

Maximum Permissible Exposure (MPE)

Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with Section Part 22, subpart H and Part 24, subpart E of the FCC CFR 47 Rules. For 47 CFR 1.1310 Radio frequency Radiation Exposure requirement.

Special Accessories

Not available for this EUT intended for grant.

Equipment Modifications

Not available for this EUT intended for grant.

Limitation

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	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 ²)	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

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Maximum Permissible Exposure (MPE) Evaluation

In this application we seek approval to the 3G Data Module. Based on the FCC OET Bulletin 65 Supplement C and 47 CFR §2.1091, we have concluded that the SIM340 module will comply with the FCC rules on RF exposure for mobile devices in cellular band and PCS band. The following analysis will demonstrate such compliance. The analysis will be done in two US bands.

Operation in GPRS 850 band (824 – 850 MHz)

The ERP of 3G Data Module in GPRS 850 is 31.95dBm max. The resulted ERP can be expressed as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBd)	Cable Loss (dB)	ERP (dBm)	Limit (dBm)
GPRS 850	824.20	128	E2	V	119.41	33.02	-7.87	3.62	21.52	38.40
				H	129.72	43.45	-7.87	3.62	31.95	38.40
	836.60	190	E2	V	119.94	33.69	-7.88	3.65	22.16	38.40
				H	129.32	43.09	-7.88	3.65	31.56	38.40
	848.80	251	E2	V	119.94	33.82	-7.88	3.68	22.26	38.40
				H	129.30	43.11	-7.88	3.68	31.55	38.40

$$\text{ERP} = 31.95 = 1566.75 \text{ mW}$$

$$\text{Power Density} = \text{ERP} * \text{Duty Cycle} / (4 \pi R^2)$$

$$= 1566.75 * 0.25 / (4 * \pi * 20^2) = 0.07796 \text{ mW/cm}^2$$

where Duty Cycle is 0.25 for GPRS 850 band operation (class 10) and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

$$\text{MPE limit} = 824/1500 = 0.55 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore 3G Data Module in Cellular band is compliant with the FCC rules on RF exposure.

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Operation in GPRS 1900 band (1850 – 1910 MHz)

The EIRP of 3G Data Module in GPRS 1900 band is 25.53dBm max. The resulted EIRP can be expressed as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBi)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)
GPRS 1900	1850.20	512	E2	V	117.05	12.66	9.90	5.56	17.00	33.00
				H	125.18	21.00	9.90	5.56	25.34	33.00
	1880.00	661	E2	V	118.12	13.76	9.99	5.61	18.14	33.00
				H	124.98	20.84	9.99	5.61	25.21	33.00
	1909.80	810	E2	V	118.50	14.17	10.08	5.66	18.59	33.00
				H	125.22	21.11	10.08	5.66	25.53	33.00

$$\text{EIRP} = 25.53 \text{ dBm} = 357.3 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{EIRP} * \text{Duty Cycle} / (4 \pi R^2) \\ &= 357.3 * 0.25 / (4 * \pi * 20^2) = 0.01778 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 0.25 for GPRS 1900 operation (class 10) and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

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

As we can see the resulted power density is below the MPE limit, therefore 3G Data Module in PCS band is compliant with the FCC rules on RF exposure.

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Operation in EDGE 850 band (824~850 MHz)

The EIRP of 3G Data Module in EDGE 850 band is 29.68dBm max. The resulted EIRP can be expressed as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBd)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)
EDGE 850	824.20	128	E2	V	116.77	30.38	-7.87	3.62	18.88	38.40
				H	127.45	41.18	-7.87	3.62	29.68	38.40
	836.60	190	E2	V	115.62	29.37	-7.88	3.65	17.84	38.40
				H	127.08	40.85	-7.88	3.65	29.32	38.40
	848.80	251	E2	V	116.02	29.90	-7.88	3.68	18.34	38.40
				H	126.94	40.75	-7.88	3.68	29.19	38.40

$$\text{EIRP} = 29.68 \text{ dBm} = 928.9 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{EIRP} * \text{Duty Cycle} / (4 \pi R^2) \\ &= 928.9 * 0.25 / (4 * \pi * 20^2) = 0.04623 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 0.25 for EDGE 850 operation (class 10) and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

$$\text{MPE limit} = 824/1500 = 0.55 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore 3G Data Module in Cellular band is compliant with the FCC rules on RF exposure.

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Operation in EDGE 1900 band (1850 – 1910 MHz)

The EIRP of 3G Data Module in EDGE 1900 band is 23.26dBm max. The resulted EIRP can be expressed as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBi)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)
EDGE 1900	1850.20	512	E2	V	116.23	11.84	9.90	5.56	16.18	33.00
				H	123.10	18.92	9.90	5.56	23.26	33.00
	1880.00	661	E2	V	114.80	10.44	9.99	5.61	14.82	33.00
				H	121.86	17.72	9.99	5.61	22.09	33.00
	1909.80	810	E2	V	115.81	11.48	10.08	5.66	15.90	33.00
				H	122.56	18.45	10.08	5.66	22.87	33.00

$$\text{EIRP} = 23.26 \text{ dBm} = 211.8 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{EIRP} * \text{Duty Cycle} / (4 \pi R^2) \\ &= 211.8 * 0.25 / (4 * \pi * 20^2) = 0.01054 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 0.25 for EDGE 1900 operation (class 10) and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

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

As we can see the resulted power density is below the MPE limit, therefore 3G Data Module in PCS band is compliant with the FCC rules on RF exposure.

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Operation in WCDMA band V(824 – 850 MHz)

The ERP of 3G Data Module in WCDMA band V is 20.99dBm. max. The resulted ERP can be expressed as follows:

EUT				Measurement					
Operation Band	Pol.	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	ERP	Limit
		MHz		V/H	dBm	dBd	dB	dBm	dBm
WCDMA B5	E2	826.4	4132	V	13.73	3.97	-4.22	13.47	38.45
				H	20.35	3.97	-4.22	20.10	38.45
		836.6	4183	V	14.01	3.99	-4.24	13.77	38.45
				H	21.23	4.00	-4.24	20.99	38.45
		846.6	4233	V	13.26	4.02	-4.24	13.04	38.45
				H	20.38	4.02	-4.24	20.16	38.45

$$\text{ERP} = 20.99 = 125.6 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{ERP} * \text{Duty Cycle} / (4 \pi R^2) \\ &= 125.6 * 1 / (4 * \pi * 20^2) = 0.025 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 1 for WCDMA Band V operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

$$\text{MPE limit} = 826/1500 = 0.55 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore 3G Data Module in WCDMA Band V band is compliant with the FCC rules on RF exposure.

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Operation in HSDPA band V (824 – 850 MHz)

The ERP of 3G Data Module in HSDPA band V is 22.00dBm max. The resulted ERP can be expressed as follows:

EUT				Measurement					
Operation Band	Pol.	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	ERP	Limit
		MHz		V/H	dBm	dBd	dB	dBm	dBm
HSDPA B5	E2	826.4	4132	V	14.84	3.97	-4.22	14.59	38.45
				H	21.45	3.97	-4.22	21.20	38.45
		836.6	4183	V	14.99	3.99	-4.24	14.75	38.45
				H	22.24	3.99	-4.24	22.00	38.45
		846.6	4233	V	14.81	4.02	-4.24	14.59	38.45
				H	21.67	4.02	-4.24	21.45	38.45

$$\text{ERP} = 22.00 \text{ dBm} = 158.5 \text{ mW}$$

$$\text{Power Density} = \text{ERP} * \text{Duty Cycle} / (4 \pi R^2)$$

$$= 158.8 * 1 / (4 * \pi * 20^2) = 0.03155 \text{ mW/cm}^2$$

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

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

$$\text{MPE limit} = 826/1500 = 0.55 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore 3G Data Module in HSDPA Band V band is compliant with the FCC rules on RF exposure.

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Operation in HSUPA band V (824 – 850 MHz)

The ERP of 3G Data Module in HSUPA band V is 21.92dBm max. The resulted ERP can be expressed as follows:

EUT				Measurement					
Operation Band	Pol.	Fundamental Frequency	CH	Antenna Pol.	S.G. Output	Antenna Gain	Cable Loss	ERP	Limit
		MHz		V/H	dBm	dBd	dB	dBm	dBm
HSUPA B5	E2	826.4	4132	V	14.38	3.97	-4.22	14.12	38.45
				H	21.59	3.97	-4.22	21.33	38.45
		836.6	4183	V	15.18	4.00	-4.24	14.94	38.45
				H	22.16	3.99	-4.24	21.92	38.45
		846.6	4233	V	14.91	4.02	-4.24	14.69	38.45
				H	21.63	4.02	-4.24	21.42	38.45

$$\text{ERP} = 21.92 \text{ dBm} = 155.6 \text{ mW}$$

$$\begin{aligned} \text{Power Density} &= \text{ERP} * \text{Duty Cycle} / (4 \pi R^2) \\ &= 155.6 * 1 / (4 * \pi * 20^2) = 0.03097 \text{ mW/cm}^2 \end{aligned}$$

where Duty Cycle is 1 for HSUPA Band V operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

$$\text{MPE limit} = 826/1500 = 0.55 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore 3G Data Module in HSUPA Band V band is compliant with the FCC rules on RF exposure.

End of Report ~

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