Direct Current Mode Stirred – A new Susceptibility Test Method for EMC and HPEM

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Abstract—The Direct Current Mode Stirred method (DCMS) is a new method which combines the advantages of Direct Current Injection (DCI) on surfaces of test objects and the advantages of a Reverberation Chamber (RC). The idea of this combination is motivated by the growing requirements of high field level susceptibility testing and the resulting significant costs. The RC already fulfills this efficiency requirement and needs quite low power to generate high field levels, but is always limited in the lower frequency range to some hundred Megahertz. In contrast to this, the DCI (or HLDD, High level Direct Drive) technique works [1] very effectively in the low frequency range, but is limited at higher frequencies to some hundred Megahertz. A combination thereof allows to extend the useful frequency range from kilohertz to gigahertz and is therefore usable for EMC and HPEM qualification without frequency limitation.

Mode Stirring Chamber, DCI, HLDD, Reverberation

I. INTRODUCTION

The generation of electromagnetic fields for Radiated Susceptibility is fairly ineffective, as the electromagnetic energy from the power amplifier has to be injected into an antenna and then be radiated with remarkable losses. Additionally, most of the electromagnetic energy is not used for interaction with the Equipment under Test (EUT) but is lost in the absorbers of an anechoic chamber. The DCI technique overcomes these radiation losses, as it puts the power of the amplifier directly onto the surface of the EUT. Nevertheless, with increasing frequency the DCI setup itself starts to radiate. This self-radiation is normally lost, but when put into a RC it can be used as an additional radiation source.

II. Theory of Operation

The following Fig. 1 shows the measurement setup with a test missile enclosed in an Open Coaxial Return Rig (OCRR) for DCI and placed within a Reverberation Chamber (RC) for Mode Stirring. On the right side the field generating antenna can be seen and at the back the stirrer of the RC. The RC has a lowest usable frequency of about 80 MHz.

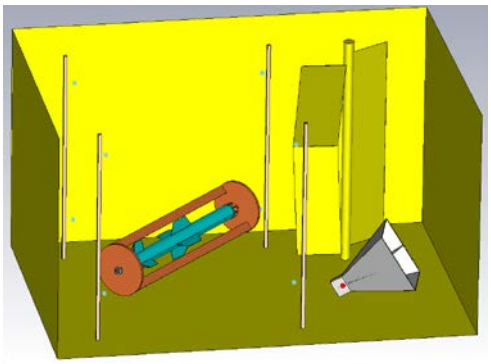

Figure 1. Setup of Direct Current Mode Stirred

The following Fig. 2 shows the achievable field strengths per 1 Watt inside the RC, which was numerically simulated. Three modes of operation are defined:

1. **DCI**: The OCRR keeps the energy on the EUT and does not radiate. The field generating antenna is not used. Very high RF levels on the EUT.
2. **DCMS hybrid**: The OCRR starts to radiate and the RC uses it as a field generating antenna. Field generating antenna not in use but Stirrer is used.
3. **MSC**: Standard use of a RC without OCRR. Field generating antenna and Stirrer in use.

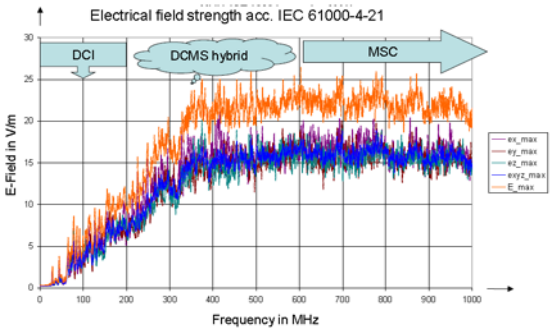

Figure 2. Modes of operation of DCMS

III. Results

The described setup of Fig. 1 has been realized, measured and numerically simulated. The setup performed as predicted, but the correlation of the injected power into the OCRR and a comparable external field strength seems challenging.

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REFERENCES

[1] EUROCAE ED-107A/SAE ARP5583A; July 2010, pp. 58-72.