



Bell Labs

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# **RF Exposure Assessment Report**

**(FCC ID: 2AD8UFW2RMBOM1)**

Regulation

**47 CFR FCC Sections 1.1307 and 1.1310**

Client

**Nokia Solutions and Networks Oy**

Product Evaluated

**Nokia Flexi Zone Multiband Outdoor Micro BTS (MBO)  
FW2RMOM1 LAA RF Module Operating in Band 46 UNII-3**

**GPCL Report Number**

TR2019-0029 MBO LAA FCC MPE

**GPCL Project Number**

2019-0029

**Date Issued**

February 13, 2019

## TABLE OF CONTENTS

<b>1.</b>	<b>ATTESTATION OF TEST RESULTS</b>	<b>4</b>
<b>2.</b>	<b>SUMMARY OF THE TEST RESULTS</b>	<b>4</b>
<b>3.</b>	<b>GENERAL INFORMATION</b>	<b>4</b>
3.1	<i>Product Descriptions</i>	
3.2	<i>Antenna Information</i>	
<b>4.</b>	<b>REQUIRED EVALUATION AND RESULTS</b>	<b>6</b>
4.1	<i>Regulatory Requirements</i>	
4.2	<i>RF Exposure Assessment</i>	
<b>5.</b>	<b>REFERENCES</b>	<b>9</b>

### Revisions


Date	Revision	Section	Change


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*The results documented in this report refer exclusively to the product specified, under the conditions and modes of operation as described herein.*

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## 1. ATTESTATION OF TEST RESULTS

<b>Company Name (Manufacturer)</b>	Nokia Solutions and Network, OY 2000 W. Lucent Lane Naperville, IL 60563
<b>FCC ID</b>	2AD8UFW2MBOM2
<b>Product Name</b>	Flexi Zone Multiband Outdoor Micro BTS (MBO) FW2RMBOM1 LAA RF Module
<b>Model Name(s)</b>	MBO LAA: FW2RMBOM1
<b>Test Requirement(s)</b>	47 CFR FCC Sections 15.407, 1.1307 and 1.1310
<b>Other Reference(s)</b>	FCC OET Bulletin 65, KDB 447498 D01
<b>Frequency Band</b>	E-UTRAN Band 46: 5735-5835 MHz (UNII-3)
<b>Test Report Number</b>	TR2019-0029 MBO LAA FCC MPE
<b>Test Laboratory</b>	Global Product Compliance Laboratory 600-700 Mountain Avenue Room 5B-108 Murray Hill, New Jersey 07974-0636 USA

The above product has been evaluated and found to be in compliance with the Commission's Rules and Regulations set forth in the above standards. The data and the descriptions about the test setup, procedures and configuration presented in this report are accurate.

## 2. SUMMARY OF THE TEST RESULTS

<b>Applied Standard(s): FCC 1.1310</b>		
<b>MBO Configuration</b>	<b>Exposure Environment</b>	<b>Proposed RF Safety Distance (cm)</b>
Equipped with either omni-direc antennas or directional antennas provided	General Population/Uncontrolled*	20

\*FCC Section 15.407(f) specified all UNII devices shall be considered to operate in a "general population/uncontrolled" environment.

### 3. GENERAL INFORMATION

#### 3.1 Product Descriptions

The Nokia Flexi Zone Multiband Outdoor Micro Base Station (MBO) is a small cell that consists of a common digital system module, up to two LTE (Long Term Evolution) RF transceivers in various combinations and optional WiFi AP (Access Point) and Bluetooth (BT) RF transceivers. Each RF transceiver supports 2 Tx/Rx. MBO digital system module supplies baseband signals, the baseband processing, control and timing to the radios.

The FW2RMBOM1 B46 LAA RF Module (MBO LAA) is a LTE Transceiver supporting a carrier bandwidth of 20 MHz and a maximum RF power output capability of 0.5W at each of its 2 MIMO transmit port outputs in the E-UTRAN Band 46 UNII-3 spectrum: 5735-5835MHz.

This RF exposure assessment is on the FW2RMBOM1 B46 LAA RF Module equipped with omnidirectional and directional antennas, respectively. The RF exposure assessment on the configurations of MBO LAA co-located with other RF modules will be provided in a separate MPE (Maximum Permissible Exposure) report.

The FW2RMBOM1 B46 LAA RF Module can only be operated with the antenna with which it is authorized.

The MBO is typically installed on poles or walls in fixed locations. Therefore, MBO is neither a portable nor a mobile wireless device. The specification of MBO LAA in terms of frequency and maximum power are provided below:

**Table 3.1.1 Product Specifications on MBO LAA\***

Product	Model Name	Technologies	Tx Freq (MHz)	Total Output P <sup>Max</sup> (dBm rms)
LAA	FW2RMBOM1	LTE-TDD, 20/40MHz BW	5735-5835	30

\*Maximum Total Output Power has taken MIMO into consideration.

#### 3.2 Antenna Information

The information on the antennas to be used by EUT were given below:

**Table 3.2.1 Data of Recommended Omni-Directional LTE Antennas for FW2RMOM1 MBO LAA from Manufacturers**

Transmitters	Antenna	Model	Max Avg Ant Gain (dBi)
LAA	Omni-Direc	FA2RA FZ 473121A 5150 ~ 5850MHz	7.5
LAA	Omni-Direc	FA2RD FZ 474881A, 5150 ~ 5850MHz	10
LAA	Directional	FA2WA FZ 473461A, 5150 ~ 5925	6

## 4. REQUIRED EVALUATION AND RESULTS

### 4.1 Regulatory Requirements

The assessment in this report was performed for AZRB RRH Band 46 LAA, operating in 5GHz UNII-1 and UNII-3 bands.

The regulatory requirements for the RF exposure compliance of RF transceivers were specified in 47 CFR FCC Parts 15 and 1.

The FCC 15.407 and 1.1310 sets out the requirements and measurement techniques used to evaluate RF exposure compliance of radiocommunication apparatus:

#### I. FCC Section 15.407(f) RF Exposure Requirements

U-NII devices are subject to the radio frequency radiation exposure requirements specified in FCC Sections 1.1307(b), 2.1091 and 2.1093, as appropriate. *All equipment shall be considered to operate in a “general population/uncontrolled” environment.* Technical information showing the basis for this statement must be submitted to the Commission upon request.

#### II. FCC Section 1.1307(b) Evaluation 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 FCC Sections 1.1310 and 2.1093.

#### III. FCC Section 1.1310 Radio Frequency Radiation Exposure Limits

At operating frequencies less than or equal to 6 GHz, the limits for maximum permissible exposure (MPE), derived from whole-body SAR limits and listed in Table 1 of Section 1.1310, may be used instead of whole-body SAR limits to evaluate the environmental impact of human exposure to RF radiation as specified in Section 1.1307(b), except for portable devices as defined in § 2.1093 as these evaluations shall be performed according to the SAR provisions in Section 2.1093 of this chapter.

At operating frequencies above 6 GHz, the MPE limits shall be used in all cases to evaluate the environmental impact of human exposure to RF radiation as specified in Section 1.1307(b).

The MPE limits listed in Table 1 of Section 1.1310 are for continuous exposure, that is, for indefinite time periods. Exposure levels higher than the limits are permitted for shorter exposure times, as long as the average exposure over the specified averaging time in Table 1 is less than the limits. Detailed information regarding procedures for evaluating compliance with all of these exposure limits can be found in the FCC's OET Bulletin 65, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields,” and in supplements to Bulletin 65.

The exposure limits specified for occupational/controlled exposure and general population/uncontrolled exposure, which are tabulated below shall be met.

**Table 4.1.1 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.

## 4.2 RF Exposure Assessment

The regulatory requirements and limits were provided in Section 4.1. The product specifications on RF transceivers and antennas were provided in Section 3.

The limits at the operation frequencies of transmitters installed in AZRB Base Station were calculated and provided in Table 4.2.1.

**Table 4.2.1 Power Density Limits for Occupational/Controlled Exposure and General Population/Uncontrolled for MBO LAA**

Environment	Frequency Range (MHz)	Min Power Density (S) (mW/cm <sup>2</sup> )
Occupational/Controlled	5735-5835	5
General Population/Uncontrolled	5735-5835	1

Per IEEE C95.3 Annex B Equation (37) or FCC's OST/OET Bulletin Number 65, the appropriate safety distance can be calculated based on the relationship between power density limit and EIRP (equivalent or effective isotopically radiated power), 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 or channels operate simultaneously, the EIRP and thus power density from all transmitters gives the worst-case scenario.

The RF exposure assessment was conducted on the MBO LAA RF Module.

**Table 4.2.2(a) Power Density at the Proposed Minimum RF Safety Distance 20cm for Uncontrolled Exposure with Omni-Directional LTE Antennas**

Module	Maxi Total P <sub>out</sub> (dBm)	Max Avg Ant Gain (dBi)	Maxi Total EIRP (mW)	Power Density S (mW/cm <sup>2</sup> )	Limit of Power Density S (mW/cm <sup>2</sup> )	S/LPD
MBO LAA	26	10	3981.1	0.792	1	0.792
MBO LAA	28.5	7.5	3981.1	0.792	1	0.791

**Table 4.2.2(b) Power Density at the Minimum RF Safety Distance 20cm for Uncontrolled Exposure with Directional LTE Antennas**

Module	Maxi Total P <sub>out</sub> (dBm)	Max Avg Ant Gain (dBi)	Maxi Total EIRP (mW)	Power Density S (mW/cm <sup>2</sup> )	Limit of Power Density S (mW/cm <sup>2</sup> )	S/LPD
MBO LAA	30	6	3981.1	0.792	1	0.792

**Table 4.2.3(a) Power Density at the Proposed Minimum RF Safety Distance 20cm for Controlled Exposure with Omni-Directional LTE Antennas**

Module	Maxi Total P <sub>out</sub> (dBm)	Max Avg Ant Gain (dBi)	Maxi Total EIRP (mW)	Power Density S (mW/cm <sup>2</sup> )	Limit of Power Density S (mW/cm <sup>2</sup> )	S/LPD
MBO LAA	26	10	3981.1	0.792	5	0.158
MBO LAA	28.5	7.5	3981.1	0.792	5	0.158

**Table 4.2.3(b) Power Density at the Minimum RF Safety Distance 20cm for Controlled Exposure with Directional LTE Antennas**

Module	Maxi Total P <sub>out</sub> (dBm)	Max Avg Ant Gain (dBi)	Maxi Total EIRP (mW)	Power Density S (mW/cm <sup>2</sup> )	Limit of Power Density S (mW/cm <sup>2</sup> )	S/LPD
MBO LAA	30	6	3981.1	0.792	5	0.158

The maximum EIRP allowed is 36dBm.

**Table 4.2.4 Power Density at the 20cm RF Safety Distance**

Exposure Environment	Max EIRP (dBm)	Max EIRP (mW)	RF Safety Distance (cm)	Power Density S (mW/cm <sup>2</sup> )	Limit of Power Density S (mW/cm <sup>2</sup> )	S/LPD
Uncontrolled	36	3981.07	20	0.792	1	0.792
Controlled	36	3981.07	20	0.792	5	0.158

Therefore,



**Table 4.2.5 Proposed RF Safety Distances for MBO LAA Band 46**

<b>Exposure</b>	<b>RF Safety Distance (cm)</b>
General Population/Uncontrolled	20
Occupational/Controlled	20

Only the general population/uncontrolled exposure environment will be considered for UNII devices.

## **5. REFERENCES**

- [1]. Title 47 Code of Federal Regulations (CFR) Parts 1, 2 and 15.
- [2]. FCC OET Bulletin 65 and Supplements, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, August 1997
- [3]. KDB 447498 D01, RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices, Oct 2015, V06
- [4]. IEEE C95.3, IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to Such Fields, 100 kHz–300 GHz, 2002 (R2008).