

**RF EXPOSURE ASSESSMENT FOR MBO B2/B66/WIFI/BT****Section 1.1307 (b) Environmental Assessment Requirement for Equipment Authorization**

Commission actions granting construction permits, licenses to transmit or renewals thereof, equipment authorizations or modifications in existing facilities, require the preparation of an Environmental Assessment (EA) if the particular facility, operation or transmitter would cause human exposure to levels of radiofrequency radiation in excess of the limits in §§ 1.1310 and 2.1093 of this chapter.

**Section 1.1310 Radio Frequency Radiation Exposure Limits**

The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of § 2.1093 of this chapter. Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation."

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**Section 15.247(i) RF Exposure Requirement for 2.4GHz DTS (Digital Transmission System) Unlicensed Transmitter Operating in 2400-2483.5MHz Band**

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.

**Section 15.407(f) RF Exposure Requirement for 5GHz UNII (National Information Infrastructure) Unlicensed Transmitter Operating in the 5.15-5.35 GHz, 5.47-5.725 GHz and 5.725-5.85 GHz bands**

U-NII devices are subject to the radio frequency radiation exposure requirements specified in 1.1307(b), 2.1091 and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

**Response**

The Nokia Flexi Zone Multiband Outdoor Micro Base Station (MBO) is typically installed on poles or walls in fixed locations. Therefore, MBO is neither a portable nor a mobile wireless device. The maximum configuration of the MBO B2/B66/WiFi consists of four RF transceiver modules: MBO B2 FW2FMBOM1 (1.9GHz), MBO B66 FW2IMBOM1 (2.1GHz), WiFi AP FZCWMBO1 (2.4GHz and 5GHz) and Bluetooth NBTM01 (2.4GHz).

The MBO BTS can have either directly-connected omnidirectional stick antennas supplied by Nokia or customer-supplied remote antennas. In this evaluation, only Nokia supplied antennas were evaluated. The customers will be responsible for the RF exposure compliance with installing customer-supplied antennas.

The information on Nokia supplied antennas is provided in Table 13.1.

The limits specified in FCC Section 1.1310 Table 1(B) for occupational/controlled exposure and general population/uncontrolled exposure, which are tabulated below in Table 13.2, shall be met.

**Table 13.1 MBO B2/B66/WiFi Antennas**

| Antenna        | Model                          | Antenna Gain (dBi)  |
|----------------|--------------------------------|---|
| Omni LTE       | FA2EA (473120A) & 1.7-2.2GHz   | Peak: <b>5</b> ; (Typ: 3.5, Min: 2)   |
| Omni WiFi*     | FAWH (473171A) DB              | WiFi @2.4GHz: Peak: 4 (Typ: 3.5; Min: 3)<br>WiFi @5GHz: Peak: <b>7</b> (Typ: 6; Min: 5.5) |
|                | FA2NA (473720A) 2.3-2.7 GHz DP | Peak: <b>4.5</b> (Typ: 3.5; Min: 1.5)   |
| Omni BlueTooth | External Dipole 2.4-2.5 GHz    | Peak: 0   |

\*Its gain numbers include the cable losses associated with the FWME mounting bracket that is used with the MBO to mount the FAWH antennas.

**Table 13.2 Limits for Occupational/Controlled Exposure and General Population/Uncontrolled Exposure (FCC Section 1.1310 Table 1(B))**

| Frequency Range (MHz)                                   | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/cm <sup>2</sup> ) | Average Time  E  <sup>2</sup> ,  H  <sup>2</sup> or S (minutes) |
|---|-----------------------------------|-----------------------------------|---|---|
| (A) Limits for Occupational/Controlled Exposure         |                                   |                                   |   |   |
| 300 - 1500  |                                   |                                   | F/300                                   | 6   |
| 1500 - 100,000  |                                   |                                   | 5.0                                     | 6   |
| (B) Limits for General Population/Uncontrolled Exposure |                                   |                                   |   |   |
| 300 - 1500  |                                   |                                   | F/1500                                  | 30  |
| 1500 - 100,000  |                                   |                                   | 1.0                                     | 30  |

Note: f = frequency in MHz; \*Plane-wave equivalent power density.

All of the transmitters installed in MBO BTS operate in the frequency range of 1.9GHz - 5GHz. The maximum power density thus needs to be less than 1.0 mW/cm<sup>2</sup> for general population/uncontrolled environment and 5.0 mW/cm<sup>2</sup> for occupational/controlled environment.

Per FCC's OST/OET Bulletin Number 65, the appropriate EIRP (equivalent or effective isotropically radiated power) limits can be calculated based on the relationship between power density and EIRP, i.e.,

$$S = \frac{EIRP}{4\pi R^2}, \quad (1)$$

where S is the power density in mW/cm<sup>2</sup>, R is the distance to the center of radiation of the antenna in cm and EIRP is in mW.

When all transmitters operate simultaneously, the EIRP and thus power density from all transmitters gives the worst-case scenario.

The maximum conducted output power for WiFi AP module FZCWMBO1 was obtained from its FCC/IC certification under FCC ID: 2AD8UFZCWMBO1 and IC ID: 109D-FZCWMBO1. The maximum conducted output power for Bluetooth module NBTM01 was obtained from its FCC certification under FCC ID: 2AD8UNBTM01. The minimum RF safety distances were calculated for individual RF module and for the entire base station, where it is assumed that the RF carriers in B2 and B66 licensed bands, and 2.4GHz and 5GHz unlicensed bands can operate simultaneously at their maximum rated power.

**Table 13.3 (a) Minimum RF Safety Distances for Uncontrolled Exposure for MBO B2/B66**

| Module                                   | Freq Band (GHz) | Maxi Total P <sub>out</sub> (2x2) (dBm) | Antenna Gain (dBi) | Maximum Total EIRP (dBm) | Maximum Total EIRP (mW) | Limit of Power Density S (mW/cm <sup>2</sup> ) | RF Safety Distance (cm) |
|--|-----------------|---|--------------------|--------------------------|-------------------------|--|-------------------------|
| MBO B2                                   | 1.9             | 40                                      | 5                  | 45                       | 31622.78                | 1  | 50.2                    |
| MBO B66                                  | 2.1             | 40                                      | 5                  | 45                       | 31622.78                | 1  | 50.2                    |
| <b>Total (Simultaneous-Transmission)</b> |                 |   |                    | <b>63245.55</b>          | <b>1</b>                | <b>70.9</b>                                    |                         |

**Table 13.3 (b) Minimum RF Safety Distances for Uncontrolled Exposure for MBO B2/B66/WiFi/BT**

| Module                                   | Freq Band (GHz) | Maxi Total P <sub>out</sub> (2x2) (dBm) | Antenna Gain (dBi) | Maximum Total EIRP (dBm) | Maximum Total EIRP (mW) | Limit of Power Density S (mW/cm <sup>2</sup> ) | RF Safety Distance (cm) |
|--|-----------------|---|--------------------|--------------------------|-------------------------|--|-------------------------|
| MBO B2                                   | 1.9             | 40                                      | 5                  | 45                       | 31622.78                | 1  | 50.2                    |
| MBO B66                                  | 2.1             | 40                                      | 5                  | 45                       | 31622.78                | 1  | 50.2                    |
| WiFi AP                                  | 2.4             | 28.2                                    | 4.5                | 32.7                     | 1862.09                 | 1  | 12.2                    |
| WiFi AP                                  | 5               | 27.5                                    | 7                  | 34.5                     | 2818.38                 | 1  | 15.0                    |
| BlueTooth                                | 2.4             | 9.6                                     | 0                  | 9.6                      | 9.099                   | 1  | 0.9                     |
| <b>Total (Simultaneous-Transmission)</b> |                 |   |                    | <b>67,935.12</b>         | <b>1</b>                | <b>73.5</b>                                    |                         |

**Table 13.3 (c) Power Density at the Proposed RF Safety Distance for MBO B2/B66**

| Module                                   | Freq Band (GHz) | Maxi Total P <sub>out</sub> (2x2) (dBm) | Maxi Antenna Gain (dBi) | Maximum Total EIRP (dBm) | Maximum Total EIRP (mW) | RF Safety Distance (cm) | Power Density S (mW/cm <sup>2</sup> ) |
|--|-----------------|---|-------------------------|--------------------------|-------------------------|-------------------------|---------------------------------------|
| MBO B2                                   | 1.9             | 40                                      | 5                       | 45                       | 31622.78                | 75                      | 0.4474                                |
| MBO B66                                  | 2.1             | 40                                      | 5                       | 45                       | 31622.78                | 75                      | 0.4474                                |
| <b>Total (Simultaneous-Transmission)</b> |                 |   |                         | <b>63245.55</b>          | <b>75</b>               | <b>0.8947</b>           |                                       |

**Table 13.3 (d) Power Density at the Proposed RF Safety Distance for MBO B2/B66/WiFi/BT**

| Module                                   | Freq Band (GHz) | Maxi Total P <sub>out</sub> (2x2) (dBm) | Maxi Antenna Gain (dBi) | Maximum Total EIRP (dBm) | Maximum Total EIRP (mW) | RF Safety Distance (cm) | Limit of Power Density S (mW/cm <sup>2</sup> ) |
|--|-----------------|---|-------------------------|--------------------------|-------------------------|-------------------------|--|
| MBO B2                                   | 1.9             | 40                                      | 5                       | 45                       | 31622.78                | 75                      | 0.4474   |
| MBO B66                                  | 2.1             | 40                                      | 5                       | 45                       | 31622.78                | 75                      | 0.4474   |
| WiFi AP                                  | 2.4             | 28.2                                    | 4.5                     | 32.7                     | 1862.09                 | 75                      | 0.0263   |
| WiFi AP                                  | 5               | 27.5                                    | 7                       | 34.5                     | 2818.38                 | 75                      | 0.0399   |
| BlueTooth                                | 2.4             | 9.6                                     | 0                       | 9.6                      | 9.099                   | 75                      | 0.0001   |
| <b>Total (Simultaneous-Transmission)</b> |                 |   |                         | <b>67,935.12</b>         | <b>75</b>               | <b>0.9611</b>           |  |

**Table 13.4 (a) Minimum RF Safety Distances for Controlled Exposure for MBO B2/B66**

| Module                                   | Freq Band (GHz) | Maxi Total P <sub>out</sub> (2x2) (dBm) | Antenna Gain | Maximum Total EIRP (dBm) | Maximum Total EIRP (mW) | Limit of Power Density S (mW/cm <sup>2</sup> ) | RF Safety Distance (cm) |
|--|-----------------|---|--------------|--------------------------|-------------------------|--|-------------------------|
| MBO B2                                   | 1.9             | 40                                      | 5            | 45                       | 31622.78                | 5  | 22.4                    |
| MBO B66                                  | 2.1             | 40                                      | 5            | 45                       | 31622.78                | 5  | 22.4                    |
| <b>Total (Simultaneous-Transmission)</b> |                 |   |              |                          | <b>63245.55</b>         | <b>5</b>                                       | <b>31.7</b>             |

**Table 13.4 (b) Minimum RF Safety Distances for Controlled Exposure for MBO B2/B66/WiFi/BT**

| Module                                   | Freq Band (GHz) | Maxi Total P <sub>out</sub> (2x2) (dBm) | Antenna Gain | Maximum Total EIRP (dBm) | Maximum Total EIRP (mW) | Limit of Power Density S (mW/cm <sup>2</sup> ) | RF Safety Distance (cm) |
|--|-----------------|---|--------------|--------------------------|-------------------------|--|-------------------------|
| MBO B2                                   | 1.9             | 40                                      | 5            | 45                       | 31622.78                | 5  | 22.4                    |
| MBO B66                                  | 2.1             | 40                                      | 5            | 45                       | 31622.78                | 5  | 22.4                    |
| WiFi AP                                  | 2.4             | 28.2                                    | 4.5          | 32.7                     | 1862.09                 | 5  | 5.4                     |
| WiFi AP                                  | 5               | 27.5                                    | 7            | 34.5                     | 2818.38                 | 5  | 6.7                     |
| BlueTooth                                | 2.4             | 9.6                                     | 0            | 9.6                      | 9.099                   | 5  | 0.4                     |
| <b>Total (Simultaneous-Transmission)</b> |                 |   |              |                          | <b>67,935.12</b>        | <b>5</b>                                       | <b>32.9</b>             |

**Table 13.4 (c) Power Density at the Proposed RF Safety Distance for MBO B2/B66**

| Module                                   | Freq Band (GHz) | Maxi Total P <sub>out</sub> (2x2) (dBm) | Antenna Gain (dBi) | Maximum Total EIRP (dBm) | Maximum Total EIRP (mW) | RF Safety Distance (cm) | Limit of Power Density S (mW/cm <sup>2</sup> ) |
|--|-----------------|---|--------------------|--------------------------|-------------------------|-------------------------|--|
| MBO B2                                   | 1.9             | 40                                      | 5                  | 45                       | 31622.78                | 35                      | 2.0542   |
| MBO B66                                  | 2.1             | 40                                      | 5                  | 45                       | 31622.78                | 35                      | 2.0542   |
| <b>Total (Simultaneous-Transmission)</b> |                 |   |                    |                          | <b>63245.55</b>         | <b>35</b>               | <b>4.1085</b>                                  |

**Table 13.4 (d) Power Density at the Proposed RF Safety Distance for MBO B2/B66/WiFi/BT**

| Module                                   | Freq Band (GHz) | Maxi Total P <sub>out</sub> (2x2) (dBm) | Antenna Gain (dBi) | Maximum Total EIRP (dBm) | Maximum Total EIRP (mW) | RF Safety Distance (cm) | Limit of Power Density S (mW/cm <sup>2</sup> ) |
|--|-----------------|---|--------------------|--------------------------|-------------------------|-------------------------|--|
| MBO B2                                   | 1.9             | 40                                      | 5                  | 45                       | 31622.78                | 35                      | 2.0542   |
| MBO B66                                  | 2.1             | 40                                      | 5                  | 45                       | 31622.78                | 35                      | 2.0542   |
| WiFi AP                                  | 2.4             | 28.2                                    | 4.5                | 32.7                     | 1862.09                 | 35                      | 0.1210   |
| WiFi AP                                  | 5               | 27.5                                    | 7                  | 34.5                     | 2818.38                 | 35                      | 0.1831   |
| BlueTooth                                | 2.4             | 9.6                                     | 0                  | 9.6                      | 9.099                   | 35                      | 0.0006   |
| <b>Total (Simultaneous-Transmission)</b> |                 |   |                    |                          | <b>67,935.12</b>        | <b>35</b>               | <b>4.4131</b>                                  |

Therefore, the RF safety distance for the Nokia Flexi Zone MBO Base Station under simultaneous-transmission conditions shall be larger than 35 cm for occupational/controlled exposure and larger than 75 cm for general population/uncontrolled exposure for either MBO B2/B66 or MBO B2/B66/WiFi/BT configurations.

**Results**

The results are summarized below in Tables 13.5 and 13.6.

**Table 13.5 Proposed Minimum RF Safety Distances for MBO B2/B66**

| Exposure                        | RF Safety Distance (cm) | Total Power Density S (mW/cm <sup>2</sup> ) | Limit of Power Density S (mW/cm <sup>2</sup> ) |
|---------------------------------|-------------------------|---|--|
| Occupational/Controlled         | 35                      | 4.1085                                      | 5  |
| General Population/Uncontrolled | 75                      | 0.8947                                      | 1  |

**Table 13.6 Proposed Minimum RF Safety Distances for MBO B2/B66/WiFi/BT**

| Exposure                        | RF Safety Distance (cm) | Total Power Density S (mW/cm <sup>2</sup> ) | Limit of Power Density S (mW/cm <sup>2</sup> ) |
|---------------------------------|-------------------------|---|--|
| Occupational/Controlled         | 35                      | 4.4131                                      | 5  |
| General Population/Uncontrolled | 75                      | 0.9611                                      | 1  |