

# 1. RF Exposure Requirements

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## 1.1 General Information

### Client Information

Applicant: Tinyphoton Ltd.  
Address of applicant: Room A708 Huibaojiang Building, No. 398 Minzhi Avenue, Shenzhen, China.

Manufacturer: Tinyphoton Ltd.  
Address of manufacturer: Room A708 Huibaojiang Building, No. 398 Minzhi Avenue, Shenzhen, China.

### General Description of EUT:

Product Name: DWARF II Smart Telescope  
Trade Name: DWARFLAB  
Model No.: CCT1D1D20101  
Adding Model(s): /  
Rated Voltage: USB DC 5V, DC 9V  
Battery DC 3.7V  
Battery Capacity: 5600mAh  
Power Adapter: /  
FCC ID: 2BABC-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, 2Mbps  
Modulation: GFSK  
Quantity of Channels: 40  
Channel Separation: 2MHz  
Type of Antenna: FPC Antenna  
Antenna Gain: 1.20dBi

#### 2.4G Wi-Fi

Support Standards: 802.11b, 802.11g, 802.11n  
Frequency Range: 2412-2462MHz for 802.11b/g/n(HT20)  
RF Output Power: 19.40dBm (Conducted)  
Type of Modulation: DBPSK,BPSK,DQPSK,QPSK,16QAM,64QAM  
Quantity of Channels: 11 for 802.11b/g/n(HT20)  
Channel Separation: 5MHz

Type of Antenna:	FPC Antenna
Antenna Gain:	1.20dBi
<b>5G Wi-Fi</b>	
Support Standards:	802.11a, 802.11n(HT20) , 802.11n-HT40, 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  $\lambda$  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 <sup>2</sup>
1.34-30	3,450 R <sup>2</sup> /f <sup>2</sup>
30-300	3.83 R <sup>2</sup>
300-1,500	0.0128 R <sup>2</sup> f
1,500-100,000	19.2R <sup>2</sup>

**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)
Bluetooth	2402	4.62	1.20	100	5.0	4.05
2.4G Wi-Fi	2412	19.40	1.20	100	20.0	19.05
5G Wi-Fi	5150	14.05	4.01	100	15.0	16.86

Frequency (MHz)	Option	Min. Distance (cm)	Max. Power (dBm) (mW)		Exposure Limit (mW)	Ratio	Result
2402	C	20.00	4.05	2.54	768.00	0.01	Pass
2412	C	20.00	19.05	80.35	768.00	0.10	Pass
5150	C	20.00	16.86	48.53	768.00	0.06	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<sub>th</sub> (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:**

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

Result: Pass