# 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

| | |
|---|---|
| **EUT** | LTE miniCard |
| **Model** | LM177 |
| **Frequency band (Operating)** | ☒ LTE Band IV: 1710.0MHz ~ 1755.0MHz<br>☒ LTE Band XIII: 704.0MHz ~ 716.0MHz<br>☐ Others |
| **Device category** | ☐ Portable (<20cm separation)<br>☒ Mobile (>20cm separation)<br>☐ Others |
| **Exposure classification** | ☐ Occupational/Controlled exposure (S = 5mW/cm$^2$)<br>☒ General Population/Uncontrolled exposure (S=1mW/cm$^2$) |
| **Antenna Specification** | Antenna Gain (LTE Band IV):  5.86 dBi    (Numeric gain: 3.85)<br>Antenna Gain (LTE Band XIII): 3.82 dBi    (Numeric gain: 2.41) |
| **Measurement Average output power** | <table><tr><th>System</th><th>Power</th><th></th></tr><tr><td>LTE Band IV</td><td>23.93 dBm</td><td>(247.17 mW)</td></tr><tr><td>LTE Band XIII</td><td>23.85 dBm</td><td>(242.66 mW)</td></tr></table> |
| **Power Target / Tolerance** | <table><tr><th>System</th><th>Target Power</th><th>Tolerance</th></tr><tr><td>LTE Band IV</td><td>23.0 dBm</td><td>± 2 dB</td></tr><tr><td>LTE Band XIII</td><td>23.0 dBm</td><td>± 2 dB</td></tr></table> |
| **Max tune up Power / Max time Average Power** | <table><tr><th>System</th><th>Max Tune up Power</th><th>Time Average Power</th></tr><tr><td>LTE Band IV</td><td>25.0dBm (316.228mW)</td><td>25.0dBm (316.228mW)</td></tr><tr><td>LTE Band XIII</td><td>25.0dBm (316.228mW)</td><td>25.0dBm (316.228mW)</td></tr></table> |
| **Evaluation applied** | ☒ MPE Evaluation*<br>☐ SAR Evaluation<br>☐ N/A |

## Revision History

| Rev. | Issue   Date | Revisions | Effect Page | Revised By |
|------|-----------|-----------|-------------|------------|
| 00 | 2014/04/22 | Initial Issue | ALL | Scott Hsu |

Page 2

Rev.00

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## TEST RESULTS

## No non-compliance noted.

### Calculation

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

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:

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

Changing to units of mW and cm, using:

*P (mW) = P (W) / 1000 and*

*d (cm) = d(m) / 100*

Yields

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

Where   *d = Distance in cm*
*P = Power in mW*
*G = Numeric antenna gain*
*S = Power density in mW / cm$^2$*

## 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$^2$*

### LTE Band IV mode:

| Ch. | Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm$^2$ | Limit (mW/cm$^2$) |
|---|---|---|---|---|---|---|
| 19975 | 1712.5 | 316.228 | 3.85 | 20 | 0.2423 | 1.000 |

### LTE Band XIII mode:

| Ch. | Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm$^2$ | Limit (mW/cm$^2$) |
|---|---|---|---|---|---|---|
| 23255 | 784.5 | 316.228 | 2.41 | 20 | 0.1517 | 0.523 |

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