

1. RF Exposure Requirements

1.1 General Information

Client Information

Applicant: Convergence (Wuhan) Technology Co., Ltd.
Address of applicant: 2101 Huigushikong, No.4 Luoyu East Road, Wuhan, Hubei, China

Manufacturer: Convergence (Wuhan) Technology Co., Ltd.
Address of manufacturer: 2101 Huigushikong, No.4 Luoyu East Road, Wuhan, Hubei, China

General Description of EUT:

Product Name: DWARF II Smart Telescope
Trade Name: DWARFLAB
Model No.: CCT1D1D20101
Adding Model(s): /
Rated Voltage: DC 5V; DC 9V; Battery DC 3.7V
Battery Capacity: 5600mAh
FCC ID: 2AXYI-DWARF
Equipment Type: Mobile device

Technical Characteristics of EUT:

Bluetooth

Bluetooth Version: V5.0 (BLE mode)
Frequency Range: 2402-2480MHz
RF Output Power: 1Mbps: 4.56dBm (Conducted)
2Mbps: 4.62dBm (Conducted)
Data Rate: 1Mbps
Modulation: GFSK
Quantity of Channels: 40
Channel Separation: 2MHz
Type of Antenna: FPC Antenna
Antenna Gain: 1.20dBi

5G Wi-Fi

Support Standards: 802.11a, 802.11n(HT20) , 802.11n-HT40, 802.11ac-VHT20,
802.11ac-VHT40, 802.11ac-VHT80
Frequency Range: 5150-5250MHz, 5725-5850MHz
RF Output Power: 14.05dBm (Conducted)
Type of Modulation: BPSK, QPSK,16QAM,64QAM, 256QAM
Type of Antenna: FPC Antenna
Antenna Gain: 4.01dBi

1.2 RF Exposure Exemption

According to §1.1307(b)(3) and 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	$19.2 R^2$

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	Min. Frequency	Max. Output Power	Max. Tune-Up Output Power	Antenna Gain	Duty Cycle	Tune-Up EIRP
	(MHz)	(dBm)	(dBm)	(dBi)	(%)	(dBm)
Bluetooth	2402	4.62	5.0	1.20	100	6.2
5G Wi-Fi	5150	14.05	15.0	4.01	100	19.01

Frequency (MHz)	Option	Min. Distance	Tune-Up ERP		Exposure Limit	Ratio	Result
		(cm)	(dBm)	(mW)	(mW)		Pass/Fail
2402	C	20.00	4.05	2.54	768.00	0.01	Pass
5150	C	20.00	16.86	48.53	768.00	0.06	Pass

Note: 1. $ERP = EIRP - 2.15\text{dB}$; $EIRP = \text{Output Power} + \text{Antenna gain}$

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

3. For option B, $P_{th}(\text{mW})$ convert to $Exposure Limit(\text{mW})$; For option C, $ERP(\text{W})$ convert to $Exposure Limit(\text{mW})$.

4. $Ratio = \text{Tune-Up ERP}(\text{mW}) / \text{Exposure Limit}(\text{mW})$

Mode for Simultaneous Multi-band Transmission:

Radio Access Technology	Ratio 1	Ratio 2	Simultaneous Ratio	Limit	Result
					Pass/Fail
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Note: BT and 5G Wi-Fi can't transmit at the same time.

Result: Pass