FCC RF Exposure Evaluation

1. Product Information

FCC ID	:	2ABRU-BW330P1
Product name	:	BDE Wi-Fi 6 & BLE Combo Module Based on CC3301/CC3300
Test Model	:	BDE-BW3301NP1
Additional Model No.	:	BDE-BW3301NP1-IN, BDE-BW3301AP1, BDE-BW3301AP1-IN, BDE-BW3301UP1, BDE-BW3301UP1-IN, BDE-BW3300NP1, BDE-BW3300NP1-IN, BDE-BW3300AP1, BDE-BW3300AP1-IN, BDE-BW3300UP1, BDE-BW3300UP1-IN
Model Declaration	:	BDE-BW3301NP1, BDE-BW3301UP1, BDE-BW3301AP1 models only antenna difference, BDE-BW3301NP1-IN, BDE-BW3301UP1-IN, BDE-BW3301AP1-IN models differ only in operating temperature. BDE-BW3300NP1, BDE-BW3300UP1, BDE-BW3300AP1, BDE-BW3300NP1-IN, BDE-BW3300UP1-IN, BDE-BW3300AP1-IN Only the model name is different
Power supply	:	Input: DC 3.3V
Hardware Version	:	V1
Software Version	:	1.7.0.50
Bluetooth Frequency Range	:	2402MHz ~ 2480MHz 2404MHz ~ 2478MHz
Channel Number	:	40 channels for Bluetooth V5.4 (BT LE) 37 channels for Bluetooth V5.4 (BT 2LE)
Channel Spacing	:	1MHz for Bluetooth V5.4 (BT LE) 2MHz for Bluetooth V5.4 (BT 2LE)
Modulation Type	:	GFSK for Bluetooth V5.4 (BT LE) GFSK for Bluetooth V5.4 (BT 2LE)
Bluetooth Version	:	V5.4
Antenna Description	:	Dipole Antenna, 2.7dBi(Max.) PCB Antenna, -2.2dBi(Max.) FPC Antenna1, 2.0dBi(Max.) FPC Antenna2, 1.5dBi(Max.) Ceramic Antenna,1.0dBi(Max.)
WIFI(2.4G Band) Frequency Range	:	2412MHz~2462MHz
Channel Number	:	11 Channels for 20MHz bandwidth(2412~2462MHz)
Channel Spacing	:	5MHz
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) IEEE 802.11ax: OFDM (1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK)
Antenna Description	:	Dipole Antenna, 2.7dBi(Max.)

		PCB Antenna, -2.2dBi(Max.) FPC Antenna1, 2.0dBi(Max.) FPC Antenna2, 1.5dBi(Max.) Ceramic Antenna,1.0dBi(Max.)
Exposure category	:	General population/uncontrolled environment
EUT Type	:	Production Unit
Device Type	:	Moblie 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 C95.1–2019: IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz 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/cm²)	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/f²)*	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/cm²)	Averaging Time (minute)
Limits for Occupational/Uncontrolled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 30	824/f	2.19/f	(180/f²)*	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

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

Internal/External Identification	Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Notes
External	Dipole Antenna	2400-2500 MHz	2.7dBi	Bluetooth/2.4GWIFI Antenna
Internal	PCB Antenna	2400-2500 MHz	-2.2dBi	Bluetooth/2.4GWIFI Antenna
External	FPC Antenna1	2400-2500 MHz	2.0dBi	Bluetooth/2.4GWIFI Antenna
External	FPC Antenna2	2400-2500 MHz	1.5dBi	Bluetooth/2.4GWIFI Antenna
External	Ceramic Antenna	2400-2500 MHz	1.0dBi	Bluetooth/2.4GWIFI Antenna

6.Conducted Power Results

[BLE]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
BLE_1M	0	2402	16.07
	19	2440	15.38
	39	2480	14.15

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
BLE_2M	0	2404	16.08
	17	2440	15.61
	36	2478	14.66

[2.4G WIFI]

Mode	Channel	Frequency (MHz)	Max Conducted Power(dBm)
11B	1	2412	16.36
	6	2437	17.48
	11	2462	17.18
11G	1	2412	18.54
	6	2437	18.19
	11	2462	18.01
11N20 SISO	1	2412	17.79
	6	2437	17.84
	11	2462	19.98
11AX20 SISO	1	2412	19.9
	6	2437	20.98
	11	2462	21.02

7.Manufacturing Tolerance

[BLE]

BT LE (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	16.0	15.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0

BT 2LE (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	16.0	15.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0

[2.4G WIFI]

11B (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	16.0	17.0	17.0
Tolerance ±(dB)	1.0	1.0	1.0
11G (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	18.0	18.0	18.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20(Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	17.0	17.0	17.0
Tolerance ±(dB)	1.0	1.0	1.0
11AX20(Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	19.0	20.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0

8.Evaluation Results

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 LE]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
BLE1M	17.0	50.1187	2.7	1.8621	0.0186	1.0000
BLE2M	17.0	50.1187	2.7	1.8621	0.0186	1.0000

[2.4G WIFI]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW				
IEEE 802.11b	18.0	63.0957	2.7	1.8621	0.0234	1.0000
IEEE 802.11g	19.0	79.4328	2.7	1.8621	0.0117	1.0000
IEEE 802.11n HT20	18.0	63.0957	2.7	1.8621	0.0234	1.0000
IEEE 802.11AX HT20	22.0	158.4893	2.7	1.8621	0.0587	1.0000

Remark:

1. Output power including tune-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.

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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