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ANNEX TO NPL CERTIFICATE FOR 200 MHz to 2 GHz HORN ANTENNAS

**Antenna Factor**

The antenna factors are valid for any separation distance from the source exceeding one wavelength. For shorter distances the change in antenna factor with distance becomes significant and additional uncertainty would therefore be introduced.

Where there is a sharp resonance in the antenna factor the uncertainty given in the certificate does not apply. At the frequency where the resonance causes a deviation of greater than 1 dB from the overall trend of the data, the magnitude of the increased uncertainty can be estimated from the height of the spike on the antenna factor graph. The affected range can be taken as ± 1.5 % of the centre frequency. Because the data is sampled at discrete points the maximum error may be much larger than that shown in the antenna factor graph.

If the antenna is used in an unlined screened room the use of these antenna factors may not give the absolute value of field strengths, but a calibration provides an essential check that the antenna is working properly. The antenna factors can be used to compare measurements made in an identical setup using a different antenna of the same type.

**Return Loss**

The antenna factors quoted apply when the mismatch between the antenna and the receiver is attenuated. A well matched 6 dB attenuator is recommended. For example, if no attenuator is used and the receiver front-end attenuation is set to zero, the antenna factor can change by typically ± 0.3 dB, assuming a receiver return loss of greater than 14 dB, an antenna return loss of 10 dB and a cable loss of 3 dB.

**ARP958 Antenna Factor**

Measurements at 1 m distance from an emitter is called for in MIL-STD-461D[1], which stipulates that procedure ARP958[2] is to be used for 1 m calibrations. It is necessary to distinguish between $AF_{1m}$ and conventional AF which enables absolute E-field strength to be obtained from the voltage output of the antenna. ARP958 describes $AF_{1m}$ as "apparent" antenna factor because it is derived from equations which do not take near-field terms into account. When these antennas are calibrated to SAE ARP958, the method calls for two identical antennas to be mounted with their faces 1 m apart. These horn antennas have aperture dimensions of 0.94m x 0.68m and there is substantial mutual coupling between them, which shows as an oscillation in a plot of antenna factor against frequency. When one of these antennas is used for EMC testing, the object being tested is unlikely to present the same mutual coupling. Approximately 2 dB of additional uncertainty should be allowed for.

**References**


[1] MIL-STD-461D, Requirements for the control of electromagnetic interference emissions and susceptibility, 1993, Department of Defence, USA.

[2] SAE ARP958:1992, Electromagnetic interference measurement antennas; standard calibration method. Society of Automotive Engineers.