Applied Electromagnetic Technology

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PSDS Application Note No. 02-A

Shielding Effectiveness Testing
Using the Precision Spherical Dipole System (PSDS)

Introduction

Shielding effectiveness testing can be extremely useful to help evaluate various gasket material and metal shield designs. The Precision Spherical Dipole system (PSDS) can be easily used to help make these measurements.

Discussion

Care must be taken when making shielding effectiveness measurements. Traditionally, a small antenna is used to create an electric field in the open, and then the antenna is placed inside the metal enclosure to be tested. The strength is measured with a RF receiver or spectrum analyzer from both tests, and the difference is considered to be the shielding effectiveness of the enclosure. However, the transmitting antenna's impedance has been changed significantly by placing it inside the metal enclosure and the resulting electric field is also changed! This effect changes with frequency, so the error can be larger or smaller across a given frequency range.

Another potential concern is the antenna orientation. A likely traditional transmit antenna will create a field with a definite polarization. Depending on the relative orientation of the antenna and the most significant leak in the enclosure, a false indication of the enclosure's shielding effectiveness could be determined.

The PSDS system offers a significant advantage over the traditional transmitting antennas. The ability to monitor the dipole's gap voltage allows the gap voltage to be set to the same value both when the PSDS is inside the metal enclosure and outside the enclosure. Regardless of the antenna's impedance, the gap voltage remains the same.

The PSDS transmitting antenna is a spherical dipole. It radiates equally in two dimensions, the same as a standard dipole. Because it is spherical, it can be orientated in any direction by simply rotating it. This allows the user to be sure that all possible leakage modes are included.

Shielding Effectiveness Testing

The most important factor with shielding effectiveness testing is to make sure the test with and without the enclosure are the same. The distance between the PSDS and the receive antenna is not important. Typically, one meter separation is used, but if the receive antennas are fixed at other distances (like 3 or 10 meters), there is no problem.

The PSDS radiating sphere should be placed on a wood table or bench. The signal level from the generator is applied to the control unit and the level increased until the reading on the control unit front panel display is at a convenient level. The received level (using a spectrum analyzer or receiver) should be noted. This should be repeated for all frequencies of interest.

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The PSDS radiating sphere is now placed inside the enclosure to test. The radiating element should be placed on a non-conducting material, and placed roughly in the center of the enclosure. The signal level of the generator is again increased until the reading on the control unit front panel display matches the previous reading. The received level is again noted, and the difference between the received level in the first test and the second test is the amount of shielding at that frequency.

Note: An empty metal enclosure is likely to have a high Q-factor. This will result in readings that are higher at frequencies where a resonance of the metal enclosure exists. A small piece of lossy material placed inside the enclosure can reduce these resonance effects, and make a more accurate result.

Summary

The PSDS is useful for making shielding effectiveness measurements. A more accurate measurement is possible, because the gap voltage (signal applied to the antenna's radiating elements) can be monitored and controlled to be the same both inside the meal enclosure and outside the metal enclosure. The PSDS radiating element can be easily rotated to allow testing of all possible slot/gap orientations.