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A 150MHz, High Voltage Mesoband Dipole Antenna for IEMI Testing

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***Abstract*—An antenna for testing immunity of equipment to intentional electromagnetic interference (IEMI) is described, along with simulated and measured test results which show a good agreement and demonstrate the high-voltage operation.**

I. INTRODUCTION

In this paper we present the design simulation and measurement of a high voltage dipole antenna which provides damped sinusoidal pulsed fields working with a pulsed source. The antenna is intended to work with a single pulse generator [1] having a double exponential waveform with a rise-time of 90 ps and FWHH of 2.5 ns and an output amplitude of up to 34 kV.

II. ANTENNA DESIGN

The initial design was carried out using the CST Microwave studio time domain solver.

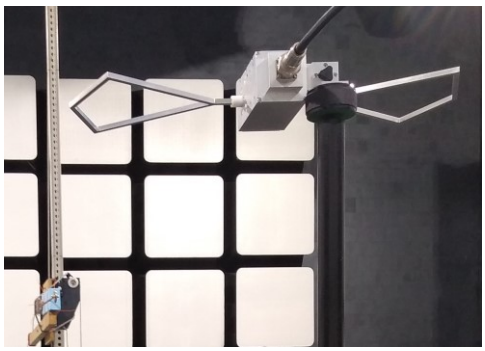

Fig. 1. 150MHz dipole under test in QinetiQ's anechoic chamber

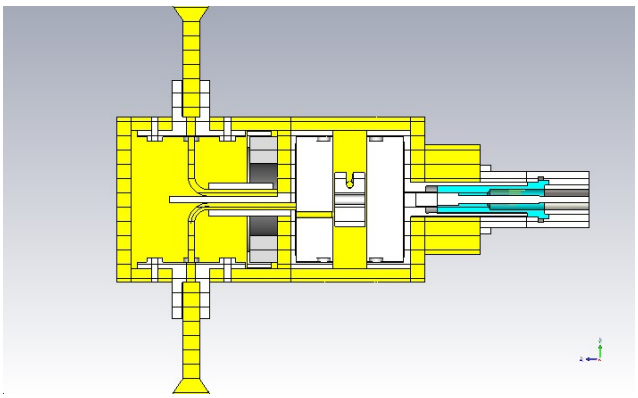

Fig. 2. Cross section of connector transition, low-pass filter and balun

A dipole with kite shaped arms was chosen (Fig. 1) as it had a resonant impedance closer to 50 ohms than a simple dipole, thus avoiding the need for a wound or physically large resonant balun to match to the 50 ohm feed. A 3-pole low-pass filter was used to suppress the higher frequency content from the pulse that might excite higher order resonances on the dipole. A simple gapped ferrite core based balun (Fig. 2) was sufficient to achieve the desired performance. The insulators are 3D printed in acrylic resin, with the remainder of the antenna made of aluminium, with copper wire connections.

III. RESULTS AND CONCLUSIONS

Measurements of the antenna performance were carried out in QinetiQ's Anechoic chamber using both a Vector network analyser (VNA) and a high voltage pulse source with D-dot sensor and sampling oscilloscope.

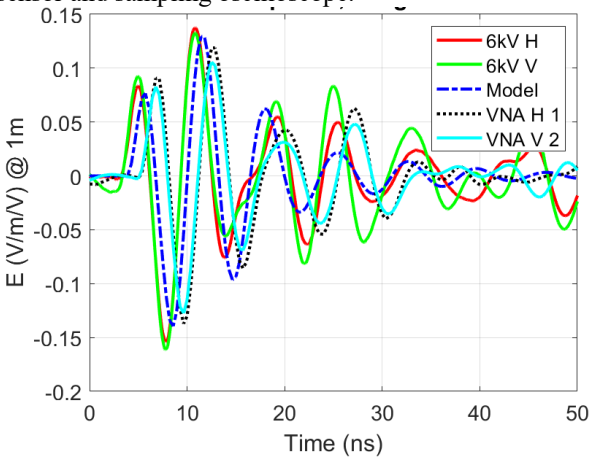

Fig. 3. Comparing Dipole antenna numerical model results with VNA and pulse measurement

Fig. 3 shows the received pulse scaled to 1 V excitation and 1 m distance. For the frequency domain measurement (VNA V 2/H 1) the pulse response is obtained from the inverse FFT of the transmission measurement convolved with the expected source pulse. Pulse measurements with a 6 kV pulse are also shown (6kV V/H). The measurements are shown with the antenna in vertical and horizontal polarisations, any difference might be attributed to the chamber. In all cases the measurements are adjusted for D-dot sensor, balun and cable losses. The measurements correspond well with the model data. The antenna was successfully tested with pulsed excitation up to 24kV.

A successful antenna design was achieved by simulation. The fabricated version seems to have a slightly larger boresight gain than that predicted but otherwise the performance corresponds well to the model.

Take-Home Messages:

- A high voltage pulse driven 150 MHz Mesoband dipole
- Robust simple to build antenna for IEMI testing
- Operates from external Broadband pulse generator
- Simple high voltage balun and low pass filter
- Computational model matches measured results

REFERENCES

[1] R. Hoad, L. Chatt, B. Petit, T. Rees, and G. Eastwood, "Mesoband and Hyperband Immunity Test Generator and Standards," in *AMEREM*, 2018.