

Non-linear Effects and Degradation of EMC Joints Irradiated by HPM

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Determination of shielding effectiveness is a vital part in the analysis of an electronic systems capability to withstand High Power Microwaves (HPM). It is usually assumed that the shielding effectiveness, determined at low field levels, is valid also at HPM threat levels. This assumption might be refuted by the presence of non-linear effects, e.g. due to electrical discharge or metal-insulator-metal junctions caused by corrosion (the “rusty bolt effect”). Irradiation at threat level may also result in damage and degradation of the shielding joint. Both these aspects have been studied (Bäckström and Lundén, FOI Report FOI-R—1246—SE, June 2004, Swedish Defence Research Agency FOI)

Measurements were performed on 31 corroded EMC joints. These were selected from two earlier studies conducted by the Swedish Corrosion Institute (SCI). In the first study the influence of accelerated corrosion on the shielding properties of different material combinations was investigated. Five objects were chosen from this study (Figure 1 and 2). In the second study 58 different combinations of gasket and frame and cover plate exposed to one year outdoor environment in Stockholm were studied. 26 objects from that study were chosen.

Two different kinds of measurements were performed: high level irradiation and determination of the transmission cross section (measured at low field levels). The latter was made in a reverberation chamber before and after the high level HPM irradiation test in order to detect any degradation of the shielding properties of the objects. The irradiation at high levels was carried out, using a 3 GHz 700 kW magnetron source, in order to find out if degradation would occur and also in if spectral broadening occurs. The radiation transmitted through the joint was detected using a D-dot probe mounted 4 cm behind the joint. The pulse length was 1 μ s and the PRF was 70 Hz.

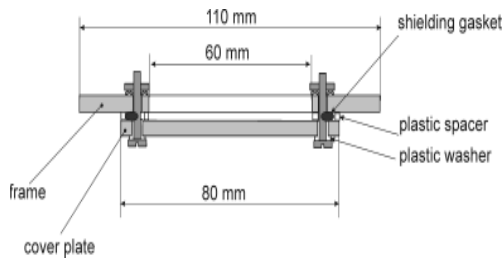


Figure 1. Geometry of the EMC joints from first study.

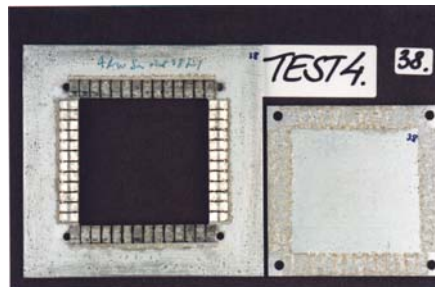


Figure 2. Test object with clear chromated aluminum/tin plated contact fingers after exposure to accelerated corrosion test.

No major degradation of the 31 corroded test objects could be detected after HPM irradiation at high field levels. Also, most of the tested objects showed rather small changes of the time domain shape of the transmitted HPM pulse. This indicates that the effects due non-linear behavior are usually weak. However, spectral analysis revealed that some objects showed enhanced peaks at 6 GHz and also indicated a significant spectral content below and around 1 MHz. This should be further evaluated in the future.