

Maximum Permissible Exposure Report

1. Product Information

EUT	: BEC 2090AC
Test Model	: BEC 2090AC
Power Supply	: AC 100-240V,50/60Hz,0.3A
Hardware Version	: V1.4
Software Version	: N/A
WIFI (2.4G Band)	:
Frequency Range	: 2412MHz-2462MHz
Channel Spacing	: 5MHz
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/n: OFDM(64QAM, 16QAM, QPSK, BPSK)
WIFI 5GWLAN Band 1	:
Frequency Range	: 5180MHz-5240MHz 4 channels for 20MHz bandwidth (5180-5240MHz)
Channel Number	: 2 channels for 40MHz bandwidth (5190~5230MHz) 1 channels for 80MHz bandwidth (5210MHz)
Modulation Type	: IEEE 802.11a/n/ac: OFDM(64QAM, 16QAM, QPSK, BPSK)
WIFI 5GWLAN 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(64QAM, 16QAM, QPSK, BPSK) Two same External Antenna, support MIMO technology
Antenna Description	: ANT0 used for WIFI TX/RX, 2.0dBi(Max.) for 2.4G Band and 2.0dBi(Max.) for 5G Band ANT1 used for WIFI TX/RX, 2.0dBi(Max.) for 2.4G Band and 2.0dBi(Max.) for 5G Band
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

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

Internal Identification	Antenna Identification in Internal photos	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna 0	Wi-Fi Chain 0	External Antenna	2 GHz – 6 GHz	2.00 dBi
Antenna 1	Wi-Fi Chain 1	External Antenna	2 GHz – 6 GHz	2.00 dBi

6. Conducted Power

2.4GWLAN(ANT0)

Test Mode	Channel	Frequency (MHz)	Measured Peak Output Power (dBm)
IEEE 802.11b	1	2412	13.12
	6	2437	12.77
	11	2462	12.81
IEEE 802.11g	1	2412	14.53
	6	2437	14.11
	11	2462	14.26
IEEE 802.11n HT20	1	2412	14.52
	6	2437	14.41
	11	2462	14.51
IEEE 802.11n HT40	3	2422	14.56
	6	2437	14.45
	9	2452	14.26

5.2GWLAN(ANT0)

Test Mode	Channel	Frequency (MHz)	Measured Average Output Power (dBm)
IEEE 802.11a	36	5180	10.94
	40	5200	10.83
	48	5240	11.29
IEEE 802.11n HT20	36	5180	10.45
	40	5200	10.82
	48	5240	11.25
IEEE 802.11n HT40	38	5190	10.48
	46	5230	10.99
IEEE 802.11ac VHT20	36	5180	10.56
	40	5200	10.77
	48	5240	11.28
IEEE 802.11ac VHT40	38	5190	10.39
	46	5230	11.05
IEEE 802.11ac VHT80	42	5210	10.78

5.8GWLAN(ANT0)

Test Mode	Channel	Frequency (MHz)	Measured Average Output Power (dBm)
IEEE 802.11a	149	5745	7.38
	157	5785	7.99
	165	5825	5.71
IEEE 802.11n HT20	149	5745	7.27
	157	5785	7.95
	165	5825	5.70
IEEE 802.11n HT40	151	5755	7.58
	159	5795	7.27
IEEE 802.11ac VHT20	149	5745	10.56
	157	5785	10.77
	165	5825	11.28
IEEE 802.11ac VHT40	151	5755	10.39
	159	5795	11.05
IEEE 802.11ac VHT80	155	5775	7.48

2.4GWLAN(ANT1)

Test Mode	Channel	Frequency (MHz)	Measured Peak Output Power (dBm)
IEEE 802.11b	1	2412	13.23
	6	2437	12.65
	11	2462	12.80
IEEE 802.11g	1	2412	15.21
	6	2437	13.96
	11	2462	14.28
IEEE 802.11n HT20	1	2412	14.58
	6	2437	14.18
	11	2462	14.49
IEEE 802.11n HT40	3	2422	15.02
	6	2437	14.52
	9	2452	14.73

5.2GWLAN(ANT1)

Test Mode	Channel	Frequency (MHz)	Measured Average Output Power (dBm)
IEEE 802.11a	36	5180	10.74
	40	5200	10.91
	48	5240	11.40
IEEE 802.11n HT20	36	5180	10.58
	40	5200	10.90
	48	5240	11.54
IEEE 802.11n HT40	38	5190	10.70
	46	5230	11.17
IEEE 802.11ac VHT20	36	5180	10.65
	40	5200	10.86
	48	5240	11.38
IEEE 802.11ac VHT40	38	5190	10.56
	46	5230	11.18
IEEE 802.11ac VHT80	42	5210	10.83

5.8GWLAN(ANT1)

Test Mode	Channel	Frequency (MHz)	Measured Average Output Power (dBm)
IEEE 802.11a	149	5745	7.55
	157	5785	8.24
	165	5825	6.13
IEEE 802.11n HT20	149	5745	7.41
	157	5785	8.11
	165	5825	6.00
IEEE 802.11n HT40	151	5755	7.56
	159	5795	7.42
IEEE 802.11ac VHT20	149	5745	10.65
	157	5785	10.86
	165	5825	11.38
IEEE 802.11ac VHT40	151	5755	10.56
	159	5795	11.18
IEEE 802.11ac VHT80	155	5775	7.60

7. Manufacturing Tolerance

2.4GWLAN(ANT0)

IEEE 802.11b (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	13.0	12.0	12.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11g (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	14.0	14.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	14.0	14.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	14.0	14.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0

5.2GWLAN(ANT0)

IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	10.0	11.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	10.0	11.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	Channel 46	/
Target (dBm)	10.0	10.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	10.0	11.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	Channel 46	/
Target (dBm)	10.0	11.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 42	/	/
Target (dBm)	10.0	/	/
Tolerance \pm (dB)	1.0	/	/

5.8G WLAN(ANT0)

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	7.0	7.0	6.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	7.0	7.0	6.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 151	Channel 159	/
Target (dBm)	7.0	7.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	10.0	10.0	11.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	Channel 159	/
Target (dBm)	10.0	11.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 155	/	/
Target (dBm)	7.0	/	/
Tolerance \pm (dB)	1.0	/	/

2.4G WLAN(ANT1)

IEEE 802.11b (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	13.0	12.0	12.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11g (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	15.0	13.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	14.0	14.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	15.0	14.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0

5.2G WLAN(ANT1)

IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	10.0	11.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	10.0	11.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	Channel 46	/
Target (dBm)	10.0	11.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	10.0	11.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	Channel 46	/
Target (dBm)	10.0	11.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 42	/	/
Target (dBm)	10.0	/	/
Tolerance \pm (dB)	1.0	/	/

5.8G WLAN(ANT1)

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	7.0	8.0	6.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	7.0	8.0	6.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 151	Channel 159	/
Target (dBm)	7.0	7.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	10.0	10.0	11.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	Channel 159	/
Target (dBm)	10.0	11.0	/
Tolerance \pm (dB)	1.0	1.0	/
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 155	/	/
Target (dBm)	7.0	/	/
Tolerance \pm (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.

ANT0:

Modulation Type		Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
		dBm	mW					
2.4G WLAN	IEEE 802.11b	14.00	25.1189	2.0	1.5849	100%	0.0079	1.0000
	IEEE 802.11g	15.00	31.6228	2.0	1.5849	100%	0.0100	1.0000
	IEEE 802.11n HT20	15.00	31.6228	2.0	1.5849	100%	0.0100	1.0000
	IEEE 802.11n HT40	15.00	31.6228	2.0	1.5849	100%	0.0100	1.0000
5.2G WLAN	IEEE 802.11a	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11n HT20	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11n HT40	11.00	12.5893	2.0	1.5849	100%	0.0040	1.0000
	IEEE 802.11ac VHT20	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11ac VHT40	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11ac VHT80	11.00	12.5893	2.0	1.5849	100%	0.0040	1.0000
5.8G WLAN	IEEE 802.11a	8.00	6.3096	2.0	1.5849	100%	0.0020	1.0000
	IEEE 802.11n HT20	8.00	6.3096	2.0	1.5849	100%	0.0020	1.0000
	IEEE 802.11n HT40	8.00	6.3096	2.0	1.5849	100%	0.0020	1.0000
	IEEE 802.11ac VHT20	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11ac VHT40	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11ac VHT80	8.00	6.3096	2.0	1.5849	100%	0.0020	1.0000

ANT1:

Modulation Type		Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
		dBm	mW					
2.4G WLAN	IEEE 802.11b	14.00	25.1189	2.0	1.5849	100%	0.0079	1.0000
	IEEE 802.11g	16.00	39.8107	2.0	1.5849	100%	0.0126	1.0000
	IEEE 802.11n HT20	15.00	31.6228	2.0	1.5849	100%	0.0100	1.0000
	IEEE 802.11n HT40	16.00	39.8107	2.0	1.5849	100%	0.0126	1.0000
5.2G WLAN	IEEE 802.11a	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11n HT20	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11n HT40	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11ac VHT20	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11ac VHT40	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11ac VHT80	11.00	12.5893	2.0	1.5849	100%	0.0040	1.0000
5.8G WLAN	IEEE 802.11a	9.00	7.9433	2.0	1.5849	100%	0.0025	1.0000
	IEEE 802.11n HT20	9.00	7.9433	2.0	1.5849	100%	0.0025	1.0000
	IEEE 802.11n HT40	8.00	6.3096	2.0	1.5849	100%	0.0020	1.0000
	IEEE 802.11ac VHT20	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11ac VHT40	12.00	15.8489	2.0	1.5849	100%	0.0050	1.0000
	IEEE 802.11ac VHT80	8.00	6.3096	2.0	1.5849	100%	0.0020	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 5G WLAN.

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

\sum of MPE ratios ≤ 1.0

8.2.1 Summary simultaneous transmission information

Modulation Type	Transmit Antenna		Antenna 0 Antenna 1 Synchronization transmit
	Antenna 0	Antenna 1	
IEEE 802.11b	Yes	Yes	Yes
IEEE 802.11g	Yes	Yes	Yes
IEEE 802.11n HT20	Yes	Yes	Yes
IEEE 802.11n HT40	Yes	Yes	Yes
IEEE 802.11a	Yes	Yes	Yes
IEEE 802.11n HT20	Yes	Yes	Yes
IEEE 802.11n HT40	Yes	Yes	Yes
IEEE 802.11ac VHT20	Yes	Yes	Yes
IEEE 802.11ac VHT40	Yes	Yes	Yes
IEEE 802.11ac VHT80	Yes	Yes	Yes
IEEE 802.11a	Yes	Yes	Yes
IEEE 802.11n HT20	Yes	Yes	Yes
IEEE 802.11n HT40	Yes	Yes	Yes
IEEE 802.11ac VHT20	Yes	Yes	Yes
IEEE 802.11ac VHT40	Yes	Yes	Yes
IEEE 802.11ac VHT80	Yes	Yes	Yes

8.2.2 Summary simultaneous transmission results

Modulation Type	MPE Antenna 0 Ratios	MPE Antenna 1 Ratios	Σ MPE ratios	Limit	Results
IEEE 802.11b	0.0079	0.0079	0.1	1.0	PASS
IEEE 802.11g	0.0100	0.0126	0.1	1.0	PASS
IEEE 802.11n HT20	0.0100	0.0100	0.1	1.0	PASS
IEEE 802.11n HT40	0.0100	0.0126	0.1	1.0	PASS
IEEE 802.11a	0.0050	0.0050	0.1	1.0	PASS
IEEE 802.11n HT20	0.0050	0.0050	0.1	1.0	PASS
IEEE 802.11n HT40	0.0040	0.0050	0.1	1.0	PASS
IEEE 802.11ac VHT20	0.0050	0.0050	0.1	1.0	PASS
IEEE 802.11ac VHT40	0.0050	0.0050	0.1	1.0	PASS
IEEE 802.11ac VHT80	0.0040	0.0040	0.1	1.0	PASS
IEEE 802.11a	0.0020	0.0025	0.1	1.0	PASS
IEEE 802.11n HT20	0.0020	0.0025	0.1	1.0	PASS
IEEE 802.11n HT40	0.0020	0.0020	0.1	1.0	PASS
IEEE 802.11ac VHT20	0.0050	0.0050	0.1	1.0	PASS
IEEE 802.11ac VHT40	0.0050	0.0050	0.1	1.0	PASS
IEEE 802.11ac VHT80	0.0020	0.0020	0.1	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.

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