Testing Laboratory 3787

RADIO EXPOSURE TEST REPORT

FCC ID	:	M4Y-SP250
Equipment	:	11ax Access Point
Brand Name	:	ZCOM
Model Name	:	SP250, SP250-S5
Applicant	:	Z Com Inc 5F, No.8, HSIN ANN RD., HSINCH SCIENCE PARK, HSINCHU, 300 TAIWAN
Manufacturer	:	Z Com Inc 5F, No.8, HSIN ANN RD., HSINCH SCIENCE PARK, HSINCHU, 300 TAIWAN
Standard	:	47 CFR Part 2.1091

The product was received on Jul. 15, 2022, and testing was started from Aug. 12, 2022 and completed on Nov. 17, 2022. 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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History of this test report

Report No.	Version	Description	Issued Date
FA261348	01	Initial issue of report	Apr. 11, 2023

Summary of Test Result

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

Declaration of Conformity:
1. The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results. 2. The measurement uncertainty please refer to report "Measurement Uncertainty".
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

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**
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 5725-5850	5180-5240 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)

1.2 Antenna Information

For EUT 1

Ant.	Port		Brand	Model Name	Antenna Type	Connector	Gain (dBi)
	WLAN 2.4GHz	WLAN 5GHz					
1	1	-	Bdtron, Inc.	1001A0018	PCB	I-PEX	Note 1
2	2	-	Bdtron, Inc.	1001A0018	PCB	I-PEX	
3	-	1	Bdtron, Inc.	1001A0016	PCB	I-PEX	
4	-	2	Bdtron, Inc.	1001A0016	PCB	I-PEX	

Note 1:

Ant.	Gain (dBi)												
	WLAN 2.4GHz							WLAN 5GHz UNII 1			WLAN 5GHz UNII 3		
	2412	2417	2422	2437	2452	2457	2462	5150	5200	5250	5750	5800	5850
1	3.03	3.19	3.34	3.95	4.87	4.94	5.21	-	-	-	-	-	-
2	5.03	5.08	5.17	5.58	5.96	5.97	5.89	-	-	-	-	-	-
3	-	-	-	-	-	-	-	4.51	4.79	5.02	3.95	2.98	3.41
4	-	-	-	-	-	-	-	4.62	4.53	5.23	5.63	4.77	4.43

For EUT 2

Ant.	Port		Brand	Model Name	Antenna Type	Connector	Gain (dBi)
	WLAN 2.4GHz	WLAN 5GHz					
1	1	-	Bdtron, Inc.	1001A0018	PCB	I-PEX	Note 2
2	2	-	Bdtron, Inc.	1001A0018	PCB	I-PEX	
3	-	1	Master Wave	98P1DUIPF000	PCB	I-PEX	
	-	2				I-PEX	

Note 2:

Ant.	Gain (dBi)												
	WLAN 2.4GHz							WLAN 5GHz UNII 1			WLAN 5GHz UNII 3		
	2412	2417	2422	2437	2452	2457	2462	5150	5200	5250	5750	5800	5850
1	3.03	3.19	3.34	3.95	4.87	4.94	5.21	-	-	-	-	-	-
2	5.03	5.08	5.17	5.58	5.96	5.97	5.89	-	-	-	-	-	-
3 (port 1)	-	-	-	-	-	-	-	7.82	8.20	8.30	8.04	7.63	7.35
3 (port 2)	-	-	-	-	-	-	-	9.01	9.21	9.58	7.59	6.82	6.62

Note 3: The above information was declared by manufacturer.

Note 4: 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	$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{SS}}\left\{\sum_{k=1}^{N_{ANT}} g_{j,k}\right\}^2}{N_{ANT}}\right]$
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)= $10^{G2/20}$;
gj,k =$(Nss1(g1,1) + Nss1(g1,2))^2$
DG = 10 log[$(Nss1(g1,1) + Nss1(g1,2))^2$ / N_{ANT}] => 10 log[$(10^{G1/20} + 10^{G2/20})^2$ / N_{ANT}]
Where ;

For EUT 1
2.4G 2412 G1= 3.03 dBi ;2.4G 2412 G2= 5.03 dBi ;DG= 7.1dBi
2.4G 2417 G1= 3.19 dBi ;2.4G 2417 G2= 5.08 dBi ;DG= 7.2dBi
2.4G 2422 G1= 3.34 dBi ;2.4G 2422 G2= 5.17 dBi ;DG= 7.31dBi
2.4G 2437 G1= 3.95 dBi ;2.4G 2437 G2= 5.58 dBi ;DG= 7.81dBi
2.4G 2452 G1= 4.87 dBi ;2.4G 2452 G2= 5.96 dBi ;DG= 8.44dBi
2.4G 2457 G1= 4.94 dBi ;2.4G 2457 G2= 5.97 dBi ;DG= 8.48dBi
2.4G 2462 G1= 5.21 dBi ;2.4G 2462 G2= 5.89 dBi ;DG= 8.57dBi
5G 5180 G1= 4.79 dBi ;5G 5180 G2= 4.53 dBi ;DG= 7.67dBi
5G 5200 G1= 4.79 dBi ;5G 5200 G2= 4.53 dBi ;DG= 7.67dBi
5G 5240 G1= 5.02 dBi ;5G 5240 G2= 5.23 dBi ;DG= 8.14dBi
5G 5745 G1= 3.95 dBi ;5G 5745 G2= 5.63 dBi ;DG= 7.84dBi
5G 5785 G1= 2.98 dBi ;5G 5785 G2= 4.77 dBi ;DG= 6.93dBi
5G 5825 G1= 3.41 dBi ;5G 5825 G2= 4.43 dBi ;DG= 6.95dBi
5G 5190 G1= 4.79 dBi ;5G 5190 G2= 4.53 dBi ;DG= 7.67dBi
5G 5230 G1= 5.02 dBi ;5G 5230 G2= 5.23 dBi ;DG= 8.14dBi
5G 5755 G1= 3.95 dBi ;5G 5755 G2= 5.63 dBi ;DG= 7.84dBi
5G 5795 G1= 2.98 dBi ;5G 5795 G2= 4.77 dBi ;DG= 6.93dBi
5G 5210 G1= 4.79 dBi ;5G 5210 G2= 4.53 dBi ;DG= 7.67dBi
5G 5775 G1= 3.95 dBi ;5G 5775 G2= 5.63 dBi ;DG= 7.84dBi

For EUT 2

2.4G 2412 G1= 3.03 dBi ;2.4G 2412 G2= 5.03 dBi ;DG= 7.1dBi
2.4G 2417 G1= 3.19 dBi ;2.4G 2417 G2= 5.08 dBi ;DG= 7.2dBi
2.4G 2422 G1= 3.34 dBi ;2.4G 2422 G2= 5.17 dBi ;DG= 7.31dBi
2.4G 2437 G1= 3.95 dBi ;2.4G 2437 G2= 5.58 dBi ;DG= 7.81dBi
2.4G 2452 G1= 4.87 dBi ;2.4G 2452 G2= 5.96 dBi ;DG= 8.44dBi
2.4G 2457 G1= 4.94 dBi ;2.4G 2457 G2= 5.97 dBi ;DG= 8.48dBi
2.4G 2462 G1= 5.21 dBi ;2.4G 2462 G2= 5.89 dBi ;DG= 8.57dBi
5G 5180 G1= 8.2 dBi ;5G 5180 G2= 9.21 dBi ;DG= 11.73dBi
5G 5200 G1= 8.2 dBi ;5G 5200 G2= 9.21 dBi ;DG= 11.73dBi
5G 5240 G1= 8.3 dBi ;5G 5240 G2= 9.58 dBi ;DG= 11.97dBi
5G 5745 G1= 8.04 dBi ;5G 5745 G2= 7.59 dBi ;DG= 10.83dBi
5G 5785 G1= 7.63 dBi ;5G 5785 G2= 6.82 dBi ;DG= 10.24dBi
5G 5825 G1= 7.63 dBi ;5G 5825 G2= 6.82 dBi ;DG= 10.24dBi
5G 5190 G1= 8.2 dBi ;5G 5190 G2= 9.21 dBi ;DG= 11.73dBi
5G 5230 G1= 8.3 dBi ;5G 5230 G2= 9.58 dBi ;DG= 11.97dBi
5G 5755 G1= 8.04 dBi ;5G 5755 G2= 7.59 dBi ;DG= 10.83dBi
5G 5795 G1= 7.63 dBi ;5G 5795 G2= 6.82 dBi ;DG= 10.24dBi
5G 5210 G1= 8.2 dBi ;5G 5210 G2= 9.21 dBi ;DG= 11.73dBi
5G 5775 G1= 8.04 dBi ;5G 5775 G2= 7.59 dBi ;DG= 10.83dBi

Note 5: **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 802.11a/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.

1.3 Table for Multiple Listing

The difference for each model is show as below:

EUT	Model Name	2.4GHz	5GHz
1	SP250	Equipped with the same antennas.	Equipped with the different antennas.
2	SP250-S5		

Note: The above information was declared by manufacturer.

1.4 Accessories

Accessories
Waterproof connector*4
Mounting bracket*1 (With screw*4)
Metal band*1
Ground wire*1: Non-shielded, 1m

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.	

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 51 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)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm^2)	S Limit (mW/cm^2)
2.4G;G1D	5.58	29.96	35.54	0.45	35.99	3.97192	51	0.12152	1.00000
5.2G;D1D	9.58	23.58	33.16	0.50	33.66	2.32274	51	0.07106	1.00000
5.8G;D1D	7.63	28.22	35.85	0.14	35.99	3.97192	51	0.12152	1.00000

MPE Exemption Option C							
Frequency (MHz)	λ/2π (m)	R (m)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	MPE Exemption
2437	0.0196	0.51	35.99	33.84	2.421	4.994	Complies
5825	0.0082		35.99	33.84	2.421	4.994	Complies

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

Simultaneous Transmissions Option C							
Frequency (MHz)	R (m)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	Simultaneous Transmissions	Simultaneous Transmissions Limit
2437	0.51	35.99	33.84	2.421	4.994	0.97	<= 1
5825		35.99	33.84	2.421	4.994		

———THE END———