



Bell Labs

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RF Exposure Assessment Report

Regulations

**47CFR Part 1.1310
IC RSS-102**

Client

Nokia Solutions and Networks Oy

Product Evaluated

**Nokia Single Band Flexi Zone Outdoor Micro Base Station G1
FWPF B14 (R3)**

GPCL Report Number
TR-2018-0017 MPE

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Revisions

Date	Revision	Section	Change

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1 ATTESTATION OF RESULTS

1.1 Product Configuration Evaluated

Company Name (Manufacturer)	Nokia Solutions and Network, OY 1455 West Shure Drive Arlington Heights IL 60004
FCCID	2AD8UFZMFWPF01
IC ID	109D-FZMFWPF01
Product Name	Nokia Single Band Flexi Zone Outdoor Micro Base Station G1 FWPF B14 (R3)
Model Number	474162A
Test Requirement(s)	47CFR Part 1.1310; RSS-102, Issue 5, March 2015
Other Reference(s)	IEEE C95.3 2002 (R2008)
Frequency Band	Band 14: Tx: 758-768 MHz and Rx: 788-798 MHz
Test Report Number	2018-0017 MPE
Test Laboratory	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 Department'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.

1.2 SUMMARY OF RESULTS

Applied Standard(s): 47CFR Part 1.1310; RSS-102		
EUT Configuration	Exposure Environement	RF Safety Distance (cm)
FCC B14	Occupational/Controlled	23
	General Population/Uncontrolled	50
IC B14	Occupational/Controlled	27
	General Population/Uncontrolled	73

2 GENERAL INFORMATION

2.1 Product Descriptions

The equipment under test (EUT) is a Nokia Solutions and Networks FlexiZone Micro Base Transceiver Station (BTS), model FWPF which operates over 3GPP frequency band 14 (BTS Tx/Rx: 758 to 768 MHz/ 788 to 798MHz). The FWPF has two co-located transmit paths with individual transmit output ports. Each transmit port supporting 5 watts (37 dBm) maximum rated RF output power. The FWPF can be operated in a 2x MIMO or as a non-MIMO transmitter. Multi-carrier operation is not supported. The maximum total output power is 10 Watts/ 40 dBm.

The FWPF supports four downlink modulation types for LTE (QPSK, 16QAM, 64QAM and 256QAM). The FWPF supports three LTE channel bandwidths (3 MHz, 5 MHz, and 10 MHz). The FWPF has external interfaces including AC power, ground, TX/RX (Ant), Ethernet “B”, Ethernet “C”, USB port, GPS and Bluetooth. The FWPF with applicable installation kit may be pole or wall mounted. Bluetooth interface has modular FCC and IC approval.

Table 2: Product Specifications on FWPF B14

Product	Model Name	Technologies	Transmitting Frequency (MHz)	Maxi Total Output Power (dBm rms)
FWPF B14	G1 FWPG B14	LTE, FDD	758 -768	37

2.2 Antenna Information

The information on the antennas supplied or recommended by Nokia were given below:

Table 3: FWPF B14 Antena Data from Manufactuerer

Transmitter	Antenna	Model	Antenna Gain (dBi)
FWPF B14	Omni-Direct 690-960 MHz/1700-2700 MH	BMHO69027002NF	Peak: 2.0

3 REQUIRED EVALUATION AND RESULTS

3.1 Regulatory Requirements

The assessment in this report was performed for the Nokia Single Band Flexi Zone Outdoor Micro Base Station G1 FWPF B14 (R3) RF transceiver, operating in the 758-768 MHz BRS, installed in FWPF B14 base station in accordance with the requirements of 47CFR Part 1.1310, IC RSP-100 and RSS-102.

3.1.1 FCC Requirements

3.1.2 47CFR Part 1.1310 Radio Frequency Radiation Exposure Limits

Per 47CFR-1.1310 “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”

Table 4: FCC Part 1.1310 LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (Minutes)
(A) Limits for Occupational/ Control Exposures				
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6
(B) Limits for General Population/ Uncontrolled Exposures				
300-1500	--	--	f/1500	6
1500-100,000	--	--	1	30

Where f is the frequency in MHz

Table 5: FCC Power Density Limits for Occupational/Controlled Exposure and General Population/Uncontrolled for FWPF B14

Environment	Frequency Range (MHz)	Min Power Density (S) (mW/cm ²)
Occupational/ Controlled	758-768	2.56
General Population/ Uncontrolled	758-768	0.51

3.1.3 IC Requirements

The regulatory requirement for the RF exposure compliance of RF transceivers was specified in RSP-100 Section 2.5: Radio apparatus shall comply with the applicable requirements of RSS-102.

The RSS-102 sets out the requirements and measurement techniques used to evaluate RF exposure compliance of radio communication apparatus:

I. RSS-102 Section 2.2 RF Exposure Technical Brief

The RF exposure technical brief shall demonstrate that the requirements of this standard have been met and that appropriate measurement methods, evaluation methodologies or calculations have been used.

II. RSS-102 Section 3 RF Exposure Evaluation

Devices that have a radiating element normally operating at or below 6 GHz, with a separation distance greater than 20 cm between the user and/or bystander and the device shall undergo an RF exposure evaluation.

RF exposure evaluation shall be made in accordance with the latest version of IEEE C95.3. The applicant must follow the applicable test methods based on the priority list of documents. The priority list is as follows: (1) RSS-102, (2) IEC and IEEE standards referenced in this document, and (3) Other recognized procedures, such as the FCC RF exposure KDB procedures referenced in this document.

III. RSS-102 SECTION 4 Exposure Limits

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

Table 6: Limits for Occupational/Controlled Exposure and General Population/Uncontrolled (RSS-102 Section 4, Tables 4 and 6)

Frequency Range (MHz)	Electric Field Strength (E) (V/m rms)	Magnetic Field Strength (H) (A/m rms)	Power Density (S) (W/m ²)	Reference Period (minutes)
(A) Limits for Occupational/Controlled Exposure				
100 – 6,000	$15.60 f^{0.25}$	$0.04138 f^{0.25}$	$0.6455 f^{0.5}$	6
1,500 – 15,000	137	0.364	50	6
15,000 – 150,000	137	0.364	50	$616,000 / f^{1.2}$
(B) Limits for General Population/Uncontrolled Exposure				
300 – 6,000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6,000 – 15,000	61.4	0.163	10	6
15,000 - 150,000	61.4	0.163	10	$616,000 / f^{1.2}$

Note: f = frequency in MHz.

4 RF Exposure Assessment

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

Table 7: IC Power Density Limits for Occupational/Controlled Exposure and General Population/Uncontrolled for FWPF B14

Environment	Frequency Range (MHz)	Min Power Density (S) (mW/cm ²)
Occupational/ Controlled	758-768	1.78
General Population/ Uncontrolled	758-768	0.243

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

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 isotropically radiated power), i.e.,

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

where S is the power density in mW/cm², 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.

4.1 FCC Exposure Assessment for FWPF B14

The FCC RF Safety Distances criteria and exposure levels for the Controlled and Uncontrolled exposure cases are summarized below in Table 8 for the **FWPF B14**.

Table 8: Proposed FCC Minimum RF Safety Distances for FWPF B14

Exposure	RF Safety Distance (cm)	Total Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
Occupational/Controlled	23	2.39	2.53
General Population/Uncontrolled	50	0.505	0.505

4.1.1 FCC Uncontrolled Exposure Results

Table 9: Minimum RF Safety Distances for Uncontrolled Exposure for MBO B14

Module	Freq. Band GHz	Max Total Pout (2x2) (dBm)	Antenna Gain (dBi)	Maximum Total EIRP (dBm)	Maximum Total EIRP (mW)	Power Density Limit (mW/cm ²)	RF Safety Distance (cm)
FWPF B14	758	40.0	2.0	42.0	15848.93	0.505	49.99
Total (Simultaneous-Transmission)					15848.93		49.99

Table 10: Uncontrolled Exposure Power Density at the Proposed RF Safety Distance; MBO B14

Module	Freq. Band GHz	Maxi Total Pout (2x2) (dBm)	Antenna Gain (dBi)	Maximum Total EIRP (dBm)	Maximum Total EIRP (mW)	RF Safety Distance (cm)	Power Density (mW/cm ²)
MBO B14	758	40.0	2.0	42.0	15848.93	50	0.505
Total (Simultaneous-Transmission)					15848.93	50	0.505

4.1.2 FCC Controlled Exposure Results

Table 11: Minimum RF Safety Distances for Controlled Exposure for MBO B14

Module	Freq. Band GHz	Maximum Total Pout (2x5W) (dBm)	Antenna Gain (dBi)	Maximum Total EIRP (dBm)	Maximum Total EIRP (mW)	Power Density Limit (mW/cm ²)	RF Safety Distance (cm)
MBO B14	758	40.0	2.0	42.0	15848.93	2.53	22.33
Total (Simultaneous-Transmission)					15848.93	2.53	22.33

Table 12: Controlled Exposure Power Density at the Proposed RF Safety Distance; MBO B14

Module	Freq Band GHz	Maxi Total Pout (2x2) (dBm)	Antenna Gain (dBi)	Maximum Total EIRP (dBm)	Maximum Total EIRP (mW)	RF Safety Distance (cm)	Power Density (mW/cm ²)
MBO B14	758	40.0	2.0	42.0	15848.93	23	2.39
Total (Simultaneous-Transmission)					15848.93		2.39

4.2 Industry Canada Exposure Assessment for FWPF B14

The IC RF Safety Distances criteria and exposure levels for the Controlled and Uncontrolled exposure cases are summarized below in Table 13 for the **FWPF B14**.

Table 13: Proposed IC Minimum RF Safety Distances for FWPF B14

Exposure	RF Safety Distance (cm)	Total Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
Occupational/Controlled	27	1.73	1.78
General Population/Uncontrolled	73	0.237	0.243

4.2.1 Industry Canada Uncontrolled Exposure Results for the MBO B14

The RF exposure assessment was conducted on the **Nokia Single Band Flexi Zone Outdoor Micro Base Station G1 FWPF B14 (R3)** with only B14 modules installed.

Table 14: Minimum RF Safety Distances for Uncontrolled Exposure

Module	Freq Band (MHz)	Maximum Total P _{out} (dBm)	Antenna Gain (dBi)	Maximum Total EIRP (dBm)	Maximum Total EIRP (mW)	Limit of Power Density S (mW/cm ²)	RF Safety Distance (cm)
MBO B14	758	40	2.0	42.0	15848.93	0.243	72.1
Total (Simultaneous-Transmission)					15848.93		72.1

Table 15: Power Density at the Minimum RF Safety Distances for Uncontrolled Exposure

Module	Freq. Band (MHz)	Maximum Total EIRP (mW)	RF Safety Distance (cm)	Power Density S (mW/cm ²)	Limit of Power Density S (mW/cm ²)	S/LPD
MBO B14	758	15848.93	73	0.237	0.243	0.974
Total (Simultaneous-Transmission)						0.974

4.2.2 Industry Canada Controlled Exposure Results for the MBO B14

Table 16: Minimum RF Safety Distances for Controlled Exposure

Module	Freq Band (MHz)	Max Total P _{out} (dBm)	Antenna Gain (dBi)	Maximum Total EIRP (dBm)	Maximum Total EIRP (mW)	Limit of Power Density S (mW/cm ²)	RF Safety Distance (cm)
MBO B14	758	40	2.0	42.0	15848.93	1.78	26.63
Total (Simultaneous-Transmission)					15848.93		

Table 17: Power Density at Minimum RF Safety Distances for Controlled Exposure

Module	Freq Band (GHz)	Maximum Total EIRP (mW)	RF Safety Distance (cm)	Power Density S (mW/cm ²)	Limit of Power Density S (mW/cm ²)	S/LPD
MBO B14	758	15848.93	27	1.731	1.78	0.972
Total (Simultaneous-Transmission)						0.972

Table 18: Minimum RF Safety Distances for MBO B14

Exposure Type	RF Safety Distance (cm)
Occupational/Controlled	27
General Population/Uncontrolled	73