



# 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 Permissive 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.<br>*Based on nerve stimulation (NS).<br>** 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 |
|-----------------------------|---------------------|------|-------------------------------|-----------------------------|--------------------|------------|-------------------------------------|---------------------------|-----------------|
|                             |                     |      |                               |                             |                    |            |                                     |                           |                 |
| G850-GMSK (2TS)             | 824                 | 849  | 33                            | 2.00                        | 4                  | 25%        | 30.98                               | 31.10                     | 7W ERP          |
| 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<br>LTE Band 2 | 1850                | 1910 | 24                            | 0.25                        | 3                  | 100%       | 27.00                               | 33.50                     | 2W EIRP         |
| WCDMA Band V<br>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:

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

| 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          | X  |
|                               | 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 | X                         | X          | 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