

Maximum Permissible Exposure Report

1. Product Information

FCC ID	: 2AUHL-U0633
EUT	: Mini 802.11ac Wireless USB Adapter
Test Model	: U0633
Power Supply	: 5V/130mA
Hardware version	: V1.1
Software version	: 1030.28
WIFI(2.4G Band)	:
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	: 802.11b: DSSS; 802.11g/n: OFDM
Antenna Description	: omni Antenna, 5dBi (Max.)
WIFI(5.2G Band)	:
Frequency Range	: 5180-5240MHz
Channel Number	: 4 Channels for 20MHz bandwidth(5180-5240MHz) 2 channels for 40MHz bandwidth(5190~5230MHz) 1 Channels for 802.11ac(VHT80)
Modulation Type	: 802.11a/n: OFDM
Antenna Description	: omni Antenna, 5dBi (Max.)
SRD(5.8G Band)	:
Frequency Range	: 5745-5825MHz
Channel Number	: 5 channels for 20MHz bandwidth(5745-5825MHz) 2 channels for 40MHz bandwidth(5755~5795MHz) 1 channels for 80MHz bandwidth(5775MHz)
Modulation Type	: IEEE 802.11a/n/ac: OFDM(64QAM, 16QAM, QPSK, BPSK)
Antenna Description	: omni Antenna, 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

VBOX7 can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna Identification in Internal photos	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna	2.4G/5G Wifi /5.8GWIFI	Dipole Antenna	2.4GHz – 2.4835GHz 5GHz – 6 GHz	5.00 dBi

6. Conducted Power

6.1 Test Setup Block Diagram



6.2 Test Procedure

- 1) The EUT was directly connected to the power meter and antenna output port as show in the Block diagram;
- 2) Reading average power in RMS detector.

6.3 Measurement Equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1	Power Meter	R&S	NRVS	100444	2019-06-11	2020-06-10
2	Power Sensor	R&S	NRV-Z32	10057	2019-06-11	2020-06-10

[2.4GHz WLAN]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
IEEE 802.11b	1	2412	7.12
	6	2437	6.43
	11	2462	6.80
IEEE 802.11g	1	2412	10.85
	6	2437	11.19
	11	2462	10.52
IEEE 802.11n HT20	1	2412	12.81
	6	2437	12.51
	11	2462	12.00
IEEE 802.11n HT40	3	2422	14.88
	6	2437	14.91
	9	2452	14.27

[5.2G WLAN]

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a	36	5180	10.38
	40	5200	9.67
	48	5240	8.34
IEEE 802.11n HT20	36	5180	10.08
	40	5200	9.06
	48	5240	8.05
IEEE 802.11n HT40	38	5190	9.29
	46	5230	8.08
IEEE 802.11ac VHT20	36	5180	9.82
	40	5200	9.11
	48	5240	7.93
IEEE 802.11ac VHT40	38	5190	9.54
	46	5230	8.02
IEEE 802.11ac VHT80	42	5210	8.44

[5.8G WLAN]

Mode	Channel	Frequency (MHz)	Maximum Average Conducted (dBm)
IEEE 802.11a	149	5745	13.50
	157	5785	12.90
	165	5825	12.25
IEEE 802.11n HT20	149	5745	13.39
	157	5785	12.81
	165	5825	12.06
IEEE 802.11n HT40	151	5755	13.60
	159	5795	12.27
IEEE 802.11ac VHT20	149	5745	13.15
	157	5785	12.96
	165	5825	12.22
IEEE 802.11ac VHT40	151	5755	13.65
	159	5795	13.03
IEEE 802.11ac VHT80	155	5775	11.99

7. Manufacturing Tolerance

2.4GHz WLAN

IEEE 802.11b (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	7.0	7.0	7.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11g (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	11.0	11.0	11.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	15.0	15.0	15.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

5.2G WLAN

IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	10.0	9.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	9.0	9.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	9.0	9.0	
Tolerance $\pm$ (dB)	1.0	1.0	
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	9.0	8.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	9.0	8.0	
Tolerance $\pm$ (dB)	1.0	1.0	
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 42		
Target (dBm)	9.0		
Tolerance $\pm$ (dB)	1.0		

5.8 WLAN

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 151	Channel 159	
Target (dBm)	13.0	13.0	
Tolerance $\pm$ (dB)	1.0	1.0	
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	Channel 159	
Target (dBm)	13.0	13.0	
Tolerance $\pm$ (dB)	1.0	1.0	
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 155		
Target (dBm)	12.0		
Tolerance $\pm$ (dB)	1.0		

8. Measurement Results

8.1 Standalone MPE

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.

List maximum power

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
IEEE 802.11b	7.12	1.3305	5.00	1.9953	100%	0.0032	1.0000
IEEE 802.11g	11.19	37.4973	5.00	1.9953	100%	0.0083	1.0000
IEEE 802.11n HT20	12.81	90.1571	5.00	1.9953	100%	0.0120	1.0000
IEEE 802.11n HT40	14.91	95.2796	5.00	1.9953	100%	0.0195	1.0000
IEEE 802.11ac VHT20	13.15	92.6830	5.00	1.9953	100%	0.0130	1.0000
IEEE 802.11ac VHT40	13.65	25.8226	5.00	1.9953	100%	0.0146	1.0000
IEEE 802.11ac VHT80	11.99	29.1072	5.00	1.9953	100%	0.0099	1.0000

Remark:

1. Output power (Average) 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

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.

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