

FCC RF Exposure Evaluation

1. Product Information

FCC ID	2A32K-B1
Product Name	B1
Test Model	B1, B1T
Power Supply	Adapter 1: Model: J151-05024001X Input: 100-240V~, 50/60Hz, 0.6A Output: 5V---2400mA Adapter 2: Model: GM53-050400-F Input: 100-240V~, 50/60Hz, 2.0A Output: 5V---4.0A
Modulation Type	Bluetooth: GFSK, $\pi/4$ DQPSK, 8DPSK BLE: GFSK 2.4G WIFI : 802.11b: DSSS 802.11g/802.11n(H20): OFDM 5G WIFI : IEEE 802.11a/n/ac: OFDM
Antenna Type	PIFA Antenna
Antenna Gain	2.0dBi
Frequency Range	2402-2480MHz/2412-2462MHz/ 5180-5240MHz/ 5745-5825MHz/5260-5320MHz / 5500-5700MHz
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 Device

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

B1 can only use antennas certificated as follows provided by manufacturer;

Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Note
PIFA Antenna	2402 MHz – 2480 MHz 2412 MHz – 2462 MHz 5180MHz - 5240MHz 5745MHz -5825MHz 5260MHz-5320MHz 5500MHz-5700MHz	2.0dBi	Bluetooth/WLAN Antenna

6. Conducted Power Results

[BT Max Conducted Power]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
GFSK	0	2402	4.71
	39	2441	5.56
	78	2480	5.74
$\pi/4$ DQPSK	0	2402	3.68
	39	2441	4.42
	78	2480	4.30
8DPSK	0	2402	3.59
	39	2441	4.42
	78	2480	4.27

[BLE Max Conducted Power]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
BT LE-1M	0	2402	4.15
	19	2440	4.63
	39	2480	4.13
BT LE-2M	0	2402	4.21
	19	2440	4.81
	39	2480	4.29

[2.4GWIFI Max Conducted Power]

Mode	Channel	Frequency(MHz)	Max Conducted Power(dBm)
IEEE 802.11b	1	2412	15.36
	6	2437	16.74
	11	2462	16.09
IEEE 802.11g	1	2412	19.61
	6	2437	20.68
	11	2462	20.49
IEEE 802.11n HT20	1	2412	19.60
	6	2437	20.39
	11	2462	20.22

[5.2GWIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	Max Conducted Power(dBm)
11A	36	5180	12.62
	40	5200	12.78
	48	5240	12.73
11N20 SISO	36	5180	11.27
	40	5200	11.40
	48	5240	11.63
11N40 SISO Mode	38	5190	11.52
	46	5230	18.53
11AC20 SISO Mode	36	5180	9.25
	40	5200	9.53
	48	5240	10.66
11AC40 SISO Mode	38	5190	13.78
	46	5230	8.29
11AC80 SISO Mode	42	5210	8.07

[5.8WIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	Max Conducted Power(dBm)
11A	149	5745	9.26
	157	5785	9.06
	165	5825	8.57
11N20 SISO	149	5745	9.08
	157	5785	8.75
	165	5825	8.40
11N40 SISO Mode	151	5755	8.95
	159	5795	8.69
11AC20 SISO Mode	149	5745	14.22
	157	5785	6.82
	165	5825	6.68
11AC40 SISO Mode	151	5755	5.80
	159	5795	5.43
11AC80 SISO Mode	155	5775	12.00

[5.3GWIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	Max Conducted Power(dBm)
11A	52	5260	12.67
	60	5300	12.72
	64	5320	12.60
11N20 SISO	52	5260	11.47
	60	5300	11.51
	64	5320	11.36
11N40 SISO Mode	54	5270	11.43
	62	5310	18.43
11AC20 SISO Mode	52	5260	9.62
	60	5300	9.49
	64	5320	16.39
11AC40 SISO Mode	54	5270	8.11
	62	5310	15.15
11AC80 SISO Mode	58	5290	14.84

[5.5WIFI Max Conducted Power]

Mode	Channel	Frequency (MHz)	Max Conducted Power(dBm)
11A	100	5500	12.80
	116	5580	12.08
	140	5700	11.48
11N20 SISO	100	5500	12.61
	116	5580	11.84
	140	5700	11.25
11N40 SISO Mode	149	5510	19.25
	157	5590	18.55
	165	5670	18.33
11AC20 SISO Mode	100	5500	17.77
	116	5580	17.22
	140	5700	9.84
11AC40 SISO Mode	149	5510	16.55
	157	5590	15.74
	165	5670	8.61
11AC80 SISO Mode	106	5530	16.03

7.Manufacturing Tolerance**<BT >**

GFSK(Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	5.0	5.0	5.0
Tolerance ±(dB)	1.0	1.0	1.0
π /4DQPSK(Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	4.0	4.0	4.0
Tolerance ±(dB)	1.0	1.0	1.0
8DPSK(Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	4.0	4.0	4.0
Tolerance ±(dB)	1.0	1.0	1.0

<BT LE >

GFSK-1M(Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	4.0	4.0	4.0
Tolerance ±(dB)	1.0	1.0	1.0
GFSK-2M(Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	4.0	4.0	4.0
Tolerance ±(dB)	1.0	1.0	1.0

<2.4G WLAN >

IEEE 802.11b (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	15.0	16.0	16.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11g (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	20.0	20.0	20.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	20.0	20.0	20.0
Tolerance ±(dB)	1.0	1.0	1.0

<5.2GWLAN >

11A (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11N20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	11.0	11.0	11.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11N40 (Average)			
Channel	Channel 38	Channel 46	/
Target (dBm)	12.0	18.0	/
Tolerance $\pm$ (dB)	1.0	1.0	/
11AC20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	9.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11AC40 (Average)			
Channel	Channel 38	Channel 46	/
Target (dBm)	13.0	8.0	/
Tolerance $\pm$ (dB)	1.0	1.0	/
11AC80 (Average)			
Channel	Channel 42	/	/
Target (dBm)	8.0	/	/
Tolerance $\pm$ (dB)	1.0	/	/

<5.8GWLAN>

11A (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	9.0	9.0	9.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11N20 SISO (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	9.0	9.0	8.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11N40 (Average)			
Channel	Channel 151	Channel 159	/
Target (dBm)	9.0	9.0	/
Tolerance $\pm$ (dB)	1.0	1.0	/
11AC20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	14.0	7.0	7.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11AC40 (Average)			

Channel	Channel 151	Channel 159	/
Target (dBm)	6.0	5.0	/
Tolerance $\pm$ (dB)	1.0	1.0	/
11AC80 (Average)			
Channel	Channel 155	/	/
Target (dBm)	12.0	/	/
Tolerance $\pm$ (dB)	1.0	/	/

<5.3GWLAN >

11A (Average)			
Channel	Channel 52	Channel 60	Channel 64
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11N20 (Average)			
Channel	Channel 52	Channel 60	Channel 64
Target (dBm)	11.0	11.0	11.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11N40 (Average)			
Channel	Channel 54	Channel 62	/
Target (dBm)	11.0	18.0	/
Tolerance $\pm$ (dB)	1.0	1.0	/
11AC20 (Average)			
Channel	Channel 52	Channel 60	Channel 64
Target (dBm)	10.0	9.0	16.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11AC40 (Average)			
Channel	Channel 54	Channel 62	/
Target (dBm)	8.0	15.0	/
Tolerance $\pm$ (dB)	1.0	1.0	/
11AC80 (Average)			
Channel	Channel 58	/	/
Target (dBm)	15.0	/	/
Tolerance $\pm$ (dB)	1.0	/	/

<5.5GWLAN>

11A (Average)			
Channel	Channel 100	Channel 116	Channel 140
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11N20 SISO (Average)			
Channel	Channel 100	Channel 116	Channel 140
Target (dBm)	12.0	12.0	11.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11N40 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	19.0	19.0	19.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11AC20 (Average)			
Channel	Channel 100	Channel 116	Channel 140
Target (dBm)	17.0	17.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11AC40 (Average)			
Channel	Channel 100	Channel 116	Channel 140
Target (dBm)	16.0	16.0	9.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11AC80 (Average)			
Channel	Channel 106	/	/
Target (dBm)	16.0	/	/
Tolerance $\pm$ (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, $r=20\text{cm}$, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

Bluetooth

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW					
GFSK	6.0	3.98	2.0	1.5849	100%	0.0013	1.0000
$\pi/4$ DQPSK	5.0	3.16	2.0	1.5849	100%	0.0010	1.0000
8-DPSK	5.0	3.16	2.0	1.5849	100%	0.0010	1.0000
GFSK-1M (BT LE)	5.0	3.16	2.0	1.5849	100%	0.0010	1.0000
GFSK-2M (BT LE)	5.0	3.16	2.0	1.5849	100%	0.0010	1.0000

2.4G

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	17.0	50.12	2.0	1.5849	100%	0.0158	1.0000
IEEE 802.11g	21.0	125.89	2.0	1.5849	100%	0.0397	1.0000
IEEE 802.11n HT20	21.0	125.89	2.0	1.5849	100%	0.0397	1.0000

5.2G

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	14.0	25.12	2.0	1.5849	100%	0.0079	1.0000
IEEE 802.11 n HT20	12.0	15.85	2.0	1.5849	100%	0.0050	1.0000
IEEE 802.11ac VHT20	11.0	12.59	2.0	1.5849	100%	0.0040	1.0000
IEEE 802.11n HT40	19.0	79.43	2.0	1.5849	100%	0.0250	1.0000
IEEE 802.11ac VHT40	14.0	25.12	2.0	1.5849	100%	0.0079	1.0000
IEEE 802.11ac VHT80	9.0	7.94	2.0	1.5849	100%	0.0025	1.0000

5.8G

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	10.0	10.00	2.0	1.5849	100%	0.0032	1.0000
IEEE 802.11 n HT20	10.0	10.00	2.0	1.5849	100%	0.0032	1.0000
IEEE 802.11ac VHT20	15.0	31.62	2.0	1.5849	100%	0.0100	1.0000
IEEE 802.11n HT40	10.0	10.00	2.0	1.5849	100%	0.0032	1.0000
IEEE 802.11ac VHT40	7.0	5.01	2.0	1.5849	100%	0.0016	1.0000
IEEE 802.11ac VHT80	13.0	19.95	2.0	1.5849	100%	0.0063	1.0000

5.3G

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	14.0	25.12	2.0	1.5849	100%	0.0079	1.0000
IEEE 802.11 n HT20	12.0	15.85	2.0	1.5849	100%	0.0050	1.0000
IEEE 802.11ac VHT20	17.0	50.12	2.0	1.5849	100%	0.0158	1.0000
IEEE 802.11n HT40	19.0	79.43	2.0	1.5849	100%	0.0250	1.0000
IEEE 802.11ac VHT40	16.0	39.81	2.0	1.5849	100%	0.0126	1.0000
IEEE 802.11ac VHT80	16.0	39.81	2.0	1.5849	100%	0.0126	1.0000

5.5G

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	19.95	2.0	1.5849	100%	0.0063	1.0000
IEEE 802.11 n HT20	13.0	19.95	2.0	1.5849	100%	0.0063	1.0000
IEEE 802.11ac VHT20	18.0	63.10	2.0	1.5849	100%	0.0199	1.0000
IEEE 802.11n HT40	20.0	100.00	2.0	1.5849	100%	0.0315	1.0000
IEEE 802.11ac VHT40	17.0	50.12	2.0	1.5849	100%	0.0158	1.0000
IEEE 802.11ac VHT80	17.0	50.12	2.0	1.5849	100%	0.0158	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

The sample support one modular and share same antenna, Bluetooth/2.4G WLAN /5G WLAN can be active at the same time, but only with interleaving of packages switched on board level. That means that they don't transmit at the same time. No need consider simultaneous transmission;

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.....