



Bell Labs

Global Product Compliance Laboratory  
600-700 Mountain Avenue  
Room 5B-108  
Murray Hill, New Jersey 07974-0636 USA

# **RF Exposure Assessment Report**

**(FCC ID: 2AD8UAZRBRH1)**

Regulation

**47 CFR FCC Sections 1.1307 and 1.1310**

Client

**Nokia Solutions and Networks Oy**

Product Evaluated

**AZRB AirScale Micro RRH Band 46 LAA UNII 1&3**  
**(Add Omni-Directional Antenna FA2RA, C2PC)**

**GPCL Report Number**

TR2018-0163 FCC MPE

**GPCL Project Number**

2018-0163

**Date Issued**

August 30, 2018

## 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 |
|------|----------|---------|--------|
|      |          |         |        |
|      |          |         |        |
|      |          |         |        |
|      |          |         |        |
|      |          |         |        |
|      |          |         |        |
|      |          |         |        |
|      |          |         |        |

*This report is the property of the client. This report shall not be reproduced except in full without the written approval of the Nokia Global Product Compliance Laboratory.*

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

Prepared By:

Reviewed By:

Signed:



8/30/2018

Date

Qin Yu

GPCL Compliance Engineer

Signed:



8/30/2018

Date

R.J. Johnson

GPCL Technical Manager

## 1. ATTESTATION OF TEST RESULTS

|                                    |                                                                                                                          |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>Company Name (Manufacturer)</b> | Nokia Solutions and Network, OY<br>2000 W. Lucent Lane<br>Naperville, IL 60563                                           |
| <b>FCC ID</b>                      | 2AD8UAZRBRH1                                                                                                             |
| <b>Product Name</b>                | AZRB AirScale Micro RRH Band 46 LAA                                                                                      |
| <b>Model Name</b>                  | AZRB                                                                                                                     |
| <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>              | 5170-5250 MHz (UNII-1); 5735-5835 MHz (UNII-3)<br>E-UTRAN Band 46                                                        |
| <b>Test Report Number</b>          | TR2018-0163 FCC MPE                                                                                                      |
| <b>Test Laboratory</b>             | Global Product Compliance Laboratory<br>600-700 Mountain Avenue<br>Room 5B-108<br>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>AZRB Configuration</b>                                                      | <b>Exposure Environment</b>      | <b>Proposed RF Safety Distance (cm)</b> |
| AZRB 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. Therefore, the distance for Occupational/Controlled environment is not provided here.

### 3. GENERAL INFORMATION

#### 3.1 Product Descriptions

The Nokia AirScale Micro RRH is a new low power Remote Radio Head (RRH) (hereinafter referred to as “AZRB”) for operation under the regulations of FCC Title 47 Part 15 Subpart E, Unlicensed National Information Infrastructure (UNII) Devices, in the 5GHz Band 46.

Currently, the AZRB LAA LTE RRH supports LTE License Assisted Access (LAA) technology only and operates only in UNII-1 (5170-5250 MHz) and UNII-3 (5735-5835 MHz) unlicensed frequency spectrums. The AZRB consists of two transceiver chains (main and diversity) that are capable of transmitting up to three 20MHz LTE carriers with a maximum RF power of 0.5W at each of its two MIMO transmit ports.

The AZRB can have either omnidirectional or directional integrated antennas. The AZRB is typically installed on poles or walls in fixed locations. Therefore, AZRB is neither a portable nor a mobile wireless device. The specifications of AZRB with their antennas are provided below:

**Table 3.1.1 Product Specifications on AZRB LAA LTE RRH Band 46\***

| Product                                                                            | Technologies                       | Transmitting Frequency (MHz) | Max Total Rated Output Power (dBm rms) |
|------------------------------------------------------------------------------------|------------------------------------|------------------------------|----------------------------------------|
| AZRB with antennas with maximum gain less than 6dBi                                | LAA, 20/40/60MHz BW, Q16/64/256QAM | UNII-1 5170-5250             | 29.0                                   |
|                                                                                    |                                    | UNII-3 5.735-5835            | 30.0                                   |
| AZRB with antennas with maximum gain less than 6dBi in UNII-1 and 7.5dBi in UNII-3 | LAA, 20/40/60MHz BW, Q16/64/256QAM | UNII-1 5170-5250             | 29.0                                   |
|                                                                                    |                                    | UNII-3 5.735-5835            | 28.5                                   |
| AZRB with antenna with the maximum gain at 9.5dBi                                  | LAA, 20/40/60MHz BW, Q16/64/256QAM | UNII-1 5170-5250             | 25.5                                   |
|                                                                                    |                                    | UNII-3 5.735-5835            | 26.5                                   |

\*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 Antenna Data from Manufacturers**

| <b>Ant</b> | <b>Model Name</b> | <b>Antenna Type/<br/>Size (mm)</b>       | <b>Frequency<br/>(MHz)</b> | <b>Max Gain<br/>UNII1 (dBi)</b> | <b>Max Gain<br/>UNII3 (dBi)</b> |
|------------|-------------------|------------------------------------------|----------------------------|---------------------------------|---------------------------------|
| 1          | AARC              | Directional<br>295(L) × 270(W) × 30(D)   | 5150 ~ 5850                | 4.91                            | 4.91                            |
| 2          | FA2RC             | Directional<br>160(L) × 110(W) × 44(D)   | 5150 ~ 5850                | 6.0                             | 6.0                             |
| 3          | VVSSP-360S-F      | Omni-Directional<br>600(L) × 100(R)      | 5150 ~ 5925                | 5.1                             | 5.1                             |
| 4          | GQ2410-06645      | Omni-Directional<br>634(L) × 127.5(R)    | 5150 ~ 5925                | 5.9                             | 5.9                             |
| 5          | 2205              | Directional<br>198(W) × 24.5(D) × 198(H) | 5150 ~ 5925                | 9.5                             | 9.5                             |
| 6          | GO4806-06664      | Omni-Directional<br>1219(L) × 52(D)      | 5150 ~ 5925                | 6.0                             | 6.0                             |
| 7          | FA2RA             | Omni-Directional<br>235(L) × 51(D)       | 5150 ~ 5850                | 6.0                             | 7.5                             |

## 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 B7/B66/BT/WiFi System**

| Environment                             | Frequency Range (MHz) | Min Power Density (S) (mW/cm <sup>2</sup> ) |
|-----------------------------------------|-----------------------|---------------------------------------------|
| <b>Occupational/ Controlled</b>         | 5170-5250             | 5                                           |
|                                         | 5735-5835             | 5                                           |
| <b>General Population/ Uncontrolled</b> | 5170-5250             | 1                                           |
|                                         | 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 AZRB base station.

**Table 4.2.2 (a) Maximum EIRP**

| <b>AZRB Equipped Ants</b> | <b>Model Name</b> | <b>Max Rated P<sub>out</sub> (dBm)</b> | <b>Antenna Gain (dBi)</b> | <b>Max Rated EIRP (dBm)</b> |
|---------------------------|-------------------|----------------------------------------|---------------------------|-----------------------------|
| 1                         | AARC              | 30.0                                   | 4.91                      | 34.91                       |
| 2                         | FA2RC             | 30.0                                   | 6.0                       | 36.0                        |
| 3                         | VVSSP-360S-F      | 30.0                                   | 5.1                       | 35.1                        |
| 4                         | GQ2410-06645      | 30.0                                   | 5.9                       | 35.9                        |
| 5                         | 2205              | 26.5                                   | 9.5                       | 36.0                        |
| 6                         | GO4806-06664      | 30.0                                   | 6.0                       | 36.0                        |
| 7                         | FA2RA             | 28.5                                   | 7.5                       | 36.0                        |

The maximum EIRP allowed is 36dBm.

Since,

$$\frac{S}{LPD} \leq 1,$$

$$\frac{EIRP}{4\pi R^2 \cdot LPD} \leq 1,$$

then

$$R \geq \sqrt{\frac{EIRP}{4\pi \cdot LPD}}. \quad (2)$$

From Equation (2), the minimum distance R = 17.8 cm for uncontrolled exposure and 7.96cm for controlled exposure with the 36dBm EIRP, the maximum allowed.

**Table 4.2.2(b) Minimum RF Safety Distances for 5GHz UNII1/3 Devices  
with Maximum EIRP Allowed (36 dBm)**

| <b>Exposure Environment</b> | <b>Max EIRP (dBm)</b> | <b>Max EIRP (mW)</b> | <b>Limit of Pwr Density S (mW/cm<sup>2</sup>)</b> | <b>RF Safety Distance (cm)</b> |
|-----------------------------|-----------------------|----------------------|---------------------------------------------------|--------------------------------|
| Uncontrolled                | 36                    | 3981                 | 1                                                 | 17.8                           |
| Controlled                  | 36                    | 3981                 | 5                                                 | 8.0                            |

**Table 4.2.3 Power Density at the 20cm RF Safety Distance**

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

Therefore,

**Table 4.2.4 Proposed RF Safety Distances for AZRB RRH Band 46 LAA**

| <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).