



## 12. Radio Frequency Exposure

### 12.1. Applicable Standards

| <div>□</div> <div>§1.1307(b)(3)(i)(A)</div>   | <div>The available maximum time-averaged power is no more than 1 mW, regardless of separation distance.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                    |   |                    |                 |  |               |           |  |           |                    |  |                    |   |     |   |      |       |   |        |             |      |   |    |        |   |       |                 |    |   |     |       |   |        |            |     |   |       |        |   |         |               |       |   |         |         |   |        |           |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------|---|--------------------|-----------------|--|---------------|-----------|--|-----------|--------------------|--|--------------------|---|-----|---|------|-------|---|--------|-------------|------|---|----|--------|---|-------|-----------------|----|---|-----|-------|---|--------|------------|-----|---|-------|--------|---|---------|---------------|-------|---|---------|---------|---|--------|-----------|
| <div>□</div> <div>§1.1307(b)(3)(i)(c)</div>   | <div>ERP is below a threshold calculated based on the distance, R between the person and the antenna / radiating structure, where <math>R &gt; \lambda / 2 \pi</math>.</div> <div>TABLE B.1—THRESHOLDS FOR SINGLE RF SOURCES<br/>SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION</div> <table><tr><th colspan="3">RF Source Frequency</th><th colspan="3">Minimum Distance</th><th>Threshold ERP</th></tr><tr><td><math>f_L</math> MHz</td><td></td><td><math>f_H</math> MHz</td><td><math>\lambda_L / 2\pi</math></td><td></td><td><math>\lambda_H / 2\pi</math></td><td>W</td></tr><tr><td>0.3</td><td>–</td><td>1.34</td><td>159 m</td><td>–</td><td>35.6 m</td><td><math>1,920 R^2</math></td></tr><tr><td>1.34</td><td>–</td><td>30</td><td>35.6 m</td><td>–</td><td>1.6 m</td><td><math>3,450 R^2/f^2</math></td></tr><tr><td>30</td><td>–</td><td>300</td><td>1.6 m</td><td>–</td><td>159 mm</td><td><math>3.83 R^2</math></td></tr><tr><td>300</td><td>–</td><td>1,500</td><td>159 mm</td><td>–</td><td>31.8 mm</td><td><math>0.0128 R^2f</math></td></tr><tr><td>1,500</td><td>–</td><td>100,000</td><td>31.8 mm</td><td>–</td><td>0.5 mm</td><td><math>19.2R^2</math></td></tr></table> <div>Subscripts L and H are low and high; <math>\lambda</math> is wavelength.<br/>From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.</div> | RF Source Frequency |                    |   | Minimum Distance   |                 |  | Threshold ERP | $f_L$ MHz |  | $f_H$ MHz | $\lambda_L / 2\pi$ |  | $\lambda_H / 2\pi$ | W | 0.3 | – | 1.34 | 159 m | – | 35.6 m | $1,920 R^2$ | 1.34 | – | 30 | 35.6 m | – | 1.6 m | $3,450 R^2/f^2$ | 30 | – | 300 | 1.6 m | – | 159 mm | $3.83 R^2$ | 300 | – | 1,500 | 159 mm | – | 31.8 mm | $0.0128 R^2f$ | 1,500 | – | 100,000 | 31.8 mm | – | 0.5 mm | $19.2R^2$ |
| RF Source Frequency                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     | Minimum Distance   |   |                    | Threshold ERP   |  |               |           |  |           |                    |  |                    |   |     |   |      |       |   |        |             |      |   |    |        |   |       |                 |    |   |     |       |   |        |            |     |   |       |        |   |         |               |       |   |         |         |   |        |           |
| $f_L$ MHz                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | $f_H$ MHz           | $\lambda_L / 2\pi$ |   | $\lambda_H / 2\pi$ | W               |  |               |           |  |           |                    |  |                    |   |     |   |      |       |   |        |             |      |   |    |        |   |       |                 |    |   |     |       |   |        |            |     |   |       |        |   |         |               |       |   |         |         |   |        |           |
| 0.3                                           | –                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1.34                | 159 m              | – | 35.6 m             | $1,920 R^2$     |  |               |           |  |           |                    |  |                    |   |     |   |      |       |   |        |             |      |   |    |        |   |       |                 |    |   |     |       |   |        |            |     |   |       |        |   |         |               |       |   |         |         |   |        |           |
| 1.34                                          | –                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 30                  | 35.6 m             | – | 1.6 m              | $3,450 R^2/f^2$ |  |               |           |  |           |                    |  |                    |   |     |   |      |       |   |        |             |      |   |    |        |   |       |                 |    |   |     |       |   |        |            |     |   |       |        |   |         |               |       |   |         |         |   |        |           |
| 30                                            | –                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 300                 | 1.6 m              | – | 159 mm             | $3.83 R^2$      |  |               |           |  |           |                    |  |                    |   |     |   |      |       |   |        |             |      |   |    |        |   |       |                 |    |   |     |       |   |        |            |     |   |       |        |   |         |               |       |   |         |         |   |        |           |
| 300                                           | –                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1,500               | 159 mm             | – | 31.8 mm            | $0.0128 R^2f$   |  |               |           |  |           |                    |  |                    |   |     |   |      |       |   |        |             |      |   |    |        |   |       |                 |    |   |     |       |   |        |            |     |   |       |        |   |         |               |       |   |         |         |   |        |           |
| 1,500                                         | –                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 100,000             | 31.8 mm            | – | 0.5 mm             | $19.2R^2$       |  |               |           |  |           |                    |  |                    |   |     |   |      |       |   |        |             |      |   |    |        |   |       |                 |    |   |     |       |   |        |            |     |   |       |        |   |         |               |       |   |         |         |   |        |           |
| <div>☒</div> <div>§ 1.1307(b)(3)(i)(B).</div> | <div>Device operates between 300 MHz and 6 GHz and the maximum time-averaged power or effective radiated power (ERP), whichever is greater, <math>\leq P_{th}</math></div> <div><math display="block">P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x &amp; d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} &amp; 20 \text{ cm} &lt; d \leq 40 \text{ cm} \end{cases}</math></div> <div>Where</div> <div><math display="block">x = -\log_{10} \left( \frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}</math></div> <div>and</div> <div><math display="block">ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f &amp; 0.3 \text{ GHz} \leq f &lt; 1.5 \text{ GHz} \\ 3060 &amp; 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}</math></div> <div><math>d</math> = the separation distance (cm);</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                    |   |                    |                 |  |               |           |  |           |                    |  |                    |   |     |   |      |       |   |        |             |      |   |    |        |   |       |                 |    |   |     |       |   |        |            |     |   |       |        |   |         |               |       |   |         |         |   |        |           |



## 12.2. EUT Specification

|                                                                                                                               |                                                                                                                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Frequency band (Operating)</b>                                                                                             | Cat M1: 814.7~823.3MHz<br>NB-IoT: 814.2~823.8MHz                                                                                                                                                                               |
| <b>Device category</b>                                                                                                        | <input type="checkbox"/> Portable (<20cm separation)<br><input checked="" type="checkbox"/> Mobile (>20cm separation)                                                                                                          |
| <b>Antenna diversity</b>                                                                                                      | <input checked="" type="checkbox"/> Single antenna<br><input type="checkbox"/> Multiple antennas<br><input type="checkbox"/> Tx diversity<br><input type="checkbox"/> Rx diversity<br><input type="checkbox"/> Tx/Rx diversity |
| <b>Evaluation applied</b>                                                                                                     | <input type="checkbox"/> Blanket 1 mW Blanket Exemption<br><input checked="" type="checkbox"/> MPE-based Exemption<br><input type="checkbox"/> SAR-based Exemption                                                             |
| <b>Remark:</b><br>The maximum conducted output power is <u>21.13dBm</u> at <u>819MHz</u> (with <u>-1.51dBi</u> antenna gain.) |                                                                                                                                                                                                                                |

## 12.3. Results

### Cat M1

| Channel Frequency (MHz) | Max. Conducted output power(dBm) | Max. Tune up power (dBm) | Antenna Gain(dBi) | Max.Tune up e.r.p. Power (dBm) | Max. Tune up e.r.p power (mW) | Limit (mW) |
|-------------------------|----------------------------------|--------------------------|-------------------|--------------------------------|-------------------------------|------------|
| 819                     | 19.85                            | 20.35                    | -1.51             | 16.69                          | 46.67                         | 3060       |

### NB-IoT

| Channel Frequency (MHz) | Max. Conducted output power(dBm) | Max. Tune up power (dBm) | Antenna Gain(dBi) | Max.Tune up e.r.p. Power (dBm) | Max. Tune up e.r.p power (mW) | Limit (mW) |
|-------------------------|----------------------------------|--------------------------|-------------------|--------------------------------|-------------------------------|------------|
| 819                     | 21.13                            | 21.63                    | -1.51             | 17.97                          | 62.66                         | 3060       |

No non-compliance noted.

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