RF Exposure Report

Report No.:	SA160817E01A
Test Model:	FW2IRWC, FW2IRWA, FW2IRA
Received Date:	Nov. 16, 2016
Test Date:	Nov. 17, 2016
Issued Date:	Nov. 29, 2016
Applicant:	Nokia Solutions and Networks
Address:	1455 West Shure Drive, Arlington Heights, IL 60004, USA
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
Lab Address:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.

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Release Control Record

Issue No.	Description	Date Issued
SA160817E01A	Original release.	Nov. 29, 2016

1 Certificate of Conformity

Product:	Flexi Zone Multiband Indoor Pico BTS
Brand:	Nokia
Test Model:	FW2IRWC, FW2IRWA, FW2IRA
Hardware Version:	A102
Sample Status:	MASS-PRODUCTION
Applicant:	Nokia Solutions and Networks
Test Date:	Nov. 17, 2016
Standards:	FCC Part 2 (Section 2.1091) KDB 447498 D01 General RF Exposure Guidance v06 IEEE C95.1 FCC Part 1 (Section 1.1310)

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : _____ , **Date:** Nov. 29, 2016

Claire Kuan / Specialist

Approved by : _____ , **Date:** Nov. 29, 2016

Max Chen / Manager

2 RF Exposure

2.1 Limits For Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm2)	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 Exposure				
300-1500	…	…	F/1500	30
1500-100,000	…	…	1.0	30

F = Frequency in MHz

2.2 MPE Calculation Formula

$Pd = (Pout*G) / (4*pi*r^2)$

where

Pd = power density in mW/cm^2

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

R = distance between observation point and center of the radiator in cm

2.3 Classification

The antenna of this product, under normal use condition, is at least 27cm away from the body of the user. So, this device is classified as **fixed device** and installations by professional service personnel.

2.4 Antenna Gain

The antennas provided to the EUT, please refer to the following table:

WLAN – 2.4GHz Antenna Spec.						
Antenna No	PCB Chain No.	Brand	Model	Antenna Type	Gain(dBi)	Frequency (GHz to GHz)
1	U20	Galtronics	NA	PIFA	5.17	2.4~2.4835
2	U21	Galtronics	NA	PIFA	4.27	2.4~2.4835

Cable Spec.					
Antenna No	Brand	Model	Connector Type	Cable Loss(dB)	Cable Length (cm)
1	NA	NA	MMCX	0	30.6
2	NA	NA	MMCX	0	9.1

WLAN – 5GHz Antenna Spec.						
Antenna No	PCB Chain No.	Brand	Model	Antenna Type	Gain(dBi)	Frequency (GHz to GHz)
1	U20	Galtronics	NA	PIFA	6.03	5.15~5.25
					6.17	5.25~5.35
					5.57	5.47~5.725
					5.18	5.725~5.85
2	U21	Galtronics	NA	PIFA	5.1	5.15~5.25
					4.91	5.25~5.35
					5.23	5.47~5.725
					5.73	5.725~5.85

Cable Spec.					
Antenna No	Brand	Model	Connector Type	Cable Loss(dB)	Cable Length (cm)
1	NA	NA	MMCX	0	30.6
2	NA	NA	MMCX	0	9.1

Bluetooth– Antenna Spec.					
Antenna Condition	Brand	Model	Antenna Type	Gain(dBi)	Frequency (MHz)
Internal BT Ant	NA	Fz PICO	PCB	1.45	2400~2500
Antenna Condition	Brand	Model	Antenna Type	Gain(dBi) <Including cable loss>	Frequency (MHz)
External BT Ant	NA	NA	Dipole	0	2400~2500

Cable Spec.					
Brand	Model	Connector Type	Cable Loss(dB)	Cable Length (cm)	Note
NA	NA	U.FL to RP SMA type (M)	1	10	This cable will be equipped with dipole antenna

LTE – Antenna Spec.					
Antenna No	Brand	Model	Antenna Type	Gain(dBi)	Frequency (GHz)
LTE Ant1(Main)	Nokia	FW2IADPM01	Slot Antenna	6.03	1.7~2.7
Antenna No	Brand	Model	Antenna Type	Gain(dBi)	Frequency (GHz)
LTE Ant2(Aux)	Nokia	FW2IADPM01	Slot Antenna	4.64	1.7~2.7

Cable Spec.				
Brand	Model	Connector Type	Cable Loss(dB)	Cable Length (mm)
NA	NA	Right angle MMCX Plug	peak gain included	287

LAA – Antenna Spec.					
Antenna No	Brand	Model	Antenna Type	Gain(dBi)	Frequency range (MHz)
1	Nokia	NA	Loop (LAA#4(Main))	5.24	5150 ~ 5250, 5725 ~ 5825
2	Nokia	NA	Loop (LAA#2(DIV))	8.26	5150 ~ 5250, 5725 ~ 5825

Cable Spec.						
Antenna No	Brand	Model	Connector Type	Cable Loss(dB)	Cable Length (mm)	Note
1	NA	NA	Right angle MMCX Plug	peak gain included	263	This cable will be equipped with Loop(LAA#4) antenna
2	NA	NA	Right angle MMCX Plug	peak gain included	263	This cable will be equipped with Loop(LAA#2) antenna

Directional gain(composite gain) :

Directional Gain.	
Frequency range (MHz)	Max Gain(dBi)
5150 ~ 5250, 5725 ~ 5825	7.66

Note:

1. Directional gain calculation is based on FCC document KDB662911

   Directional gain = GANT MAX + 10 log(NANT/NSS) dBi,
   where
   NSS = the number of independent spatial streams of data ;
   GANT MAX is.the gain of the antenna having the highest gain (in dBi).

2. Two directional gain values are calculated, directional gain values based on actual measurement data.

2.5 Calculation Result

For General Population

For WLAN:

Frequency Band (MHz)	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2412-2462	199.467	7.74	27	0.12940	1
5180-5240, 5745-5825	384.025	8.47	27	0.29473	1

NOTE:

2.4GHz: Directional gain = 10 log[($10^{G1/20}$ + $10^{G2/20}$)^2 / 2] = 7.74dBi

5GHz: Directional gain = 10 log[($10^{G1/20}$ + $10^{G2/20}$)^2 / 2] = 8.47dBi

For Bluetooth:

Frequency Band (MHz)	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2402-2480	9.099	1.45	27	0.00139	1

For LTE:

Frequency Band (MHz)	Max EIRP Power (dBm)	Max EIRP Power (mW)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2112.5-2177.5	29.60	912.011	27	0.09955	1

For LAA:

Frequency Band (MHz)	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
5160-5240, 5745-5.825	582.879	7.66	27	0.37123	1

Note: Directional gain = 7.66dBi

For Occupational Population

For WLAN:

Frequency Band (MHz)	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2412-2462	199.467	7.74	20	0.23583	5
5180-5240, 5745-5825	384.025	8.47	20	0.53714	5

NOTE:

2.4GHz: Directional gain = 10 log[($10^{G1/20}$ + $10^{G2/20}$)^2 / 2] = 7.74dBi

5GHz: Directional gain = 10 log[($10^{G1/20}$ + $10^{G2/20}$)^2 / 2] = 8.47dBi

For Bluetooth:

Frequency Band (MHz)	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2402-2480	9.099	1.45	20	0.00253	5

For LTE:

Frequency Band (MHz)	Max EIRP Power (dBm)	Max EIRP Power (mW)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2112.5-2177.5	29.60	912.011	20	0.18144	1

For LAA:

Frequency Band (MHz)	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
5160-5240, 5745-5.825	582.879	7.66	20	0.67656	5

Note: Directional gain = 7.66dBi

Conclusion:

The formula of calculated the MPE is:

CPD1 / LPD1 + CPD2 / LPD2 + ……etc. < 1

CPD = Calculation power density

LPD = Limit of power density

For General Population

Therefore, the worst-case situation is 0.12940 / 1 + 0.29473 / 1 + 0.00139 / 1 + 0.09955 / 1 + 0.37123 / 1= 0.89630, which is less than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.

For Occupational Population

Therefore, the worst-case situation is 0.23583 / 5 + 0.53714 / 5 + 0.00253 / 5 + 0.18144 / 5 + 0.67656 / 5= 0.32670, which is less than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.

3 Brief Summary of results

The wireless device described within this report has been shown to be capable of compliance with the basic restrictions related to human exposure to electromagnetic fields for both General public and Occupational. The calculations shown in this report were made in accordance the procedures specified in the applied test specification(s)

Configuration	Required Compliance Boundary(m)	
	Occupational	General Population
WiFi 2.4G + WiFi 5G + Bluetooth + LTE + LAA	0.20	0.27

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