

FCC Maximum Permissible Exposure (MPE) Estimation Report

Report Number : **68.710.24.0268.01-S1** Date of Issue: 2024-09-05

Model / HVIN : **Q10**

Product Type : Robot Vacuum Cleaner

Applicant : Shenzhen Tunnu Innovation Co., Ltd.

Address : 4 Floor, Tsinghua University Research Institute, Yuehai Street,
NanShan district, 518000 Shenzhen, Guangdong Province,

PEOPLE'S REPUBLIC OF CHINA

Manufacturer : Shenzhen Tunnu Innovation Co., Ltd.

Address : 4 Floor, Tsinghua University Research Institute, Yuehai Street,
NanShan district, 518000 Shenzhen, Guangdong Province,
PEOPLE'S REPUBLIC OF CHINA

Test Result : **Positive** **Negative**

Total pages including Appendices : 9

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2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park,
Guankou Erlu, Nantou, Nanshan District,
Shenzhen, Guangdong, China

Telephone: 86 755 8828 6998

Fax: 86 755 8828 5299

FCC Registration No.: 514049

FCC Designation Number: CN5009

3 Description of the Equipment Under Test

Product:	Robot Vacuum Cleaner
Model no.:	Q10
FCC ID:	2BELS-Q10
Options and accessories:	Base station Manufacturer: Shenzhen Topband Co., Ltd. Model: Q10-S Input: 120VAC, 60Hz, 24W for Charging, 80W for Drying, 800W for Heating water, 1000W for Collecting dust Output: DC23.65V, 2.5A
Ratings:	Input: DC23.65V, 2.5A (for charging only) Battery: 14.4V, 5000mAh
RF Transmission Frequency:	2412MHz - 2462MHz for 2.4GHz Wi-Fi 2402MHz - 2480MHz for BLE (1Mbps) 2402MHz - 2480MHz for BR/EDR
No. of Operated Channel:	11 for 2.4GHz Wi-Fi 802.11b, 802.11n (HT20) 9 for 2.4GHz Wi-Fi 802.11n (HT40) 40 for BLE (1Mbps) 79 for BR/EDR
Modulation:	802.11b: BPSK, QPSK, CCK 802.11g: BPSK, QPSK, 16-QAM, 64-QAM 802.11n: BPSK, QPSK, 16-QAM, 64-QAM BLE: GFSK BR/EDR: GFSK, Pi/4DQPSK, 8DPSK
Antenna Type:	Integrated FPC antenna
Antenna Gain:	4.2 dBi for 2.4GHz Wi-Fi & Bluetooth
Description of the EUT:	The EUT is a Robot Vacuum Cleaner supports Wi-Fi and Bluetooth functions: 2412MHz - 2462MHz for 2.4GHz Wi-Fi; 2402MHz - 2480MHz for BLE (1Mbps); 2402MHz - 2480MHz for BR/EDR.

4 Test Specifications

Test Standards	
ANSI Std C95.1-1992	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.(IEEE Std C95.1-1991)
KDB 447498 D01	General RF Exposure Guidance v06
CFR § 2.1091	Radiofrequency radiation exposure evaluation: mobile devices.

5 General Information

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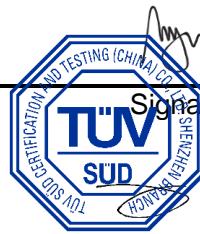
Prepared By
Project Engineer

2024-09-05

Date

Myron Yu

Name



Myron Yu
Signature

Approved by
Project Manager

2024-09-05

Date

Jessie He

Name

Jessie He
Signature

6 RF Exposure Requirements

An estimation of MPE in this application for product is used to ensure if it complies with the rules of the standard in the regulation list above.

Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure. It is broken down into two categories, Occupational/controlled and General population/uncontrolled.

Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation:

$$S = \frac{P \times G}{4 \times \pi \times R^2}$$

Where:

S = power density

P = power input to the antenna

G = numeric gain of the antenna in the direction of interest relative to an isotropic radiator

R= distance to the centre of radiation of the antenna

EIRP = P*G

The antenna of the product, under normal use condition is at least 20 cm away from the body of the user. Warning statement to the user for keeping at least 20cm separation distance and the prohibition of operating to a person has been printed on the user's manual. Therefore, the S of the device is calculated with R=20cm, and if it is below the limit S, then we can conclude the device complies with the rules.

7 FCC MPE Limits

We analysis if it comply with the limits for General population/uncontrolled exposure. The FCC MPE limits for field strength and power density are given in 47CFR 1.1310(Table below). These limits are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP), and also partly based on guidelines recommended by the American National Standards Institute (ANSI) in Section 4.1 of ANSI/IEEE C95.1.

(A) Limits for Occupational/controlled Exposure				
Frequency Range(MHz)	Electric Field Strength(E)(V/m)	Magnetic Field Strength(H)(A/m)	Power Density (S)(mW/cm ²)	Averaging Time (minute) E ² , H ² or S
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
(B) Limits for General Population/uncontrolled Exposure				
Frequency Range(MHz)	Electric Field Strength(E)(V/m)	Magnetic Field Strength(H)(A/m)	Power Density (S)(mW/cm ²)	Averaging Time (minute) E ² , H ² or S
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	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

8 RF Exposure Evaluation (FCC)

8.1 Calculation of Power Density for Single Chain Transmitters

Mode	EIRP (dBm)	EIRP (mW)	R (cm)	S (mW/cm ²)	Limit (mW/cm ²)
2.4GHz Wi-Fi	17.45	55.59	20	0.0111	1.0
BLE	4.99	3.16	20	0.0006	1.0
BR/EDR	7.50	5.62	20	0.0011	1.0

Remark: 2.4GHz Wi-Fi and Bluetooth can't transmit simultaneously.

8.2 Conclusion

According to the table above, the calculated power density S is below the limit value of 1 mW/cm², therefore, the product complies with the requirements.