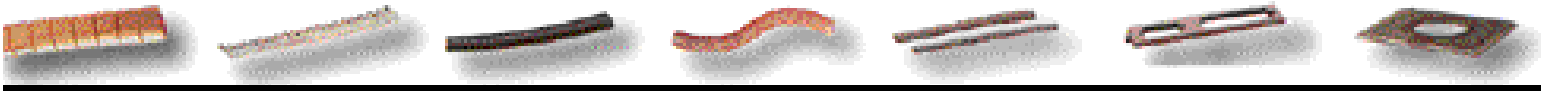
TECH NOTES

LAIRD TECHNOLOGIES



Rule-of-Thumb for Calculating Aperture Size

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By: Gary Fenical

Most of today's electronic devices require shielding to meet their mandatory EMC specifications for both emissions and immunity. With devices becoming smaller and more densely populated some require shielding just so they do not interfere with their own operation.

The shielding effectiveness of an aperture, and ultimately of an enclosure itself, is generally a function of the size of the largest aperture in the enclosure. Enclosure can be defined as anything from a PC board shield to a shielded building and everything in between.

Let's break apertures into two categories, slot and round holes, because they have different characteristics and ultimately give different results.

The following formula provides a simple model for calculating the worst-case shielding effectiveness of a slot aperture. Some error results from its use, but it is adequate for design because the shielding effectiveness is greater than the calculation indicates. Shielding effectiveness of a single aperture with slot opening length (L = longest dimension) is given by:

$SE_{dB}=20 \log_{10} \lambda/2 L$

where:
L=length of slot (meters) and L>w and L>>t
λ=wavelength in meters
t=thickness

Round apertures do not use the same formula. Therefore, solving for the following equation for a round aperture will, of course, yield different results.

$SE_{dB}=40 \log_{10} \lambda/2 L$

The aforementioned formulas are for one aperture. For an array of apertures the complete formula is:

$SE_{dB}=K \log_{10} \lambda/2 L - 20 \log n \rfloor_{L \leq} \lambda/2$

where:
K=20 for a slot
K=40 for a round hole
n=number of apertures within $\lambda/2$

The following equation is solved in terms of the length (L) to determine what size aperture is required for a given attenuation.

$$L=10^{\lambda/(SE_{dB}/K)}/2$$

In general however, based upon today's requirements, operating frequencies and power levels, apertures should be smaller than $\lambda/50$ and not larger than $\lambda/20$. Obviously, this is a rule-of-thumb as the title states. For the final design, the designer should always know the amount of attenuation required at each frequency and calculate the appropriate values. Generally, this is best achieved by performing preliminary or investigative measurements on a calibrated site.

Please see reverse side for Aperture Design Rule-of-Thumb chart.

The following chart solves for aperture dimension for the λ/50 (60dB) and λ/20 (40dB) lengths for slots and round holes. Several examples are shown by the blue X.

- 0.025" at 200MHz is acceptable for a slot or but may be overkill for a round hole.
- 0.5" at 800MHz is acceptable for a round hole but not a slot.
- 0.2" at 4GHz is not acceptable within these guidelines.