Comparison of Electromagnetic Coupling Measurements and the Energy needed for Destruction of Electronic Systems

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Abstract— As of yet no definitive standard for destructive high-power microwave (HPM) testing of electronic systems exists and there is a need to investigate different methodologies. Since destructive testing require the destruction of potentially expensive systems the aim of such a methodology should be to extract as much data as possible from a small number of destructive tests. A twostep method for rationalizing destructive testing in a reverberating chamber is proposed. The first step consists of measuring the coupling of electromagnetic energy into the object, this step is similar to measuring the absorption cross section of the system. This information is then used to determine at what frequency, or frequencies, destructive testing should be performed. Comparison of coupling measurements and the energy needed to destroy simple objects as a function of frequency are presented.

Keywords-High Power Microwaves; HPM; reverberation chamber; absorption cross section; destructive testing

I. INTRODUCTION

In destructive High Power Microwave (HPM) testing of electronic devices it is important to know at what frequencies electromagnetic energy is coupled in to the object [1]. This is especially true for non-communicating systems where so called ‘back-door’ coupling occur not through the antenna but through cables, connectors or directly onto the circuit board of the electronic system. For communicating systems the ‘front-door’ coupling of electromagnetic energy over a wide frequency band gives information about the efficiency of out-of-band coupling relative to in-band coupling. Here we present results from electromagnetic coupling measurements into simple electronic objects (RFID-tags) and compare the results from coupling at different frequencies to the energy density needed to destroy the object at different frequencies.

II. EXPERIMENTAL RESULT

To find out at which frequencies the RFID-tags absorb energy the absorption cross section ratio between 2 and 4 GHz was measured using a reverberation chamber. Since the absorption of each tag is small the absorption was measured using 15 tags in the chamber, see top plate in Figure 1. Based on the measured absorption it was decided to perform high level destructive testing at the first absorption peak (2.12 GHz) and at the absorption minimum at 2.30 GHz, see lower plate in Figure 1.

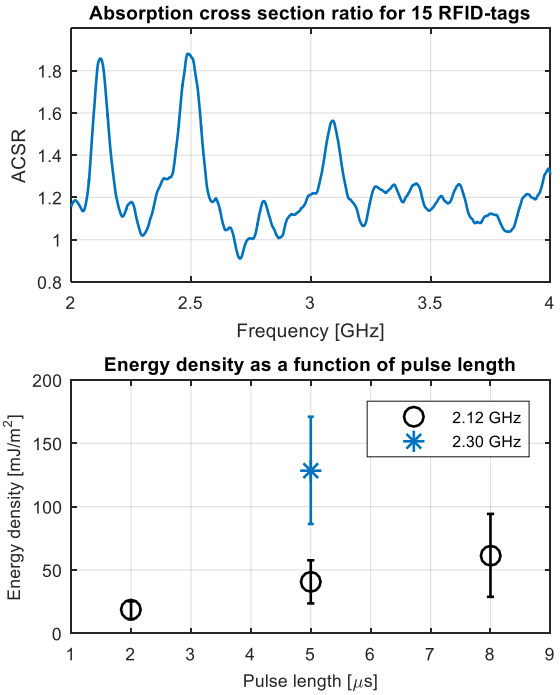

Figure 1. Top: total absorption cross section ratio for 15 RFID-tags. Bottom: Energy density needed for destruction of tags as a function of pulse length at two different frequencies. Marker indicates median value and errorbars indicate standard deviation. At 2.30 GHz only one pulse length was tested.

It takes almost three times as much energy to destroy the tag at an absorption minimum as compared to the energy at absorption maximum. More complete datasets and experiments on other simple objects will be presented.

REFERENCES

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