



RADIO EXPOSURE TEST REPORT

FCC ID : Z8H89FT0069

Equipment : ePMP 6 GHz Force 4600C SM / ePMP 4600L 6 GHz 2x2 Access Point

Brand Name : Cambium Networks

Model Name : ePMP 6 GHz Force 4600C SM / ePMP 4600L 6 GHz 2x2 Access Point

Model Number : C068940P151A

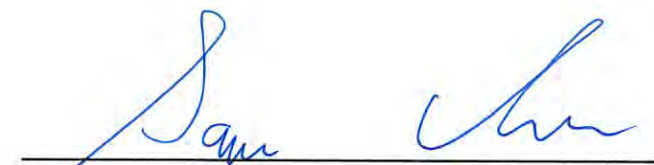
Applicant : Cambium Networks Inc.
3800 Golf Road, Suite 360 Rolling Meadows, IL 60008, USA

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. 09, 2021 and completed on May 14, 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
No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.)



Table of Contents

History of this test report.....	3
Summary of Test Result.....	4
1 General Description	5
1.1 EUT General Information	5
1.2 Antenna Information	6
1.3 Table for Multiple Listing	7
1.4 Table for Permissive Change	7
1.5 Accessories	7
1.6 Applicable Standards	8
1.7 Testing Location	8
2 Maximum Permissible Exposure	9
2.1 Limit of Maximum Permissible Exposure	9
2.2 MPE Calculation Method	9
2.3 MPE Exemption	10
2.4 Calculated Result and Limit.....	11

Photographs of EUT v01



History of this test report

Report No.	Version	Description	Issued Date
FA140145-01	01	Initial issue of report	Jan. 23, 2024
FA140145-01	02	1. Revise Dish antenna gain in UNII5&7. 2. For Dish antenna: Revise the Maximum Permissible Exposure results of 6GHz because the test measurement method of Maximum Equivalent Isotropically Radiated Power (E.I.R.P.) changed.	May 22, 2024
FA140145-01	03	Add RF Exposure for 6FX mode	May 31, 2024



Summary of Test Result

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

Note: Reference to Sporton Project No.: 140145-06 and 140145-08.

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: Sophia Shiung



1 General Description

1.1 EUT General Information

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)

1.2 Antenna Information

For Dish Antenna:

Ant.	Port	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	
						UNII3	UNII5&7
1	1	Cambium	ePMP 6GHz 2x2 Dish Antenna	Dish (Directional Ant.)	RP-SMA	25.21	28.7
	2	Cambium	ePMP 6GHz 2x2 Dish Antenna	Dish (Directional Ant.)	RP-SMA	25.21	28.7

Note 1: The Dish antenna is cross polarization.

For Sector Antenna:

Ant.	Ant. CH	Port	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	
							UNII3&5	UNII7
1	0	-	Cambium	ePMP 2x2 6GHz MU-MIMO Sector Antenna	Sector (Directional Ant.)	RP-SMA	18	18.73
	1	1	Cambium	ePMP 2x2 6GHz MU-MIMO Sector Antenna	Sector (Directional Ant.)	RP-SMA	18	18.73
	2	2	Cambium	ePMP 2x2 6GHz MU-MIMO Sector Antenna	Sector (Directional Ant.)	RP-SMA	18	18.73
	3	-	Cambium	ePMP 2x2 6GHz MU-MIMO Sector Antenna	Sector (Directional Ant.)	RP-SMA	18	18.73

Note 2: The Sector antenna has four CH ports. Only two CH ports (CH1 and CH2) were used for the EUT. The Sector antenna is cross polarization: CH 1 is vertical and CH 2 is horizontal.

Note 3: The above information was declared by manufacturer.

Note 4: Directional gain information for Dish antenna

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 $N_{ANT} \leq 4$	$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$
BF	$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$	$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$

Ex.

Directional Gain (NSS1) formula :

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

$$NSS1(g1,1) = 10^{G1/20} ; NSS1(g1,2) = 10^{G2/20} ; NSS1(g1,3) = 10^{G3/20} ; NSS1(g1,4) = 10^{G4/20}$$

$$g_{j,k} = (NSS1(g1,1) + NSS1(g1,2) + NSS1(g1,3) + NSS1(g1,4))^2$$

$$DG = 10 \log[(NSS1(g1,1) + NSS1(g1,2) + NSS1(g1,3) + NSS1(g1,4))^2 / N_{ANT}] \Rightarrow 10$$

$$\log[(10^{G1/20} + 10^{G2/20} + 10^{G3/20} + 10^{G4/20})^2 / N_{ANT}]$$

Where;



Dish ANT
Cross-Polarized Antenna
6G UNII-5 G1= 28.70 dBi ; G2= 28.70 dBi ;DG= 28.70 dBi
6G UNII-7 G1= 28.70 dBi ; G2= 28.70 dBi ;DG= 28.70 dBi

Note 5: For 5GHz function**For IEEE 802.11a/n/ac/ax (2TX/2RX):**

Port 1 and Port 2 can be used as transmitting/receiving antenna.
Port 1 and Port 2 could transmit/receive simultaneously.

For 6GHz function**For IEEE 802.11ax (2TX/2RX):**

Port 1 and Port 2 can be used as transmitting/receiving antenna.
Port 1 and Port 2 could transmit/receive simultaneously.

1.3 Table for Multiple Listing

Equipment Name / Model Name	Function	Support
ePMP 6 GHz Force 4600C SM	Client	WLAN 5GHz UNII 3 / 6GHz UNII 5&7
ePMP 4600L 6 GHz 2x2 Access Point	AP	

Note: The above information was declared by manufacturer.

1.4 Table for Permissive Change

This product is an extension of original one reported under Sporton project number: FA140145-02

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

Modifications	Performance Checking
1. Add 6GHz for Standard Power (6SD), Fixed Client (6FC) and Standard Client (6FX) through SW change. 2. Add a new directional Sector Antenna for the EUT with the same antenna type but lower gain than the original. (Refer to section 1.2 for detailed information.)	RF Exposure for WLAN 6GHz and for Sector Antenna.

Note: Other test results were based on original report.

1.5 Accessories

N/A.



1.6 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

1.7 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 ISCED.

Note 1: The tested sample for Standard Power Access Point mode (6SD) with Dish antenna for WLAN 6GHz was received on Jul. 06, 2022.

Note 2: The tested sample with Sector antenna (except for 6FX mode) was received on Nov. 15, 2023.

Note 3: The tested sample for Standard Client mode (6FX) was received on Sep. 21, 2023.



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 371 cm for Dish antenna and at 132 cm for Sector antenna to show compliance with the power density limit. The following formula was used to calculate the Power Density:

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d}$$

$$\text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

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, <= Pth.

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

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 Dish antenna:

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)
5.8G;D1D	25.21	27.63	52.84	0.50	53.34	215.77444	371	0.12475	1.00000

MPE Exemption Option C							
Frequency (MHz)	$\lambda/2\pi$ (m)	R (cm)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	MPE Exemption
5745	0.8305	371	53.34	51.19	131.522	264.271	Complies

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)	Option	TL EIRP (dBm)
6.2G;D1D (6SD)	28.70	7.23	35.93	0.06	35.99	371	0.00230	1.00000	C	56.369
6.2G;D1D (6FX)	28.70	0.96	29.66	0.33	29.99	371	0.00058	1.00000	C	56.369
6.7G;D1D (6SD)	28.70	7.17	35.87	0.12	35.99	371	0.00230	1.00000	C	56.369
6.7G;D1D (6FX)	28.70	0.64	29.34	0.50	29.84	371	0.00056	1.00000	C	56.369

For Sector antenna:

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)	Option	TL EIRP (dBm)
5.8G;D1D	18.00	28.88	46.88	0.50	47.38	132	0.24983	1.00000	C	47.393
6.2G;D1D (6SD)	18.00	-	29.84	0.50	30.34	132	0.00494	1.00000	C	47.393
6.2G;D1D (6FX)	18.00	11.95	29.95	0.04	29.99	132	0.00456	1.00000	C	47.393
6.7G;D1D (6SD)	18.73	-	31.84	0.50	32.34	132	0.00783	1.00000	C	47.393
6.7G;D1D (6FX)	18.73	11.13	29.86	0.13	29.99	132	0.00456	1.00000	C	47.393

Note: The above antenna gain was declared by manufacturer.

————THE END————