

FCC RF Exposure Evaluation

1. Product Information

FCC ID	2BD5N-SCUBAX1PRO
Product Name	CORDLESS ROBOTIC POOL CLEANER
Test Model	PRT1P
Power Supply	DC 21.6V from battery, charged by Charging base from AC adapter
Modulation Type	Bluetooth Low Energy :GFSK 2.4G Wi-Fi: DSSS , OFDM
Antenna Type	FPC Antenna
Antenna Gain	-1.12 dBi
Frequency Range	Bluetooth BR/EDR: 2402MHz~2480MHz Bluetooth Low Energy: 2402MHz~2480MHz 2.4G Wi-Fi: 2412MHz~2462MHz
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

CQ_F20_01 can only use antennas certificated as follows provided by manufacturer;

Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Note
FPC Antenna	2402MHz~2480MHz 2412MHz~2462MHz	-1.12dBi	Antenna

6. Conducted Power Results

[Max Conducted Power]
2.4G Wi-Fi

Mode	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)
802.11b	2412	14.57
	2437	14.32
	2462	14.67
802.11g	2412	14.97
	2437	14.85
	2462	15.21
802.11n (HT20)	2412	14.90
	2437	14.95
	2462	15.02

BLE

Mode	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)
1M	2402	-1.13
	2440	-0.33
	2480	0.96

BT

Mode	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)
GFSK	2402	-1.04
	2441	-0.16
	2480	1.04
Pi/4DQPSK	2402	0.70
	2441	1.93
	2480	2.69
8DPSK	2402	1.19
	2441	2.53
	2480	3.17

7.Manufacturing Tolerance

< 2.4G Wi-Fi >

802.11b			
Channel	2412MHz	2437MHz	2462MHz
Target (dBm)	14	14	14
Tolerance \pm (dB)	1.0	1.0	1.0
802.11g			
Channel	2412MHz	2437MHz	2462MHz
Target (dBm)	14	14	15
Tolerance \pm (dB)	1.0	1.0	1.0
802.11n(HT20)			
Channel	2412MHz	2437MHz	2462MHz
Target (dBm)	14	14	15
Tolerance \pm (dB)	1.0	1.0	1.0

<BLE >

BLE 1M			
Channel	2402MHz	2440MHz	2480MHz
Target (dBm)	-2	-1	0
Tolerance \pm (dB)	1.0	1.0	1.0

<BT >

GFSK			
Channel	2402MHz	2441MHz	2480MHz
Target (dBm)	-2	-1	1
Tolerance \pm (dB)	1.0	1.0	1.0
Pi/4DQPSK			
Channel	2402MHz	2441MHz	2480MHz
Target (dBm)	0	1	2
Tolerance \pm (dB)	1.0	1.0	1.0
8DPSK			
Channel	2402MHz	2441MHz	2480MHz
Target (dBm)	1	2	3
Tolerance \pm (dB)	1.0	1.0	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.

BT

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
8DPSK	4	2.5119	-1.12	0.7727	100%	0.0004	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					
BLE1M	1	1.2589	-1.12	0.7727	66.08%	0.0002	1.0000

2.4G Wi-Fi

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
802.11b	15	31.6228	-1.12	0.7727	99.84%	0.0049	1.0000
802.11g	16	39.8107	-1.12	0.7727	98.57%	0.0061	1.0000
802.11n(HT20)	16	39.8107	-1.12	0.7727	88.80%	0.0061	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 supports a modular, 1 antennas, No need to 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.....