Testing Laboratory 3787

RADIO EXPOSURE TEST REPORT

FCC ID	:	2AVNXCYAF5G
Equipment	:	AirgainConnect Fleet
Brand Name	:	Airgain
Model Name	:	CY-AF5G-B-NAT
Applicant	:	Airgain, Inc. 3611 Valley Centre Drive, Ste. 150, San Diego, CA 92130 USA
Manufacturer	:	MitraStar Technology Corporation No. 6, Innovation Rd II, Science-Based Industrial, Hsin-Chu, Taiwan
Standard	:	47 CFR Part 2.1091

The product was received on Apr. 29, 2024, and testing was started from May 02, 2024 and completed on Jun. 04, 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 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

Report No.	Version	Description	Issued Date
FA441623-01	01	Initial issue of report	Jul. 15, 2024

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/manufacturer 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: Muse Chan

1 General Description

1.1 EUT General Information

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, 1024QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
5GHz WLAN	5150-5250 5250-5350 5470-5725 5725-5850	5180-5240 5260-5320 5500-5700 5745-5825	802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
Bluetooth	2400-2483.5	2402-2480	BR / EDR: FHSS (GFSK / π/4-DQPSK / 8DPSK) LE: GFSK

1.2 Antenna Information

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	Airgain	M03AGDKE-LA1X82BU	Monopole	I-PEX	Note 1
2	Airgain	M03AGDKF-LR1X190BU	Monopole	I-PEX	
3	Airgain	M03AGDKG-LK1X137BU	Monopole	I-PEX	
4	Airgain	CH56AGDKZ F56AGDKA-LB1X132BU4LI	Monopole	I-PEX	
5	Airgain	CH56AGDKZ F56AGDKB-LB1X130BU4LI	Monopole	I-PEX	
6	Airgain	N54AGDKC-LY1X255BU4LI	Monopole	I-PEX	
7	Airgain	N54AGDKJ-LE1X272BU4LI	Monopole	I-PEX	

Note 1:

Ant.	Port		Antenna Gain (dBi)				
	WLAN 2.4GHz	WLAN 5GHz	WLAN 2.4GHz	WLAN 5GHz			
				UNII 1	UNII 2A	UNII 2C	UNII 3
1	1	1	2.96	4.26	3.77	4.92	4.62
2	2	2	5.07	4.24	4.38	5.94	4.07

Ant.	Port	Antenna Gain (dBi)		
	Bluetooth	2400MHz	2440MHz	2480MHz
3	1	6.30	6.00	5.30

Item	Directional Gain (dBi)				
	WLAN 2.4GHz	WLAN 5GHz			
		UNII 1	UNII 2A	UNII 2C	UNII 3
2T1S	5.16	5.93	5.87	8.18	7.17
2T2S	5.07	4.26	4.38	5.94	4.62

For Ant. 4~7:

Antenna Gain (dBi)																		
WCDMA			LTE															
B2	B4	B5	B2	B4	B5	B7	B12	B13	B14	B25	B26	B29	B38	B41	B42	B48	B66	B71
5.4	5.9	2.3	5.4	5.9	2.3	5.7	1.6	2.2	2.2	5.4	2.3	2.0	5.8	5.7	4.7	5.9	5.9	1.5

Antenna Gain (dBi)								
5G NR								
n2	n5	n25	n41	n48	n66	n71	n77	n78
5.4	2.3	5.4	5.7	5.9	5.9	1.5	6.7	6.7

Note 2: The above information (except WLAN antenna gain and directional gain) was declared by manufacturer.

Note 3: The antenna gain and directional gain are measured which follow the procedure of KDB 662911 D03.

Note 4: **For 2.4GHz function:**

For IEEE 802.11 b/g/n/ax (2TX/2RX):

Port 1~2 can be used as transmitting/receiving antenna.

Port 1~2 could transmit/receive simultaneously.

For 5GHz function:

For IEEE 802.11 a/n/ac/ax (2TX/2RX):

Port 1~2 can be used as transmitting/receiving antenna.

Port 1~2 could transmit/receive simultaneously.

For Bluetooth function (1TX/1RX):

Only Port 1 can be used as transmitting/receiving antenna.

1.3 Table for EUT Supports Functions

Function	Support Type	Supports Band
AP Router	Master	2.4GHz and 5GHz UNII 2A~3
Slave	Slave without radar detection	2.4GHz and 5GHz UNII 1~3

Note: The above information was declared by manufacturer.

1.4 Table of WWAN Module

The EUT contains WCDMA, LTE, 5G NR modules, the detail information as following.

Brand Name	Model Name	FCC ID	Function
Telit	FN990A28	RI7FN990A28	WCDMA: Band 2/4/5 LTE: Band 2/4/5/7/12/13/14/25/26/29/38/41/42/48/66/71 5G NR: Band n2/n5/n25/n41/n48/n66/n71/n77/n78

1.5 Accessories

Coupler*1

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 ISED.	

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/ cm²)	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/f²)	<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/ cm²)	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/f²)	<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 53 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

E (V/m) = $\frac{\sqrt{30 \times P \times G}}{d}$ Power Density: *Pd* (W/m²) = $\frac{E^2}{377}$

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.

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

Where

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

and

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

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 > λ / 2 π.

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^2f.
1,500-100,000	19.2R^2.
Note: R is in meters, f is in MHz.	

2.4 Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;G1D	5.07	28.87	31.79	0.50	1694.338	53	C	5393.3	0.3143
5.2G;D1D	4.26	23.92	26.03	0.50	449.780	53	C	5393.3	0.0834
5.3G;D1D	4.38	23.96	26.19	0.50	466.659	53	C	5393.3	0.0866
5.6G;D1D	5.94	23.97	27.76	0.08	608.135	53	C	5393.3	0.1128
5.8G;D1D	4.62	28.3	30.77	0.50	1339.677	53	C	5393.3	0.2485
2.4G;BT-LE	6.30	10.59	14.74	0.50	33.420	53	C	5393.3	0.0062
WCDMA II	5.4	24.5	27.75	0.5	668.344	53	C	5393.28	0.1239
WCDMA IV	5.9	24.5	28.25	0.5	749.894	53	C	5393.28	0.1390
WCDMA V	2.3	24.5	24.65	0.5	327.341	53	C	2962.70848	0.1105
Band 2	5.4	24	27.25	0.5	595.662	53	C	5393.28	0.1104
Band 4	5.9	24	27.75	0.5	668.344	53	C	5393.28	0.1239
Band 5	2.3	24	24.15	0.5	291.743	53	C	2962.70848	0.0985
Band 7	5.7	24	27.55	0.5	638.263	53	C	5393.28	0.1183
Band 12	1.6	24	23.45	0.5	248.313	53	C	2513.26848	0.0988
Band 13	2.2	24	24.05	0.5	285.102	53	C	2793.71904	0.1021
Band 14	2.2	24	24.05	0.5	285.102	53	C	2833.26976	0.1006
Band 25	5.4	24	27.25	0.5	595.662	53	C	5393.28	0.1104
Band 26	2.3	24	24.15	0.5	291.743	53	C	2926.75328	0.0997
Band 38	5.8	24	27.65	0.5	653.131	53	C	5393.28	0.1211
Band 41	5.7	26	29.55	0.5	1011.579	53	C	5393.28	0.1876
Band 42	4.7	22.5	25.05	0.5	358.922	53	C	5393.28	0.0665
Band 48	5.9	22.5	26.25	0.5	473.151	53	C	5393.28	0.0877

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
Band 66	5.9	24	27.75	0.5	668.344	53	C	5393.28	0.1239
Band 71	1.5	24	23.35	0.5	242.661	53	C	2383.82976	0.1018
n2	5.4	24.5	27.75	0.5	668.344	53	C	5393.28	0.1239
n5	2.3	24.5	24.65	0.5	327.341	53	C	2962.70848	0.1105
n25	5.4	24.5	27.75	0.5	668.344	53	C	5393.28	0.1239
n41	5.7	27.5	31.05	0.5	1428.894	53	C	5393.28	0.2649
n48	5.9	22.5	26.25	0.5	473.151	53	C	5393.28	0.0877
n66	5.9	24.5	28.25	0.5	749.894	53	C	5393.28	0.1390
n71	1.5	24.5	23.85	0.5	272.270	53	C	2383.82976	0.1142
n77	6.7	27.5	32.05	0.5	1798.871	53	C	5393.28	0.3335
n78	6.7	27.5	32.05	0.5	1798.871	53	C	5393.28	0.3335

Simultaneous Transmission Analysis Mode: WLAN 2.4GHz + WLAN 5GHz + Bluetooth + WWAN

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;G1D	5.07	28.87	31.79	0.50	1694.338	53	C	5393.3	0.3143
5.8G;D1D	4.62	28.3	30.77	0.50	1339.677	53	C	5393.3	0.2485
2.4G;BT-LE	6.30	10.59	14.74	0.50	33.420	53	C	5393.3	0.0062
n77	6.70	27.5	32.05	0.50	1798.871	53	C	5393.3	0.3337
Sum TL Ratio_C	0.9027								
Ratio Limit	1								

Note: The above antenna gain was declared by manufacturer.

THE END