nat® Maximum Permissible Exposure

NAT Part #: **NPX136D**
Document #: **\605-0**

Description: **FCC and IC requirement**
Rev: **1.00**

This calculation for MPE is required for submission to IC and FCC for compliance. The calculation will be performed for the common case of the aluminum aircraft skin separating humans from the transmitting antenna, and the case of only free space separation from the transmitting antenna.

No conductive ground plane

In the case where there is no conductive ground plane between the person and the transmitting antenna the following formula applies as we have assumed a far field condition:

P_d = Power Density
$EIRP_i$ = Effective Isotropic Radiated Power
R_{min} = Minimum Acceptable Radius from Transmitter

$$R_{\min} = \sqrt{\frac{EIRP_i}{4\pi P_d}} \quad \text{Eqn 1}$$

The maximum permissible power density (P_d) from Table 5 of Safety Code 6 is $2W/m^2$. The $EIRP_i$ for a ideal dipole antenna with a gain of 2.14dB and the radio transmitting 10W would be 42.1dBm or 16.4W. Evaluating Eqn. 1:

$$R_{\min} = \sqrt{\frac{16.4W}{4\pi \frac{2W}{m^2}}} = 80.7cm$$

Therefore the minimum distance from the antenna during transmission is 80.7cm.

Conductive Ground Plane

The following shows the effect of the aluminum aircraft skin on the MPE.

For this case we will assume an ideal dipole with gain of 2.14dB and an infinite plane of aluminum such as an enclosed aircraft cockpit.

For the typical case of 1mm thick aircraft skin the absorption loss is:

$$A_{dB} = 131t\sqrt{F\mu_r\sigma_r} \quad \text{Eqn. 2}$$

(Pg.184 Controlling Radiated Emissions by Design, Michel Mardiguian)

where
t = thickness of conductive barrier in mm

F = frequency in MHz
μ_r = permeability relative to Cu
σ_r = conductivity relative to Cu

$$A_{dB} = 131 * 1\sqrt{136 * 1 * 0.6} = 1183dB$$

Reflection losses can be calculated using Eqn 3:

$$R_{dB} = 20\log\frac{(K+1)^2}{4K} \quad \text{Eqn 3}$$

where

$$K = \frac{120\pi}{Z_b}$$

where Z_b = shield barrier impedance/square

As aluminum is a relatively good conductor we will assume a Zb of 1.

Therefore R_{db} = 39.5dB

The total attenuation through the aluminum sheet is A_{dB} + R_{dB} = 1222dB

The worst case scenario where all the transmitter power is radiated directly at the aluminum sheet the power on the other side would be 42.14dBm – 1222dBm = -1180.4dBm.

This result is so small that there would be no impact on any persons on the other side of the infinite plane of aluminum aircraft skin.

References:

RSS-102 - Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields

Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields

Controlling Radiated Emissions by Design, Michel Mardiguian, 1992, Van Nostrand Reinhold

Trevor Lynch-Staunton, Design Engineer

John Carr, Certification Manager