Measurements of Isotropic Absorption Cross Sections of Lossy Structures

A Contribution to the Shielding Effectiveness of Cavities

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***Abstract*— This paper describes measurements and results from the characterization of COTS absorbers and resistive structures, with respect to the isotropic absorption cross section in an overmoded cavity. The aim of this work is to increase practical and theoretical knowledge in how to increase shielding effectiveness (SE) of a cavity (i.e. avionics bay). The results will be an input to a practical guideline on how to increase the protection level against High Power Microwaves (HPM). Measurements of these materials and structures have been done in a reverberation chamber (RC).**

Keywords - absorption cross section; high power microwaves; shielding; reverberation chamber.

I. Introduction

The threat from HPM sources has recently entered military standards, such as Mil-Std 464C. Also, in the aircraft industry one is required to harden the system against High Intensity Radiated Fields (HIRF). An increased threat level requires a higher level of protection, i.e. shielding effectiveness (SE) of cavities, such as avionics bays. By introducing lossy materials or resistive structures according to [2] and [3], the quality factor (Q) of the cavity can be decreased, and thus the SE increased. Different types of lossy materials and resistive structures have been systematically investigated, to see which ones will fit our needs best, for different applications. The tested materials consist of both dielectric and magnetically load absorbers. The effects of resistive lattice structures have also been investigated.

II. Lossy Structures

A. *The Power Balance Approach*

Based on the power balance approach [1], the determination of the average shielding effectiveness $\langle SE \rangle$ can be derived:

$$\langle SE \rangle = \frac{2\pi \cdot V}{\sigma_a \cdot \lambda \cdot Q} \qquad (1)$$

Eq. (1) makes clear that by lowering σ_a (the aperture cross section) or the Q-value in a cavity, $\langle SE \rangle$ will increase. Our current studies aim to lower the Q-value.

B. *Isotropic absorption cross section of lossy structures*

By comparing measurements of Q in an empty reverberation chamber vs. a loaded ditto – Q_{empty} vs. Q_{loaded} – the isotropic absorption cross section $\langle \sigma_{lm} \rangle$ in (2), can be calculated.

$$\langle \sigma_{lm} \rangle = \frac{2\pi \cdot V}{\lambda} \cdot \left(\frac{1}{Q_{loaded}} - \frac{1}{Q_{empty}}\right) \qquad (2)$$

The reverberation chamber was loaded with several types of lossy COTS absorbers and resistive structures. One example of a measurement is given in Figure 1.

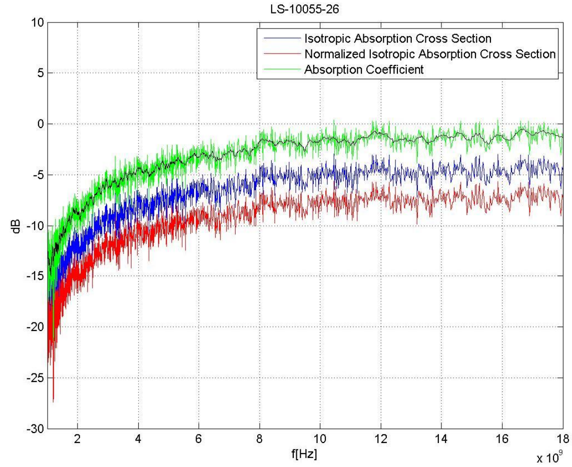

Figure 1. Measurement of absorption cross section, LS-10055-26 absorber from ARC Technologies, Inc.

C. *Applicability*

Adding absorbing materials into avionics bays is a simple way to significantly increase the shielding effectiveness without major design changes.

References

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