

Maximum Permissible Exposure Report

1. Product Information

EUT : Wireless Cast
Test Model : ZL006
Power Supply : Input: DC 5V, 1A
Hardware Version : H3DL1_DDR3 VER2.1
Software Version : build-166

2.4G WIFI

Frequency Range : 2412MHz ~ 2462MHz
Channel Spacing : 5MHz
Channel Number : 11 Channel for 20MHz bandwidth(2412~2462MHz)
7 Channel for 40MHz bandwidth(2422~2452MHz)
Modulation Type : 802.11b: DSSS; 802.11g/n: OFDM
Antenna Description : PCB Antenna, 0dBi(Max.)

5G WIFI :

Frequency Range : 5180-5240MHz, 5260-5320MHz, 5500-5700MHz,
5745-5825MHz
Channel Number : 4 Channels for 20MHz bandwidth(5180-5240MHz)
4 Channels for 20MHz bandwidth(5260-5320MHz)
11 Channels for 20MHz bandwidth(5500-5700MHz)
5 channels for 20MHz bandwidth(5745-5825MHz)
2 channels for 40MHz bandwidth(5190~5230MHz)
2 channels for 40MHz bandwidth(5270~5310MHz)
5 Channels for 40MHz bandwidth(5510-5670MHz)
2 channels for 40MHz bandwidth(5755~5795MHz)
Modulation Type : IEEE 802.11a/n: OFDM (256QAM,64QAM,16QAM,QPSK
BPSK)
Antenna Description : PCB Antenna, 0dBi(Max.)
Exposure category : General population/uncontrolled environment
EUT Type : Production Unit
Device Type : Mobile Device

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 C95.1-2019](#): IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz 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.

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/Uncontrolled 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

ZL006-Plus can only use antennas certificated as follows provided by manufacturer;

Internal/External Identification	Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Notes
2.4G-5GWIFI Antenna	PCB antenna	5000-6000 MHz	0 dBi	2.4G-5GWIFI Antenna

6. Conducted Power

[2.4G WLAN]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
IEEE 802.11b	1	2412	16.85
	6	2437	16.94
	11	2462	16.43
IEEE 802.11g	1	2412	16.96
	6	2437	16.5
	11	2462	16.47
IEEE 802.11n HT20	1	2412	16.93
	6	2437	16.7
	11	2462	16.65
IEEE 802.11n HT40	3	2422	16.21
	6	2437	16.4
	9	2452	16.09

[5.2GHz WLAN]

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a	36	5180	13.3
	40	5200	13.41
	48	5240	13.31
IEEE 802.11n HT20	36	5180	13.39
	40	5200	13.23
	48	5240	13.07
IEEE 802.11n HT40	38	5190	13.01
	46	5230	12.38

[5.3GHz WLAN]

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a	52	5260	12.46
	56	5280	12.83
	64	5320	13.16
IEEE 802.11n HT20	52	5260	12.2
	56	5280	12.95
	64	5320	12.42
IEEE 802.11n HT40	54	5270	12.74
	62	5310	12.57

[5.5GHz WLAN]

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a	100	5500	12.93
	120	5600	12.45
	140	5700	13.11
IEEE 802.11n HT20	100	5500	14.11
	120	5600	13.66
	140	5700	13.35
IEEE 802.11n HT40	149	5510	14.47
	157	5590	13.99
	165	5670	13.49

[5.8GHz WLAN]

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a	149	5745	12.59
	157	5785	12.28
	165	5825	13.33
IEEE 802.11n HT20	149	5745	13.06
	157	5785	12.59
	165	5825	12.54
IEEE 802.11n HT40	151	5755	10.99
	159	5795	11.09

7. Manufacturing Tolerance

[2.4GHz WLAN]			
IEEE 802.11b (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	16.0	16.0	16.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11g (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	16.0	16.0	16.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	16.0	16.0	16.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	16.0	16.0	16.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
[5.2GHz WLAN]			
IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	13.0	12.0	
Tolerance $\pm$ (dB)	1.0	1.0	
[5.3GHz WLAN]			
IEEE 802.11a (Average)			
Channel	Channel 52	Channel 56	Channel 64
Target (dBm)	12.0	12.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 52	Channel 56	Channel 64
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 54	Channel 62	
Target (dBm)	12.0	12.0	

Tolerance $\pm$ (dB)	1.0	1.0
[5.5GHz WLAN]		
IEEE 802.11b (Peak)		
Channel	Channel 100	Channel 120
Target (dBm)	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0
IEEE 802.11g (Peak)		
Channel	Channel 100	Channel 120
Target (dBm)	14.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0
IEEE 802.11n HT20 (Peak)		
Channel	Channel 149	Channel 157
Target (dBm)	14.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0
[5.8GHz WLAN]		
IEEE 802.11a (Average)		
Channel	Channel 149	Channel 157
Target (dBm)	12.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0
IEEE 802.11n HT20 (Average)		
Channel	Channel 149	Channel 157
Target (dBm)	13.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0
IEEE 802.11n HT40 (Average)		
Channel	Channel 151	Channel 159
Target (dBm)	10.0	11.0
Tolerance $\pm$ (dB)	1.0	1.0

8. Measurement 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.

[2.4GWLAN]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
IEEE 802.11b	17.0	50.1187	0	1.0000	0.009976	1.0000
IEEE 802.11g	17.0	50.1187	0	1.0000	0.009976	1.0000
IEEE 802.11n HT20	17.0	50.1187	0	1.0000	0.009976	1.0000
IEEE 802.11n HT40	17.0	50.1187	0	1.0000	0.009976	1.0000

[5.2GHz WLAN]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
IEEE 802.11a	14.0	25.1189	0	1.0000	0.005000	1.0000
IEEE 802.11n HT20	14.0	25.1189	0	1.0000	0.005000	1.0000
IEEE 802.11n HT40	14.0	25.1189	0	1.0000	0.005000	1.0000

[5.3GHz WLAN]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	14.0	25.1189	0	1.0000	0.005000	1.0000
IEEE 802.11n HT20	13.0	19.9526	0	1.0000	0.003971	1.0000
IEEE 802.11n HT40	13.0	19.9526	0	1.0000	0.003971	1.0000

[5.5GHz WLAN]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	14.0	25.1189	0	1.0000	0.005000	1.0000
IEEE 802.11n HT20	15.0	31.6228	0	1.0000	0.006294	1.0000
IEEE 802.11n HT40	15.0	31.6228	0	1.0000	0.006294	1.0000

[5.8GHz WLAN]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	14.0	25.1189	0	1.0000	0.005000	1.0000
IEEE 802.11n HT20	14.0	25.1189	0	1.0000	0.005000	1.0000
IEEE 802.11n HT40	12.0	15.8489	0	1.0000	0.003155	1.0000

Remark:

1. Output power including turn-up tolerance;
2. Output power was adjust to duty cycle at 100% if measured duty cycle less than 98%;
3. MPE evaluate distance is 20cm from user manual provide by manufacturer.

8.2 Simultaneous Transmission MPE Evaluation

The sample only support one WLAN modular and one antenna, no need consider simultaneous transmission;

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-----