



# APPENDIX I RADIO FREQUENCY EXPOSURE

## LIMIT

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

## EUT Specification

|                                   |  |        |                       |
|-----------------------------------|--|--------|-----------------------|
| <b>EUT</b>                        | Laptop   |        |                       |
| <b>Model</b>                      | R13IXXXXXX (X=0~9,A~Z or blank) ; R8300XXXXXX (X=0~9,A~Z or blank) ; PWS98XXXXXX (X=0~9,A~Z)   |        |                       |
| <b>RF Module</b>                  | 1. Intel<br>2. SIERRA  | Model: | 1. N6235<br>2. EM7355 |
| <b>Frequency band (Operating)</b> | <input checked="" type="checkbox"/> GPRS Class 10: 824MHz ~ 849MHz<br><input checked="" type="checkbox"/> GPRS Class 10: 1850MHz ~ 1910MHz<br><input checked="" type="checkbox"/> EDGE Class 10 & 11 & 12: 824MHz ~ 849MHz<br><input checked="" type="checkbox"/> EDGE Class 10 & 11 & 12: 1850MHz ~ 1910MHz<br><input checked="" type="checkbox"/> CDMA EvDo: 824MHz ~ 849MHz<br><input checked="" type="checkbox"/> CDMA EvDo: 1850MHz ~ 1910MHz<br><input checked="" type="checkbox"/> CDMA EvDo: 816.0MHz ~ 823.975MHz<br><input checked="" type="checkbox"/> UMTS: 824MHz ~ 849MHz<br><input checked="" type="checkbox"/> UMTS: 1710MHz ~ 1755MHz<br><input checked="" type="checkbox"/> UMTS: 1850MHz ~ 1910MHz<br><input checked="" type="checkbox"/> LTE Band XVII: 704MHz ~ 716MHz<br><input checked="" type="checkbox"/> LTE Band XIII: 777MHz ~ 787MHz<br><input checked="" type="checkbox"/> LTE Band V: 824MHz ~ 849MHz<br><input checked="" type="checkbox"/> LTE Band IV: 1710MHz ~ 1755MHz<br><input checked="" type="checkbox"/> LTE Band II: 1850MHz ~ 1910MHz<br><input checked="" type="checkbox"/> LTE Band XXV: 1850MHz ~ 1915MHz<br><input checked="" type="checkbox"/> WLAN: 2400MHz ~ 2483.5MHz<br><input checked="" type="checkbox"/> WLAN: 5725MHz ~ 5850MHz<br><input checked="" type="checkbox"/> Bluetooth: 2400MHz ~ 2483.5MHz<br><input type="checkbox"/> Others |        |                       |
| <b>Device category</b>            | <input type="checkbox"/> Portable (<20cm separation)<br><input checked="" type="checkbox"/> Mobile (>20cm separation)<br><input type="checkbox"/> Others   |        |                       |
| <b>Exposure classification</b>    | <input type="checkbox"/> Occupational/Controlled exposure (S = 5mW/cm <sup>2</sup> )<br><input checked="" type="checkbox"/> General Population/Uncontrolled exposure (S=1mW/cm <sup>2</sup> )  |        |                       |
| <b>Evaluation applied</b>         | <input checked="" type="checkbox"/> MPE Evaluation*<br><input type="checkbox"/> SAR Evaluation<br><input type="checkbox"/> N/A   |        |                       |

Remark : 1. For more details, please refer to the User's manual of the EUT.

2. The model R13I was considered the main model for testing.



**For EM7355 Module:**

| Mode | Equipment Category | Max Transmitter Duty Cycle | Transmitter Range (MHz) | Maximum Conducted Power |      | Max Antenna Gain (dBi) |            |
|------|--------------------|----------------------------|-------------------------|-------------------------|------|------------------------|------------|
|      |                    |                            |                         | (dBm)                   | (W)  | Standalone             | Collocated |
| GPRS | Class 10           | 25%                        | 824-849                 | 33.0                    | 2.00 | 6.5                    | 3.0        |
|      |                    |                            | 1850-1910               | 30.0                    | 1.00 | 3.0                    | 3.0        |
| EDGE | Class 10           | 25%                        | 824-849                 | 28.0                    | 0.63 | 6.5                    | 3.0        |
|      |                    |                            | 1850-1910               | 27.0                    | 0.50 | 3.0                    | 3.0        |
|      | Class 11           | 37.50%                     | 824-849                 | 26.2                    | 0.42 | 6.5                    | 3.0        |
|      |                    |                            | 1850-1910               | 25.2                    | 0.33 | 3.0                    | 3.0        |
|      | Class 12           | 50%                        | 824-849                 | 25.0                    | 0.32 | 6.5                    | 3.0        |
|      |                    |                            | 1850-1910               | 24.0                    | 0.25 | 3.0                    | 3.0        |
| CDMA | EvDo               | 100%                       | 824-849                 | 25.0                    | 0.32 | 6.5                    | 3.0        |
|      |                    |                            | 1850-1910               | 25.0                    | 0.32 | 3.0                    | 3.0        |
|      |                    |                            | 816.0 – 823.975         | 25.0                    | 0.32 | 6.5                    | 3.0        |
| UMTS | HSDPA<br>HSUPA     | 100%                       | 824 - 849               | 24.0                    | 0.25 | 6.5                    | 3.0        |
|      |                    |                            | 1710-1755               | 24.0                    | 0.25 | 6.0                    | 6.0        |
|      |                    |                            | 1850 -1910              | 24.0                    | 0.25 | 3.0                    | 3.0        |
| LTE  | Band 17            | 100%                       | 704 -716                | 24.0                    | 0.25 | 9.0                    | 6.0        |
|      | Band 13            |                            | 777 -787                | 24.0                    | 0.25 | 9.0                    | 6.0        |
|      | Band 5             |                            | 824 -849                | 24.0                    | 0.25 | 6.5                    | 3.0        |
|      | Band 4             |                            | 1710 -1755              | 24.0                    | 0.25 | 6.0                    | 6.0        |
|      | Band 2             |                            | 1850 -1910              | 24.0                    | 0.25 | 3.0                    | 3.0        |
|      | Band 25            |                            | 1850 -1915              | 24.0                    | 0.25 | 3.0                    | 3.0        |

**For N6235 Module:**

| Mode | Transmitter Range (MHz) | Maximum Conducted Power |        | Max Antenna Gain (dBi) |
|------|-------------------------|-------------------------|--------|------------------------|
|      |                         | (dBm)                   | (W)    |                        |
| WLAN | 2400 -2483.5            | 16.9                    | 0.049  | 1.86                   |
| WLAN | 5725 -5850              | 23.9                    | 0.246  | 1.82                   |
| BT   | 2400 -2483.5            | 6.8                     | 0.0048 | 2.6                    |



|                                   | Technology       | Frequency     | Maximum Conducted Power |        | Maximum Antenna Gain | Average EIRP |          | Power Density @ 20cm | FCC MPE Limit      |
|-----------------------------------|------------------|---------------|-------------------------|--------|----------------------|--------------|----------|----------------------|--------------------|
|                                   |                  | MHz           | dBm                     | W      | dBi                  | dBm          | mW       | mW/cm <sup>2</sup>   | mW/cm <sup>2</sup> |
| <b>EM7355 Module (Collocated)</b> | <b>GPRS 2 UL</b> | 824-849       | 33.0                    | 2.00   | 3.0                  | 29.98        | 995.268  | 0.198                | 0.549              |
|                                   | <b>EDGE 2 UL</b> | 824-849       | 28.0                    | 0.63   | 3.0                  | 24.98        | 314.731  | 0.063                | 0.549              |
|                                   | <b>EDGE 3 UL</b> | 824-849       | 26.2                    | 0.42   | 3.0                  | 24.94        | 311.911  | 0.062                | 0.549              |
|                                   | <b>EDGE 4UL</b>  | 824-849       | 25.0                    | 0.32   | 3.0                  | 24.99        | 315.479  | 0.063                | 0.549              |
|                                   | <b>GPRS 2 UL</b> | 1850-1910     | 30.0                    | 1.00   | 3.0                  | 26.98        | 498.816  | 0.099                | 1.000              |
|                                   | <b>EDGE 2 UL</b> | 1850-1910     | 27.0                    | 0.50   | 3.0                  | 23.98        | 250.000  | 0.050                | 1.000              |
|                                   | <b>EDGE 3 UL</b> | 1850-1910     | 25.2                    | 0.33   | 3.0                  | 23.94        | 247.760  | 0.049                | 1.000              |
|                                   | <b>EDGE 4UL</b>  | 1850-1910     | 24.0                    | 0.25   | 3.0                  | 23.99        | 250.594  | 0.050                | 1.000              |
|                                   | <b>CDMA BC0</b>  | 824-849       | 25.0                    | 0.3    | 3.0                  | 28.00        | 630.957  | 0.126                | 0.549              |
|                                   | <b>CDMA BC1</b>  | 1850-1910     | 25.0                    | 0.3    | 3.0                  | 28.00        | 630.957  | 0.126                | 1.000              |
|                                   | <b>CDMA BC10</b> | 816.0-823.975 | 25.0                    | 0.3    | 3.0                  | 28.00        | 630.957  | 0.126                | 0.544              |
|                                   | <b>UMTS</b>      | 824 -849      | 24.0                    | 0.251  | 3.0                  | 27.00        | 501.187  | 0.100                | 0.549              |
|                                   | <b>UMTS</b>      | 1710-1755     | 24.0                    | 0.251  | 6.0                  | 30.00        | 1000.000 | 0.199                | 1.000              |
|                                   | <b>UMTS</b>      | 1850 -1910    | 24.0                    | 0.251  | 3.0                  | 27.00        | 501.187  | 0.100                | 1.000              |
|                                   | <b>LTE</b>       | 704 -716      | 24.0                    | 0.3    | 6.0                  | 30.00        | 1000.000 | 0.199                | 0.469              |
|                                   | <b>LTE</b>       | 777 -787      | 24.0                    | 0.3    | 6.0                  | 30.00        | 1000.000 | 0.199                | 0.518              |
|                                   | <b>LTE</b>       | 824 -849      | 24.0                    | 0.3    | 3.0                  | 27.00        | 501.187  | 0.100                | 0.549              |
| <b>LTE</b>                        | 1710 -1755       | 24.0          | 0.3                     | 6.0    | 30.00                | 1000.000     | 0.199    | 1.000                |                    |
| <b>LTE</b>                        | 1850 -1910       | 24.0          | 0.3                     | 3.0    | 27.00                | 501.187      | 0.100    | 1.000                |                    |
| <b>LTE</b>                        | 1850 -1915       | 24.0          | 0.3                     | 3.0    | 27.00                | 501.187      | 0.100    | 1.000                |                    |
| <b>N6235 Module (Collocated)</b>  | <b>WLAN</b>      | 2400 -2483.5  | 16.9                    | 0.049  | 1.86                 | 18.76        | 75.162   | 0.015                | 1.000              |
|                                   | <b>WLAN</b>      | 5725 -5850    | 23.9                    | 0.246  | 1.82                 | 25.72        | 373.250  | 0.074                | 1.000              |
|                                   | <b>BT</b>        | 2400 -2483.5  | 6.8                     | 0.0048 | 2.6                  | 9.40         | 8.709    | 0.002                | 1.000              |



### Revision History

| Rev. | Issue Date | Revisions     | Effect Page | Revised By   |
|------|------------|---------------|-------------|--------------|
| 00   | 2014/04/18 | Initial Issue | ALL         | Gloria Chang |
| 01   | 2014/05/06 | Revised       | ALL         | Gloria Chang |



## **TEST RESULTS**

**No non-compliance noted.**

### **Calculation**

Given  $E = \frac{\sqrt{30 \times P \times G}}{d}$  &  $S = \frac{E^2}{377}$

Where  $E$  = Field strength in Volts / meter

$P$  = Power in Watts

$G$  = Numeric antenna gain

$d$  = Distance in meters

$S$  = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{377d^2}$$

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = d \text{ (m)} / 100$$

Yields

$$S = \frac{30 \times (P/1000) \times G}{377 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \text{Equation 1}$$

Where  $d$  = Distance in cm

$P$  = Power in mW

$G$  = Numeric antenna gain

$S$  = Power density in mW / cm<sup>2</sup>



**Maximum Permissible Exposure**

Substituting the MPE safe distance using  $d = 20$  cm into Equation 1:

$$S = 0.000199 \times P \times G$$

Where  $P =$  Power in mW

$G =$  Numeric antenna gain

$S =$  Power density in mW / cm<sup>2</sup>

**Test Result**

**Table 1: WLAN + BT Collocated MPE Calculation**

| WLAN Band (GHz) | WLAN Pd (mW/cm <sup>2</sup> ) | BT Pd (mW/cm <sup>2</sup> ) | WLAN + BT Pd (mW/cm <sup>2</sup> ) | Limit |
|-----------------|-------------------------------|-----------------------------|------------------------------------|-------|
| 2.3 - 2.4       | 0.074                         | 0.002                       | 0.076                              | 1.000 |
| 2.4 - 2.5       |                               |                             |                                    |       |
| 2.5 - 2.7       |                               |                             |                                    |       |
| 3.3 - 3.8       |                               |                             |                                    |       |
| 5.725 - 5.85    |                               |                             |                                    |       |

**Table 2: WWAN 850MHz + WLAN + BT Collocated MPE Calculation**

| WLAN Band (GHz) | WLAN + BT Pd (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) | (WLAN + BT Pd) / (MPE Limit) | 850 MHz WWAN Pd (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) | (WWAN 850 MHz) / MPE Limit | (850 MHz WWAN + WLAN + BT fraction) | Limit |
|-----------------|------------------------------------|-------------------------------------|------------------------------|---------------------------------------|-------------------------------------|----------------------------|-------------------------------------|-------|
| 2.3 - 2.4       | 0.076                              | 1.000                               | 0.076                        | 0.198                                 | 0.549                               | 0.360                      | 0.436                               | 1.000 |
| 2.4 - 2.5       |                                    |                                     |                              |                                       |                                     |                            |                                     |       |
| 2.5 - 2.7       |                                    |                                     |                              |                                       |                                     |                            |                                     |       |
| 3.3 - 3.8       |                                    |                                     |                              |                                       |                                     |                            |                                     |       |
| 5.725 - 5.85    |                                    |                                     |                              |                                       |                                     |                            |                                     |       |



**Table 3: WWAN 1900MHz + WLAN + BT Collocated MPE Calculation**

| WLAN Band (GHz) | WLAN + BT Pd (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) | (WLAN + BT Pd) / (MPE Limit) | 1900 MHz WWAN Pd (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) | (WWAN 1900 MHz) / MPE Limit | (1900 MHz WWAN + WLAN + BT fraction) | Limit |
|-----------------|------------------------------------|-------------------------------------|------------------------------|--|-------------------------------------|-----------------------------|--------------------------------------|-------|
| 2.3 - 2.4       | 0.076                              | 1.000                               | 0.076                        | 0.126                                  | 1.000                               | 0.126                       | 0.202                                | 1.000 |
| 2.4 - 2.5       |                                    |                                     |                              |  |                                     |                             |                                      |       |
| 2.5 - 2.7       |                                    |                                     |                              |  |                                     |                             |                                      |       |
| 3.3 - 3.8       |                                    |                                     |                              |  |                                     |                             |                                      |       |
| 5.725 - 5.85    |                                    |                                     |                              |  |                                     |                             |                                      |       |

**Table 4: WWAN 700MHz + WLAN + BT Collocated MPE Calculation**

| WLAN Band (GHz) | WLAN + BT Pd (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) | (WLAN + BT Pd) / (MPE Limit) | 700 MHz WWAN Pd (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) | (WWAN 700 MHz) / MPE Limit | (700 MHz WWAN + WLAN + BT fraction) | Limit |
|-----------------|------------------------------------|-------------------------------------|------------------------------|---------------------------------------|-------------------------------------|----------------------------|-------------------------------------|-------|
| 2.3 - 2.4       | 0.076                              | 1.000                               | 0.076                        | 0.199                                 | 0.469                               | 0.424                      | 0.500                               | 1.000 |
| 2.4 - 2.5       |                                    |                                     |                              |                                       |                                     |                            |                                     |       |
| 2.5 - 2.7       |                                    |                                     |                              |                                       |                                     |                            |                                     |       |
| 3.3 - 3.8       |                                    |                                     |                              |                                       |                                     |                            |                                     |       |
| 5.725 - 5.85    |                                    |                                     |                              |                                       |                                     |                            |                                     |       |



**Table 5: WWAN 1700MHz + WLAN + BT Collocated MPE Calculation**

| WLAN Band (GHz) | WLAN + BT Pd (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) | (WLAN + BT Pd) / (MPE Limit) | 1700 MHz WWAN Pd (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) | (WWAN 1700 MHz) / MPE Limit | (1700 MHz WWAN + WLAN + BT fraction) | Limit |
|-----------------|------------------------------------|-------------------------------------|------------------------------|--|-------------------------------------|-----------------------------|--------------------------------------|-------|
| 2.3 - 2.4       | 0.076                              | 1.000                               | 0.076                        | 0.199                                  | 1.000                               | 0.199                       | 0.275                                | 1.000 |
| 2.4 - 2.5       |                                    |                                     |                              |  |                                     |                             |                                      |       |
| 2.5 - 2.7       |                                    |                                     |                              |  |                                     |                             |                                      |       |
| 3.3 - 3.8       |                                    |                                     |                              |  |                                     |                             |                                      |       |
| 5.725 - 5.85    |                                    |                                     |                              |  |                                     |                             |                                      |       |