Measurement of MPE

1. Foreword

In adopt with the Human Exposure IEEE C95.1, and according to the FCC 1.1310. The *Maximum Permissible Exposure (MPE)* is obligated to measure in order to prove the safety of radiation harmfulness to the human body.

The *Gain* of the antenna used is measured in an a*nechoic chamber.* The *maximum total power to the antenna* is to be recorded. By adopting the **Friis Transmission Formula** and the *power gain of the antenna,* we can find the distance right away from the product, where the limit of the MPE is.

2. Limits for *Maximum Permissible Exposure (MPE)*

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Filed Strength (H) (A/m)	Power Density (S) (mW/cm2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
(A) Limits for Occupational/Controlled Exposure				
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

EUT Specification

EUT	GSM/GPRS module
Frequency band (Operating)	☒ GSM 850: 824MHz ~ 849MHz ☒ PCS: 1930 ~ 1990 MHz ☐ WLAN: 2.412GHz ~ 2.462GHz ☐ WLAN: 5.15GHz ~ 5.25GHz ☐ WLAN: 5.725GHz ~ 5.850GHz ☐ Bluetooth: 2.402 GHz ~ 2.482 GHz ☐ Others: _____
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation) ☐ Others: _____
Exposure classification	General Population/Uncontrolled exposure 850MHz(S=824.2/1500=0.549 mW/cm^2) 1909.8MHz$(S=1mW/cm^2)$

Antenna diversity	☒ Single antenna
	 ☐ Multiple antennas
	      ☐ Tx diversity
	      ☐ Rx diversity
	      ☐ Tx/Rx diversity

Max. output power	GSM 850: 31.12dBm GSM 1900: 27.31dBm
Antenna gain (Max)	0 dBi (Numeric gain: 1)
Evaluation applied	☒ MPE Evaluation ☐ SAR Evaluation* ☐ N/A

Remark:
1. *The maximum output power of GSM 850 is31.12*dBm (1294.20mW) *at 824.20MHz (with 1 numeric antenna gain.)&PCS 1900 is 27.31dBm(538.27mW) at 1850.20MHz(with 1 numeric antenna gain.)*

For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 850MHz(S=824.2/1500=0.549 mW/cm^2)1909.8MHz$(S=1mW/cm^2)$ *even if the calculation indicates that the power density would be larger.*

TEST RESULTS

No non-compliance noted.

<u>Calculation</u>

Given $\quad E = \dfrac{\sqrt{30 \times P \times G}}{d} \quad$ & $\quad S = \dfrac{E^2}{3770}$

Where E = Field strength in Volts / meter

    P = Power in Watts

    G = Numeric antenna gain
    d = Distance in meters

    S = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

  P (mW) = P (W) / 1000 and

  d (cm) = d(m) / 100

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \textbf{\textit{Equation 1}}$$

Where d = Distance in cm

    P = Power in mW

    G = Numeric antenna gain

    S = Power density in mW / cm^2

<u>Maximum Permissible Exposure</u>

Substituting the MPE safe distance using d = 20 cm into Equation 1:

Yields

$$S = 0.000199 \times P \times G$$

Where P = Power in mW

    G = Numeric antenna gain

    S = Power density in mW / cm^2

Result:

GSM 850

EUT output power = 1294.20mW
Numeric Antenna gain = 1
→ Power density = 0.258 mW / cm^2

PCS 1900

EUT output power =538.27mW

Numeric Antenna gain = 1

→ Power density = 0.107 mW / cm^2