



# MPE Evaluation for WP8548 Radio Module

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## **1. Introduction**

In this application we seek modular approval for the WP8548 radio module. This Maximum Permissible Exposure (MPE) report demonstrates compliance analysis for WP8548 radio module with FCC CFR 47 §2.1091 and IC RSS-102 for operation in mobile exposure conditions. The MPE analysis is limited for US / Canada bands only.

The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure.

Any collocated transmitter must have a valid FCC ID with the collocated parameters defined in this MPE report. A separation distance of 20cm or more shall be maintained between the end user and each collocated transmitting antenna.

## 2. RF Exposure Limits and Equations

### FCC Limits:

Table 1 lists the MPE limits for general population as specified in §1.1307.

#### (B) Limits for General Population/Uncontrolled Exposure

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  E  <sup>2</sup> ,  H  <sup>2</sup> or S (minutes)
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
1500-100,000	--	--	1.0	30

f = frequency in MHz \*Plane-wave equivalent power density

Table 1 : Limits for Maximum Permissible Exposure (MPE)

### IC Limits:

IC has adopted the RF field strength limits established in Health Canada's RF exposure guideline. The limits are shown in Table 2 below per RSS-102.

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m <sup>2</sup> )	Reference Period (minutes)
0.003-10 <sup>21</sup>	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ f <sup>0.5</sup>	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ f <sup>0.25</sup>	0.1540/ f <sup>0.25</sup>	8.944/ f <sup>0.5</sup>	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 f <sup>0.3417</sup>	0.008335 f <sup>0.3417</sup>	0.02619f <sup>0.6834</sup>	6
6000-15000	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>
<b>Note:</b> f is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

Table 2 : RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

In the frequency range of 300-6000 MHz, the IC limits are more stringent than the FCC limits. The MPE evaluation in this report will be based on the IC limits, so the deduced output power and antenna gain limits will guarantee compliance with both FCC and IC requirements.

### **EQUATIONS:**

$$\text{EIRP (dBm)} = \text{Conducted Power (dBm)} + \text{Antenna Gain (dBi)}$$

Power density is given by :

$$S = \text{EIRP} / (4 \pi * D^2)$$

where

S = Power density (mW/cm<sup>2</sup>)

EIRP = Equivalent Isotropic Radiated Power (mW)

D = Separation distance (cm)

### 3. WP8548 Product Specifications

WP8548 will transmit on only one band and mode of operation at any one time. Table 3 lists the supported frequency bands in Canada/USA and the maximum power in each of those bands.

Technology	Band	UL Freq. (MHz)	DL Freq. (MHz)	Max Power
WCDMA / HSDPA / HSUPA / HSPA+	B2	1850 – 1910	1930 – 1990	24 dBm
	B5	824 – 849	869 – 894	24 dBm
GSM	G850	824 – 849	869 – 894	33 dBm
	G1900	1850 – 1910	1930 – 1990	30 dBm
EDGE	G850	824 – 849	869 – 894	27.5 dBm
	G1900	1850 – 1910	1930 – 1990	26.5 dBm

Table 3: WP8548 Frequency Bands and Output Power

WP8548 supports multislot Class 10 GPRS and Class 12 EGPRS with power backoff for GMSK modulation at 3 and 4 times slots, as specified in Table 4.

Power Class	Mode	Band	Coding Scheme	Modulation	Power Backoff (dB)			
					Time Slot1	Time Slot2	Time Slot3	Time Slot4
12	EGPRS	GSM850	MCS1 - MCS4	GMSK	0	0	3	5
		GSM900						
		GSM850	MCS5 - MCS9	8PSK	0	0	0	0
		GSM900						
		GSM1800	MCS1 - MCS4	GMSK	0	0	2	3
		GSM1900						
		GSM1800	MCS5 - MCS9	8PSK	0	0	0	0
		GSM1900						

Table 4: WP8548 Power Backoff

### 4. Stand-alone Transmission

When WP8548 module transmits as a stand-alone mobile device, the source-based time-averaged EIRP is calculated by summing up conducted power and antenna gain. The antenna gains are chosen so that the resulted radiated power levels are within the limits specified by the FCC rules and IC Radio Standards Specifications (RSS). The IC exemption limits for routine RF exposure evaluation are calculated using the lowest frequency of the operating band presenting the most stringent limits.

As shown in Table 5 below, the resulted EIRP are always below the IC exemption limits for all the operating modes.

Operating Mode	TX Freq Range (MHz)		Max Time-Avg Cond Power (dBm)	Max Time-Avg Cond Power (W)	Max Ant Gain (dBi)	Duty Cycle	Source-Based Time-Averaged Max EIRP	IC Exemption Limit (EIRP)	ERP/EIRP Limits
<b>G850-GMSK (2TS)</b>	<b>824</b>	<b>849</b>	<b>33</b>	<b>2.00</b>	<b>4</b>	<b>25%</b>	<b>30.98</b>	<b>31.10</b>	<b>7W ERP</b>
G850-GMSK (3TS)	824	849	30	1.00	4	38%	29.74	31.10	7W ERP
G850-GMSK (4TS)	824	849	28	0.63	4	50%	28.99	31.10	7W ERP
G850-8PSK (4TS)	824	849	27.5	0.56	4	50%	28.49	31.10	7W ERP
G1900-GMSK (2TS)	1850	1910	30	1.00	3	25%	26.98	33.50	2W EIRP
G1900-GMSK (3TS)	1850	1910	28	0.63	3	38%	26.74	33.50	2W EIRP
G1900-GMSK (4TS)	1850	1910	27	0.50	3	50%	26.99	33.50	2W EIRP
G1900-8PSK (4TS)	1850	1910	26.5	0.50	3	50%	26.49	33.50	2W EIRP
WCDMA Band II LTE Band 2	1850	1910	24	0.25	3	100%	27.00	33.50	2W EIRP
WCDMA Band V LTE Band 5	824	849	24	0.25	4	100%	28.00	31.10	7W ERP

Table 5: WP8548 Stand-Alone Transmission

## **5. Collocated Transmission**

When WP8548 module co-transmits with radio transmitter(s) as a mobile device, per KDB 447498 D01, simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is  $\leq 1.0$ .

The evaluation here considers a WiMAX or WLAN transmitter, and a Bluetooth transmitter as collocated transmitters. Their radiated output power levels are listed in Table 6 below. The MPE ratio is defined by the ratio of power density to MPE limit. The sum of the MPE ratios is calculated as follows:

$$\begin{aligned}\sum MPE \text{ Ratio} &= \text{Max} (WP8548 \text{ MPE ratio}) + \text{Max} (WLAN/WiMax \text{ MPE ratio}) + BT \text{ MPE Ratio} \\ &= 0.769+0.192+0.037=0.998 < 1.0\end{aligned}$$

Operating Mode	TX Freq Range (MHz)		Max Time-Avg Cond Power (dBm)	Max Time-Avg Cond Power (W)	Max Ant Gain (dBi)	Duty Cycle	Source-Based Time-Averaged Max EIRP	Power Density @20 cm (W/m <sup>2</sup> )	IC MPE Limit (W/m <sup>2</sup> )	IC Power Density MPE Ratio
G850-GMSK (2TS)	824	849	33	2.00	3	25%	29.98	1.98	2.58	0.769
G850-GMSK (3TS)	824	849	30	1.00	3	38%	28.74	1.49	2.58	0.578
G850-GMSK (4TS)	824	849	28	0.63	3	50%	27.99	1.25	2.58	0.486
G850-8PSK (4TS)	824	849	27.5	0.56	3	50%	27.49	1.12	2.58	0.433
G1900-GMSK (2TS)	1850	1910	30	1.00	3	25%	26.98	0.99	4.48	0.222
G1900-GMSK (3TS)	1850	1910	28	0.63	3	38%	26.74	0.94	4.48	0.210
G1900-GMSK (4TS)	1850	1910	27	0.50	3	50%	26.99	0.99	4.48	0.222
G1900-8PSK (4TS)	1850	1910	26.5	0.45	3	50%	26.49	0.89	4.48	0.198
WCDMA Band II	1850	1910	24	0.25	3	100%	27.00	1.00	4.48	0.223
WCDMA Band V	824	849	24	0.25	3	100%	27.00	1.00	2.58	0.387
WLAN 2.4 GHz	2400	2500				100%	27.00	1.00	5.35	0.186
WLAN 5 GHz	5150	5850				100%	27.00	1.00	9.01	0.111
WiMAX	2300	2400				100%	27.00	1.00	5.19	0.192
	2500	2700				100%	27.00	1.00	5.50	0.181
	3300	3800				100%	27.00	1.00	6.65	0.150
Bluetooth	2400	2500				100%	20.00	0.20	5.35	0.037

Table 6: WP8548 Collocated Transmission

## 6. Conclusion

The analysis presented in this report concludes that the WP8548 radio module, when transmitting either in standalone or simultaneously with other co-located radio transmitters within a host device, is compliant with the FCC/IC RF exposure requirements in mobile exposure condition, provided the conducted power and antenna gain do not exceed the limits in Table 7 for each given frequency band and operating mode.

	Operating Mode	TX Freq Range (MHz)		Antenna Gain Limits (dBi)		EIRP Limits of Collocated Radio Transmitters (dBm)
				Stand-Alone	Collocated	
WP8548	GPRS/EDGE850	824	849	4	3	
	GPRS/EDGE1900	1850	1910	3	3	
	WCDMA Band V	824	849	4	3	
	WCDMA Band II	1850	1910	3	3	
Collocated Radio Transmitters	WLAN 2.4 GHz	2400	2500			27
	WLAN 5 GHz	5150	5850			27
	WiMAX	2300	2400			27
		2500	2700			27
		3300	3800			27
	Bluetooth	2400	2500			20

Table 7: WP8548 RF Exposure Conditions