

Maximum Permissible Exposure Report

1. Product Information

FCC ID	: 2AUHL-E1322
EUT	: Wireless Repeater/AP/Router
Test Model	: E1322
Additional Model No.	: WE1322, WM1322
Models Declaration	: PCB board, structure and internal of these model(s) are the same, only the models No. are different. So no additional models were tested.
Power Supply	: Input: AC100-240V,50/60Hz, 50mA
Hardware Version	: V1.3
Software Version	: 3.4.14b
2.4G WLAN	
Frequency Range	: 2412 – 2462 MHz
Channel Number	: 11 Channels for 20MHz bandwidth (2412~2462MHz) 7 Channels for 40MHz bandwidth (2422~2452MHz)
Channel Spacing	: 5MHz
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	: ANT0: PCB Antenna, 3.5dBi(Max.) ANT1: PCB Antenna, 3.5dBi(Max.)
WIFI(5.2G Band)	
Frequency Range	: 5180MHz ~ 5240MHz
Channel Number	: 4 channels for 20MHz bandwidth(5180-5240MHz) 2 channels for 40MHz bandwidth(5190~5230MHz) 1 channels for 80MHz bandwidth(5210MHz)
Modulation Type	: 802.11a/n/ac: OFDM (64QAM, 16QAM, QPSK, BPSK)
Antenna Description	: ANT0: PCB Antenna, 4.5dBi(Max.) ANT1: PCB Antenna, 4.5dBi(Max.)
SRD(5.8G Band)	
Frequency Range	: 5745MHz ~ 5825MHz
Channel Number	: 5 channels for 20MHz bandwidth(5745-5825MHz) 2 channels for 40MHz bandwidth(5755~5795MHz) 1 channels for 80MHz bandwidth(5775MHz)
Modulation Type	: 802.11a/n/ac: OFDM (64QAM, 16QAM, QPSK, BPSK)
Antenna Description	: ANT0: PCB Antenna, 4.5dBi(Max.) ANT1: PCB Antenna, 4.5dBi(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 C95.1-1999](#): 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

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
PCB Antenna 0	2400MHz-2500MHz	3.5 dBi	WiFi Antenna
	5150MHz-5250MHz 5720MHz-5850MHz	4.5 dBi	
PCB Antenna 1	2400MHz-2500MHz	3.5 dBi	WiFi Antenna
	5150MHz-5250MHz 5720MHz-5850MHz	4.5 dBi	

6. Conducted Power

[2.4GWIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	ANT 0 Max Conducted Power(dBm)	ANT 1 Max Conducted Power(dBm)
11B	1	2412	16.39	14.10
	6	2437	14.22	14.57
	11	2462	13.43	15.14
11G	1	2412	16.40	12.85
	6	2437	16.53	15.89
	11	2462	14.05	15.41
11N20SISO	1	2412	15.90	12.88
	6	2437	14.49	14.68
	11	2462	14.11	14.65
11N40SISO	3	2422	14.93	12.78
	6	2437	14.16	13.87
	9	2452	13.97	14.31

[5.2GWIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	ANT 0 Max Conducted Power(dBm)	ANT 1 Max Conducted Power(dBm)
11A	36	5180	15.17	15.80
	40	5200	15.31	15.30
	48	5240	15.70	15.66
11N20 SISO	36	5180	15.99	15.19
	40	5200	16.39	15.50
	48	5240	15.96	15.77
11N40 SISO	38	5190	14.98	15.56
	46	5230	15.34	15.93
11AC20 SISO	36	5180	15.30	15.27
	40	5200	15.55	15.49
	48	5240	15.93	15.81
11AC40 SISO	38	5190	15.15	15.04
	46	5230	15.48	15.51
11AC80 SISO	42	5210	14.75	15.15

[5.8WIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	ANT 0 Max Conducted Power(dBm)	ANT 1 Max Conducted Power(dBm)
11A	149	5745	14.86	14.94
	157	5785	14.73	14.81
	165	5825	14.84	14.79
11N20 SISO	149	5745	14.01	14.99
	157	5785	14.20	15.09
	165	5825	14.15	14.83
11N40 SISO	151	5755	14.42	14.46
	159	5795	14.85	14.67
11AC20 SISO	149	5745	15.30	15.27
	157	5785	15.55	15.49
	165	5825	15.93	15.81
11AC40 SISO	151	5755	15.15	15.04
	159	5795	15.48	15.51
11AC80 SISO	155	5775	13.30	14.47

7. Measurement Results

2.4GWIFI (ANT0)

IEEE 802.11b			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	16.0	14.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11g			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	16.0	16.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n20			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	16.0	14.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n40			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	14.0	14.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0

2.4GWIFI (ANT1)

IEEE 802.11b			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	14.0	14.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11g			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	13.0	15.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n20			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	13.0	14.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n40			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	13.0	13.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0

5.2GWIFI (ANT0)

IEEE 802.11a			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	15.0	15.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	16.0	16.0	16.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	15.0	15.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n40			
Channel	Channel 38	Channel 46	/
Target (dBm)	15.0	15.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT40			
Channel	Channel 38	Channel 46	/
Target (dBm)	15.0	15.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT80			
Channel	Channel 42	/	/
Target (dBm)	14.0	/	/
Tolerance \pm (dB)	1.0	/	/

5.2GWIFI (ANT1)

IEEE 802.11a			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	15.0	15.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	15.0	15.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	15.0	15.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n40			
Channel	Channel 38	Channel 46	/
Target (dBm)	15.0	15.0	/
Tolerance \pm (dB)	1.0	1.0	/

IEEE 802.11ac VHT40			
Channel	Channel 38	Channel 46	/
Target (dBm)	15.0	15.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT80			
Channel	Channel 42	/	/
Target (dBm)	15.0	/	/
Tolerance \pm (dB)	1.0	/	/

5.8GWIFI (ANT0)

IEEE 802.11a			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	14.0	14.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	14.0	14.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	15.0	15.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n40			
Channel	Channel 151	Channel 159	/
Target (dBm)	14.0	14.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT40			
Channel	Channel 151	Channel 159	/
Target (dBm)	15.0	15.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT80			
Channel	Channel 155	/	/
Target (dBm)	13.0	/	/
Tolerance \pm (dB)	1.0	/	/

5.8GWIFI (ANT1)

IEEE 802.11a			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	15.0	15.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	15.0	15.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	15.0	15.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n40			
Channel	Channel 151	Channel 159	/
Target (dBm)	15.0	15.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT40			
Channel	Channel 151	Channel 159	/
Target (dBm)	15.0	15.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT80			
Channel	Channel 155	/	/
Target (dBm)	14.0	/	/
Tolerance \pm (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.

Mode	RF output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
2.4G WIFI (ANT0)	17	50.12	3.5	2.24	0.022	1.0
2.4G WIFI (ANT1)	16	39.81	3.5	2.24	0.018	1.0
5.2G WIFI (ANT0)	17	50.12	4.5	2.82	0.028	1.0
5.2G WIFI (ANT1)	16	39.81	4.5	2.82	0.022	1.0
5.8G WIFI (ANT0)	16	39.81	4.5	2.82	0.022	1.0
5.8G WIFI (ANT1)	16	39.81	4.5	2.82	0.022	1.0

Remark:

1. Output power including turn-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer.
3. MPE values = $PG/4\pi R^2$;
4. The maximum permissible exposure for 300~1500MHz is $f/1500$ mW/cm², for 1500~100,000MHz is 1.0 mW/cm².

8.2 Simultaneous Transmission MPE

The sample support antennas for 2.4G WIFI and 5G WIFI, so need consider simultaneous transmission; Simultaneous transmission MPE

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

Σ of MPE ratios ≤ 1.0

Mode	MPE1 (mW/cm ²)	MPE2 (mW/cm ²)	Σ MPE ratios	Limit	Results
2.4G WIFI+2.4G WIFI	0.022	0.018	0.040	1.0000	PASS
5.2G WIFI +5.2G WIFI	0.028	0.022	0.050	1.0000	PASS
5.8G WIFI+5.8G WIFI	0.022	0.022	0.044	1.0000	PASS
5.2G WIFI+5.8G WIFI	0.028	0.022	0.050	1.0000	PASS

Remark:

The worst case results were recorded.

The 2.4G WIFI and 5G WIFI can't transmit at the same time.

9. Conclusion

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

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