

Coupling Calculations of Narrowband, Mesoband, and Hyperband Electric Field Waveforms to Network Cable Systems

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Recently the International Electrotechnical Commission (IEC) published a new standard dealing with the radiated and conducted high power electromagnetic (HPEM) threats that are associated with the problem of intentional electromagnetic interference (IEMI). The standard is IEC 61000-2-13: High power electromagnetic (HPEM) environments – Radiated and conducted.

In this new standard, four categories of narrowband and wideband waveforms are described in order to provide better definitions for the bandwidths of threat waveforms. These categories are provided in table 1 below along with a new parameter known as the bandratio.

Table 1. High power electromagnetic waveform bandwidth definitions

Band type	Percent bandwidth (<i>pbw</i>)	Bandratio (<i>br</i>)
Hypoband or narrowband	$\leq 1 \%$	$br \leq 1.01$
Mesoband	$1 \% < pbw \leq 100 \%$	$1.01 < br \leq 3$
Sub-hyperband	$100 \% < pbw \leq 163.4 \%$	$3 < br \leq 10$
Hyperband	$163.4 \% < pbw \leq 200 \%$	$br > 10$

The object of this paper is to take HPEM waveforms from these categories and to perform coupling calculations of the incident electromagnetic fields for a simple cable geometry for lengths less than 10 meters.

The analysis approach begins with the selection of 4 analytic waveforms, one from each category. Coupling calculations are performed as a function of the angle of incidence on a cable in free space. The angular variations will be tabulated to show the sensitivity of the results for each category of waveform. In addition, the maximum coupled currents and other waveform norms will be tabulated and compared with the incident waveforms to determine the coupling efficiencies.

The paper will conclude with a discussion of the factors not considered in the paper, including reflections from nearby surfaces, polarization of the incident fields, and the impact of more complex cable layouts.