Gobi3000™ Module FCC MPE Evaluation

80-N2162-205 Rev. A

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Revision history

Revision	Date	Description
A	July 14, 2010	Initial release

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1 Introduction

Qualcomm seeks modular approval for the Gobi3000™ Module wireless modem for use in mobile configuration. This Maximum Permissive Exposure ("MPE") report demonstrates compliance for the Gobi3000™ WWAN mPCIe module with FCC CFR 47 §1.1310 and 2.1091 for standalone and collocated simultaneous transmission in mobile exposure conditions. The MPE analysis is valid for transmitters operating within the parameters defined in Table 2 used for analysis.

Any collocated transmitter must have a valid FCC ID documenting equivalent or degraded RF characteristics with the collocated parameters defined in this MPE analysis.

The mobile classification applies when 20 cm or more separation distance is maintained between the end user and both WWAN and WLAN transmission antennas.

The WWAN MPE calculations in the filing are based on conservative conducted transmit power exceeding those listed in the FCC ID J9CGOBI3000 filing and the maximum allowable antenna gains per relevant grant notes. The higher transmit power levels are used to present a worst case assessment.

Portable user conditions or additional collocated modules not allowed based on this RF exposure analysis require a Class II permissive change and updated MPE or SAR report.

2 Product Declarations

Table 1 summarizes transmitter parameters associated with this permissive change application.

Table 1 WWAN Transmitter Declarations

Mode	Equipment Category	Max Transmitter Duty Cycle	Band Name	Available in U.S.	Transmitter Range (MHz)	Maximum Conducted Power		Max Antenna Gain (dBi)
						(dBm)	(W)	
GPRS/EDGE	GPRS/EDGE Cat 10 (Max 2 UL TX Slots)	25%	850 MHz - US Cellular	Yes	824-849	33.00	2.01	4.00
			900 MHz - EGSM	No	880-915	33.00	2.01	4.00
			1800 MHz - DCS	No	1710-1785	30.00	1.00	3.50
			1900 MHz - US PCS	Yes	1850-1910	30.00	1.00	3.50
WCDMA/HSPA	R7 HSDPA Cat 10 R6 HSUPA Cat 6	100%	Band 1 2.1 GHz	No	1920-1980	25.00	0.316	3.50
			Band 2 1900 MHz	Yes	1850-1910	25.00	0.316	3.50
			Band 4 1700 MHz – AWS	Yes	1710-1755	25.00	0.316	3.50
			Band 5 850 MHz	Yes	824-849	25.00	0.316	4.00
			Band 6 800 MHz (Japan)	No	830-840	25.00	0.316	4.00
			Band 8 900 MHz	No	880-915	25.00	0.316	4.00
CDMA2000	1x EVDO Release 0 EVDO Revision A	100%	BC0 850 MHz	Yes	824-849	25.00	0.316	4.00
			BC1 1900 MHz	Yes	1850-1910	25.00	0.316	3.50
			BC6 2100 MHz – IMT	No	1920-1980	25.00	0.316	3.50
			BC15 1700 – AWS	Yes	1710.1755	25.00	0.316	3.50

2.1 Collocated Transmitters

This MPE analysis is applicable to any collocated transmitters with transmit power less than or equal to 29.0 dBm. Specific FCC IDs for those devices are not necessary or identified in this analysis providing they are classified as mobile transmitters. A 100% duty cycle is used for calculations to present a worst-case analysis.

3 Transmitter Summary

Table 2 summarizes transmitter parameters associated with this permissive change application.

The WWAN modes of operation reflect the Gobi3000 module parameters associated with this FCC ID J9CGOBI3000.

The WLAN and WIMAX transmit power and antenna gain parameters represent a maximum transmit power for a given frequency band.

Integration of a WLAN module that exceeds the parameters requires a new FCC authorization or permissive change application. A worst-case antenna gain of 5 dBi has been assumed for all collocated antennas.

Table 2 WWAN and WLAN Declared Transmitter Parameters

Technology	Frequency (MHz)	Maximum Conducted Power (dBm)	Conducted Power (W)	Maximum Antenna Gain (dBi)	Duty Cycle
GPRS 2 UL	824	33.0	2.01	4.00	0.25
CDMA2000	824	25.0	0.32	4.00	1.00
UMTS	824	25.0	0.32	4.00	1.00
GPRS 2 UL	1850	30.0	1.00	3.50	0.25
CDMA2000	1850	25.00	0.32	3.50	1.00
UMTS	1850	25.00	0.32	3.50	1.00
WLAN	2400	29.00	0.794	5.00	1.00
WLAN	5150	29.00	0.794	5.00	1.00
WLAN	5250	29.00	0.794	5.00	1.00
WLAN	5500	29.00	0.794	5.00	1.00
WLAN	5800	29.00	0.794	5.00	1.00
WIMAX	2600	29.00	0.794	5.00	1.00

4 RF Exposure Limits and Equations

According to FCC CFR 47 §1.1310, the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b).

Table 3 Limits for Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
30-300	61.4	0.163	1.0	6
300-1500	…	…	f/300	6
1500-100,000	…	…	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
30-300	27.5	0.073	0.2	30
300-1500	…	…	f/1500	30
1500-100,000	…	…	1.0	30

Friis transmission formula:

$$P_d = \frac{P_{out} \times G}{4\pi R^2}$$

Where,

P_d = power density (mW/cm2)

P_{out} = output power to antenna (mW)

G = gain of antenna in linear scale

R = distance between observation point and center of the radiator (cm)

Table 4 shows duty cycles for typical technologies.

Table 4 Technology Duty Cycles for MPE Calculations

Technology	Duty Cycle
CDMA2000	100%
WCDMA	100%
GSM	12.5%
GPRS Cat 10 (2 Uplink Transmit Slots)	25.0%

5 MPE Calculations

5.1 Stand Alone Transmitter Calculations

The power density calculations for standalone transmitters at an exposure separation distance of 20 cm are shown in Table 5 per the transmit power and antenna gain values declared in Table 2.

For frequency dependent limits, the lowest transmitter frequency was used to represent the lowest MPE limit (e.g. 824MHz = 0.549 mW/cm^2).

The WLAN power levels listed represent the worst-case values for the corresponding frequency ranges given.

Table 5 WWAN and WLAN Standalone MPE Calculations

Technology	Frequency (MHz)	Maximum Conducted Power (dBm)	Conducted Power (W)	Maximum Antenna Gain (dBi)	Duty Cycle	Average EIRP (dBm)	Average EIRP (W)	Power Density @ 20cm (mW/cm^2)	FCC MPE Limit (mW/cm^2)
GPRS 2 UL	824	33.0	2.01	4.00	0.25	31.02	1.26	**0.252**	0.549
CDMA2000	824	25.0	0.32	4.00	1.00	29.00	0.79	0.158	0.549
UMTS	824	25.0	0.32	4.00	1.00	29.00	0.79	0.158	0.549
GPRS 2 UL	1850	30.0	1.00	3.50	0.25	27.48	0.56	0.111	1.000
CDMA2000	1850	25.00	0.32	3.50	1.00	28.50	0.71	**0.141**	1.000
UMTS	1850	25.00	0.32	3.50	1.00	28.50	0.71	0.141	1.000
WLAN	2400	29.00	0.794	5.00	1.00	34.00	2.51	0.500	1.000
WLAN	5150	29.00	0.794	5.00	1.00	34.00	2.51	0.500	1.000
WLAN	5250	29.00	0.794	5.00	1.00	34.00	2.51	0.500	1.000
WLAN	5500	29.00	0.794	5.00	1.00	34.00	2.51	0.500	1.000
WLAN	5800	29.00	0.794	5.00	1.00	34.00	2.51	0.500	1.000
WIMAX	2600	29.00	0.794	5.00	1.00	34.00	2.51	0.500	1.000

5.2 Collocated MPE Calculations

Per OET 65, when RF sources have difference frequencies, the fraction of the FCC power density limit shall be determined and the sum of all fractional components shall be less than 1.

Table 6 WWAN 850 MHz Collocation Power Density

WLAN Band	WLAN Pd (mW/cm^2)	FCC MPE Limit (mW/cm^2)	(WLAN Pd) / (MPE Limit)	850 MHz WWAN Pd (mW/cm^2)	FCC MPE Limit (mW/cm^2)	(WWAN 850 MHz) / MPE Limit)	(850 MHz WWAN fraction) + (WLAN fraction)	Limit	Pass/Fail
2.4 GHz	0.500	1.000	0.500	0.252	0.549	0.458	0.958	1	Pass
5.1 GHz	0.500	1.000	0.500	0.252	0.549	0.458	0.958	1	Pass
5.2 GHz	0.500	1.000	0.500	0.252	0.549	0.458	0.958	1	Pass
5.5 GHz	0.500	1.000	0.500	0.252	0.549	0.458	0.958	1	Pass
5.8 GHz	0.500	1.000	0.500	0.252	0.549	0.458	0.958	1	Pass
2.6 GHz	0.500	1.000	0.500	0.252	0.549	0.458	0.958	1	Pass

Table 7 WWAN 1900 MHz Collocation Power Density

Band	WLAN Pd (mW/cm^2)	FCC MPE Limit (mW/cm^2)	(WLAN Pd) / (MPE Limit)	1900 MHz Pd (mW/cm^2)	FCC MPE Limit (mW/cm^2)	(WWAN 1900 MHz) / MPE Limit)	(1900 MHz WWAN fraction) + (WLAN fraction)	Limit	Pass/Fail
2.4 GHz	0.500	1.000	0.500	0.141	1.000	0.141	0.641	1	Pass
5.1 GHz	0.500	1.000	0.500	0.141	1.000	0.141	0.641	1	Pass
5.2 GHz	0.500	1.000	0.500	0.141	1.000	0.141	0.641	1	Pass
5.5 GHz	0.500	1.000	0.500	0.141	1.000	0.141	0.641	1	Pass
5.8 GHz	0.500	1.000	0.500	0.141	1.000	0.141	0.641	1	Pass
2.6 GHz	0.500	1.000	0.500	0.141	1.000	0.141	0.641	1	Pass