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Report No.: 1712TW0105-U6 Report Version: Issue Date: 02-28-2018

RF Exposure Evaluation Declaration

FCC ID: 2AD8UFZCWM2B1

APPLICANT: Nokia Solutions and Networks, OY

Application Type: Certification

Product: AC220m Wi-Fi module ID US

Model No.: WM2B-AC220m

NOKIA Trademark:

FCC Classification: Digital Transmission System (DTS)

Unlicensed National Information Infrastructure (UNII)

Test Procedure(s): KDB 447498 D01v06

Reviewed By : Paddy Chen (Paddy Chen)

Approved By : Change Reviewed By





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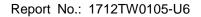
The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standards through the calibration of the equipment and evaluated measurement uncertainty herein.

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Revision History

Report No.	Version	Description	Issue Date	Note
1712TW0105-U6	Rev. 01	Initial Report	02-28-2018	Valid



§2.1033 General Information

Applicant:	Nokia Solutions and Networks, OY			
Applicant Address:	2000 W. Lucent Lane, Naperville, Illinois, United States, 60563			
Manufacturer:	Nokia Solutions and Networks, OY			
Manufacturer Address:	2000 W. Lucent Lane, Naperville, Illinois, United States, 60563			
Test Site:	MRT Technology (Taiwan) Co., Ltd			
Test Site Address:	No. 38, Fuxing Second Rd., Guishan Dist., Taoyuan City 333,			
	Taiwan (R.O.C)			
FCC Registration No.:	153292			
Test Device Serial No.:	N/A ☐ Production ☐ Pre-Production ☐ Engineering			

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Fuxing Rd., Taoyuan, Taiwan (R.O.C)

- •MRT facility is a FCC registered (Reg. No. 153292) test facility with the site description report on file and is designated by the FCC as an Accredited Test Film.
- MRT facility is an IC registered (MRT Reg. No. 21723-1) test laboratory with the site description on file at Industry Canada.
- MRT Lab is accredited to ISO 17025 by the American Association for Laboratory
 Accreditation (TAF) under the American Association for Laboratory Accreditation Program
 (TAF Cert. No. 3261) in EMC, Telecommunications and Radio testing for FCC, Industry
 Taiwan, EU and TELEC Rules.

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1. PRODUCT INFORMATION

1.1. Equipment Description

Product Name:	AC220m Wi-Fi module ID US				
Model No.:	WM2B-AC220m				
Brand Name:	Nokia				
Wi-Fi Specification	802.11a/b/g/n/ac				
Frequency Range	2.4GHz:				
	For 802.11b/g/n-HT20: 2412 ~ 2462 MHz				
	For 802.11n-HT40: 2422 ~ 2452 MHz				
	5GHz:				
	For 802.11a/n-HT20/ac-VHT20:5180~5320MHz, 5500~5720MHz,				
	5745~5825MHz				
	For 802.11n-HT40/ac-VHT40:5190~5310MHz, 5510~5710MHz,				
	5755~5795MHz				
	For 802.11ac-VHT80:5210MHz, 5290MHz, 5530MHz, 5610MHz, 5690MI				
	5775MHz				
Type of Modulation	802.11b: DSSS				
	802.11g/n/ac: OFDM				
Modulation Technology	CCK, DQPSK, DBPSK for DSSS				
	16QAM, 64QAM, 256QAM, QPSK, BPSK for OFDM				



1.2. Antenna Description

Antenna	Brand	Connector	Cable	Antenna	Frequency	Gain	
Port		Type	Length	Type	(MHz)	(dBi)	
Ant 0			MMCX	9.1cm	PIFA	5250 ~ 5350	4.91
Anto	Galtronics	IVIIVICA	9.1011	FIFA	5470 ~ 5725	5.23	
Ant 1	Gaillonics	NANACY	30.6cm	PIFA	5250 ~ 5350	6.17	
Anti		MMCX	30.6Cm	FIFA	5470 ~ 5725	5.57	

Frequency	Tx	Per Chain Max		Beam Forming		CDD Directional Gain	
Band (MHz)	Paths	Antenna Gain (dBi)		Directional Gain (dBi)		(dBi)	
		A = 4 O	A	For	For	For	For
		Ant 0	Ant 1	Power	PSD	Power	PSD
5250 ~ 5350	2	4.91	6.17	8.57	8.57	6.17	9.18
5470 ~ 5725	2	5.23	5.57	8.41	8.41	5.57	8.58

Note1: The EUT supports Cyclic Delay Diversity (CDD) technology for 802.11a/b/g/n/ac mode, and CDD signals are correlated.

Note 2: The EUT supports Beam Forming technology for 802.11n/ac mode.

Note 3: For CDD transmissions, directional gain is calculated as follows, $N_{ANT} = 2$, $N_{SS} = 1$.

Two antennas have the same gain, G_{ANT} , Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

- For power spectral density (PSD) measurements on all devices,
 Array Gain = 10 log (N_{ANT}/ N_{SS}) dB = 3.01;
- For power measurements on IEEE 802.11 devices,
 Array Gain = 0 dB for N_{ANT} ≤ 4;

Note 4: For Beam Forming transmissions, directional gain = $10*log[(10^{G1/20} + 10^{G2/20} + ... + 10^{GN/20})^2/N_{ANT}]dBi$.



2. RF Exposure Evaluation

2.1. Limits

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range	Electric Field	Magnetic Field	Power Density	Average Time		
(MHz)	Strength (V/m)	Strength (A/m)	(mW/cm ²)	(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		

f= Frequency in MHz

Calculation Formula: Pd = (Pout*G)/(4*pi*r2)

Where

Pd = power density in mW/cm2

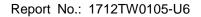
Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

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

Pd is the limit of MPE, 1mW/cm². If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.





2.2. Test Result of RF Exposure Evaluation

Product	AC220m Wi-Fi module ID US
Test Item	RF Exposure Evaluation (For General Population)

Test Mode	Frequency	Maximum	Safety	Power	Limit of Power
	Band (MHz)	EIRP (dBm)	Distance	Density	Density
			(cm)	(mW/cm ²)	(mW/cm ²)
802.11a/n-HT20/ n-H40/ac-VHT20	5250 ~ 5350,	29.61	24	0.1263	1
ac-VHT40/ac-VHT80	5470 ~ 5725				

Note: Directional Gain Calculation as below:

 $5250 \sim 5350 \text{MHz}$ Directional Gain = $10 \cdot \log[(10^{4.91/20} + 10^{6.17/20})^2/2] = 8.57 \text{ dBi}$

5470 ~ 5725MHz Directional Gain = $10*log[(10^{5.23/20} + 10^{5.57/20})^2/2] = 8.41 dBi$

Product	AC220m Wi-Fi module OD US
Test Item	RF Exposure Evaluation (For Occupational)

Test Mode	Frequency	Maximum	Safety	Power	Limit of Power
	Band (MHz)	EIRP (dBm)	Distance	Density	Density
			(cm)	(mW/cm ²)	(mW/cm ²)
802.11a/n-HT20/ n-H40/ac-VHT20 ac-VHT40/ac-VHT80	5250 ~ 5350, 5470 ~ 5725	29.61	20	0.1819	5

Note: Directional Gain Calculation as below:

 $5250 \sim 5350 \text{MHz}$ Directional Gain = $10 \cdot \log[(10^{4.91/20} + 10^{6.17/20})^2/2] = 8.57 \text{ dBi}$

 $5470 \sim 5725 \text{MHz}$ Directional Gain = $10*\log[(10^{5.23/20} + 10^{5.57/20})^2/2] = 8.41 \text{ dBi}$



2.3. Summary of Test Result

The wireless device described within this report has been shown to be capable of compliance with 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 specifications

Configuration	Required Compliance Boundary (cm)			
Configuration	General Population	Occupational		
2.4GHz + 5GHz	24	20		

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