

## 15. The Derivation of Maximum Allowable Gain

### 15.1. The Justification How Gain is Derived:

This submittal(s) (test report) is intended to comply with Section Part 27, subpart C & subpart L of the FCC CFR 47 Rules. As per FCC's ruling part, 1.1310, the power density limit for General Population/Uncontrolled Exposure is f/1500 mW/cm<sup>2</sup> through 300MHz to 1500MHz, and 1.0 mW/cm<sup>2</sup> through 1.5 GHz to 100 GHz, respectively. Since this related application is characterized as mobile application as defined by FCC, the MPE is obtained at 20cm in determination for its compliance with the power density limit.

The formula listing as follows is applied in determination of Power Density:

$$S = (P * G) / (4 * R^2)$$

Where,

S = Power Density

P = Conducted Output Power Measured at Antenna Port

G = Gain of Maximum Transmitting Antenna (linear gain)

R = Separating Distance from Transmitting Antenna

This related radio application is classified as mobile device in operation of general population / uncontrolled exposure condition.

### Limitation

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minute)
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 <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-15000	/	/	1.0	30

F = frequency in MHz

\* = Plane-wave equipment power density

s otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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## 15.2. Maximum Linear Gain Determination using MPE

Re-arrange the formula of Power Density in terms of maximum gain,

It yields,

$$G = S \cdot (4 \cdot R^2) - P$$

Where,

$S = F/1500 \text{ mW/cm}^2$  (300-1500Mhz) or  $1.0 \text{ mW/cm}^2$  (1.5GHz-100GHz)

$P =$  Conducted Output Power Measured at Antenna Port with respect to applied band.

$G =$  Maximum Linear Gain

$R = 20\text{cm}$

## Maximum Linear Gain Determination using ERP/EIRP

As per 27.50 (d)(4) ERP/EIRP is limited as 1W. Maximum allowable gain that complies with them can be obtained by the following relationship.

**EIRP/ERP = Maximum Allowable Gain + Maximum Burst Power as measured at antenna terminal**

Re-arrange the above equation in terms of Maximum Allowable Gain, *It yields,*

**Maximum Allowable Gain = EIRP/ERP – Maximum Burst Power as measured at antenna terminal**

## Maximum Source-based Time Average power for WCDMA/HSPA mode:

*Refer to page 20, 23.44dBm for HSDPA Band IV*

## 15.3. The Computation of Maximum Allowable Linear Gain using MPE limit

Operation in WCDMA Band IV (1712.4 – 1752.6MHz)

Given the maximum source-based time-averaged power as 23.44dBm, and MPE limit as  $1.0\text{mW/cm}^2$ .

Therefore, antenna gain is calculated as 13.57dBi

## 15.4. The Computation of Maximum Allowable Linear Gain using ERP/EIRP limit

Operation in WCDMA Band IV (1712.4 – 1752.6MHz)

Given the maximum burst averaged power as 23.44dBm, and EIRP limit as 1W

Therefore, antenna gain is calculated as 6.56dBi

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