



RADIO EXPOSURE TEST REPORT

FCC ID : 2ABLK-GPR2022XX
Equipment : GigaPro p6dx, GigaPro p6lx
Brand Name : Calix
Model Name : p6dx GPR2022H, p6lx GPR2022LH
Applicant : Calix Inc.
1035 N. McDowell Blvd. Petaluma, CA94954 U.S.A.
Standard : 47 CFR Part 2.1091

The product was received on Jan. 22, 2024, and testing was started from Jan. 22, 2024 and completed on Jul. 29, 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

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Photographs of EUT v01



History of this test report

TEL : 886-3-656-9065
FAX : 886-3-656-9085
Report Template No.: CB-A1_1 Ver1.1

Page Number : 3 of 13
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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:

1. 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.
2. The presented declaration output power of Lora for EUT in the report are provided by the manufacturer, and We, Sporton International Inc. Hsinchu Laboratory does not guarantee its accuracy.

Reviewed by: Sam Chen**Report Producer: Cathy Chiu**



1 General Description

1.1 EUT General Information

For EUT 1:

RF General Information			
Evaluation Mode	Frequency Range (MHz)	Operating Frequency (MHz)	Modulation Type
2.4GHz WLAN	2400-2483.5	2412-2462	802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) VHT: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
5GHz WLAN	5150-5250 5250-5350 5470-5725 5725-5850	5180-5240 5260-5320 5500-5720 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)

For EUT 2:

RF General Information			
Evaluation Mode	Frequency Range (MHz)	Operating Frequency (MHz)	Modulation Type
2.4GHz WLAN	2400-2483.5	2412-2462	802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) VHT: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
5GHz WLAN	5150-5250 5250-5350 5470-5725 5725-5850	5180-5240 5260-5320 5500-5720 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)
Lora	902-928	500k: 923.3-927.5 125k: 902.3-914.9	Chirp Spread Spectrum (CSS)



1.2 Antenna Information

For EUT 1:

Ant.	Port	Brand Name	Model Name	Antenna Type	Connector	Gain (dBi)	
						2.4GHz	5GHz
1	1	HLt	6NS1293	Sector	I-PEX	-	9.10
2	2	HLt	6NS1293	Sector	I-PEX	-	9.20
3	3	HLt	6NS1293	Sector	I-PEX	-	9.20
4	4	HLt	6NS1293	Sector	I-PEX	-	9.20
5	1	HLt	6NS1293	Sector	I-PEX	8.60	-
6	2	HLt	6NS1293	Sector	I-PEX	8.60	-

For EUT 2:

Ant.	Port	Brand Name	Model Name	Antenna Type	Connector	Gain (dBi)
						LoRa
7	1	HL Tronics	P-0809-02PN	Dipole	N Type	2

Note 1: The above information was declared by manufacturer.

Note 2: 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 ≤ 4	$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{ANT}} \left(\sum_{k=1}^{N_{ch}} g_{j,k} \right)^2}{N_{ANT}} \right]$
BF	$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{ANT}} \left(\sum_{k=1}^{N_{ch}} g_{j,k} \right)^2}{N_{ANT}} \right]$	$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{ANT}} \left(\sum_{k=1}^{N_{ch}} g_{j,k} \right)^2}{N_{ANT}} \right]$

Ex.

Directional Gain (NSS1) formula :

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

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

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

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

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

Where ;

$$2.4G \ G1 = 8.60 \text{ dBi} ; G2 = 8.60 \text{ dBi}$$

$$5G \text{ UNII-1} \ G1 = 9.10 \text{ dBi} ; G2 = 9.20 \text{ dBi} ; G3 = 9.20 \text{ dBi} ; G4 = 9.20 \text{ dBi}$$

$$5G \text{ UNII-2A} \ G1 = 9.10 \text{ dBi} ; G2 = 9.20 \text{ dBi} ; G3 = 9.20 \text{ dBi} ; G4 = 9.20 \text{ dBi}$$

$$5G \text{ UNII-2C} \ G1 = 9.10 \text{ dBi} ; G2 = 9.20 \text{ dBi} ; G3 = 9.20 \text{ dBi} ; G4 = 9.20 \text{ dBi}$$

$$5G \text{ UNII-3} \ G1 = 9.10 \text{ dBi} ; G2 = 9.20 \text{ dBi} ; G3 = 9.20 \text{ dBi} ; G4 = 9.20 \text{ dBi}$$

Cross-Polarized Antenna

$$2.4G \ DG = 8.60 \text{ dBi}$$

$$5G \text{ UNII-1} \ DG = 12.21 \text{ dBi}$$

$$5G \text{ UNII-2A} \ DG = 12.21 \text{ dBi}$$

$$5G \text{ UNII-2C} \ DG = 12.21 \text{ dBi}$$

$$5G \text{ UNII-3} \ DG = 12.21 \text{ dBi}$$

80+80M

$$5G \text{ UNII-1} \ DG = 9.20 \text{ dBi}$$

$$5G \text{ UNII-2A} \ DG = 9.20 \text{ dBi}$$

$$5G \text{ UNII-2C} \ DG = 12.21 \text{ dBi}$$

Note 3: For 2.4GHz function:

For IEEE 802.11 b/g/n/VHT/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 5GHz function:

For IEEE 802.11 a/n/ac/ax (4TX/4RX):

Port 1~4 can be used as transmitting/receiving antenna.

Port 1~4 could transmit/receive simultaneously.

For LoRa function (1TX/1RX):

Only Port 1 can be use as transmitting antenna.



1.3 Table for Multiple Listing

EUT	Equipment Name	Model Name	Description
1	GigaPro p6dx	p6dx GPR2022H	Without certified LoRa module
2	GigaPro p6lx	p6lx GPR2022LH	With certified LoRa module

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: FA430430

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

Modifications	Performance Checking
1. Add the EUT 2 with a certified Lora module (Equipment Name: GigaPro p6lx / Model Name: p6lx GPR2022LH / FCC ID : 2AAS9-WMDS183G2) 2. Add UNII-2A and UNII-2C bands for this device through SW change. 3. Change the capacitor and inductor of 2.4GHz. 4. Update the MPE distance to 56 cm from 51 cm.	MPE for EUT 2
5. Remove the manufacturer's information on test report. (Company name: Alpha Networks Inc. / Company address: No. 8, Li-Hsin 7th Rd., Hsinchu Science Park, Hsinchu 300094, Taiwan).	After evaluating, it does not affect the test.

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

1.5 Table for EUT Supports Functions

Function
AP Router
Bridge
Extender

Note: The above information was declared by manufacturer.



1.6 Accessories

Accessories
Wall-mounted rack*1
Sealing Collar 1*1
Sealing Collar 2*1

1.7 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

1.8 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.



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 EUT 1: 51 cm / EUT 2: 56 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, <= 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 EUT 1:

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;D1D	8.60	27.26	33.71	0.13	2421.029	51	C	4994.0	0.4850
5.2G;D1D	9.20	24.70	31.75	0.50	1678.804	51	C	4994.0	0.3363
5.8G;D1D	9.20	26.77	33.82	0.02	2421.029	51	C	4994.0	0.4850
5.3G;D1D	9.20	20.68	27.73	0.11	608.135	51	C	4994.0	0.1218
5.6G;D1D	9.20	20.75	27.80	0.04	608.135	51	C	4994.0	0.1218

For EUT 2:

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;D1D	8.60	27.26	33.71	0.13	2421.029	56	C	6021.2	0.4022
5.2G;D1D	9.20	24.70	31.75	0.50	1678.804	56	C	6021.2	0.2789
5.3G;D1D	9.20	20.68	27.73	0.11	608.135	56	C	6021.2	0.1010
5.6G;D1D	9.20	20.75	27.80	0.04	608.135	56	C	6021.2	0.1010
5.8G;D1D	9.20	26.77	33.82	0.02	2421.029	56	C	6021.2	0.4022
0.9G;F1D	2.00	27.54	27.39	0.50	615.177	56	C	3621.9	0.1699

**Simultaneous Transmission Analysis Mode:****Mode 1: EUT 1 + WLAN 2.4GHz + WLAN 5GHz**

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;D1D	8.60	27.26	33.71	0.13	2421.029	51	C	4994.0	0.4850
5.8G;D1D	9.20	26.77	33.82	0.02	2421.029	51	C	4994.0	0.4850
Sum TL Ratio_C	0.97								
Ratio Limit	1								

Mode 2: EUT 2 + WLAN 2.4GHz + WLAN 5GHz + LoRa

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;D1D	8.60	27.26	33.71	0.13	2421.029	56	C	6021.2	0.4022
5.8G;D1D	9.20	26.77	33.82	0.02	2421.029	56	C	6021.2	0.4022
0.9G;F1D	2.00	27.54	27.39	0.50	615.177	56	C	3621.9	0.1699
Sum TL Ratio_C	0.9743								
Ratio Limit	1								

Note: The above antenna gain was declared by manufacturer.

————THE END————