



Maximum Permissible Exposure Report

1. Product Information

FCC ID:	2AV9UEZ504-1
Product name	Formuler Z10
Test Model	Z10
Power supply	Input: 12V===1A For Adapter 1 Input: 100-240V~, 50/60Hz, 0.35A MAX Output: 12.0V===1.0A For Adapter 2 Input: 100-240V~, 50/60Hz, 0.5A MAX Output: 12.0V===1.5A For Adapter 3 Input: 100-240V~, 50/60Hz, 0.4A Max Output: 12.0V===1.0A
Hardware Version	EZ504-1
Software Version	10.10.23-r26859
Bluetooth	
Frequency Range	2402MHz ~ 2480MHz
Channel Number	79 channels for Bluetooth V5.0(DSS) 40 channels for Bluetooth V5.0 (DTS)
Channel Spacing	1MHz for Bluetooth V5.0 (DSS) 2MHz for Bluetooth V5.0 (DTS)
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8-DPSK for Bluetooth V5.0(DSS) GFSK for Bluetooth V5.0 (DTS)
Bluetooth Version	V5.0
Antenna Description	Internal Antenna, 2.0dBi (max.)
2.4G WLAN	
Frequency Range	2412MHz ~ 2462MHz
Channel Spacing	5MHz
Channel Number	11 Channels for 20MHz bandwidth (2412~2462MHz) 7 Channels for 40MHz bandwidth (2422~2452MHz)
Modulation Type	IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK)
Antenna Description	Antenna 0: Internal Antenna, 2.0dBi (max.) Antenna 1: Internal Antenna, 2.0dBi (max.)
5.2G WLAN	
Frequency Range	5180-5240MHz
Channel Number	4 Channels for 20MHz bandwidth(5180MHz-5240MHz) 2 channels for 40MHz bandwidth(5190MHz~5230MHz) 1 channels for 80MHz bandwidth(5210MHz)
Modulation Type	IEEE 802.11a/n/ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)
Antenna Description	Antenna 0: Internal Antenna, 2.0dBi (max.)



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	Antenna 1: Internal Antenna, 2.0dBi (max.)
5.8G WLAN	
Frequency Range	5745MHz-5825MHz
Channel Number	5 channels for 20MHz bandwidth(5745MHz-5825MHz) 2 channels for 40MHz bandwidth(5755MHz~5795MHz) 1 channels for 80MHz bandwidth(5775MHz)
Modulation Type	IEEE 802.11a/n/ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)
Antenna Description	Antenna 0: Internal Antenna, 2.0dBi (max.) Antenna 1: Internal Antenna, 2.0dBi (max.)
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
Antenna	2400MHz ~ 6000MHz	2.0dBi	BT WiFi Antenna



**6. Conducted Power**

[BT Max Conducted Power]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
GFSK	0	2402	3.63
	39	2441	4.44
	78	2480	4.53
$\pi/4$ DQPSK	0	2402	3.73
	39	2441	4.22
	78	2480	4.24
8DPSK	0	2402	3.81
	19	2441	4.25
	39	2480	4.3

[BLE Max Conducted Power]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
BLE_1M	0	2402	-1.42
	19	2440	-1.84
	39	2480	-1.86

[2.4GWIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	Ant 0 Max Conducted Power(dBm)	Ant 1 Max Conducted Power(dBm)
11B	1	2412	12.65	14.34
	6	2437	13.8	14.8
	11	2462	13.2	15.36
11G	1	2412	16.06	15.81
	6	2437	16.37	16.83
	11	2462	15.85	16.99
11N20 SISO	1	2412	14.84	14.89
	6	2437	14.95	15.39
	11	2462	14.91	17.28
11N40 SISO	3	2422	14.82	14.85
	6	2437	15.51	15.3
	9	2452	14.42	15.62

[2.4GWIFI Max Conducted Power] Ant 0+Ant 1

Mode	Channel	Frequency (MHz)	Max Conducted Power(dBm)
11N20MIMO	1	2412	17.88
	6	2437	18.19
	11	2462	19.27
11N40MIMO	3	2422	17.85
	6	2437	18.42
	9	2452	18.07



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[5.2GWIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	Ant 0 Max Conducted Power(dBm)	Ant 1 Max Conducted Power(dBm)
11A	36	5180	10.12	11.31
	40	5200	10.13	15.56
	48	5240	9.27	14.11
11N20 SISO	36	5180	10.02	15.12
	40	5200	9.23	14.89
	48	5240	8.28	14.02
11N40 SISO	38	5190	9.75	10.17
	46	5230	10.53	8.68
11AC20 SISO	36	5180	8.3	11.01
	40	5200	9.06	10.55
	48	5240	8.16	9.39
11AC40 SISO	38	5190	10.06	10.22
	46	5230	10.01	8.59
11AC80 SISO	42	5210	10.43	7.73

[5.2GWIFI Max Conducted Power] Ant 0+Ant 1

Mode	Channel	Frequency (MHz)	Max Conducted Power(dBm)
11N20 MIMO	36	5180	16.29
	40	5200	15.93
	48	5240	15.05
11N40 MIMO	38	5190	12.98
	46	5230	12.71
11AC20 MIMO	36	5180	12.87
	40	5200	12.88
	48	5240	11.83
11AC40 MIMO	38	5190	13.15
	46	5230	12.37
11AC80 MIMO	42	5210	12.30

[5.8WIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	Ant 0 Max Conducted Power(dBm)	Ant 1 Max Conducted Power(dBm)
11A	149	5745	8.98	9.66
	157	5785	8.95	10.84
	165	5825	10.15	11.37
11N20 SISO	149	5745	8.79	8.8
	157	5785	8.98	9.79
	165	5825	9.35	10.51
11N40 SISO	151	5755	8.89	8.59
	159	5795	8.76	9.57
11AC20 SISO	149	5745	8.89	8.66
	157	5785	9.03	9.8
	165	5825	9.65	10.43
11AC40 SISO	151	5755	8.76	8.46
	159	5795	8.91	9.59
11AC80 SISO	155	5775	9.5	7.63



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[5.8WIFI Max Conducted Power]Ant 0+Ant 1

Mode	Channel	Frequency (MHz)	Max Conducted Power(dBm)
11N20 MIMO	149	5745	11.81
	157	5785	12.41
	165	5825	12.98
11N40 MIMO	151	5755	11.75
	159	5795	12.19
11AC20 MIMO	149	5745	11.79
	157	5785	12.44
	165	5825	13.07
11AC40 MIMO	151	5755	11.62
	159	5795	12.27
11AC80 MIMO	155	5775	11.68

7. Measurement Results

BT

GFSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	3.0	4.0	4.0
Tolerance \pm (dB)	1.0	1.0	1.0
$\pi/4$ DQPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	3.0	4.0	4.0
Tolerance \pm (dB)	1.0	1.0	1.0
8DPSK (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	3.0	4.0	4.0
Tolerance \pm (dB)	1.0	1.0	1.0

BLE

BT LE (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	-1.0	-1.0	-1.0
Tolerance \pm (dB)	1.0	1.0	1.0

2.4GWIFI

11B (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	14.0	14.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
11G (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	15.0	16.0	16.0
Tolerance \pm (dB)	1.0	1.0	1.0
11N20 MIMO (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	17.0	18.0	19.0
Tolerance \pm (dB)	1.0	1.0	1.0
11N40 MIMO (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	17.0	18.0	18.0
Tolerance \pm (dB)	1.0	1.0	1.0



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5.2GWIFI

11A (Peak)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	11.0	15.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20 MIMO (Peak)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	16.0	15.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
11N40 MIMO (Peak)			
Channel	Channel 38	Channel 46	
Target (dBm)	12.0	12.0	
Tolerance ±(dB)	1.0	1.0	
11AC20 MIMO (Peak)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	12.0	12.0	11.0
Tolerance ±(dB)	1.0	1.0	1.0
11AC40 MIMO (Peak)			
Channel	Channel 38	Channel 46	
Target (dBm)	13.0	12.0	
Tolerance ±(dB)	1.0	1.0	
11AC80 MIMO (Peak)			
Channel	Channel 42		
Target (dBm)	12.0		
Tolerance ±(dB)	1.0		

5.8GWIFI

11A (Peak)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	9.0	10.0	11.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20 MIMO (Peak)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.0	12.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0
11N40 MIMO (Peak)			
Channel	Channel 151	Channel 159	
Target (dBm)	11.0	12.0	
Tolerance ±(dB)	1.0	1.0	
11AC20 MIMO (Peak)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.0	12.0	13.0
Tolerance ±(dB)	1.0	1.0	1.0
11AC40 MIMO (Peak)			
Channel	Channel 151	Channel 159	
Target (dBm)	11.0	12.0	
Tolerance ±(dB)	1.0	1.0	
11AC80 MIMO (Peak)			
Channel	Channel 155		
Target (dBm)	11.0		
Tolerance ±(dB)	1.0		





8. Evaluation Results

8.1 Standalone MPE Evaluation

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, $r=20\text{cm}$, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

BT

Band/Mode	RF output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
GFSK	5.0	3.1623	2.0	1.5849	0.0010	1.0000
$\pi/4$ DQPSK	5.0	3.1623	2.0	1.5849	0.0010	1.0000
8DPSK	5.0	3.1623	2.0	1.5849	0.0010	1.0000

BLE

Band/Mode	RF output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
BT LE	0	1.0000	2.0	1.5849	0.0003	1.0000

2.4GWIFI

Band/Mode	RF output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11b	16.0	39.8107	2.0	1.5849	0.0126	1.0000
IEEE 802.11g	17.0	50.1187	2.0	1.5849	0.0158	1.0000
IEEE 802.11n HT20	20.0	100.0000	2.0	1.5849	0.0315	1.0000
IEEE 802.11n HT40	19.0	79.4328	2.0	1.5849	0.0251	1.0000

5.2GWIFI

Band/Mode	RF output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
11A	16.0	39.8107	2.0	1.5849	0.0126	1.0000
11N20 MIMO	17.0	50.1187	2.0	1.5849	0.0158	1.0000
11N40 MIMO	13.0	19.9526	2.0	1.5849	0.0063	1.0000
11AC20 MIMO	13.0	19.9526	2.0	1.5849	0.0063	1.0000
11AC40 MIMO	14.0	25.1189	2.0	1.5849	0.0079	1.0000
11AC80 MIMO	13.0	19.9526	2.0	1.5849	0.0063	1.0000

5.8GWIFI

Band/Mode	RF output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
11A	12.0	15.8489	2.0	1.5849	0.0050	1.0000
11N20 MIMO	13.0	19.9526	2.0	1.5849	0.0063	1.0000
11N40 MIMO	13.0	19.9526	2.0	1.5849	0.0063	1.0000
11AC20 MIMO	14.0	25.1189	2.0	1.5849	0.0079	1.0000
11AC40 MIMO	13.0	19.9526	2.0	1.5849	0.0063	1.0000
11AC80 MIMO	12.0	15.8489	2.0	1.5849	0.0050	1.0000



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8.2 Simultaneous Transmission MPE

The sample support one 2.4GWLAN&5.2G WLAN&5.8G WLAN, another one 2.4GWLAN&5.2G WLAN&5.8G WLAN and another one BT transmit antenna, so need consider simultaneous transmission;

Simultaneous transmission MPE

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

$\Sigma\Sigma$ of MPE ratios ≤ 1.0

Mode	MPE1 (mW/cm2)	MPE2 (mW/cm2)	Σ MPE ratios	Limit	Results
BT+2.4G WIFI	0.0010	0.0315	0.0325	1.0	PASS
BT+5.2G WIFI	0.0010	0.0158	0.0168	1.0	PASS
BT+5.8G WIFI	0.0010	0.0079	0.0089	1.0	PASS
BLE+2.4G WIFI	0.0003	0.0315	0.0318	1.0	PASS
BLE+5.2G WIFI	0.0003	0.0158	0.0161	1.0	PASS
BLE+5.8G WIFI	0.0003	0.0079	0.0082	1.0	PASS
2.4G WIFI+2.4G WIFI	0.0315	0.0315	0.0630	1.0	PASS
2.4G WIFI+5.2G WIFI	0.0315	0.0158	0.0473	1.0	PASS
2.4G WIFI+5.8G WIFI	0.0315	0.0079	0.0394	1.0	PASS
5.2G WIFI+5.2G WIFI	0.0158	0.0158	0.0316	1.0	PASS
5.2G WIFI+5.8G WIFI	0.0158	0.0079	0.0237	1.0	PASS
5.8G WIFI+5.8G WIFI	0.0079	0.0079	0.0158	1.0	PASS

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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