Proceedings Paper:

Dawson, John F. orcid.org/0000-0003-4537-9977, Hoad, Richard, Petit, Barney et al. (7 more authors) (Accepted: 2021) A Lightweight, Compact, High voltage Hyperband Antenna for IEMI Testing. In: Joint IEEE International Symposium on Electromagnetic Compatibility, Signal Power Integrity and EMC Europe. . (In Press)

2021 Joint IEEE International Symposium on Electromagnetic Compatibility, Signal and Power Integrity, EMC Europe

A Lightweight, Compact, High voltage Hyperband Antenna for IEMI Testing

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***Abstract*—A robust lightweight antenna for testing immunity of equipment to intentional electromagnetic interference (IEMI), based on a planar Vivaldi design, is described, along with simulated and measured test results.**

I. INTRODUCTION

In this paper we present a lightweight (~3 kg), compact, robust, high voltage antenna which provides Hyperband pulsed fields working with a pulsed source and can be accommodated on a typical EMC test mast. The antenna is intended to work with a single pulse generator [1] having a double exponential waveform with a rise-time of 90 ps a 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. The overall size and shape were selected to maximise the field achieved whilst maintaining good field uniformity across a 3m square at 3m distance and meeting a mass constraint of about 3 kg. The finished antenna and details of the feed and balun can be seen in Fig. 1 and 2. A simple connector transition with a gapped ferrite ring balun was found to give good performance. A moulded low loss polypropylene insulator was used in the connector transition with acrylic supports for the Vivaldi like antenna structure.

Fig. 1. 530 mm×760 mm (L× H) Coplanar Vivaldi with weight reduced blades and acrylic support structure under test in anechoic chamber

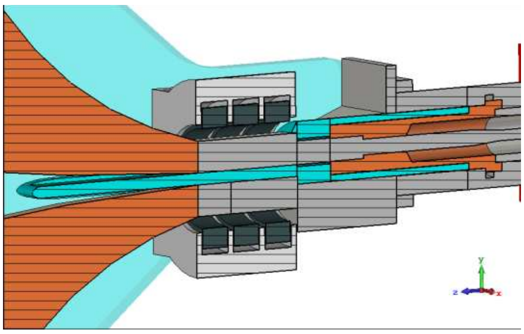

Fig. 2. Cross section through the 7-16 connector transition and balun

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 20 Gsample/s sampling oscilloscope.

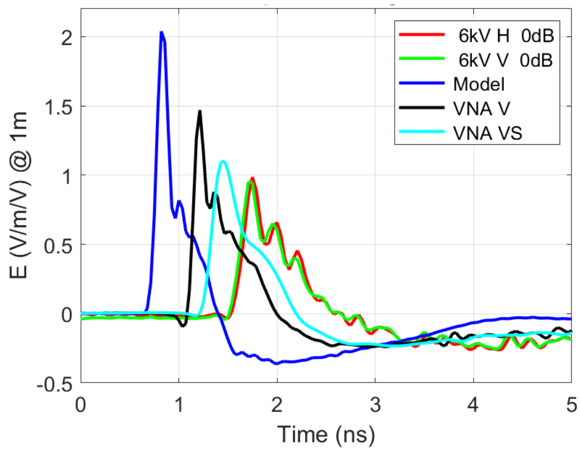

Fig. 3. Comparing Hyperband antenna numerical model results with VNA and pulse measurement

Fig. 3 shows the received pulse scaled to 1 V excitation and 1 m distance. For the frequency domain measurement (VNA V) with a VNA the pulse response is obtained from the inverse FFT of the transmission measurement convolved with the expected source pulse. The limited oscilloscope bandwidth is expected to result in a reduced amplitude of the measured pulse and our prediction is given as VNA VS. Two measurements are shown with the pulse generator with the antenna in vertical and horizontal polarisations (6kV H/V 0dB). In all cases the measurements are adjusted for D-dot sensor cable and cable losses, the pulses are offset in time to allow the initial peak to be clearly seen. A field uniformity of better than -2dB at the corners of a 3m square at 3m distance was achieved.

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

Take-Home Messages:

- A lightweight (~3kg) hyperband, high voltage (34kV) antenna
- Robust simple to build antenna for IEMI testing
- Good pulse shape, field strength and uniformity
- 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.