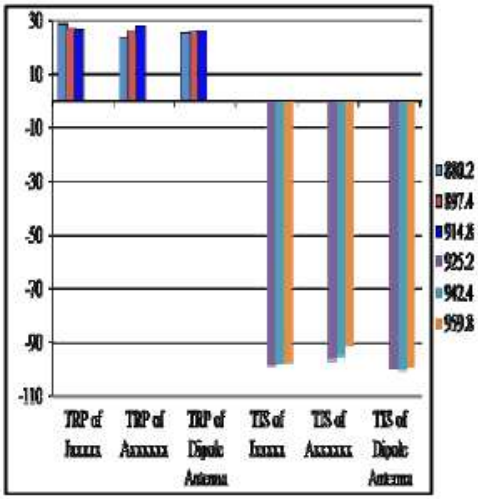


Figure 8: TRP and TIS of GSM900.

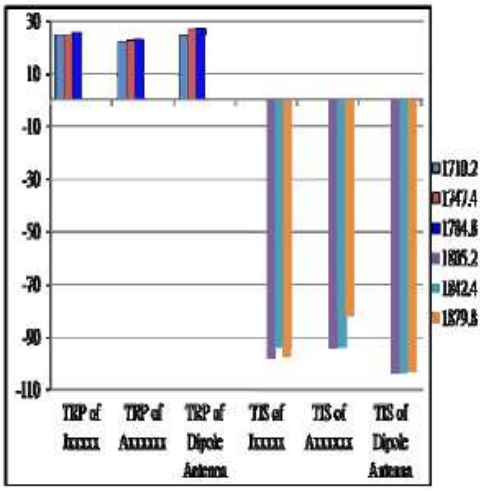


Figure 9: TRP and TIS of GSM1800.

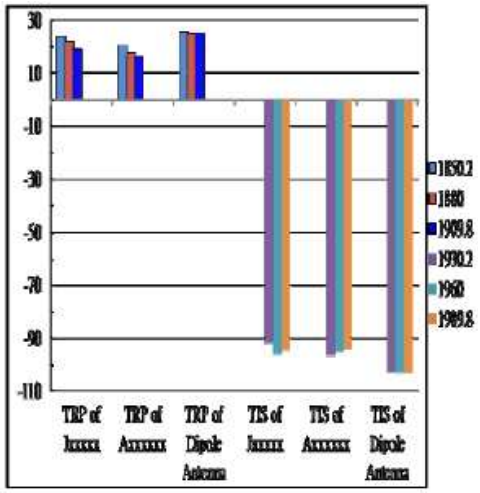


Figure 10: TRP and TIS of GSM1900.

tem are around 27 vdBm and −100 dBm respectively for the four bands. Comparing the measured results of TRP and TIS, the performance of developed antenna is equal or better than that of market available antennas.

4. CONCLUSIONS

When the antennas inside the compact communication systems, the operating frequency of antennas will be shifted to higher frequency, additionally, the efficiency and peak gain will be degraded because the antenna energy is absorbed or reflected by the compact communication systems.

The simulated and measured results of the return loss and radiation patterns are in good agreements. The TRP and TIS performances of GSM system with the developed antenna at the four bands are equal or better than that of commercial available two antennas.

REFERENCES

1. GEMS, 3-D High Performance parallel EM simulation Software, www.2comu.com.