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

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EUT Specification

EUT	Notebook PC
Frequency band (Operating)	☐ WLAN: 2.412GHz ~ 2.462GHz ☐ WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz ☐ WLAN: 5.745GHz ~ 5.825GHz ☒ Others: Bluetooth: 2.402GHz ~ 2.480GHz
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation) ☐ Others _____
Exposure classification	☐ Occupational/Controlled exposure *(S = 5mW/cm^2)* ☒ General Population/Uncontrolled exposure *(S=1mW/cm^2)*

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

Max. output power	1.04dBm (1.271mW)
Antenna gain (Max)	1.51dBi (Numeric gain: 1.416mW)
Evaluation applied	☒ MPE Evaluation ☐ SAR Evaluation ☐ N/A

Remark:

1. *The maximum output power is <u>1.04dBm (1.271mW) at</u> <u>2441MHz</u> (with <u>1.416numeric antenna gain</u>.)*
2. *DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance.*
3. *For mobile or fixed location transmitters, no SAR consideration applied. The minimum separation generally be used is at least 20 cm, even if the calculations indicate that the MPE distance would be lesser.*

TEST RESULTS

No non-compliance noted.

Calculation

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

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

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

Where   d = Distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²

Maximum Permissible Exposure

EUT output power = 1.271mW
Numeric Antenna gain = 1.416

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 / cm²

→ *Power density = 0.0004mW / cm²*

(For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm² even if the calculation indicates that the power density would be larger.)