

FCC RF Exposure Evaluation

1. Product Information

Product name	:	Smart all-in-one live streaming machine
Test Model	:	SNL02
Power Supply	:	AC 110~220V 50-60Hz 48W
Applicant	:	Shenzhen cadothy technology Co.,Ltd
Address of applicant	:	Room 203, 2nd Floor, Building 5, Shenzhen Software Industry Base, No.11,13,and 15, Haitian 1stRoad,No.14,Haitian 2nd Road,Binhai Community,Yuehai Street,Nanshan District,Shenzhen
Bluetooth		
Frequency Range	:	2402MHz~2480MHz
Channel Number	:	79 channels for Bluetooth
Modulation Type	:	GFSK, $\pi/4$ -DQPSK, 8-DPSK for Bluetooth
Antenna Description	:	ANT0: PCB Antenna, 1.12dBi(Max.)
WIFI(2.4G Band)		
Frequency Range	:	2412MHz~2462MHz
Channel Number	:	11 Channels for 20MHz bandwidth (2412~2462MHz) 7 Channels for 40MHz bandwidth (2422~2452MHz)
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, 1.12dBi(Max.)
WIFI(5.2G Band)		
Frequency Range	:	5180MHz~5240MHz
Channel Number	:	4 channels for 20MHz bandwidth(5180MHz~5240MHz) 2 channels for 40MHz bandwidth(5190MHz~5230MHz)
Modulation Type	:	IEEE 802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)
Antenna Description	:	Ant1: PCB Antenna, 1.31dBi(Max.)
WIFI(5.8G Band)		

Frequency Range	:	5745MHz~5825MHz
Channel Number	:	5 channels for 20MHz bandwidth(5745MHz~5825MHz) 2 channels for 40MHz bandwidth(5755MHz~5795MHz) 1 channels for 80MHz bandwidth(5775MHz)
Modulation Type	:	IEEE 802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)
Antenna Description	:	Ant1: PCB Antenna, 1.19 dBi(Max.)
Exposure category	:	General population/uncontrolled environment
Device Type	:	Mobile Device

2. Evaluation method and Limit

Requirement

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 KDB447498 D01 General RF Exposure Guidance v06 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 modeled 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 planewave 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.

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 f/300	6
300 – 1500	/	/	5	6
1500 – 100,000	/	/		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 f/1500	30
300 – 1500	/	/	1.0	30
1500 – 100,000	/	/		30

F=frequency in MHz

*=Plane-wave equivalent power density

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

As declared by the Applicant, the EUT transmits with the maximum source-based Duty Cycle of 100%-see the User manual, and the EUT is a wireless device used in a mobile application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum mobile separation distance, $r = 20\text{cm}$, as well as the gain of the used antenna is 2.00dBi for BT&WLAN, and the power drift from Turn-up Procedure provide by manufacturer as following states, the RF power density can be obtained.

3. 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 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

4. Conducted Power Results

[BT]

Mode	Channel	Frequency (MHz)	Max Conducted Power(dBm)
GFSK	00	2402	-0.46
	39	2441	-0.59
	79	2480	-1.67
$\pi/4$ -DQPSK	00	2402	1.88
	39	2441	1.69
	79	2480	0.59
8-DPSK	00	2402	1.81
	39	2441	1.64
	79	2480	0.56

[2.4G WIFI]

Mode	Channel	Frequency (MHz)	Ant 0 Max Conducted Power(dBm)
IEEE 802.11b	1	2412	10.31
	6	2437	10.44
	11	2462	10.2
IEEE 802.11g	1	2412	9.64
	6	2437	9.84
	11	2462	10.47
IEEE 802.11n HT20	1	2412	10.33
	6	2437	10.15
	11	2462	10.26
IEEE 802.11n HT40	3	2422	10.62
	6	2437	10.31
	9	2452	10.38

[5.2G WIFI]

Mode	Channel	Frequency (MHz)	Ant 1 Max Conducted Power(dBm)
IEEE 802.11a	36	5180	9.27
	40	5200	9.36
	48	5240	10.1
IEEE 802.11n HT20	36	5180	7.91
	40	5200	9.23
	48	5240	8.73
IEEE 802.11n HT40	38	5190	10.01
	46	5230	9.8
IEEE 802.11ac VHT20	36	5180	8.61
	40	5200	9.32
	48	5240	8.47
IEEE 802.11ac VHT40	38	5190	9.86
	46	5230	9.81

[5.8G WIFI]

Mode	Channel	Frequency (MHz)	Ant 1 Max Conducted Power(dBm)
IEEE 802.11a	149	5745	10.68
	157	5785	10.57
	165	5825	9.83
IEEE 802.11n HT20	149	5745	12.4
	157	5785	10.78
	165	5825	10.04
IEEE 802.11n HT40	151	5755	9.82
	159	5795	9.29
IEEE 802.11ac VHT20	149	5745	10.53
	157	5785	9.38
	165	5825	8.98
IEEE 802.11ac VHT40	151	5755	10.18
	159	5795	9.16
IEEE 802.11ac VHT80	155	5775	9.95

5. Manufacturing Tolerance

[BT]

GFSK(Peak)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	1.0	1.0	1.0
Tolerance $\pm$ (dB)	2.0	2.0	2.0
$\pi/4$ -DQPSK(Peak)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	1.0	1.0	1.0
Tolerance $\pm$ (dB)	2.0	2.0	2.0
8-DPSK(Peak)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	1.0	1.0	1.0
Tolerance $\pm$ (dB)	2.0	2.0	2.0

[2.4G WIFI Ant0]

IEEE 802.11b (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	9.0	9.0	9.0
Tolerance $\pm$ (dB)	2.0	2.0	2.0
IEEE 802.11g (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	9.0	9.0	9.0
Tolerance $\pm$ (dB)	2.0	2.0	2.0
IEEE 802.11n HT20 (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	9.0	9.0	9.0
Tolerance $\pm$ (dB)	2.0	2.0	2.0
IEEE 802.11n HT40 (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	9.0	9.0	9.0
Tolerance $\pm$ (dB)	2.0	2.0	2.0

[5.2G WIFI Ant1]

IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	9.0	9.0

Tolerance $\pm$ (dB)	2.0	2.0	2.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	9.0	9.0
Tolerance $\pm$ (dB)	2.0	2.0	2.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	9.0	9.0	
Tolerance $\pm$ (dB)	2.0	2.0	
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	9.0	9.0
Tolerance $\pm$ (dB)	2.0	2.0	2.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	9.0	9.0	
Tolerance $\pm$ (dB)	2.0	2.0	

[5.8G WIFI Ant1]

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.0	9.0	9.0
Tolerance $\pm$ (dB)	2.0	2.0	2.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.0	9.0	9.0
Tolerance $\pm$ (dB)	2.0	2.0	2.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 151	Channel 159	
Target (dBm)	11.0	9.0	
Tolerance $\pm$ (dB)	2.0	2.0	
IEEE 802.11ac VHT20 (Average)			

Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	11.0	9.0	9.0
Tolerance $\pm$ (dB)	2.0	2.0	2.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	Channel 159	
Target (dBm)	11.0	9.0	
Tolerance $\pm$ (dB)	2.0	2.0	
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 155		
Target (dBm)	9.0		
Tolerance $\pm$ (dB)	2.0		

6. Evaluation Results

Standalone 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.

Antenna 0:

BT

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
GFSK	3.00	1.9953	1.12	1.2942	0.0005	1.0000
$\pi/4$ DQPSK	3.00	1.9953	1.12	1.2942	0.0005	1.0000
8DPSK	3.00	1.9953	1.12	1.2942	0.0005	1.0000

2.4GWLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
802.11b	11.00	12.5893	1.12	1.2942	0.0032	1.0000
802.11g	11.00	12.5893	1.12	1.2942	0.0032	1.0000
802.11n(HT20)	11.00	12.5893	1.12	1.2942	0.0032	1.0000
802.11n(HT40)	11.00	12.5893	1.12	1.2942	0.0032	1.0000

Antenna 1:

5.2GWLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
802.11a	11.00	12.5893	1.31	1.3521	0.0034	1.0000
802.11n20	11.00	12.5893	1.31	1.3521	0.0034	1.0000
802.11n40	11.00	12.5893	1.31	1.3521	0.0034	1.0000
802.11ac20	11.00	12.5893	1.31	1.3521	0.0034	1.0000
802.11ac40	11.00	12.5893	1.31	1.3521	0.0034	1.0000

5.8GWLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
802.11a	13.00	19.9526	1.19	1.3152	0.0052	1.0000
802.11n20	13.00	19.9526	1.19	1.3152	0.0052	1.0000
802.11n40	13.00	19.9526	1.19	1.3152	0.0052	1.0000
802.11ac20	13.00	19.9526	1.19	1.3152	0.0052	1.0000
802.11ac40	13.00	19.9526	1.19	1.3152	0.0052	1.0000
802.11ac80	11.00	12.5893	1.19	1.3152	0.0033	1.0000

Remark:

1. Output power including tune-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer;

Simultaneous Transmission

According to KDB447498 D01 General RF Exposure Guidance v06 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

$\sum$ of MPE ratios ≤ 1.0

Summary simultaneous transmission results

Maximum MPE ratio ANT0 (2.4GWLAN)	Maximum MPE ratio ANT1 (5.8GWLAN)	$\sum$ MPE ratios	Limit	Results
0.0032	0.0052	0.0084	1.0	PASS

Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure and SAR Exclusion Threshold per KDB447498 D01 General RF Exposure Guidance v06.