Design of an Ultra Wide Band Dipole Antenna for High Power Electromagnetics

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***Abstract*— It is important to design the proper antenna in ultra wide band (UWB) systems for effect analysis. We design the UWB antenna of 200MHz frequency bandwidth by using electromagnetic programs such as CST and FEKO. Marx generator is applied to the proposed antenna to complete the UWB system. Measurement data agree with the simulation results.**

***Keywords* — Ultra wide band (UWB), Dipole antenna, Far voltage, Integrated Antenna Source (IAS) system**

I. INTRODUCTION

Integrated antenna source (IAS) systems have been researched as an important issue of ultra wide band (UWB) systems [1]. While the main study of IAS system is focused on the high voltage power supply, we here study a spark gap antenna to efficiently control the radiated pulse property. We first develop the UWB system so as to show a specific frequency bandwidth of 200MHz. We then experimentally and numerically validate the UWB system.

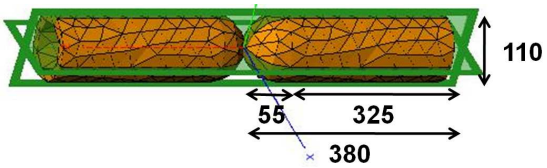

Figure 1. Design of UWB dipole antenna (unit:*mm*)

II. DESIGN AND VALIDATION

The center frequency of dipole antennas can be derived as:

$$\text{frequency} = \text{speed of light} / \lambda \qquad (1)$$

where λ is the wavelength. Thus, to design 200MHz frequency, λ is 1.5m. From $\lambda/4$ dipole theory, the required dipole length is about 0.38m. Based on this background, we design the dipole-shaped antenna as shown in figure 1. The antenna has 380mm length and 110mm diameter. To reduce the oscillation of signal, the ratio of the diameter to the length is determined by using electromagnetic simulations. In addition, to eliminate the unexpected breakdown, we trim the head of dipoles as in the figure 1 and case the antenna with charging by nitrogen gas.

We applied a Marx generator to the proposed antenna to verify the performance of the antenna system. Electric fields radiated from the dipole antenna are measured by using D-dot (Prodyn AD-80[2]) sensors. Figure 2 indicates the measured signal in time domain. The peak to peak electric fields is 140kV. Figure 3 shows the signals in frequency domain. Three lines represent the measured data, the computed signal in FEKO, and the computed signal in CST, respectively.

The measured frequency of peak electric fields appears at

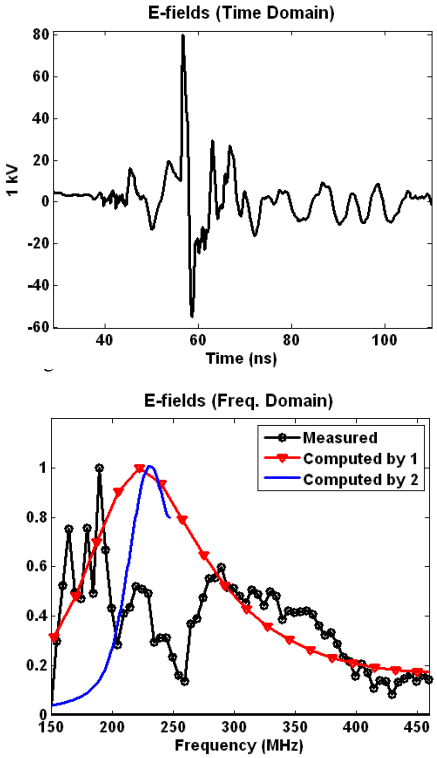

Figure 3. Fields waveforms in frequency domain

190MHz. Although the measured frequency is lower than those of simulations, this difference can be from the slight fabrication error of 20mm distortion. Therefore, the measured data agree with the simulation results. The figure also shows the secondary peak in the wavelength of 0.8~1.2m. This may be caused by the path consists of Marx generator, dipole part, and the connecting cable since the wavelength of this unexpected antenna is similar to that of the secondary peak.

III. CONCLUSION

A UWB system is developed to have a specific center frequency. We design the specific antenna by electromagnetic simulations. We then combine a Marx generator with the antenna. The frequency bandwidth of the developed UWB system is validated by numerical and experimental results.

REFERENCES

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[2] PRODYN, http://www.prodyntech.com