

FCC RF Exposure Evaluation

1. Product Information

FCC ID	2BBTW-X23A3U-Z1
Product Name	ADTH NEXTGEN TV Box
Test Model	X23A3U-Z2, X23A3U-XX
Power Supply	Input: 100-240V~ 50/60Hz 0.6A Output: 12V-1.5A
Modulation Type	Bluetooth BR/EDR: GFSK, π /4DQPSK, 8DPSK Bluetooth LE: GFSK 2.4G WIFI: IEEE 802.11b: DSSS IEEE 802.11/g/n: OFDM 5G WIFI : IEEE 802.11a/ac/n: OFDM
Antenna Type	Bluetooth: PCB Antenna WIFI ANT 1: PIFA Antenna WIFI ANT 2: PCB Antenna
Antenna Gain	Bluetooth: 1.44dBi 2.4G WIFI ANT 1: 2.43dBi 2.4G WIFI ANT 2: 0.45dBi 5G WIFI ANT 1: 5.39dBi 5G WIFI ANT 2: 4.24dBi
Frequency Range	Bluetooth: 2402 – 2480MHz 2.4G WIFI: 2412MHz~2462MHz 5G WIFI: 5180 – 5240MHz/ 5745 - 5825MHz
Exposure Category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Mobile Device

2. Evaluation Method and Limit

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 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

X23A3U-Z2 can only use antennas certificated as follows provided by manufacturer;

Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Note
Internal Antenna	2402 MHz-2480 MHz 2412MHz-2462MHz 5180MHz-5240MHz 5745MHz-5825MHz	Bluetooth: 1.44dBi 2.4G WIFI ANT 1: 2.43dBi 2.4G WIFI ANT 2: 0.45dBi 5G WIFI ANT 1: 5.39dBi 5G WIFI ANT 2: 4.24dBi	Bluetooth & WLAN Antenna

6. Conducted Power Results

[BT]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
GFSK	0	2402	8.75
	39	2441	8.90
	78	2480	7.21
$\pi/4$ DQPSK	0	2402	10.60
	39	2441	9.90
	78	2480	9.43
8DPSK	0	2402	14.07
	39	2441	14.61
	78	2480	14.16

[BLE]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
1M	0	2402	10.22
	19	2440	10.39
	39	2480	9.84
2M	0	2402	9.60
	19	2440	9.58
	39	2480	8.43

[2.4GWIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	Max Conducted Power(dBm)		
			ANT1	ANT2	MIMO
IEEE 802.11b	1	2412	14.04	15.51	/
	6	2437	14.52	14.70	/
	11	2462	15.51	14.86	/
IEEE 802.11g	1	2412	9.17	8.52	/
	6	2437	7.75	8.52	/
	11	2462	8.64	8.50	/
IEEE 802.11n HT20 SISO	1	2412	9.71	9.15	/
	6	2437	8.02	8.86	/
	11	2462	8.31	8.68	/
IEEE 802.11n HT40 SISO	3	2422	9.41	9.12	/
	6	2437	8.05	8.68	/
	9	2452	8.12	8.48	/
IEEE 802.11n HT20 MIMO	1	2412	9.52	8.38	12.00
	6	2437	7.80	8.12	10.97
	11	2462	7.63	8.00	10.83
IEEE 802.11n HT40 MIMO	3	2422	9.00	8.72	11.87
	6	2437	7.54	8.33	10.96
	9	2452	7.55	8.07	10.83

[5.2GWIFI Max Conducted Power]

Mode	Frequency (MHz)	Max Conducted Power(dBm)		
		ANT1	ANT2	MIMO
802.11a	5180	8.77	9.82	/
	5200	9.79	10.27	/
	5240	10.25	11.34	/
802.11n (HT20) SISO	5180	9.25	9.87	/
	5200	9.62	10.37	/
	5240	10.20	11.31	/
802.11n (HT40) SISO	5190	9.34	9.97	/
	5230	9.90	10.96	/
802.11n (HT20) MIMO	5180	8.25	7.93	11.10
	5200	7.77	8.58	11.20
	5240	8.12	9.44	11.84
802.11n (HT40) MIMO	5190	7.24	8.43	10.89
	5230	7.69	8.94	11.37
802.11ac (VHT20) SISO	5180	8.42	9.04	/
	5200	8.85	9.58	/
	5240	9.33	10.50	/
802.11ac (VHT40) SISO	5190	8.59	9.13	/
	5230	9.08	10.09	/
802.11ac (VHT80) SISO	5210	9.23	10.26	/
802.11ac (VHT20) MIMO	5180	7.65	8.51	11.11
	5200	7.69	9.13	11.48
	5240	8.56	10.04	12.37
802.11ac (VHT40) MIMO	5190	8.14	8.85	11.52
	5230	8.66	9.95	12.36
802.11ac (VHT80) MIMO	5210	8.90	9.62	12.29

[5.8WIFI Max Conducted Power]

Mode	TX Type	Frequency (MHz)	Conducted Output Power (dBm)		
			ANT1	ANT2	MIMO
802.11a	SISO	5745	10.60	11.37	/
		5785	12.97	10.60	/
		5825	14.04	12.46	/
802.11n (HT20)	SISO	5745	10.94	10.36	/
		5785	12.01	9.74	/
		5825	13.10	11.31	/
802.11n (HT40)	SISO	5755	10.64	10.69	/
		5795	11.57	9.48	/
802.11n	MIMO	5745	9.36	9.09	12.24

(HT20)		5785	10.61	8.38	12.65
		5825	11.52	9.81	13.76
802.11n (HT40)	MIMO	5755	9.09	9.30	12.21
		5795	10.22	8.11	12.30
802.11ac (VHT20)	SISO	5745	10.47	10.67	/
		5785	11.75	9.59	/
		5825	12.92	11.24	/
802.11ac (VHT40)	SISO	5755	10.78	10.87	/
		5795	11.83	9.65	/
802.11ac (VHT80)	SISO	5775	11.94	10.79	/
802.11ac (VHT20)	MIMO	5745	9.51	9.32	12.43
		5785	10.82	8.47	12.81
		5825	11.68	9.85	13.87
802.11ac (VHT40)	MIMO	5755	9.24	9.52	12.39
		5795	10.50	8.33	12.56
802.11ac (VHT80)	MIMO	5775	10.55	9.48	13.06

7.Manufacturing Tolerance

<BT>

GFSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	9.0	9.0	8.0
Tolerance ±(dB)	1.0	1.0	1.0
π /4DQPSK(Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	11.0	10.0	10.0
Tolerance ±(dB)	1.0	1.0	1.0
8DPSK(Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	15.0	15.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0

<BLE-1M>

GFSK (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	11.0	11.0	10.0
Tolerance ±(dB)	1.0	1.0	1.0

<BLE-2M>

GFSK (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	10.0	10.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0

<2.4G WIFI >

11B (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	16.0	15.0	16.0
Tolerance ±(dB)	1.0	1.0	1.0
11G (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	10.0	9.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20 (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	12.0	11.0	11.0
Tolerance ±(dB)	1.0	1.0	1.0
11N40 (Average)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	12.0	11.0	11.0
Tolerance ±(dB)	1.0	1.0	1.0

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11A (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	11.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	12.0	12.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0
11N40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	11.0	12.0	
Tolerance ±(dB)	1.0	1.0	
11AC20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	12.0	12.0	13.0
Tolerance ±(dB)	1.0	1.0	1.0
11AC40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	12.0	13.0	
Tolerance ±(dB)	1.0	1.0	
11AC80 (Average)			
Channel	Channel 42		
Target (dBm)	13.0		
Tolerance ±(dB)	1.0		

<5.8GWIFI >

11A (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	12.0	11.0	13.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	13.0	13.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0
11N40 (Average)			
Channel	Channel 151	Channel 159	
Target (dBm)	13.0	13.0	
Tolerance ±(dB)	1.0	1.0	
11AC20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	13.0	13.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0
11AC40 (Average)			
Channel	Channel 151	Channel 159	
Target (dBm)	13.0	13.0	
Tolerance ±(dB)	1.0	1.0	
11AC80 (Average)			
Channel	Channel 155		
Target (dBm)	14.0		
Tolerance ±(dB)	1.0		

8. Evaluation 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 =20cm, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

BT

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
GFSK	9.0	7.9433	1.44	1.3932	100%	0.0022	1.0000
π/4DQPSK	11.0	12.5893	1.44	1.3932	100%	0.0035	1.0000
8-DPSK	15.0	31.6228	1.44	1.3932	100%	0.0088	1.0000

BLE

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
GFSK	11.0	12.5893	1.44	1.3932	100%	0.0035	1.0000
GFSK	10.0	10.0000	1.44	1.3932	100%	0.0028	1.0000

2.4G WIFI

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	16.0	39.8107	2.43	1.7498	100%	0.0139	1.0000
IEEE 802.11g	10.0	10.0000	2.43	1.7498	100%	0.0035	1.0000
IEEE 802.11n HT20	12.0	15.8489	4.51	2.8249	100%	0.0089	1.0000
IEEE 802.11n HT40	12.0	15.8489	4.51	2.8249	100%	0.0089	1.0000

5.2G WIFI

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	12.0	15.8489	4.24	2.6546	100%	0.0084	1.0000
IEEE 802.11n HT20	12.0	15.8489	7.84	6.0814	100%	0.0192	1.0000
IEEE 802.11n HT40	12.0	15.8489	7.84	6.0814	100%	0.0192	1.0000
IEEE 802.11ac20	13.0	19.9526	7.84	6.0814	100%	0.0241	1.0000
IEEE 802.11ac40	13.0	19.9526	7.84	6.0814	100%	0.0241	1.0000
IEEE 802.11Ac80	13.0	19.9526	7.84	6.0814	100%	0.0241	1.0000

5.8G WIFI

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	13.0	19.9526	5.39	3.4594	100%	0.0137	1.0000
IEEE 802.11n HT20	14.0	25.1189	7.84	6.0814	100%	0.0304	1.0000
IEEE 802.11n HT40	13.0	19.9526	7.84	6.0814	100%	0.0241	1.0000
IEEE 802.11ac20	14.0	25.1189	7.84	6.0814	100%	0.0304	1.0000
IEEE 802.11ac40	13.0	19.9526	7.84	6.0814	100%	0.0241	1.0000
IEEE 802.11Ac80	14.0	25.1189	7.84	6.0814	100%	0.0304	1.0000

Remark:

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

8.2 Simultaneous Transmission MPE**Simultaneous transmission MPE**

2.4G WIFI MPE (mW/cm ²)	5G WIFI MPE (mW/cm ²)	BT MPE (mW/cm ²)	BLE MPE (mW/cm ²)	Max.sum of the MPE ratios	Limit	Test Results
0.0139	0.0304	0.0088	0.0035	0.0566	1	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.....