731 Enterprise Drive
Lexington, KY 40510

Telephone: 859-226-1000
Facsimile: 859-226-1040
www.intertek-etlsemko.com

MPE Calculation

§ 1.1310: The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

Part 1.1310 Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f^2)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f^2)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

1.1 Test Procedure

An MPE evaluation for was performed in order to show that the device was compliant with §2.1091. The maximum power density was calculated for each transmitter at a separation distance of 20cm.

For each transmitter the maximum RF exposure at a 20 cm distance using the formula:

$$ConductedPower_{mW} = 10^{ConductedPower(dBm)/10}$$

$$PowerDensity = \frac{ConductedPower_{mW} \times Ant.Gain}{4\pi \times (20_{cm})^2}$$

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1.2 Results:

The device contains Cellular and Bluetooth transmitters which can transmit simultaneously. The following calculations show that the total power density from each transmitter at 20cm is less than the limit for general population / un-controlled exposure. With the worst case Cellular and Bluetooth radios transmitting simultaneously, the MPE calculations are less than the applicable limit. The device meets the RF exposure limit at a 20cm separation distance as required by part 2.1091 of the FCC rules with all modules transmitting simultaneously[1].

The total sum of the ratio of the power densities to the corresponding limit for all radios capable of transmitting simultaneously was computed as follows:

Total = (GSM or UMTS Power Density / Limit GSM or UMTS) + (Bluetooth Power Density / Limit Bluetooth)

Total = (0.25 / 0.549) + (0.0045 / 1) = 0.4558 + 0.0045 = 0.4603

Compliance is shown by the sum of the radio of the power densities for all radios that can transmit simultaneously being less than 1.

[1] The cellular radio is only capable of transmitting in one mode at a time (Cell band or PCS band).

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Individual Radio Test Results:

Bluetooth

Frequency	2412	MHz		
Limit	1.000	mW/cm^2		
Distance	20	cm		
Power	12	dBm		
TX Ant Gain	1.5	dBi		
EIRP	13.5		22.38721	mW
Power Density	**0.0045**	mW/cm^2 at 20cm		
MPE / Limit Ratio	**0.0045**			

GSM850

Frequency	824.2	MHz		
Limit	0.549	mW/cm^2		
Distance	20	cm		
Maximum Scaled Power	33	dBm		
TX Ant Gain	-2	dBi		
EIRP	31		1258.925	mW
Power Density	**0.2505**	mW/cm^2 at 20cm		
MPE / Limit Ratio	**0.4558**			

GSM1900

Frequency	1850.2	MHz		
Limit	1.000	mW/cm^2		
Distance	20	cm		
Maximum Scaled Power	30	dBm		
TX Ant Gain	0	dBi		
EIRP	30		1000	mW
Power Density	**0.1989**	mW/cm^2 at 20cm		
MPE / Limit Ratio	**0.1989**			

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UMTS V

Frequency	826.4	MHz		
Limit	0.551	mW/cm^2		
Distance	20	cm		
Maximum Scaled Power	24	dBm		
TX Ant Gain	-2	dBi		
EIRP	22		158.4893	mW
Power Density	**0.0315**	mW/cm^2 at 20cm		
MPE / Limit Ratio	**0.0572**			

UMTS II

Frequency	1852.4	MHz		
Limit	1.000	mW/cm^2		
Distance	20	cm		
Maximum Scaled Power	24	dBm		
TX Ant Gain	0	dBi		
EIRP	24		251.1886	mW
Power Density	**0.0500**	mW/cm^2 at 20cm		
MPE / Limit Ratio	**0.0500**			