

## 1 RF Exposure Requirements

An estimation of MPE in this application for product is used to ensure if it complies to the rules of the standard in the regulation list above.

Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure. It is broken down into two categories, Occupational/controlled and General population/uncontrolled.

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.

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.

We analysis if it comply with the limits for General population/uncontrolled exposure. The FCC's MPE limits for field strength and power density are given in 47CFR 1.1310(Table below).These limits are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP), and also partly based on guidelines recommended by the American National Standards Institute (ANSI) in Section 4.1 of ANSI/IEEE C95.1.

**Table: Limits For Maximum Permissible Exposure (MPE)**

<b>(A) Limits for Occupational/controlled Exposure</b>				
Frequency Range(MHz)	Electric Field Strength(E)(V/m)	Magnetic Field Strength(H)(A/m)	Power Density (S)(mW/cm <sup>2</sup> )	Averaging Time (minute) E  <sup>2</sup> , H  <sup>2</sup> or S
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f <sup>2</sup> )*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6
<b>(B) Limits for General Population/uncontrolled Exposure</b>				
Frequency Range(MHz)	Electric Field Strength(E)(V/m)	Magnetic Field Strength(H)(A/m)	Power Density (S)(mW/cm <sup>2</sup> )	Averaging Time (minute) E  <sup>2</sup> , H  <sup>2</sup> or S
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	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

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation:

$$S = \frac{P \times G}{4 \times \pi \times R^2}$$

Where:

S = power density

P = power input to the antenna

G = numeric gain of the antenna in the direction of interest relative to an isotropic radiator

R= distance to the centre of radiation of the antenna

$$\text{EIRP} = P \cdot G$$

The antenna of the product, under normal use condition is at least 20 cm away from the body of the user. Warning statement to the user for keeping at least 20cm separation distance and the prohibition of operating to a person has been printed on the user's manual. Therefore, the S of the device is calculated with R=20cm, and if it is below the limit S, then we can conclude the device complies with the rules.

## 2 RF Exposure Evaluation

### 2.1 Operation in GSM 850

(uplink: 824-849MHz, downlink: 869-894MHz)

Antenna type	Mode	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
External antenna	1TS*(1/8)	33	0	33	249.41	20	0.0496	0.549	Pass
	2TS*(2/8)	32	0	32	396.22	20	0.0789	0.549	Pass
	3TS*(3/8)	30	0	30	375	20	0.0746	0.549	Pass
	4TS*(4/8)	29	0	29	397.16	20	<b>0.0791</b>	0.549	Pass

Note:\*- based on the maximum tune-up tolerance limit declared by manufacturer

According to the Table, we can conclude the max power density level at 20 cm is **0.0791 mW/cm<sup>2</sup>**, which is below the uncontrolled exposure limit of 0.549mW/cm<sup>2</sup> at 824MHz, so we can conclude it is into compliance.

### 2.2 Operation in GSM1900

(uplink: 1850-1910MHz, downlink: 1930-1990MHz)

Antenna type	Mode	Tune-up* limit (dBm)	Gain (dBi)	EIRP* (dBm)	EIRP (mW)	R(cm)	S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Conclusion
External antenna	1TS*(1/8)	27	0	27	62.65	20	0.0125	1.000	Pass
	2TS*(2/8)	26	0	26	99.53	20	0.0198	1.000	Pass
	3TS*(3/8)	24	0	24	94.20	20	0.0187	1.000	Pass
	4TS*(4/8)	23	0	23	99.76	20	<b>0.0199</b>	1.000	Pass

Note:\*- based on the maximum tune-up tolerance limit declared by manufacturer

According to the Table, we can conclude the max power density level at 20 cm is **0.0199 mW/cm<sup>2</sup>**, which is below the uncontrolled exposure limit of 1.000mW/cm<sup>2</sup> at 1850MHz, so we can conclude it is into compliance.