RFID Terminal Maximum Permitted Exposure (MPE) Calculations:

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1. Reference Document:

The Reference Document for the MPE limits has been taken as the OET Bulletin 65 (Edition 97-01).

2. Applicable Limits:

'Appendix A' details the relevant exposure criteria in the above FCC Document. For the purposes of calculations on the RFID System the limits have been used which are applicable to General Population/Uncontrolled Exposure. See values detailed below:

The following limits are applicable:
Over the 300 – 1500MHz range f/1500 mW/sq.cm

This equates to the following power density levels:
RFID operating at frequency 902MHz: 0.601mW/sq.cm
RFID operating at 928MHz: 0.612mW/sq.cm

WLAN operating at 2.4 – 2.483GHz 1mW/sq.cm
applicable over the 1.5GHz–100GHz range

Note:
These limits are only applicable to operation of equipment in the far field.
Calculations show that at RFID frequencies the far field is beyond a distance of 53mm, and at WLAN frequencies beyond a distance of 19mm.
Therefore, the proposed operational distance of 23cm is well into the far field.

3. Calculation of power density

The RF power density at an operational distance R from the antenna is calculated by the following expression $S = (P.G)/4.\ \pi.R^2$

where S = power density in mW/sq.cm
P = power output in mW
G = antenna gain (numeric gain value)
R = operating distance from antenna in cm

3.1 WLAN

Transmitted power 100mW
Antenna gain 1.26 (+1dBi)

RF power density at 23cm from the antenna $S = (100 \times 1.26)/4.\pi.23^2$ mW/sq.cm
$= 0.0189$ mW/sq.cm

The FCC limit is 1.0 mW/sq.cm

(Note: for information, the minimum operational distance for the FCC limit is at 3.1cm)

3.2 RFID

Transmitted power 1000mW
Antenna gain 4.0 (+6dBi)

RF power density at 23cm from the antenna $S = (1000 \times 4.0)/4.\pi.23^2$ mW/sq.cm
$= 0.601$ mW/sq.cm

The FCC limit is 0.601 mW/sq.cm at 902MHz
The FCC limit is 0.612 mW/sq.cm at 928MHz

3.3 Co-locational operation

Maximum possible combined transmitted power: 1100mW
Assuming the worst case Specification Limit of 0. 601mW/sq.cm applies, as for the operational lowest frequency and antenna gain of 4.

The minimum 'safe' distance is calculated as $((P_{max} \times G)/4\ \pi.S)^{\frac{1}{2}}$ cm.

where P = 1100
G = 4
S = 0.601

Therefore, to comply with the FCC limit, the minimum safe operational distance is calculated from the above as 24.1cm.

4. Summary of results

The RFID is within the FCC limits for General Population/Uncontrolled Exposure at a minimum operating distance of 23cm.
The WLAN is within the FCC limits for General Population/Uncontrolled Exposure to a minimum distance of 3.1cm.
Consideration of a possible increase in maximum transmitted power due to simultaneous, or co-location, operation indicates that a minimum operational distance of 24.1 cm should be specified.