Maximum Permissible Exposure Report

1. Product Information

FCC ID:	2A2FV-ZGFREEBOX
Product name	Wireless Module for Portable Scanner
Test Model	ZGFreeBox-T
Power supply	Input: 25.2V⎓3.0A For Adapter: Input: 100-245V~,50/60Hz, 2.5A Max Output: 25.2V⎓3.0A
Operation frequency	5180MHz-5240MHz 5745MHz-5825MHz
Antenna Type	Internal Antenna
Antenna Gain	5.0dBi(Max)
Hardware version	/
Software version	/
Channel Number	4 channels for 20MHz bandwidth (5180-5240MHz) 2 channels for 40MHz bandwidth (5190~5230MHz) 1 channels for 80MHz bandwidth(5210MHz) 5 channels for 20MHz bandwidth(5745-5825MHz) 2 channels for 40MHz bandwidth(5755~5795MHz) 1 channels for 80MHz bandwidth(5775MHz)
Channel Spacing	5MHz
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Mobile Devices

2. Evaluation Method

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.
In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modelled or measured field strengths or power density, is ≤ 1.0. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

3. Limit

3. 1 Refer Evaluation Method

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
FCC KDB publication 447498 D01 General 1 RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.
FCC CFR 47 part1 1.1310: Radiofrequency radiation exposure limits.
FCC CFR 47 part2 2.1091: Radiofrequency radiation exposure evaluation: Mobile Devices

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3. 2 Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
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

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 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

F=frequency in MHz
*=Plane-wave equivalent power density

4. MPE Calculation Method

Predication of MPE limit at a given distance
Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S=power density
P=power input to antenna
G=power gain of the antenna in the direction of interest relative to an isotropic radiator
R=distance to the center of radiation of the antenna

5. Antenna Information

ES-D4 can only use antennas certificated as follows provided by manufacturer;

Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Notes
Internal Antenna	5180MHz-5240MHz 5745MHz-5825MHz	5.0dBi	WiFi Antenna

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6. Conducted Power

[5.2G WIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	Max Conducted Power(dBm)
11A	36	5180	10.18
	40	5200	10.39
	48	5240	9.05
11N20 SISO	36	5180	10.25
	40	5200	10.54
	48	5240	9.5
11N40 SISO	38	5190	10.14
	46	5230	9.58
11AC20 SISO	36	5180	9.76
	40	5200	10.12
	48	5240	9.13
11AC40 SISO	38	5190	10.08
	46	5230	9.41
11AC80 SISO	42	5210	10.33

[5.8G WIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	Max Conducted Power(dBm)
11A	149	5745	6.36
	157	5785	7.37
	165	5825	8.68
11N20 SISO	149	5745	6.26
	157	5785	6.62
	165	5825	7.87
11N40 SISO	151	5755	6.54
	159	5795	7.21
11AC20 SISO	149	5745	9.76
	157	5785	10.12
	165	5825	9.13
11AC40 SISO	151	5755	10.08
	159	5795	9.41
11AC80 SISO	155	5775	7.33

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7. Measurement Results

[5.2G WIFI]

11A (Peak)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	10.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20 SISO (Peak)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	10.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0
11N40 SISO (Peak)			
Channel	Channel 38		Channel 46
Target (dBm)	10.0		9.0
Tolerance ±(dB)	1.0		1.0
11AC20 SISO (Peak)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	10.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0
11AC40 SISO (Peak)			
Channel	Channe38		Channel 46
Target (dBm)	10.0		9.0
Tolerance ±(dB)	1.0		1.0
11AC80 SISO (Peak)			
Channel	Channel 42		
Target (dBm)	10.0		
Tolerance ±(dB)	1.0		

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[5.8G WIFI]

11A (Peak)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	6.0	7.0	8.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20 SISO (Peak)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	6.0	6.0	7.0
Tolerance ±(dB)	1.0	1.0	1.0
11N40 SISO (Peak)			
Channel	Channel 151		Channel 159
Target (dBm)	6.0		7.0
Tolerance ±(dB)	1.0		1.0
11AC20 SISO (Peak)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	9.0	10.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0
11AC40 SISO (Peak)			
Channel	Channe151		Channel 159
Target (dBm)	10.0		9.0
Tolerance ±(dB)	1.0		1.0
11AC80 SISO (Peak)			
Channel	Channel 155		
Target (dBm)	7.0		
Tolerance ±(dB)	1.0		

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8. Evaluation Results

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, r =20cm, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

[5.2G WIFI]

Band/Mode	f (GHz)	RF output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm2)	MPE Limits (mW/cm2)
		dBm	mW				
11A	5.200	11.0	12.5893	5.0	1.0000	0.0079	1.0000
11N20 SISO	5.200	11.0	12.5893	5.0	1.0000	0.0079	1.0000
11N40 SISO	5.190	11.0	12.5893	5.0	1.0000	0.0079	1.0000
11AC20 SISO	5.200	11.0	12.5893	5.0	1.0000	0.0079	1.0000
11AC40 SISO	5.190	11.0	12.5893	5.0	1.0000	0.0079	1.0000
11AC80 SISO	5.210	11.0	12.5893	5.0	1.0000	0.0079	1.0000

[5.8G WIFI]

Band/Mode	f (GHz)	RF output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm2)	MPE Limits (mW/cm2)
		dBm	mW				
11A	5.825	9.0	7.9433	5.0	1.0000	0.0050	1.0000
11N20 SISO	5.825	8.0	6.3096	5.0	1.0000	0.0040	1.0000
11N40 SISO	5.795	8.0	6.3096	5.0	1.0000	0.0040	1.0000
11AC20 SISO	5.785	11.0	12.5893	5.0	1.0000	0.0079	1.0000
11AC40 SISO	5.755	11.0	12.5893	5.0	1.0000	0.0079	1.0000
11AC80 SISO	5.775	8.0	6.3096	5.0	1.0000	0.0040	1.0000

Remark:
1. Output power including turn-up tolerance;
2. Output power is burst average power;
3. MPE evaluate distance is 20cm from user manual provide by manufacturer;
4. MPE values = $PG/4\pi R^2$

9. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

----------THE END OF REPORT----------

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