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/cm²)	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/f²)	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/f²)	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 using the following formula.

$$PowerDensity = \frac{EIRP_{mW}}{4\pi \times (20_{cm})^2}$$

Once the power density for each transmitter was calculated, it was compared to the applicable MPE limit and converted to a percentage of the total power density for the device considering multiple transmissions.

1.2   Results:

The device contains FHSS and GSM 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 FHSS and either the GSM850 or GSM1900 radios transmitting simultaneously, the worse case MPE calculations are less than 8.3% of 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 both radios transmitting simultaneously[1].

FHSS Radio:

Radiated Output Power (Computed From Field Strength Measurement 13.26mW

$$PowerDensity(FHSS) = \frac{13.26_{mW}}{4\pi \times (20_{cm})^2} = 0.003mW/cm\text{\textasciicircum}2$$

MPE Limit at 903.2MHz = 0.602 mW/cm^2

FHSS Power Density % of Limit = (0.003 / 0.602) x 100 = 0.5%

GSM 850 Radio:

Radiated Output Power (Measured with TIA-603C Substitution Method) = 709mW

$$PowerDensity(GSM\,850) = \frac{709_{mW}}{4\pi \times (20_{cm})^2} = 0.14mW/cm\text{\textasciicircum}2$$

Duty Cycle Correction for GSM Slot Configuration (2 Used / 8 Possible) = 0.25

Power Density Corrected for GSM Duty Cycle = (0.14mW/cm^2) * 0.25 = 0.035mW/cm^2

MPE Limit at 824MHz = 0.549 mW/cm^2

GSM 850 Power Density % of Limit = (0.035 / 0.549) x 100 = 6.35%

GSM 1900 Radio:

Radiated Output Power (Measured with TIA-603C Substitution Method) = 11564mW

$$PowerDensity(GSM\,1900) = \frac{1564_{mW}}{4\pi \times (20_{cm})^2} = 0.311mW/cm\text{\textasciicircum}2$$

Duty Cycle Correction for GSM Slot Configuration (2 Used / 8 Possible) = 0.25

Power Density Corrected for GSM Duty Cycle = (0.311mW/cm^2) * 0.25 = 0.078mW/cm^2

MPE Limit above 1500MHz = 1 mW/cm^2

GSM 1900 Power Density % of Limit = (0.078 / 1) x 100 = 7.8%

The wost case simultaneous transmission with FHSS and GSM1900 is 7.8% + 0.5% = 8.3% of applicable MPE limit.

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[1] It is not possible for the GSM 850 radio to transmit simultaneously with the GSM1900 radio.