



FCC RF Exposure Evaluation

1. Product Information

FCC ID	:	2BALY-HC5
Product name	:	HC5 NB-IoT Sensor
Test Model	:	HC5
Power supply	:	DC 3.6V, 6.3Ah By Battery
Hardware Version	:	/
Software Version	:	/
Bluetooth Frequency Range	:	2402MHz~2480MHz
Channel Number	:	40 channels for Bluetooth V5.0 (DTS)
Channel Spacing	:	2MHz for Bluetooth V5.0 (DTS)
Modulation Type	:	GFSK for Bluetooth V5.0 (DTS)
Bluetooth Version	:	V5.0
Antenna Description	:	PCB Antenna, 1.0dBi((Max.)
NB-IoT support Frequency bands	:	NB-IoT bands:2/4/5/12/13/17/25/66
Antenna Description	:	FPC Self-adhesive 3M 468P
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/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/Uncontrolled 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. Conducted Power Results

[BT LE]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
BT LE	0	2402	-0.17
	19	2440	0.38
	39	2480	-0.92

6. Manufacturing Tolerance

[BT LE]

BT LE (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	0	0	0
Tolerance \pm (dB)	1.0	1.0	1.0

7. 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, $r = 20\text{cm}$, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

7.1 Standalone Evaluation

[BT LE]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
BT LE	1.0	1.2589	1.0	1.2589	0.000315	1.0000

[NB-IoT]

NB-IoT modular output power including tune up tolerance from NB-IoT modular FCC MPE Report (Report No.: 2012RSU022-U4, FCC ID: XMR2021BC660KGL); antenna gain from antenna information LTE;

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
NB-IoT Band 2	25.00	316.2278	3.80	2.3988	0.1510	1.0000
NB-IoT Band 4	25.00	316.2278	3.80	2.3988	0.1510	1.0000
NB-IoT Band 5	25.00	316.2278	3.50	2.2387	0.1409	0.5493
NB-IoT Band 12	25.00	316.2278	3.50	2.2387	0.1409	0.4660
NB-IoT Band 13	25.00	316.2278	3.50	2.2387	0.1409	0.5180
NB-IoT Band 17	25.00	316.2278	3.50	2.2387	0.1409	0.4693
NB-IoT Band 25	25.00	316.2278	3.80	2.3988	0.1510	1.0000
NB-IoT Band 66	25.00	316.2278	3.80	2.3988	0.1510	1.0000

Remark:

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

8. Simultaneous Transmission MPE Evaluation



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The EUT support one BT modular and one NB-IoT modular, BT modular and NB-IoT modular share difference antenna, so need consider simultaneous transmission;
According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;
 \sum of MPE ratios ≤ 1.0

BLE MPE ratios	NB-NoT MPE ratios	\sum MPE ratios	Limit	Results
0.000315	0.3024	0.3027	1.0	Pass

Remark:

1. Output power including turn-up tolerance;
2. Output power is burst average power;
3. MPE evaluate distance is 20cm from user manual provide by manufacturer;
4. MPE values = $PG/4\pi R^2$

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-----

