

Maximum Permissible Exposure Report

1. Product Information

FCC ID	: 2ADXC18WMD3AA
EUT	: Wireless Extender
Model Number	: LKV388M-Dual, LKV388N-Dual, 388N-Dual-SSID, 388M-Dual-SSID
Model Declaration	: All the PCB, constructure and PCB components are the same except the model numbers are different.
Test Model	: LKV388M-Dual
Power Supply	: DC 5V/2A supplied by power adapter Adapter input: AC 100V~240V, 50/60Hz, 0.3A
Hardware Version	: V1.0
Software Version	: V1.0
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 80MHz bandwidth(5210MHz)
Modulation Type	: 802.11a/n/ac: OFDM(64QAM, 16QAM, QPSK, BPSK)
WIFI(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	: 802.11a/n/ac: OFDM(64QAM, 16QAM, QPSK, BPSK)
Antenna Description	:
	Two same External Antennas; ANT0(MAIN) used for WIFI TX/RX, 5.0dBi(Max.) for 5G Band ANT1(AUX) used for WIFI TX/RX, 5.0dBi(Max.) for 5G Band
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

LKV388M-Dual 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 0 (MAIN)	5G Wifi Chain 0	External Antenna	5.18GHz – 5.24 GHz 5.745GHz – 5.825 GHz	5.0dBi(Max.) for 5G Band
Antenna 1 (AUX)	5G Wifi Chain 1	External Antenna	5.18GHz – 5.24 GHz 5.745GHz – 5.825 GHz	5.0dBi(Max.) for 5G Band

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	2017-06-17	2018-06-16
2	Power Sensor	R&S	NRV-Z32	10057	2017-06-17	2018-06-16

5GHz WLAN Band 1

IEEE 802.11a						
Frequency (MHz)	Antenna 0			Antenna 1		
	5180	5200	5240	5180	5200	5240
Average Conducted Power(dBm)	4.72	4.54	4.84	5.26	5.10	5.02
IEEE 802.11n HT20						
Frequency (MHz)	Antenna 0			Antenna 1		
	5180	5200	5240	5180	5200	5240
Average Conducted Power(dBm)	4.82	5.08	4.91	5.39	5.23	5.20
IEEE 802.11ac VHT20						
Frequency (MHz)	Antenna 0			Antenna 1		
	5180	5200	5240	5180	5200	5240
Average Conducted Power(dBm)	5.32	5.14	5.51	5.23	5.04	5.43
IEEE 802.11n HT40						
Frequency (MHz)	Antenna 0			Antenna 1		
	5190	/	5230	5190	/	5230
Average Conducted Power(dBm)	3.37	/	2.71	2.97	/	3.20
IEEE 802.11ac VHT40						
Frequency (MHz)	Antenna 0			Antenna 1		
	5190	/	5230	5190	/	5230
Average Conducted Power(dBm)	2.48	/	2.61	3.22	/	3.56
IEEE 802.11ac VHT80						
Frequency (MHz)	Antenna 0			Antenna 1		
	/	5210	/	/	5210	/
Average Conducted Power(dBm)	/	1.52	/	/	1.90	/

5GHz WLAN Band 3

IEEE 802.11a						
Frequency (MHz)	Antenna 0			Antenna 1		
	5745	5785	5825	5745	5785	5825
Average Conducted Power(dBm)	4.27	5.63	5.32	5.13	5.65	5.50
IEEE 802.11n HT20						
Frequency (MHz)	Antenna 0			Antenna 1		
	5745	5785	5825	5745	5785	5825
Average Conducted Power(dBm)	5.12	5.56	5.22	5.28	5.30	5.40
IEEE 802.11ac VHT20						
Frequency (MHz)	Antenna 0			Antenna 1		
	5745	5785	5825	5745	5785	5825
Average Conducted Power(dBm)	5.32	5.14	5.51	5.23	5.04	5.41
IEEE 802.11n HT40						
Frequency (MHz)	Antenna 0			Antenna 1		
	5755	/	5795	5755	/	5795
Average Conducted Power(dBm)	3.04	/	3.47	3.23	/	3.63
IEEE 802.11ac VHT40						
Frequency (MHz)	Antenna 0			Antenna 1		
	5755	/	5795	5755	/	5795
Average Conducted Power(dBm)	2.45	/	2.47	3.15	/	3.17
IEEE 802.11ac VHT80						
Frequency (MHz)	Antenna 0			Antenna 1		
	/	5775	/	/	5775	/
Average Conducted Power(dBm)	/	1.30	/	/	1.70	/

7. Manufacturing Tolerance

5GHz WLAN Band 1

IEEE 802.11a (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5180	5200	5240	5180	5200	5240
Target (dBm)	5.0	5.0	5.0	5.0	5.0	5.0
Tolerance \pm (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5180	5200	5240	5180	5200	5240
Target (dBm)	5.0	5.0	5.0	5.0	5.0	5.0
Tolerance \pm (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5180	5200	5240	5180	5200	5240
Target (dBm)	5.0	5.0	5.0	5.0	5.0	5.0
Tolerance \pm (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5190	/	5230	5190	/	5230
Target (dBm)	3.0	/	3.0	3.0	/	3.0
Tolerance \pm (dB)	1.0	/	1.0	1.0	/	1.0
IEEE 802.11ac VHT40 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5190	/	5230	5190	/	5230
Target (dBm)	3.0	/	3.0	3.0	/	3.0
Tolerance \pm (dB)	1.0	/	1.0	1.0	/	1.0
IEEE 802.11ac VHT80 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	/	5210	/	/	5210	/
Target (dBm)	/	2.0	/	/	2.0	/
Tolerance \pm (dB)	/	1.0	/	/	1.0	/

5GHz WLAN Band 3

IEEE 802.11a (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5745	5785	5825	5745	5785	5825
Target (dBm)	5.0	5.0	5.0	5.0	5.0	5.0
Tolerance \pm (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5745	5785	5825	5745	5785	5825
Target (dBm)	5.0	5.0	5.0	5.0	5.0	5.0
Tolerance \pm (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5745	5785	5825	5745	5785	5825
Target (dBm)	5.0	5.0	5.0	5.0	5.0	5.0
Tolerance \pm (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5755	/	5795	5755	/	5795
Target (dBm)	3.0	/	3.0	3.0	/	3.0
Tolerance \pm (dB)	1.0	/	1.0	1.0	/	1.0
IEEE 802.11ac VHT40 (Average)						
Frequency (MHz)	Antenna 0			Antenna 1		
	5755	/	5795	5755	/	5795
Target (dBm)	3.0	/	3.0	3.0	/	3.0
Tolerance \pm (dB)	1.0	/	1.0	1.0	/	1.0
IEEE 802.11ac VHT80 (Average)						
Frequency	Antenna 0			Antenna 1		

(MHz)	/	5775	/	/	5775	/
Target (dBm)	/	2.0	/	/	2.0	/
Tolerance \pm (dB)	/	1.0	/	/	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.

5GHz WLAN Band 1

Antenna 0

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
IEEE 802.11a	6.00	3.9811	5.0000	3.1623	100%	0.0025	1.0000
IEEE 802.11n HT20	6.00	3.9811	5.0000	3.1623	100%	0.0025	1.0000
IEEE 802.11ac VHT20	6.00	3.9811	5.0000	3.1623	100%	0.0025	1.0000
IEEE 802.11n HT40	4.00	2.5119	5.0000	3.1623	100%	0.0016	1.0000
IEEE 802.11ac VHT40	4.00	2.5119	5.0000	3.1623	100%	0.0016	1.0000
IEEE 802.11ac VHT80	3.00	1.9953	5.0000	3.1623	100%	0.0013	1.0000

Antenna 1

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
IEEE 802.11a	6.00	3.9811	5.0000	3.1623	100%	0.0025	1.0000
IEEE 802.11n HT20	6.00	3.9811	5.0000	3.1623	100%	0.0025	1.0000
IEEE 802.11ac VHT20	6.00	3.9811	5.0000	3.1623	100%	0.0025	1.0000
IEEE 802.11n HT40	4.00	2.5119	5.0000	3.1623	100%	0.0016	1.0000
IEEE 802.11ac VHT40	4.00	2.5119	5.0000	3.1623	100%	0.0016	1.0000
IEEE 802.11ac VHT80	3.00	1.9953	5.0000	3.1623	100%	0.0013	1.0000

5GHz WLAN Band 3

Antenna 0

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
IEEE 802.11a	6.00	3.9811	5.0000	3.1623	100%	0.0025	1.0000
IEEE 802.11n HT20	6.00	3.9811	5.0000	3.1623	100%	0.0025	1.0000
IEEE 802.11ac VHT20	6.00	3.9811	5.0000	3.1623	100%	0.0025	1.0000
IEEE 802.11n HT40	4.00	2.5119	5.0000	3.1623	100%	0.0016	1.0000
IEEE 802.11ac VHT40	4.00	2.5119	5.0000	3.1623	100%	0.0016	1.0000
IEEE 802.11ac VHT80	3.00	1.9953	5.0000	3.1623	100%	0.0013	1.0000

Antenna 1

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
IEEE 802.11a	6.00	3.9811	5.0000	3.1623	100%	0.0025	1.0000
IEEE 802.11n HT20	6.00	3.9811	5.0000	3.1623	100%	0.0025	1.0000
IEEE 802.11ac VHT20	6.00	3.9811	5.0000	3.1623	100%	0.0025	1.0000
IEEE 802.11n HT40	4.00	2.5119	5.0000	3.1623	100%	0.0016	1.0000
IEEE 802.11ac VHT40	4.00	2.5119	5.0000	3.1623	100%	0.0016	1.0000
IEEE 802.11ac VHT80	3.00	1.9953	5.0000	3.1623	100%	0.0013	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 supports 2 antennas for 5G WLAN. The two antennas can transmit simultaneous for 802.11n & ac mode.
 According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;
 \sum of MPE ratios ≤ 1.0

8.2.1 Summary simultaneous transmission information

Modulation Type	Work Frequency Band	Transmit Antenna		Antenna 0 Antenna 1 Synchronization transmit
		Antenna 0 (MAIN)	Antenna 1 (AUX)	
IEEE 802.11a	5.8G/5.2GHz	Yes	Yes	No
IEEE 802.11n HT20	5.8G/5.2GHz	Yes	Yes	Yes
IEEE 802.11n HT40	5.8G/5.2GHz	Yes	Yes	Yes
IEEE 802.11ac VHT20	5.8G/5.2GHz	Yes	Yes	Yes
IEEE 802.11ac VHT40	5.8G/5.2GHz	Yes	Yes	Yes
IEEE 802.11ac VHT80	5.8G/5.2GHz	Yes	Yes	Yes

8.2.2 Summary simultaneous transmission results

Antenna 0 and Antenna 1 for 5G WLAN Band 1

Modulation Type	MPE _{Antenna0} (mW/cm ²)	MPE _{Antenna1} (mW/cm ²)	\sum MPE ratios	Limit	Results
IEEE 802.11n HT20	0.0025	0.0025	0.0050	1.0	PASS
IEEE 802.11ac VHT20	0.0025	0.0025	0.0050	1.0	PASS
IEEE 802.11n HT40	0.0016	0.0016	0.0032	1.0	PASS
IEEE 802.11ac VHT40	0.0016	0.0016	0.0032	1.0	PASS
IEEE 802.11ac VHT80	0.0013	0.0013	0.0026	1.0	PASS

Antenna 0 and Antenna 1 for 5G WLAN Band 3

Modulation Type	MPE _{Antenna0} (mW/cm ²)	MPE _{Antenna1} (mW/cm ²)	\sum MPE ratios	Limit	Results
IEEE 802.11n HT20	0.0025	0.0025	0.0050	1.0	PASS
IEEE 802.11ac VHT20	0.0025	0.0025	0.0050	1.0	PASS
IEEE 802.11n HT40	0.0016	0.0016	0.0032	1.0	PASS
IEEE 802.11ac VHT40	0.0016	0.0016	0.0032	1.0	PASS
IEEE 802.11ac VHT80	0.0013	0.0013	0.0026	1.0	PASS

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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