



RADIO EXPOSURE TEST REPORT

FCC ID : Z8H89FT0068

Equipment : ePMP 4600 6 GHz 4x4 Access Point

Brand Name : Cambium Networks

Model Name : ePMP 4600 6 GHz 4x4 Access Point

Model Number : C060940P021A

Applicant : Cambium Networks Inc.
3800 Golf Road, Suite 360 Rolling Meadows, IL 60008, USA

Manufacturer : Cambium Networks, Ltd.
Ashburton, TQ13 7UP, UK

Standard : 47 CFR Part 2.1091

The product was received on Nov. 22, 2021, and testing was started from Dec. 02, 2021 and completed on Jun. 19, 2024. We, Sporton International Inc. Hsinchu Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in 47 CFR Part 2.1091 and shown compliance with the applicable technical standards.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. Hsinchu Laboratory, the test report shall not be reproduced except in full.

Approved by: Sam Chen

Sporton International Inc. Hsinchu Laboratory

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Photographs of EUT v01



History of this test report

[illegible]



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
2	-	Exposure evaluation	PASS	-

Conformity Assessment Condition:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacture who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the chapter "Measurement Uncertainty".

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Sam Chen

Report Producer: Cathy Chiu



1 General Description

1.1 EUT General Information

For IEEE:

RF General Information			
Evaluation Mode	Frequency Range (MHz)	Operating Frequency (MHz)	Modulation Type
5GHz WLAN	5725-5850	5745-5825	802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
6GHz WLAN	5925-6425 6525-6875	5955-6415 6535-6855	802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)

For Non IEEE:

RF General Information			
Evaluation Mode	Frequency Range (MHz)	Operating Frequency (MHz)	Modulation Type
6GHz WLAN	6525-6875	6835, 6795	OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)



1.2 Antenna Information

Ant.	Port	Brand	Model Name	Antenna Type	Connector	Gain (dBi)		
						UNII3	UNII5	UNII7
1	1	Cabmium Networks	ePMP 4x4 6GHz MU-MIMO Sector Antenna	Sector Antenna	Reversed-SMA	18	18	18.73
	2	Cabmium Networks	ePMP 4x4 6GHz MU-MIMO Sector Antenna	Sector Antenna	Reversed-SMA	18	18	18.73
	3	Cabmium Networks	ePMP 4x4 6GHz MU-MIMO Sector Antenna	Sector Antenna	Reversed-SMA	18	18	18.73
	4	Cabmium Networks	ePMP 4x4 6GHz MU-MIMO Sector Antenna	Sector Antenna	Reversed-SMA	18	18	18.73

Note 1: The above information was declared by manufacturer.

Note 2: Antenna polarization: 2 Vertical (port 1, 3) and 2 Horizontal (port 2, 4).

Note 3: Directional gain information

Type	Maximum Output Power	Power Spectral Density
Non-BF	Directional gain = Max.gain + array gain. For power measurements on IEEE 802.11 devices Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$	$Directional\ Gain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{ant}} \left\{ \sum_{k=1}^{N_{ant}} g_{j,k} \right\}^2}{N_{ANT}} \right]$
BF	$Directional\ Gain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{ant}} \left\{ \sum_{k=1}^{N_{ant}} g_{j,k} \right\}^2}{N_{ANT}} \right]$	$Directional\ Gain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{ant}} \left\{ \sum_{k=1}^{N_{ant}} g_{j,k} \right\}^2}{N_{ANT}} \right]$

Ex.

Directional Gain (NSS1) formula :

$$Directional\ Gain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{ant}} \left\{ \sum_{k=1}^{N_{ant}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

$$NSS1(g_{1,1}) = 10^{G_1/20} ; NSS1(g_{1,2}) = 10^{G_2/20} ; NSS1(g_{1,3}) = 10^{G_3/20} ; NSS1(g_{1,4}) = 10^{G_4/20}$$

$$g_{j,k} = (NSS1(g_{1,1}) + NSS1(g_{1,2}) + NSS1(g_{1,3}) + NSS1(g_{1,4}))^2$$

$$DG = 10 \log[(NSS1(g_{1,1}) + NSS1(g_{1,2}) + NSS1(g_{1,3}) + NSS1(g_{1,4}))^2 / N_{ANT}] \Rightarrow 10$$

$$\log[(10^{G_1/20} + 10^{G_2/20} + 10^{G_3/20} + 10^{G_4/20})^2 / N_{ANT}]$$

Where ;

Two polarization, port 1, 3 for vertical polarization and port 2, 4 for horizontal polarization

$$5G\ G_1 = 18\text{ dBi}; G_2 = 18\text{ dBi}; G_3 = 18\text{ dBi}; G_4 = 18\text{ dBi}; DG = 21.01\text{ dBi}$$

Cross-Polarized Antenna

$$6G\ UNII-5\ G_1 = 18\text{ dBi}; G_2 = 18\text{ dBi}; G_3 = 18\text{ dBi}; G_4 = 18\text{ dBi}; DG = 21.01\text{ dBi}$$

$$6G\ UNII-7\ G_1 = 18.73\text{ dBi}; G_2 = 18.73\text{ dBi}; G_3 = 18.73\text{ dBi}; G_4 = 18.73\text{ dBi}; DG = 21.74\text{ dBi}$$

**For 5GHz:****IEEE 802.11a/n/ac/ax mode (4TX/4RX):**

Port 1, Port 2, Port 3 and Port 4 can be used as transmitting/receiving antenna.

Port 1, Port 2, Port 3 and Port 4 could transmit/receive simultaneously.

For 6GHz:**For IEEE:****IEEE 802.11ax mode (4TX/4RX):**

Port 1, Port 2, Port 3 and Port 4 can be used as transmitting/receiving antenna.

Port 1, Port 2, Port 3 and Port 4 could transmit/receive simultaneously.

For Non IEEE:**4TX/4RX:**

Port 1, Port 2, Port 3 and Port 4 can be used as transmitting/receiving antenna.

Port 1, Port 2, Port 3 and Port 4 could transmit/receive simultaneously.

1.3 Table for Permissive Change

This product is an extension of original one reported under Sporton project number: FA133141-01

Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
Adding frequencies for 6835 MHz at 80MHz and 6795 MHz at 160MHz for Non IEEE.	MPE for 6GHz UNII 7

Note: Other test results are based on original test report.

1.4 Accessories

Accessories
Wall Bracket*1

1.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ 47 CFR Part 2.1091
- ♦ KDB 447498 D04 Interim General RF Exposure Guidance v01

The following reference test guidance is not within the scope of accreditation of TAF.

- ♦ 47 CFR Part 1.1307
- ♦ 47 CFR Part 1.1310



1.6 Testing Location

Testing Location Information	
Test Lab. : Sporton International Inc. Hsinchu Laboratory	
Hsinchu	ADD: No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.)
(TAF: 3787)	TEL: 886-3-656-9065 FAX: 886-3-656-9085
	Test site Designation No. TW3787 with FCC.
	Conformity Assessment Body Identifier (CABID) TW3787 with ISED.

Note: The tested sample of MPE for 6GHz UNII 7 was received on Jun. 07, 2024.



2 Maximum Permissible Exposure

2.1 Limit of Maximum Permissible Exposure

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-3.0	614	1.63	*(100)	<6
3.0-30	1842/f	4.89/f	*(900/f ²)	<6
30-300	61.4	0.163	1.0	<6
300-1500	-	-	f/300	<6
1500-100,000	-	-	5	<6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	*(100)	<30
1.34-30	824/f	2.19/f	*(180/f ²)	<30
30-300	27.5	0.073	0.2	<30
300-1500	-	-	f/1500	<30
1500-100,000	-	-	1.0	<30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

2.2 MPE Calculation Method

The MPE was calculated at 105 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d} \quad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$



2.3 MPE Exemption

Option (A): 1.1307(b)(3)(i)(A): Available maximum time-averaged power is < 1 mW

Option (B): 1.1307(b)(3)(i)(B): Device operates between 300 MHz and 6 GHz and the maximum time-averaged power or effective radiated power (ERP), whichever is greater, <= P_{th}.

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

Option (C): 1.1307(b)(3)(i)(C): ERP is below a threshold calculated based on the distance

R between the person and the antenna / radiating structure, where $R > \lambda / 2 \pi$.

Single RF Sources Subject to Routine Environmental Evaluation	
RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$.
1.34-30	$3,450 R^2/f^2$.
30-300	$3.83 R^2$.
300-1,500	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.
Note: R is in meters, f is in MHz.	



2.4 Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

For IEEE:

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)
5.8G;D1D	18.00	26.87	42.72	0.5	20989.399	105	C	21168

MPE Exemption Option C							
Frequency (MHz)	$\lambda/2\pi$ (cm)	R (cm)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	MPE Exemption
5745	83	105	45.37	43.22	20.989	21.168	Complies

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)
6.2G;D1D	18.00	17.67	33.52	0.32	2421.029	105	C	21168.2
6.7G;D1D	18.73	17.01	33.59	0.25	2421.029	105	C	21168.2

For Non IEEE:

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)
6.7G;D1D	18.73	17.03	33.61	0.23	2421.029	105	C	21168.2

————THE END————