

1. RF Exposure Requirements

1.1 General Information

Client Information

Applicant: Shenzhen Waterworld Information Co., Ltd.
Address of applicant: 1F, Building3, Dexinchang Wisdom Park, No.23 Heping Road, Longhua district, Shen Zhen city, China

Manufacturer: Shenzhen WaterWorld Information Co.,Ltd.
Address of manufacturer: Floor 1, Building 3, Dexinchang WitPark, No:23 Heping Road, Qinghua Community, Longhua Street, Longhua District, Shenzhen

General Description of EUT:

Product Name: Wireless Dual Band Gigabit Router
Trade Name: /
Model No.: AX3000
Adding Model(s): /
Rated Voltage: DC12V
Battery Capacity: /
Power Adapter: MODEL: GQ12-120100-CU
INPUT:AC100-240V~50/60Hz 0.4A
OUTPUT:DC12V,1A
FCC ID: 2BAII-AX3000
Equipment Type: Portable device

Technical Characteristics of EUT:

Wi-Fi(2.4GHz)

Support Standards: 802.11b, 802.11g, 802.11n
Frequency Range: 2412-2462MHz for 802.11b/g/n/ax(HT/HE20)
2422-2452MHz for 802.11n/ax(HT/HE40)
RF Output Power: Antenna 0: 18.30dBm (Conducted)
Antenna 1: 19.27dBm (Conducted)
Type of Modulation: CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM, 256QAM, 1024QAM
Quantity of Channels: 11 for 802.11b/g/n/ax(HT/HE20); 7 for 802.11n/ax(HT/HE40)
Channel Separation: 5MHz
Type of Antenna: External Antenna
Antenna Gain: Antenna 0: 4.78dBi
Antenna 1: 4.78dBi

Wi-Fi(5GHz)

Support Standards: 802.11a, 802.11n(HT20) , 802.11n-HT40, 802.11ac-VHT20/40/80/160,
802.11ax-HE20/40/80/160
Frequency Range: 5180-5240MHz, 5260-5320MHz, 5745-5825MHz
Max. RF Output Power: Antenna 1: 18.68dBm (Conducted)

	Antenna 2: 18.86dBm (Conducted)
	Antenna 3: 18.71dBm (Conducted)
Type of Modulation:	QPSK, 16QAM, 64QAM, 256QAM, 1024QAM
Type of Antenna:	External Antenna
	Antenna 1:4.42dBi
Antenna Gain:	Antenna 2:4.42dBi
	Antenna 3:4.42dBi

1.2 RF Exposure Exemption

According to §1.1307(b)(3) and KDB 447498 D04 Interim General RF Exposure Guidance v01, system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

Option A: FCC Rule Part 1.1307 (b)(3)(i)(A):The available maximum time-averaged power is no more than 1mW, regardless of separation distance.

Option B: FCC Rule Part 1.1307 (b)(3)(i)(B): The available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

Option C: FCC Rule Part 1.1307 (b)(3)(i)(C): The minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters.

Single RF Sources Subject to Routine Environmental Evaluation	
RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R ²
1.34-30	3,450 R ² /f ²
30-300	3.83 R ²
300-1,500	0.0128 R ² f
1,500-100,000	19.2R ²

For Multiple RF sources: FCC Rule Part 1.1307(b)(3)(ii):

- (A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required).
- (B) In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

1.3 Calculated Result

Radio Access Technology	Prediction Frequency (MHz)	Output Power (dBm)	Antenna Gain (dBi)	Duty Cycle (%)	Tune-Up Time-Averaged Power (dBm)	ERP (dBm)
Wi-Fi(2.4GHz) Antenna 0	2412	18.30	4.78	100	19.00	21.63
Wi-Fi(2.4GHz) Antenna 1	2412	19.27	4.78	100	20.00	22.63
Wi-Fi(5GHz) Antenna 0	5180	18.68	4.42	100	19.00	21.27
Wi-Fi(5GHz) Antenna 1	5180	18.86	4.42	100	19.00	21.27
Wi-Fi(5GHz) Antenna 2	5180	18.71	4.42	100	19.00	21.27

Radio Access Technology	Frequency (MHz)	Option	Min. Distance	Max. Power		Exposure Limit	Ratio	Result
			(cm)	(dBm)	(mW)	(mW)		Pass/Fail
Wi-Fi(2.4GHz) Antenna 0	2412	C	20.00	21.63	145.55	768.00	0.19	Pass
Wi-Fi(2.4GHz) Antenna 1	2412	C	20.00	22.63	183.23	768.00	0.24	Pass
Wi-Fi(5GHz) Antenna 0	5180	C	20.00	21.27	133.97	768.00	0.17	Pass
Wi-Fi(5GHz) Antenna 1	5180	C	20.00	21.27	133.97	768.00	0.17	Pass
Wi-Fi(5GHz) Antenna 2	5180	C	20.00	21.27	133.97	768.00	0.17	Pass

Note: 1. Time-Averaged Power=Output Power * Duty Cycle; ERP= Time-Averaged Power+ Antenna gain-2.15dB

2. Option A, B and C refers as clause 1.2.

3. For option B, Max (time-averaged power, effective radiated power (ERP)) converts to Max. Power. For option C, ERP converts to Max. Power;

4. For option B, P_{th} (mW) converts to Exposure Limit (mW); For option C, ERP (W) converts to Exposure Limit (mW).

5. Ratio= Tune-Up ERP (mW)/ Exposure Limit (mW)

Mode for Simultaneous Multi-band Transmission:

Radio Access Technology	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5	Simultaneous Ratio	Limit	Result
								Pass/Fail
Wi-Fi(2.4GHz)Antenna 0 + Antenna 1 + Wi-Fi(5GHz)Antenna 0 + Antenna 1 + Antenna 2	0.19	0.24	0.17	0.17	0.17	0.94	1	Pass

Result: Pass