

Maximum Permissible Exposure Report

1. Product Information

FCC ID : YCJULTRA
 EUT : CPE
 Test Model : ESPRESSObin-Ultra
 Additional Model No. : /
 Model Declaration : /
 Power Supply : Input: AC 100V-240V,50/60Hz ,0.8A Max
 : Output: DC 12V 2A
 Hardware Version : V1.0
 Software Version : V1.0

WIFI (2.4G Band)

Frequency Range : 2412MHz-2462MHz
 Channel Spacing : 5MHz
 Channel Number : 11 channels for 20MHz bandwidth(2412MHz~2462MHz)
 : 7 channels for 40MHz bandwidth(2422MHz~2452MHz)
 Modulation Type : IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK);
 : IEEE 802.11g/n: OFDM(64QAM, 16QAM, QPSK, BPSK)

WIFI (5G Band 1)

Frequency Range : 5180MHz-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)

WIFI (5G Band 3)

Frequency Range : 5745MHz-5825MHz
 : 5 channels for 20MHz bandwidth (5745-5825MHz)
 Channel Number : 2 channels for 40MHz bandwidth (5755~5795MHz)
 : 1 channels for 80MHz bandwidth (5775MHz)
 Modulation Type : IEEE 802.11a/n/ac: OFDM(256QAM,64QAM, 16QAM, QPSK, BPSK)

Antenna Description

Two same external antenna;
 Chain 0 used for WIFI TX/RX, 2.0dBi(Max.);
 Chain 1 used for WIFI TX/RX, 2.0dBi(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 C95.1–1999](#): 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

NeoPix Prime can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Note
ANT0	External Antenna	2000 MHz – 6000 MHz	2.00 dBi	WLAN Antenna
ANT1	External Antenna	2000 MHz – 6000 MHz	2.00 dBi	WLAN Antenna

6. Conducted Power

[2.4GHz WLAN]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)	
			Antenna 0	Antenna 1
IEEE 802.11b	1	2412	11.09	11.1
	6	2437	16.19	11.27
	11	2462	16.00	11.13
IEEE 802.11g	1	2412	16.35	16.33
	6	2437	16.48	16.43
	11	2462	16.32	16.32
IEEE 802.11n HT20	1	2412	16.63	16.6
	6	2437	16.74	16.75
	11	2462	16.59	16.59
IEEE 802.11n HT40	3	2422	16.69	16.71
	6	2437	16.76	16.76
	9	2452	16.7	16.74

[5GHz WLAN Band 1]

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)	
			Antenna 0	Antenna 1
IEEE 802.11a	36	5180	10.65	10.85
	40	5200	10.16	9.81
	48	5240	8.92	9.15
IEEE 802.11n HT20	36	5180	8.79	7.96
	40	5200	9.86	9.44
	48	5240	8.79	8.9
IEEE 802.11n HT40	38	5190	9.69	8.74
	46	5230	9.42	9.44
IEEE 802.11ac VHT20	36	5180	9.55	7.98
	40	5200	10.36	9.4
	48	5240	9.29	10.98
IEEE 802.11ac VHT40	38	5190	11.04	9.65
	46	5230	10.02	11.01
IEEE 802.11ac VHT80	42	5210	10.9	7.96

[5GHz WLAN Band 3]

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)	
			Antenna 0	Antenna 1
IEEE 802.11a	149	5745	9.04	9.45
	157	5785	8.58	8.83
	165	5825	7.94	8.4
IEEE 802.11n HT20	149	5745	9.27	9.32
	157	5785	8.61	8.95
	165	5825	8	8.53
IEEE 802.11n HT40	151	5755	9.65	9.98
	159	5795	11.26	9.77
IEEE 802.11ac VHT20	149	5745	9.55	7.98
	157	5785	10.36	9.4
	165	5825	9.29	10.98
IEEE 802.11ac VHT40	151	5755	11.04	9.65
	159	5795	10.02	11.01
IEEE 802.11ac VHT80	155	5775	10.72	7.77

7. Manufacturing Tolerance

[2.4GHz WLAN]

IEEE 802.11b (Peak)						
Channel	Channel 1		Channel 6		Channel 11	
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	11	11	16	11	16	11
Tolerance \pm (dB)	1.0		1.0		1.0	
IEEE 802.11g (Peak)						
Channel	Channel 1		Channel 6		Channel 11	
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	16	16	16	16	16	16
Tolerance \pm (dB)	1.0		1.0		1.0	
IEEE 802.11n HT20 (Peak)						
Channel	Channel 1		Channel 6		Channel 11	
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	16	16	16	16	16	16
Tolerance \pm (dB)	1.0		1.0		1.0	
IEEE 802.11n HT40 (Peak)						
Channel	Channel 3		Channel 6		Channel 9	
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	16	16	16	16	16	16
Tolerance \pm (dB)	1.0		1.0		1.0	

[5GHz WLAN Band 1]

IEEE 802.11a (Average)						
Channel	Channel 36		Channel 40		Channel 48	
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	10	10	10	9	8	9
Tolerance \pm (dB)	1.0		1.0		1.0	
IEEE 802.11n HT20 (Average)						
Channel	Channel 36		Channel 40		Channel 48	
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	8	7	9	9	8	8
Tolerance \pm (dB)	1.0		1.0		1.0	
IEEE 802.11n HT40 (Average)						
Channel	Channel 38		Channel 46			
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	9	8	9	9		
Tolerance \pm (dB)	1.0		1.0		1.0	
IEEE 802.11ac VHT20 (Average)						
Channel	Channel 36		Channel 40		Channel 48	
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	9	7	10	9	9	10
Tolerance \pm (dB)	1.0		1.0		1.0	
IEEE 802.11ac VHT40 (Average)						
Channel	Channel 38		Channel 46			
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	11	9	10	11		
Tolerance \pm (dB)	1.0		1.0		1.0	
IEEE 802.11ac VHT80 (Average)						
Channel	Channel 42					
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	10	7				
Tolerance \pm (dB)	1.0		1.0		1.0	

[5GHz WLAN Band 3]

IEEE 802.11a (Average)						
Channel	Channel 149		Channel 157		Channel 165	
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	9	9	8	8	7	8
Tolerance ± (dB)	1.0		1.0		1.0	
IEEE 802.11n HT20 (Average)						
Channel	Channel 149		Channel 157		Channel 165	
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	9	9	8	8	8	8
Tolerance ± (dB)	1.0		1.0		1.0	
IEEE 802.11n HT40 (Average)						
Channel	Channel 151		Channel 159			
	Ant 0	Ant 1	Ant 0	Ant 1		
Target (dBm)	9	9	11	9		
Tolerance ± (dB)	1.0		1.0			
IEEE 802.11ac VHT20 (Average)						
Channel	Channel 149		Channel 157		Channel 165	
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1
Target (dBm)	9	7	10	9	9	10
Tolerance ± (dB)	1.0		1.0		1.0	
IEEE 802.11ac VHT40 (Average)						
Channel	Channel 151		Channel 159			
	Ant 0	Ant 1	Ant 0	Ant 1		
Target (dBm)	11	9	10	11		
Tolerance ± (dB)	1.0		1.0			
IEEE 802.11ac VHT80 (Average)						
Channel	Channel 155					
	Ant 0			Ant 1		
Target (dBm)	10			7		
Tolerance ± (dB)	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.

[2.4GHz Band]

[Antenna 0]

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	50.1187	2.00	1.5849	0.015811	1.0000
IEEE 802.11g	17	50.1187	2.00	1.5849	0.015811	1.0000
IEEE 802.11n HT20	17	50.1187	2.00	1.5849	0.015811	1.0000
IEEE 802.11n HT40	17	50.1187	2.00	1.5849	0.015811	1.0000

[Antenna 1]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11b	12	15.8489	2.00	1.5849	0.005000	1.0000
IEEE 802.11g	17	50.1187	2.00	1.5849	0.015811	1.0000
IEEE 802.11n HT20	17	50.1187	2.00	1.5849	0.015811	1.0000
IEEE 802.11n HT40	17	50.1187	2.00	1.5849	0.015811	1.0000

[5.2GHz Band]

[Antenna 0]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	11	12.5893	2.00	1.5849	0.003971	1.0000
IEEE 802.11n HT20	10	10.0000	2.00	1.5849	0.003155	1.0000
IEEE 802.11n HT40	10	10.0000	2.00	1.5849	0.003155	1.0000
IEEE 802.11ac VHT20	11	12.5893	2.00	1.5849	0.003971	1.0000
IEEE 802.11ac VHT40	12	15.8489	2.00	1.5849	0.005000	1.0000
IEEE 802.11ac VHT80	10	10.0000	2.00	1.5849	0.003155	1.0000

[Antenna 1]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	11	12.5893	2.00	1.5849	0.003971	1.0000
IEEE 802.11n HT20	10	10.0000	2.00	1.5849	0.003155	1.0000
IEEE 802.11n HT40	10	10.0000	2.00	1.5849	0.003155	1.0000
IEEE 802.11ac VHT20	11	12.5893	2.00	1.5849	0.003971	1.0000
IEEE 802.11ac VHT40	12	15.8489	2.00	1.5849	0.005000	1.0000
IEEE 802.11ac VHT80	8	6.3096	2.00	1.5849	0.001990	1.0000

[5.8GHz Band]

[Antenna 0]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	10	10.0000	2.00	1.5849	0.003155	1.0000
IEEE 802.11n HT20	10	10.0000	2.00	1.5849	0.003155	1.0000
IEEE 802.11n HT40	12	15.8489	2.00	1.5849	0.005000	1.0000
IEEE 802.11ac VHT20	11	12.5893	2.00	1.5849	0.003971	1.0000
IEEE 802.11ac VHT40	12	15.8489	2.00	1.5849	0.005000	1.0000
IEEE 802.11ac VHT80	11	12.5893	2.00	1.5849	0.003971	1.0000

[Antenna 1]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	10	10.0000	2.00	1.5849	0.003155	1.0000
IEEE 802.11n HT20	10	10.0000	2.00	1.5849	0.003155	1.0000
IEEE 802.11n HT40	10	10.0000	2.00	1.5849	0.003155	1.0000
IEEE 802.11ac VHT20	11	12.5893	2.00	1.5849	0.003971	1.0000
IEEE 802.11ac VHT40	12	15.8489	2.00	1.5849	0.005000	1.0000
IEEE 802.11ac VHT80	8	6.3096	2.00	1.5849	0.001990	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 supports 2T2R MIMO technology for WLAN.
According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

\sum of MPE ratios \leq 1.0

8.2.1 Summary simultaneous transmission information

Modulation Type	Work Frequency Band	Transmit Antenna		Antenna 0 Antenna 1 Synchronization transmit
		Antenna 0	Antenna 1	
OFDM	2.4GHz Band/5.2GHz Band /5.8GHz Band	Yes	Yes	Yes

8.2.2 Summary simultaneous transmission results

Antenna 0 and Antenna 1 for 2.4GHz Band

Modulation Type	MPE _{Antenna 0} Ratios	MPE _{Antenna 1} Ratios	Σ MPE ratios	Limit	Results
IEEE 802.11n HT20	0.015811	0.015811	0.031622	1.0	PASS
IEEE 802.11n HT40	0.015811	0.015811	0.031622	1.0	PASS

Antenna 0 and Antenna 1 for 5.2GHz Band

Modulation Type	MPE _{Antenna 0} Ratios	MPE _{Antenna 1} Ratios	Σ MPE ratios	Limit	Results
IEEE 802.11n HT20	0.003155	0.003155	0.006310	1.0	PASS
IEEE 802.11n HT40	0.003155	0.003155	0.006310	1.0	PASS
IEEE 802.11ac VHT20	0.003971	0.003971	0.007942	1.0	PASS
IEEE 802.11ac VHT40	0.005000	0.005000	0.010000	1.0	PASS
IEEE 802.11ac VHT80	0.003155	0.001990	0.005145	1.0	PASS

Antenna 0 and Antenna 1 for 5.8GHz Band

Modulation Type	MPE _{Antenna 0} Ratios	MPE _{Antenna 1} Ratios	Σ MPE ratios	Limit	Results
IEEE 802.11n HT20	0.003155	0.003155	0.006310	1.0	PASS
IEEE 802.11n HT40	0.005000	0.003155	0.008155	1.0	PASS
IEEE 802.11ac VHT20	0.003971	0.003971	0.007942	1.0	PASS
IEEE 802.11ac VHT40	0.005000	0.005000	0.010000	1.0	PASS
IEEE 802.11ac VHT80	0.003971	0.001990	0.005961	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.

-----THE END OF REPORT-----