

## 14. Maximum Permissible Exposure (MPE)

### 14.1. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with § 2.1091 radiofrequency radiation exposure evaluation: mobile devices of the FCC CFR 47 Rules, CFR 1.1310 (b) Radio frequency Radiation Exposure Requirement.

### 14.2. Special Accessories

Not available for this EUT intended for grant.

### 14.3. Equipment Modifications

Not available for this EUT intended for grant.

### 14.4. 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

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m <sup>2</sup> )	Averaging Time (minutes)
0.003-1	280	2.19	-	6
1-10	280/f	2.19/f	-	6
10-30	28	2.19/f	-	6
30-300	28	0.073	2*	6
300-1500	1.585 f <sup>0.5</sup>	0.0042 f <sup>0.5</sup>	f/150	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/f <sup>1.2</sup>
150000-300000	0.158 f <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> f <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> f	616000/f <sup>1.2</sup>

**Note:** f is frequency in MHz.

\* Power density limit is applicable at frequencies greater than 100 MHz.

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#### 14.5. Maximum Permissible Exposure (MPE) Evaluation

The evaluation and calculation as deduces below presents only worst-case that produces highest value of the result:

Operation Configuration of the Worst-Case picked up to evaluate:

**GPRS 850 / 1900, WCDMA II, HSDPA V**

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Operation in GPRS850 band (824.2 – 848.8 MHz)

The ERP of Base Station in GPRS 850 band is 17.65dBm max. The resulted power density at a distance of 20cm can be deducted as follows:

EUT			Measurement					
Operation Band	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	ERP	Limit
	MHz		V/H	dBm	dBd	dB	dBm	dBm
GPRS 850	824.2	128	V	14.75	3.75	-3.03	15.48	38.45
			H	16.92	3.75	-3.03	<b>17.65</b>	38.45
	836.6	190	V	14.09	3.76	-3.07	14.78	38.45
			H	16.92	3.76	-3.07	17.61	38.45
	848.8	251	V	13.70	3.77	-3.11	14.36	38.45
			H	16.39	3.77	-3.11	17.05	38.45

$$\text{ERP} = 17.65\text{dBm} = 58.210\text{mW}$$

$$\begin{aligned}\text{Power Density} &= \text{EIRP} \times \text{Duty Cycle} / (4 \times R^2) \\ &= 58.210 \times 0.5 / (4 \times 20^2) = 0.00579\text{mW/cm}^2\end{aligned}$$

where Duty Cycle is 0.5 for GPRS 850 band operation and R is 20cm.

The MPE limit for General Population/Uncontrolled Exposure is referred to in section 14.4, and it is,

$$\text{MPE limit} = 0.5773\text{mW/cm}^2$$

The resulted power density is below the limit of MPE, and therefore Base Station in GPRS850 band is compliant with the FCC rules on RF exposure.

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Operation in GPRS1900 band (1850.2 – 1909.8 MHz)

The EIRP of Base Station in GPRS 1900 band is 28.38dBm max. The resulted power density at a distance of 20cm can be deducted as follows:

EUT			Measurement					
Operation Band	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	EIRP	Limit
	MHz		V/H	dBm	dBi	dB	dBm	dBm
GPRS 1900	1850.2	512	V	26.76	5.22	-4.67	27.32	33.00
			H	18.89	5.22	-4.67	19.44	33.00
	1880.0	661	V	27.38	5.16	-4.70	27.83	33.00
			H	18.87	5.16	-4.70	19.32	33.00
	1909.8	810	V	28.03	5.09	-4.74	<b>28.38</b>	33.00
			H	20.57	5.09	-4.74	20.92	33.00

$$\text{EIRP} = 28.38\text{dBm} = 688.652\text{mW}$$

$$\begin{aligned}\text{Power Density} &= \text{EIRP} \times \text{Duty Cycle} / (4 \times R^2) \\ &= 688.652 \times 0.5 / (4 \times 20^2) = 0.06655\text{mW/cm}^2\end{aligned}$$

where Duty Cycle is 0.5 for GPRS1900 band operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is referred to in section 14.4, and it is,

$$\text{MPE limit} = 1.0\text{mW/cm}^2$$

The resulted power density is below the limit of MPE, and therefore Base Station in GSM1900 band is compliant with the FCC rules on RF exposure.

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Operation in WCDMA II band (1852.4 – 1907.6 MHz)

The EIRP of Base Station in WCDMA II band is 25.62dBm max. The resulted power density at a distance of 20cm can be deducted as follows:

EUT			Measurement					
Operation Band	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	EIRP	Limit
	MHz		V/H	dBm	dBi	dB	dBm	dBm
WCDMA B2	1852.4	9262	V	25.07	5.22	-4.67	<b>25.62</b>	33.00
			H	17.69	5.22	-4.67	18.24	33.00
	1880.0	9400	V	21.46	5.16	-4.70	21.91	33.00
			H	17.05	5.16	-4.70	17.50	33.00
	1907.6	9538	V	20.07	5.10	-4.74	20.43	33.00
			H	16.06	5.09	-4.74	16.42	33.00

$$\text{EIRP} = 25.62\text{dBm} = 364.754\text{mW}$$

$$\begin{aligned}\text{Power Density} &= \text{EIRP} \times \text{Duty Cycle} / (4 \times R^2) \\ &= 364.754 \times 1 / (4 \times 20^2) = 0.0726\text{mW/cm}^2\end{aligned}$$

where Duty Cycle is 1 for WCDMA II band operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is referred to in section 14.4, and it is,

$$\text{MPE limit} = 1.0\text{mW/cm}^2$$

The resulted power density is below the limit of MPE, and therefore Base Station in WCDMA II band is compliant with the FCC rules on RF exposure.

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Operation in HSDPA V band (826.4 – 846.6 MHz)

The ERP of Base Station in HSDPA V band is 17.23dBm max. The resulted power density at a distance of 20cm can be deducted as follows:

EUT			Measurement					
Operation Band	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	ERP	Limit
	MHz		V/H	dBm	dBd	dB	dBm	dBm
HSDPA B5	826.4	4132	V	11.57	3.76	-3.03	12.29	38.45
			H	16.25	3.76	-3.03	16.97	38.45
	836.6	4183	V	11.11	3.76	-3.07	11.80	38.45
			H	16.53	3.76	-3.07	<b>17.23</b>	38.45
	846.6	4233	V	12.42	3.77	-3.10	13.09	38.45
			H	15.50	3.77	-3.10	16.16	38.45

$$\text{ERP} = 17.23\text{dBm} = 52.845\text{mW}$$

$$\begin{aligned}\text{Power Density} &= \text{EIRP} \times \text{Duty Cycle} / (4 \pi R^2) \\ &= 52.845 \times 1 / (4 \times \pi \times 20^2) = 0.01052\text{mW/cm}^2\end{aligned}$$

where Duty Cycle is 1 for HSDPA V band operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is referred to in section 14.4, and it is,

$$\text{MPE limit} = 0.5644\text{mW/cm}^2$$

The resulted power density is below the limit of MPE, and therefore Base Station in HSDPA V band is compliant with the FCC rules on RF exposure.

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