

Antenna Gain Measurement Report

Applicant : Plume Design, Inc.

Product Name : SuperPod with WiFi 6

Trade Name : Plume Design, Inc.

Model Number : F4A

Applicable Standard : FCC 47 CFR PART 15 SUBPART C
FCC 47 CFR PART 15 SUBPART E
ANSI C63.10:2013

Received Date : Mar. 02, 2022

Test Period : Jun. 03, 2022

Issued Date : Jun. 17, 2022

Issued by

A Test Lab Techno Corp.
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Taoyuan City 33465, Taiwan (R.O.C.)
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Taiwan Accreditation Foundation accreditation number: 1330
Frequency Range : 9 kHz to 40 GHz
Test Firm MRA designation number: TW0010

Note:

- 1.The test results are valid only for samples provided by customers and under the test conditions described in this report.
- 2.This report shall not be reproduced except in full, without the written approval of A Test Lab Technology Corporation.
- 3.The relevant information is provided by customers in this test report. According to the correctness, appropriateness or completeness of the information provided by the customer, if there is any doubt or error in the information which affects the validity of the test results, the laboratory does not take the responsibility.

Revision History

Rev.	Issued Date	Revisions	Revised By
00	Jun. 17, 2022	Initial Issue	Nina Lin

Verification of Compliance

Applicant : Plume Design, Inc.

Product Name : SuperPod with WiFi 6

Trade Name : Plume Design, Inc.

Model Number : F4A

FCC ID : 2AG7G-F4A

Applicable Standard : FCC 47 CFR PART 15 SUBPART C
FCC 47 CFR PART 15 SUBPART E
ANSI C63.10:2013

Test Result : Complied

Performing Lab. : A Test Lab Techno Corp.
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Taiwan Accreditation Foundation accreditation number: 1330

A Test Lab Techno Corp. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by A Test Lab Techno Corp. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Approved By :

(Kai Yu Yang)

TABLE OF CONTENTS

1	General Information	5
1.1.	Summary of Test Result	5
1.2.	Measurement Uncertainty	6
2	EUT Description	7
2.1.	Antenna System Description	8
3	Test Methodology	9
3.1.	Mode of Operation	9
3.2.	EUT Test Step	11
3.3.	Configuration of Test System Details	12
3.4.	Test Instruments.....	13
3.5.	Test Site Environment	14
3.6.	Measurement Environment	14
4	Measurement Method	15
4.1.	Maximum Output Power & Beamforming Gain Measurement.....	15
5	Test Results	17
5.1	Maximum Output Power & Beamforming Gain Measurement	17

Appendix A. Test Setup Photographs

1 General Information

1.1. Summary of Test Result

Standard	Item	Result	Remark
15.247(b)	Maximum Output Power & Beamforming Gain	---	---
15.407(a)	Maximum Output Power & Beamforming Gain	---	---

Note 1: The above test items refer to the test standards.

Decision Rule

- Uncertainty is not included.
- Uncertainty is included.

Standard	Description
CFR47, Part 15, Subpart C	Intentional Radiators
CFR47, Part 15, Subpart E	Unlicensed National Information Infrastructure Devices
ANSI C63. 10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 558074 D01 15.247 Meas Guidance v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
KDB789033 D02 v02r01	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
KDB 987594 D02 v01r01	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure 6 GHz (U-NII) Devices Part 15, Subpart E
KDB 412172 D01 Determining ERP and EIRP v01r01	GUIDELINES FOR DETERMINING THE EFFECTIVE RADIATED POWER (ERP) AND EQUIVALENT ISOTROPICALLY RADIATED POWER (EIRP) OF AN RF TRANSMITTING SYSTEM
KDB 662911 D01 v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band (e.g., MIMO, Smart Antenna, etc)
KD 662911 D03 MIMO Antenna Gain Measurement v01	Provision to Allow Measurement of Directional Gain of Multi-Antenna Systems for Compliance Verification

1.2. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Radiated Emission	1000 MHz ~ 12750 MHz	4.3 dB
Duty Cycle		2.4 %

2 EUT Description

Applicant	Plume Design, Inc. 325 Lytton Ave., Palo Alto, CA 94301			
Product Name	SuperPod with WiFi 6			
Trade Name	Plume Design, Inc.			
Model Number	F4A			
FCC ID	2AG7G-F4A			
Operate Frequency (WLAN 2.4G)	Frequency Band		Frequency Range (MHz)	Number of Channels
	IEEE 802.11b IEEE 802.11g IEEE 802.11n 20 MHz (64QAM) IEEE 802.11n 20 MHz (256QAM) IEEE 802.11ax 20 MHz		2412 - 2462	11
	IEEE 802.11n 40 MHz (64QAM) IEEE 802.11n 40 MHz (256QAM) IEEE 802.11ax 40 MHz		2422 - 2452	9
Operate Frequency (WLAN 5G)	IEEE 802.11a IEEE 802.11n 5 GHz 20 MHz / IEEE 802.11ac 20 MHz / IEEE 802.11ax 20 MHz	U-NII Band I	5180 – 5240	4
		U-NII Band II-A	5260 – 5320	4
		U-NII Band II-C	5500 – 5720	12
		U-NII Band III	5745 – 5825	5
	IEEE 802.11n 5 GHz 40 MHz / IEEE 802.11ac 40 MHz / IEEE 802.11ax 40 MHz /	U-NII Band I	5190 – 5230	2
		U-NII Band II-A	5270 – 5310	2
		U-NII Band II-C	5510 – 5710	6
		U-NII Band III	5755 – 5795	2
	IEEE 802.11ac 80 MHz / IEEE 802.11ax 80 MHz /	U-NII Band I	5210	1
		U-NII Band II-A	5290	1
		U-NII Band II-C	5530 – 5690	3
		U-NII Band III	5775	1
Modulation Type	OFDM			
Antenna Delivery	Reference section 3.1			
Operate Temp. Range	-30 ~ 50 °C			
EUT Power Rating	100-240 V, 50-60 Hz, 0.45 A			

2.1. Antenna System Description

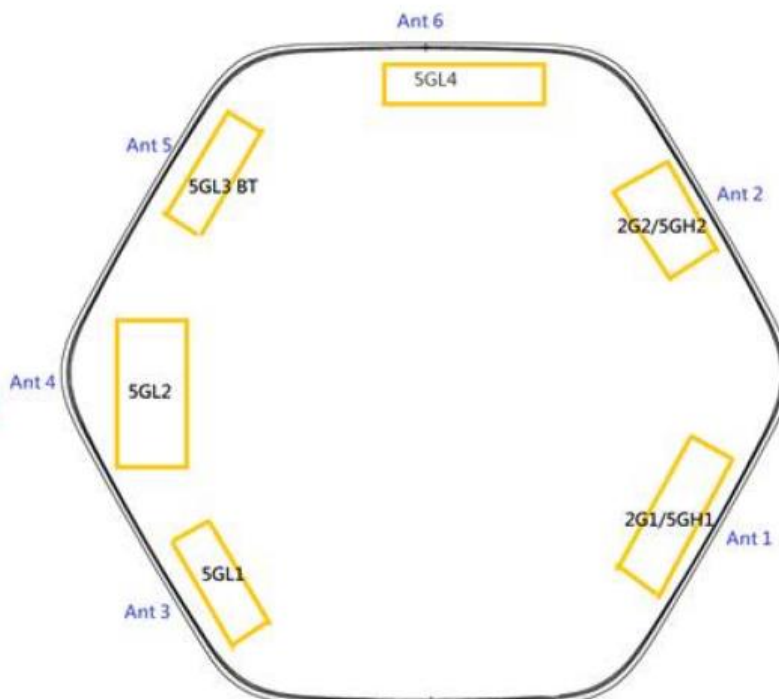
Ant.	Ant. Type	Gain (dBi)					
		2.4GHz	5GHz				6GHz
			Band I	Band II-A	Band II-C	Band III	
1	PIFA Antenna	2.5	---	---	4.1	2.8	---
2	PIFA Antenna	3.1	---	---	2.2	2.4	---
3	PIFA Antenna	---	3.3	3.2	---	---	---
4	PIFA Antenna	---	2.2	2.1	---	---	---
5	PIFA Antenna	---	3	3.1	---	---	---
6	PIFA Antenna	---	3.7	3.7	---	---	---

Specification		Ant. 1	Ant. 2	Ant. 3	Ant. 4	Ant. 5	Ant. 6	Remark
2.4G	IEEE 802.11 b/g/n/ac/ax	V						1X1
	IEEE 802.11 b/g/n/ac/ax	V	V					2x2
5G	IEEE 802.11 a/n/ac/ax	V						1x1
	IEEE 802.11 a/n/ac/ax	V	V					2x2
	IEEE 802.11 a/n/ac/ax			V				1x1
	IEEE 802.11 a/n/ac/ax			V	V			2x2
	IEEE 802.11 a/n/ac/ax			V	V	V		3x3
	IEEE 802.11 a/n/ac/ax			V	V	V	V	4x4

Note 1: The above information is provided by customers.

Note 2: The EUT has six antennas.

Note 3: Please see the attached file, WLAN Antenna Summary Report for F3A_0810.



3 Test Methodology

3.1. Mode of Operation

In the test report use EUT model: F4A to operate testing.

Decision of Test ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: Beamforming off mode
Mode 2: Beamforming on mode

Note 1: Beamforming off mode

Software used to control the EUT for staying in continuous transmitting mode was programmed.

After verification, all tests were carried out with the worst case test modes.

Note 2: Beamforming on mode

Software used to control the EUT for staying in continuous transmitting mode was programmed.

After verification, all tests were carried out with the worst case test modes.

Test Mode	ANT-1+2	ANT-1+2	ANT-3+4+5+6
Band	2.4 GHz	5 GHz	5 GHz
Mode 1	V	V	V
Mode 2	V	V	V

WLAN 2.4 GHz:

Test Mode	Antenna Delivery	Data Rate (Mbps)	Test Channel
Mode 1 Mode 2	2TX	MCS11	1

WLAN 5 GHz:

Test Mode	Antenna Delivery	Data Rate (Mbps)	Band	Test Channel
Mode 1 Mode 2	2TX	MCS11	U-NII Band I	36
			U-NII Band II-A	52
			U-NII Band II-C	---
			U-NII Band III	---
Mode 1 Mode 2	3TX	MCS11	U-NII Band I	36
			U-NII Band II-A	52
			U-NII Band II-C	---
			U-NII Band III	---
Mode 1 Mode 2	4TX	MCS11	U-NII Band I	36
			U-NII Band II-A	52
			U-NII Band II-C	---
			U-NII Band III	---
Mode 1 Mode 2	2TX	MCS11	U-NII Band I	---
			U-NII Band II-A	---
			U-NII Band II-C	100
			U-NII Band III	149

3.2. EUT Test Step

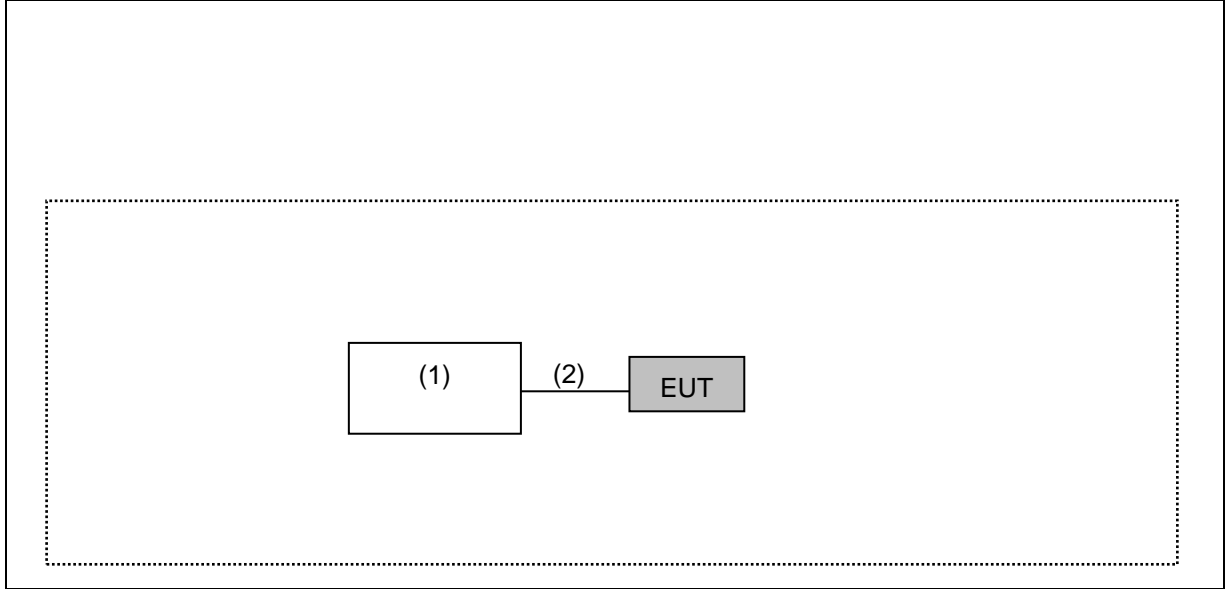
The EUT is operated in the engineering mode to fix the TX frequency for the purposes of measurement. According to its specifications, the EUT must comply with the requirements of Section 15.247 & 15.407 under the FCC Rules Part 15 Subpart C & E.

1.	Setup the EUT shown on "Configuration of Test System Details".
2.	Turn on the power of all equipment.
3.	Turn on TX function.
4.	EUT run test program.

Measurement Software			
No.	Description	Software	Version
1	Radiated Emission	EZ EMC	1.1.4.4

3.3. Configuration of Test System Details

Radiated Emission



Devices Description					
	Product	Manufacturer	Model Number	Serial Number	Power Cord
(1)	Notebook	acer	N19C1	---	---
(2)	RJ45	---	---	---	---



X axis mode



Y axis mode



Z axis mode

By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that "Y axis" position was the worst, then the final test was executed the worst condition and test data were recorded in this report.

3.4. Test Instruments

For Radiated Emissions

Test Period: Jun. 03, 2022

Testing Engineer: Louis Shen

Radiation test sites		Fully Anechoic Room				
Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
<input checked="" type="checkbox"/>	Spectrum Analyzer	Agilent	E4446A	MY46180578	Sep. 11, 2021	1 year
<input type="checkbox"/>	Spectrum Analyzer (20 Hz~26.5 GHz)	Agilent	N9020A	US47520902	Sep. 09, 2021	1 year
<input type="checkbox"/>	Preamplifier (30 MHz~1 GHz)	EMCI	EMC330N	980303	Aug. 25, 2021	1 year
<input type="checkbox"/>	Preamplifier (1 GHz~26.5 GHz)	EMCI	EMC012645SE	980266	Aug. 23, 2021	1 year
<input type="checkbox"/>	Preamplifier (1 GHz~26.5 GHz)	EMCI	EMC012645SE	980289	Jan. 15, 2021	1 year
<input type="checkbox"/>	Preamplifier (26.5 GHz~40 GHz)	EMCI	EMC2654045	980028	Aug. 19, 2021	1 year
<input type="checkbox"/>	Trilog Broadband Antenna (30 MHz~1 GHz)	Schwarzbeck Mess-Elektronik	VULB9168	01146	Jul. 19, 2021	1 year
<input type="checkbox"/>	Bilog Antenna (30 MHz~1.3 GHz)	ETS	3142C	00086484	Sep. 23, 2021	1 year
<input type="checkbox"/>	Double Ridged Horn Antenna (1 GHz~18 GHz)	ETS	3117	00152321	Sep. 17, 2021	1 year
<input checked="" type="checkbox"/>	Double Ridged Guide Antenna (1 GHz~18 GHz)	ETS	3115	00070475	May 18, 2022	1 year
<input type="checkbox"/>	Broadband Horn Antenna (18 GHz~40 GHz)	Schwarzbeck Mess-Elektronik	9170	9170-320	Aug. 24, 2021	1 year
<input checked="" type="checkbox"/>	RF Cable	EMCI	EMC102-KM-KM -8000	001	Feb. 17, 2022	1 year
<input type="checkbox"/>	Bluetooth Tester	R&S	CBT	100350	Mar. 17, 2021	2 years
<input type="checkbox"/>	Wireless Connectivity Tester	R&S	CMW270	102208	Jun. 02, 2021	1 year
<input type="checkbox"/>	Power Supply	KEITHLEY	2303	4045290	Jan. 19, 2022	1 year
<input checked="" type="checkbox"/>	Software	EZ EMC	1.1.4.4	N/A	N.C.R.	---

Note: N.C.R. = No Calibration Request.

3.5. Test Site Environment

Items	Required (IEC 60068-1)	Actual
Temperature (°C)	15-35	20-30
Humidity (%RH)	25-75	45-75

3.6. Measurement Environment

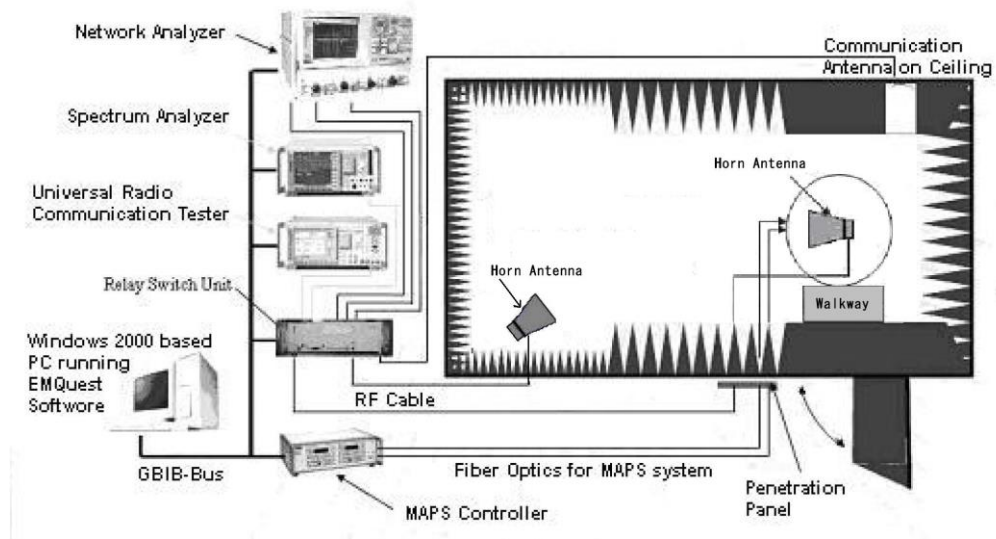
Chamber Type	Measuring Distance	Measure the height of the antenna	Turntable Diameter
Rectangular Fully Anechoic Chamber	3 m	1.5 m	1.6 m

4 Measurement Method

4.1. Maximum Output Power & Beamforming Gain Measurement

For Radiation Method

■ Test Setup



■ Test Procedure**■ DTS Devices:**

The test is performed in accordance with ANSI C63.10:2013 section 11.9.2.2.2 & 11.9.2.2.4, Section 2.3 of KDB 412172 D01 Determining ERP and EIRP v01r01, Guidelines for Compliance Testing of Digital Transmission System (DTS) Devices.

1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a antenna tower.
3. The height of antenna is fixed 1.5 meter , Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. Beamforming Gain (dB) = Beamforming On EIRP (dBm) - Beamforming Off EIRP (dBm)

■ U-NII Devices:

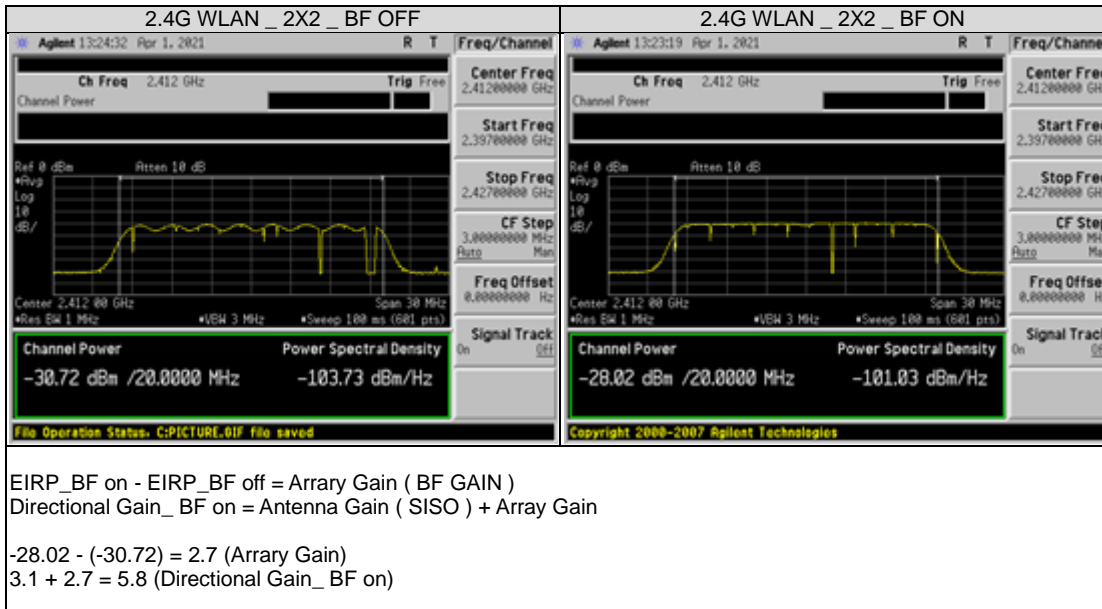
The test is performed in accordance with ANSI C63.10:2013 section 12.3.2.2 & 12.3.2.4, Section 2.3 of KDB 412172 D01 Determining ERP and EIRP v01r01, Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices.

Accordance with ANSI C63.10:2013 section 12.1.2 use radiated compliance measurements.

1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a antenna tower.
3. The height of antenna is fixed 1.5 meter , Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. Beamforming Gain (dB) = Beamforming On EIRP (dBm) - Beamforming Off EIRP (dBm)

5 Test Results

5.1 Maximum Output Power & Beamforming Gain Measurement



Band	EIRP_Beamforming		Array Gain (BF on - BF off)	Antenna Gain (Max Gain)	Directional Gain_ BF on	Axis	High	Angle
	ON	OFF						
2.4G WLAN _ 2X2	-28.02	-30.72	2.7	3.1	5.8	H	150	92
5G WLAN _ 2X2 _ Band I	-43.26	-45.71	2.45	3.3	5.75	H	150	92
5G WLAN _ 2X2 _ Band II-A	-41.18	-43.77	2.59	3.2	5.79	H	150	264
5G WLAN _ 3X3 _ Band I	-42.01	-44.13	2.12	3.3	5.42	H	150	264
5G WLAN _ 3X3 _ Band II-A	-40.17	-42.85	2.68	3.2	5.88	H	150	264
5G WLAN _ 4X4 _ Band I	-38.25	-41.83	3.58	3.7	7.28	H	150	264
5G WLAN _ 4X4 _ Band II-A	-36.10	-40.81	4.71	3.7	8.41	H	150	264
5G WLAN _ 2X2 _ Band II-C	-37.88	-40.08	2.2	4.1	6.3	H	150	92
5G WLAN _ 2X2 _ Band III	-39.21	-41.93	2.72	2.8	5.52	H	150	92

--- END---