

Antenna Gain Measurement Report

Applicant : Plume Design, Inc.

Product Name : SuperPod with WiFi 6E

Trade Name : Plume Design, Inc.

Model Number : M1A

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

Received Date : Dec. 12, 2022

Test Period : Jan. 20 ~ Mar. 18, 2023

Issued Date : Jan. 11, 2024

Issued by

Eurofins E&E Wireless Taiwan Co., Ltd.
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Taiwan Accreditation Foundation accreditation number: 1330
Frequency Range: 9 kHz to 325 GHz (Bade test site)
Test Firm Registration Number: 226252
Frequency Range: 9 kHz to 40 GHz (Wugu test site)
Test Firm Registration Number: 191812

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 Eurofins E&E Wireless Taiwan Co., Ltd.
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

Version	Issued Date	Revisions	Revised By
00	Jan. 11, 2024	Initial Issue	Emma Chao

Verification of Compliance

Applicant : Plume Design, Inc.

Product Name : SuperPod with WiFi 6E

Trade Name : Plume Design, Inc.

Model Number : M1A

FCC ID : 2AG7G-M1A

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. : Eurofins E&E Wireless Taiwan Co., Ltd.
No. 140-1, Changan Street, Bade District,
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Taiwan Accreditation Foundation accreditation number: 1330

Eurofins E&E Wireless Taiwan Co., Ltd. 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 Eurofins E&E Wireless Taiwan Co., Ltd. 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 : _____

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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. Testing Location

Lab Name: Eurofins E&E Wireless Taiwan Co., Ltd.

Site Address: No. 140-1, Changan Street, Bade District, Taoyuan City 334025, Taiwan (R.O.C.)

Site Address: No. 2, Wuquan 5th Rd. Wugu Dist., New Taipei City, Taiwan (R.O.C.)

1.3. Measurement Uncertainty

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

1.4. Test Site Environment

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

(*)The measurement ambient temperature is within this range.

1.5. 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

2 EUT Description

The product specifications of the EUT presented in the report are declared by the manufacturer who shall take full responsibility for the authenticity

Applicant	Plume Design, Inc. 325 Lytton Ave., Palo Alto, CA 94301, United States			
Product Name	SuperPod with WiFi 6E			
Trade Name	Plume Design, Inc.			
Model Number	M1A			
FCC ID	2AG7G-M1A			
Operate Frequency	Frequency Band		Frequency Range (MHz)	Number of Channels
	802.11b 802.11g 802.11n 20 MHz (64QAM) 802.11n 20 MHz (256QAM) 802.11ax 20 MHz		2412 - 2462	11
	802.11n 40 MHz (64QAM) 802.11n 40 MHz (256QAM) 802.11ax 40 MHz		2422 - 2452	9
	802.11a 802.11n 20 MHz / 802.11ac 20 MHz / 802.11ax 20 MHz	U-NII Band 1	5180 – 5240	4
		U-NII Band 2-A	5260 – 5320	4
		U-NII Band 2-C	5500 – 5700	11
		Straddle band	5720	1
		U-NII Band 3	5745 – 5825	5
		U-NII Band 5	5955 – 6415	24
		U-NII Band 6	6435 – 6515	5
		U-NII Band 7	6535 – 6855	17
	802.11n 40 MHz / 802.11ac 40 MHz / 802.11ax 40 MHz	U-NII Band 8	6875 – 7115	13
		U-NII Band 1	5190 – 5230	2
		U-NII Band 2-A	5270 – 5310	2
U-NII Band 2-C		5510 – 5670	5	
Straddle band		5710	1	
U-NII Band 3		5755 – 5795	2	
U-NII Band 5		5965 – 6405	12	
U-NII Band 6		6445 – 6485	2	
U-NII Band 7	6525 – 6845	9		
U-NII Band 8	6885 – 7085	6		

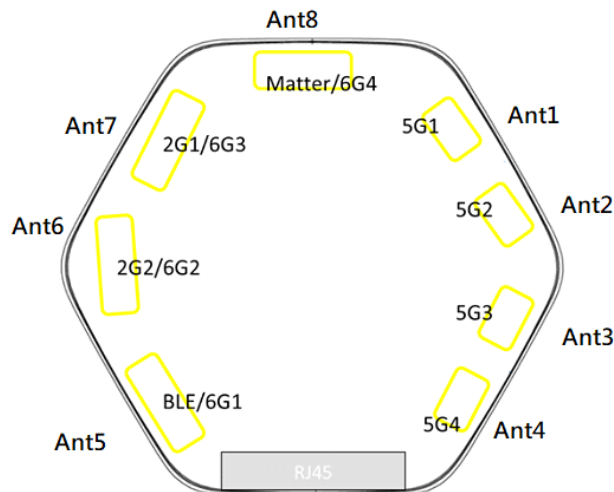
Operate Frequency	Frequency Band	Frequency Range (MHz)	Number of Channels	
Operate Frequency	802.11ac 80 MHz / 802.11ax 80 MHz	U-NII Band 1	5210	1
		U-NII Band 2-A	5290	1
		U-NII Band 2-C	5530 – 5610	2
		Straddle band	5690	1
		U-NII Band 3	5775	1
		U-NII Band 5	5985 – 5385	6
		U-NII Band 6	6465	1
		U-NII Band 7	6545 – 6865	5
		U-NII Band 8	6945 – 7025	2
	802.11ax 160 MHz	U-NII Band 5	6025 – 6345	3
		U-NII Band 6	6505	1
		U-NII Band 7	6665 – 6825	2
		U-NII Band 8	6985	1
Modulation Type	CCK / OFDM / OFDMA			
Antenna Delivery	Reference section 3.1			
EUT Power Rating	100-240 V, 50-60 Hz, 0.6 A			

2.1. Antenna System Description

Ant.	Ant. Type	Gain (dBi)								
		2.4 GHz	5 GHz				6 GHz			
			Band 1	Band 2-A	Band 2-C	Band 3	Band 5	Band 6	Band 7	Band 8
1	IFA Antenna	---	3.60	3.50	4.20	4.30	---	---	---	---
2	IFA Antenna	---	2.90	3.40	4.30	4.30	---	---	---	---
3	IFA Antenna	---	2.30	2.30	3.20	3.30	---	---	---	---
4	IFA Antenna	---	2.40	2.90	3.10	2.00	---	---	---	---
5	IFA Antenna	---	---	---	---	---	5.50	5.20	6.20	5.90
6	IFA Antenna	-0.70	---	---	---	---	4.10	3.70	4.40	4.60
7	IFA Antenna	2.20	---	---	---	---	4.40	3.40	4.00	5.00
8	IFA Antenna	---	---	---	---	---	4.50	4.50	4.30	5.00

Specification		Ant. 1	Ant. 2	Ant. 3	Ant. 4	Ant. 5	Ant. 6	Ant. 7	Ant. 8	Remark
2.4 G	802.11 b/g/n/ac/ax							V		1X1
	802.11 b/g/n/ac/ax						V	V		2x2
5 G	802.11 a/n/ac/ax	V								1x1
	802.11 a/n/ac/ax	V	V	V	V					4x4
6 G	802.11 a/n/ac/ax					V				1x1
	802.11 a/n/ac/ax					V	V	V	V	4x4

Note : The above information is provided by the applicant. Please see Antenna Summary Report for M1A.



3 Test Methodology

3.1. Mode of Operation

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-6+7	ANT-1+2+3+4	ANT-5+6+7+8
Band	2.4 GHz	5 GHz	6 GHz
Mode 1	V	V	V
Mode 2	V	V	V

WLAN 2.4 GHz:

Test Mode	Antenna Delivery	Bandwidth	Test Channel
Mode 1 Mode 2	2TX	20M	6
		40M	6

WLAN 5 GHz:

Test Mode	Antenna Delivery	Bandwidth	Band	Test Channel
Mode 1 Mode 2	4TX	20M	U-NII Band 1	40
			U-NII Band 2-A	56
			U-NII Band 2-C	120
			U-NII Band 3	157
Mode 1 Mode 2	4TX	40M	U-NII Band 1	38
			U-NII Band 2-A	54
			U-NII Band 2-C	118
			U-NII Band 3	151
Mode 1 Mode 2	4TX	80M	U-NII Band 1	42
			U-NII Band 2-A	58
			U-NII Band 2-C	122
			U-NII Band 3	155

WLAN 6 GHz:

Test Mode	Antenna Delivery	Bandwidth	Band	Test Channel
Mode 1 Mode 2	4TX	20M	U-NII Band 5	45
			U-NII Band 6	105
			U-NII Band 7	145
			U-NII Band 8	209
Mode 1 Mode 2	4TX	40M	U-NII Band 5	43
			U-NII Band 6	107
			U-NII Band 7	147
			U-NII Band 8	211
Mode 1 Mode 2	4TX	80M	U-NII Band 5	39
			U-NII Band 6	103
			U-NII Band 7	151
			U-NII Band 8	215
Mode 1 Mode 2	4TX	160M	U-NII Band 5	47
			U-NII Band 6	111
			U-NII Band 7	143
			U-NII Band 8	207

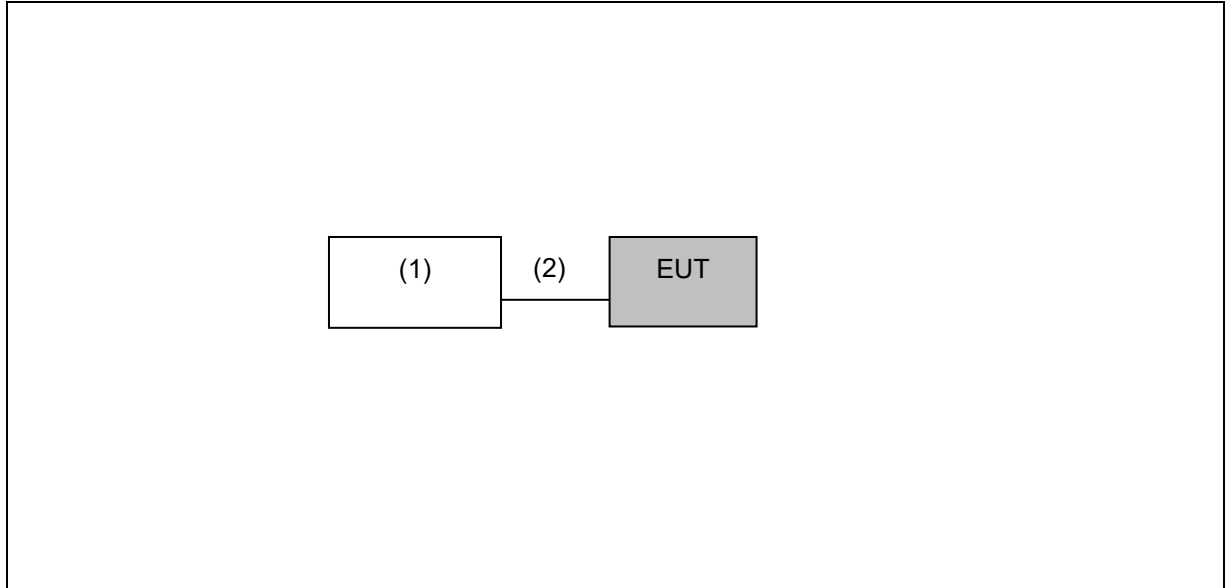
3.2. EUT Test Step

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.

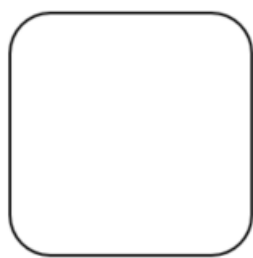
1.	Setup the EUT shown on "Configuration of Test System Details".
2.	Turn on the power of all equipment.
3.	Turn on TX function.
4.	EUT run test program.

3.3. Configuration of Test System Details

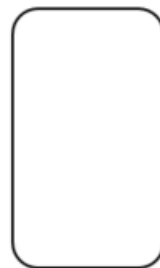
Radiated Emission



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: Jan. 20 ~ Mar. 18, 2023

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. 28, 2022	1 year
<input type="checkbox"/>	Spectrum Analyzer (20 Hz~26.5 GHz)	Agilent	N9020A	US47520902	Sep. 01, 2022	1 year
<input type="checkbox"/>	Preamplifier (30 MHz~1 GHz)	EMCI	EMC330N	980303	Aug. 23, 2022	1 year
<input type="checkbox"/>	Preamplifier (1 GHz~26.5 GHz)	EMCI	EMC012645SE	980266	Oct. 19, 2022	1 year
<input type="checkbox"/>	Preamplifier (1 GHz~26.5 GHz)	EMCI	EMC012645SE	980289	Jan. 13, 2022 Feb. 16, 2023	1 year
<input type="checkbox"/>	Preamplifier (26.5 GHz~40 GHz)	EMCI	EMC2654045	980028	Sep. 02, 2022	1 year
<input type="checkbox"/>	Trilog Broadband Antenna (30 MHz~1 GHz)	Schwarzbeck Mess-Elektronik	VULB9168	01146	Jul. 22, 2022	1 year
<input type="checkbox"/>	Bilog Antenna (30 MHz~1.3 GHz)	ETS	3142C	00086484	Nov. 11, 2022	1 year
<input type="checkbox"/>	Double Ridged Horn Antenna (1 GHz~18 GHz)	ETS	3117	00152321	Sep. 19, 2022	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. 25, 2022	1 year
<input type="checkbox"/>	Horn Antenna (18 GHz~40 GHz)	ETS	3116	00086467	Dec. 05, 2022	1 year
<input checked="" type="checkbox"/>	RF Cable	EMCI	EMC102-KM- KM-8000	001	Feb. 17, 2022 Feb. 08, 2023	1 year
<input type="checkbox"/>	Bluetooth Tester	R&S	CBT	100350	Mar. 17, 2021 Mar. 20, 2023	2 years
<input type="checkbox"/>	Wireless Connectivity Tester	R&S	CMW270	102208	Jun. 01, 2022	1 year
<input type="checkbox"/>	Power Supply	KEITHLEY	2303	4045290	Jan. 06, 2023	1 year
<input checked="" type="checkbox"/>	Software	EZ EMC	1.1.4.4	N/A	N.C.R.	---

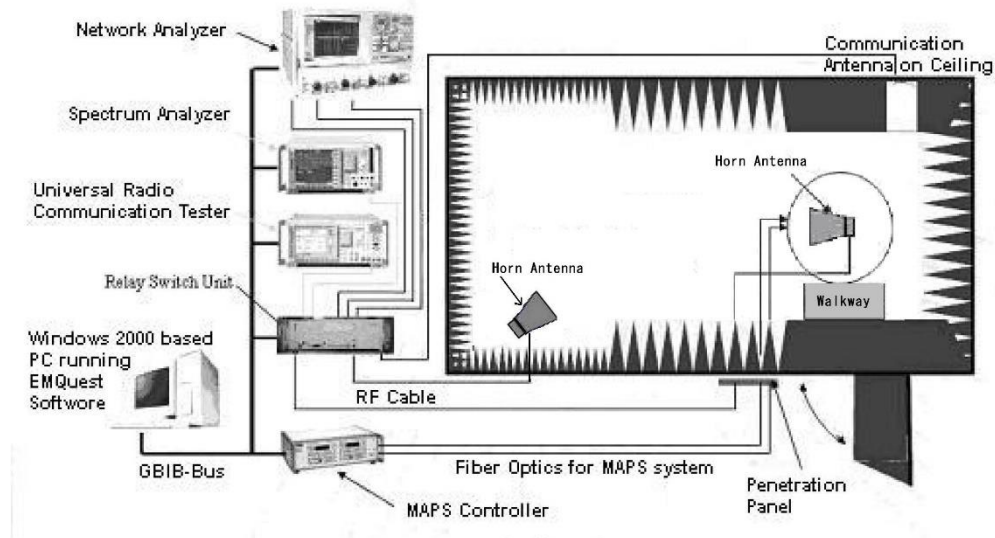
Note: N.C.R. = No Calibration Request.

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_20M_2437	8.27	7.4	0.87	2.20	3.07	H	150	35
2.4G WLAN_2X2_40M_2437	7.75	5.03	2.72	2.20	4.92	H	150	35
5G WLAN_4X4_20M_5200	8.7	4.38	4.32	3.60	7.92	H	150	280
5G WLAN_4X4_20M_5280	8.64	3.86	4.78	3.50	8.28	H	150	280
5G WLAN_4X4_20M_5600	6.28	2.77	3.51	4.30	7.81	H	150	270
5G WLAN_4X4_20M_5785	6.5	2.47	4.03	4.30	8.33	H	150	265
5G WLAN_4X4_40M_5190	9.11	4.88	4.23	3.60	7.83	H	150	270
5G WLAN_4X4_40M_5270	8.8	3.9	4.9	3.50	8.4	H	150	275
5G WLAN_4X4_40M_5590	6.83	3.05	3.78	4.30	8.08	H	150	271
5G WLAN_4X4_40M_5755	7.56	3.36	4.2	4.30	8.5	H	150	263
5G WLAN_4X4_80M_5210	8.05	3.76	4.29	3.60	7.89	H	150	280
5G WLAN_4X4_80M_5290	8.12	3.6	4.52	3.50	8.02	H	150	275
5G WLAN_4X4_80M_5610	5.76	2.11	3.65	4.30	7.95	H	150	268
5G WLAN_4X4_80M_5775	6.04	2.22	3.82	4.30	8.12	H	150	267
6E WLAN_4X4_20M_6175	-5.43	-10.35	4.92	5.50	10.42	V	150	340
6E WLAN_4X4_20M_6475	-5.58	-9.42	3.84	5.20	9.04	V	150	333
6E WLAN_4X4_20M_6675	-5.93	-10.53	4.6	6.20	10.8	V	150	357
6E WLAN_4X4_20M_6995	-5.12	-9.14	4.02	5.90	9.92	V	150	350
6E WLAN_4X4_40M_6165	-6.29	-11.04	4.75	5.50	10.25	V	150	340
6E WLAN_4X4_40M_6485	-3.82	-8.15	4.33	5.20	9.53	V	150	24
6E WLAN_4X4_40M_6685	-5.46	-10.64	5.18	6.20	11.38	V	150	17
6E WLAN_4X4_40M_7005	-5.97	-9.56	3.59	5.90	9.49	V	150	351
6E WLAN_4X4_80M_6145	-7.35	-11.69	4.34	5.50	9.84	V	150	345
6E WLAN_4X4_80M_6465	-5.85	-9.61	3.76	5.20	8.96	V	150	25
6E WLAN_4X4_80M_6705	-7.83	-12.32	4.49	6.20	10.69	V	150	27
6E WLAN_4X4_80M_7025	-7.85	-11.91	4.06	5.90	9.96	V	150	350

Band	EIRP_Beamforming		Array Gain (BF on - BF off)	Antenna Gain (Max Gain)	Directional Gain_BF on	Axis	High	Angle
	ON	OFF						
6E WLAN_4X4_160M_6185	-9.1	-12.98	3.88	5.50	9.38	V	150	20
6E WLAN_4X4_160M_6505	-9.44	-13.32	3.88	5.20	9.08	V	150	14
6E WLAN_4X4_160M_6665	-11.5	-17.45	5.95	6.20	12.15	V	150	356
6E WLAN_4X4_160M_6985	-11.92	-15.1	3.18	5.9	9.08	V	150	351

Notes:

1. EIRP_BF on - EIRP_BF off = Array Gain (BF GAIN).
2. Directional Gain_BF on = Antenna Gain (SISO) + Array Gain.
3. The result for EIRP_BF on and EIRP_BF off, please refer to Appendix B.

--- END---