

RF Exposure Evaluation Report

APPLICANT : Thundercomm Technology Co., Ltd
EQUIPMENT : Cellular Module
BRAND NAME : TurboX
MODEL NAME : CM6125
FCC ID : 2AOHHTURBOXCM6125
STANDARD : 47 CFR Part 2.1091

The product evaluation date was started from Nov. 08, 2022 and completed on Nov. 08, 2022. We, Sporton International Inc. (Shenzhen), would like to declare that the device has been evaluated in accordance with 47 CFR Part2.1091, and pass the limit. Without written approval of Sporton International Inc. (Shenzhen), the test report shall not be reproduced except in full.



Approved by: Si Zhang

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People's Republic of China



Table of Contents

1. ADMINISTRATION DATA	4
1.1. Testing Laboratory	4
2. GUIDANCE APPLIED	4
3. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)	5
4. MAXIMUM RF AVERAGE OUTPUT TUNE UP POWER AMONG PRODUCTION UNITS	7
5. RF EXPOSURE LIMIT INTRODUCTION	9
6. RADIO FREQUENCY RADIATION EXPOSURE EVALUATION	11
6.1. Standalone assessment	11
6.2. Simultaneous Transmission MPE Test Exemption	12



1. Administration Data

1.1. Testing Laboratory

Sporton International Inc. (Shenzhen) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.01.

Testing Laboratory			
Test Firm	Sporton International Inc. (Shenzhen)		
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055 People's Republic of China TEL: +86-755-86379589 FAX: +86-755-86379595		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR01-SZ	CN1256	421272

Applicant	
Company Name	Thundercomm Technology Co., Ltd
Address	No. 107, Middle Datagu Road, Xiantao Street, Yubei District, Chongqing, China, 401122

Manufacturer	
Company Name	Thundercomm Technology Co., Ltd
Address	No. 107, Middle Datagu Road, Xiantao Street, Yubei District, Chongqing, China, 401122

2. Guidance Applied

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC 47 CFR Part 2.1091
- KDB 447498 D04 Interim General RF Exposure Guidance v01
- FCC 47 CFR Part 1.1307



3. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	Cellular Module
Brand Name	TurboX
Model Name	CM6125
FCC ID	2AOHHTURBOXCM6125
Wireless Technology and Frequency Range	WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band IV: 1710 MHz ~ 1755 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2 : 1850 MHz ~ 1910 MHz LTE Band 4 : 1710 MHz ~ 1755 MHz LTE Band 5 : 824 MHz ~ 849 MHz LTE Band 7 : 2500 MHz ~ 2570 MHz LTE Band 12 : 699 MHz ~ 716 MHz LTE Band 13 : 777 MHz ~ 787 MHz LTE Band 14: 788 MHz ~ 798 MHz LTE Band 17: 704 MHz ~ 716 MHz LTE Band 25 : 1850 MHz ~ 1915 MHz LTE Band 26 : 814 MHz ~ 849 MHz LTE Band 41: 2535 MHz ~ 2655 MHz LTE Band 66 : 1710 MHz ~ 1780 MHz LTE Band 71: 663 MHz ~ 698 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5700 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	RMC 12.2Kbps HSDPA HSUPA DC-HSDPA HSPA+(16QAM uplink is not supported) LTE: QPSK, 16QAM, 64QAM 802.11b/g/n HT20/HT40 802.11a/n/ac HT20/HT40/VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE
Antenna Gain	WCDMA Band II : 3.0 dBi WCDMA Band IV : 4.5 dBi WCDMA Band V : 1.2 dBi LTE Band 2 : 3.0 dBi LTE Band 4 : 4.5 dBi LTE Band 5 : 1.2 dBi LTE Band 7 : 4.0 dBi LTE Band 12 : 1.2 dBi LTE Band 13 : 1.2 dBi LTE Band 14 : 1.2 dBi LTE Band 17 : 1.2 dBi LTE Band 25 : 3.0 dBi LTE Band 26 : 1.2 dBi LTE Band 41 : 4.0 dBi LTE Band 66: 4.5 dBi LTE Band 71: 2.0 dBi Ant1: WLAN2.4GHz/Bluetooth: 2.9 dBi WLAN5.2GHz: 3.1 dBi WLAN5.3GHz: 3.2 dBi WLAN5.5GHz: 3.2 dBi WLAN5.8GHz: 3.1 dBi Ant2:



	WLAN2.4GHz/Bluetooth: 3.5 dBi WLAN5.2GHz: 2.99 dBi WLAN5.3GHz: 2.99 dBi WLAN5.5GHz: 2.99 dBi WLAN5.8GHz: 2.99 dBi
Antenna Type	WWAN : Monopole Antenna Ant1: WLAN5GHz : Dipole Antenna WLAN2.4GHz/Bluetooth : Dipole Antenna Ant2: WLAN5GHz : PIFA Antenna WLAN2.4GHz/Bluetooth : PIFA Antenna
HW Version	V03
SW Version	Turbox-CM6125_xx.xx_la1.0.V.userdebug.20220509.0843
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. This product has two WLAN/BT antennas with the same conducted output power level. Ant1 is for the original case, Ant2 is for the new case.
3. This is a variant report. The change note could be referred to the CM6125_Class II Permissive Change letter which is exhibit separately. Based on the similarity between current and previous project, only added re-evaluation the related cases of two new antennas, all the other test results are referred to the original report FA232507.

Comments and Explanations:

1. The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.
2. The maximum RF output tune up power, antenna gain also the safe distance used for evaluate RF exposure were declared by manufacturer.



4. Maximum RF average output tune up power among production units

<WCDMA>

Mode		Maximum Average power(dBm)
WCDMA	Band II	24.00
	Band IV	24.00
	Band V	24.00

<LTE>

Mode		Maximum Average power(dBm)
LTE	Band 2	24.00
	Band 4	24.00
	Band 5	24.00
	Band 7	24.00
	Band 12	24.00
	Band 13	24.00
	Band 14	24.00
	Band 17	24.00
	Band 25	24.00
	Band 26	24.00
	Band 41	24.00
	Band 66	24.00
	Band 71	24.00

<2.4GHz WLAN>

Frequency	Mode	Maximum Average Power (dBm)
WLAN 2.4GHz	802.11b	18.00
	802.11g	17.00
	802.11n-HT20	17.00
	802.11n-HT40	17.00

<5GHz WLAN>

Frequency	Mode	Maximum Average Power (dBm)
WLAN 5.2GHz	802.11a	16.50
	802.11n-HT20	15.50
	802.11n-HT40	16.00
	802.11ac-VHT20	15.50
	802.11ac-VHT40	16.00
	802.11ac-VHT80	16.00
WLAN 5.3GHz	802.11a	16.50
	802.11n-HT20	15.50
	802.11n-HT40	16.00
	802.11ac-VHT20	15.50
	802.11ac-VHT40	16.00
	802.11ac-VHT80	16.00
WLAN 5.5GHz	802.11a	16.50
	802.11n-HT20	15.50
	802.11n-HT40	16.50
	802.11ac-VHT20	15.50
	802.11ac-VHT40	16.50
	802.11ac-VHT80	16.50
WLAN 5.8GHz	802.11a	16.50
	802.11n-HT20	16.00
	802.11n-HT40	16.50
	802.11ac-VHT20	15.50
	802.11ac-VHT40	16.50
	802.11ac-VHT80	16.50

<Bluetooth>

Frequency	Mode	Maximum Average Power (dBm)
Bluetooth	BR/EDR	13.00
	LE	9.00

5. RF Exposure Limit Introduction

1. Per 1.1307(b)(3), (i) For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

- (A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);
- (B) Or 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. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases} \quad [1]$$

Where $x = -\log_{10}\left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}}\right)$ and f is in GHz [2]

and $ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} < f \leq 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} < f \leq 6 \text{ GHz} \end{cases} \quad [3]$

- (C) Or using Table 1 and 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. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value)

Table 1 to § 1.1307(b)(3)(i)(C) - 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



2. For multiple RF sources: Multiple RF sources are exempt if:

- (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). This exemption may not be used in conjunction with other exemption criteria other than those is paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).
- (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.

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

- a. a = number of fixed, mobile, or portable RF sources claiming exemption using the § 1.1307(b)(3)(i)(B) formula for Pth, including existing exempt transmitters and those being added.
- b. b = number of fixed, mobile, or portable RF sources claiming exemption using the applicable § 1.1307(b)(3)(i)(C) Table 1 formula for Threshold ERP, including existing exempt transmitters and those being added.
- c. c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance.
- d. Pi, the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive)
- e. Pth,i the exemption threshold power (Pth) according to the § 1.1307(b)(3)(i)(B) formula for fixed, mobile, or portable RF source i.
- f. ERPj the available maximum time-averaged power or the ERP, whichever is greater, of fixed, mobile, or portable RF source j.
- g. ERPth,j exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least λ/2π, according to the applicable § 1.1307(b)(3)(i)(C) Table 1 formula at the location in question.
- h. Evaluatedk the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation.
- i. Exposure Limitk either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable sources RF source k, as applicable from § 1.1310 of this chapter.
- j. The relationship between EIRP and ERP is: ERP (dBm) = EIRP - 2.15, Where EIRP is the sum of the conducted power (dBm) and the antenna gain (dBi)

The sum of the ratios of the applicable terms for SAR-based, MPE-based and measured SAR or MPE shall be less than 1, to determine simultaneous transmission exposure compliance



6. Radio Frequency Radiation Exposure Evaluation

6.1. Standalone assessment

Band	Antenna Gain (dBi)	Maximum Conducted Power (dBm)	Maximum EIRP (dBm)	Maximum ERP (dBm)	Maximum ERP (mW)	Separation Distance (cm)	Part1.1307 option(b) Threshold (mW)	Part1.1307 option(b) P/Pth
WCDMA Band 2	3.00	24.00	27.00	24.85	305.49	20	3060.000	0.100
WCDMA Band 4	4.50	24.00	28.50	26.35	431.52	20	3060.000	0.141
WCDMA Band 5	1.20	24.00	25.20	23.05	201.84	20	1680.960	0.149
LTE Band 2	3.00	24.00	27.00	24.85	305.49	20	3060.000	0.100
LTE Band 4	4.50	24.00	28.50	26.35	431.52	20	3060.000	0.141
LTE Band 5	1.20	24.00	25.20	23.05	201.84	20	1680.960	0.149
LTE Band 7	4.00	24.00	28.00	25.85	384.59	20	3060.000	0.126
LTE Band 12	1.20	24.00	25.20	23.05	201.84	20	1425.960	0.176
LTE Band 13	1.20	24.00	25.20	23.05	201.84	20	1585.080	0.158
LTE Band 14	1.20	24.00	25.20	23.05	201.84	20	1607.520	0.156
LTE Band 17	1.20	24.00	25.20	23.05	201.84	20	1436.160	0.175
LTE Band 25	3.00	24.00	27.00	24.85	305.49	20	3060.000	0.100
LTE Band 26	1.20	24.00	25.20	23.05	201.84	20	1660.560	0.151
LTE Band 41	4.00	24.00	28.00	25.85	384.59	20	3060.000	0.126
LTE Band 66	4.50	24.00	28.50	26.35	431.52	20	3060.000	0.141
LTE Band 71	2.00	24.00	26.00	23.85	242.66	20	1352.520	0.186
WLAN2.4GHz Band	3.50	18.00	21.50	19.35	86.10	20	3060.000	0.028
WLAN5.2GHz Band	3.10	16.50	19.60	17.45	55.59	20	3060.000	0.018
WLAN5.3GHz Band	3.20	16.50	19.70	17.55	56.89	20	3060.000	0.019
WLAN5.5GHz Band	3.20	16.50	19.70	17.55	56.89	20	3060.000	0.019
WLAN5.8GHz Band	3.10	16.50	19.60	17.45	55.59	20	3060.000	0.018
Bluetooth	3.50	13.00	16.50	14.35	27.23	20	3060.000	0.009

Note:

1. Chose the maximum power to do MPE analysis.
2. Chose the maximum RF output tune up power of all antennas among same frequency WLAN bands and the maximum antenna gain to perform MPE calculation conservatively.



6.2. Simultaneous Transmission MPE Test Exemption

WWAN P/Pth Ratio	Bluetooth P/Pth Ratio	Sum of the Ratio WWAN + Bluetooth
0.186	0.009	0.195
WWAN P/Pth Ratio	WLAN 2.4GHz P/Pth Ratio	Sum of the Ratio WWAN + WLAN 2.4GHz
0.186	0.028	0.214
WWAN P/Pth Ratio	WLAN 5GHz P/Pth Ratio	Sum of the Ratio WWAN + WLAN 5GHz
0.186	0.019	0.205

Note:

1. According to Part1.1307 (b)(3)(i)(B), the P/Pth Ratio is using for Sim-Tx analysis, above table was showing summation ratio is smaller than 1.
2. According to the EUT characteristic, WLAN 2.4GHz and Bluetooth can't transmit simultaneously.
3. According to the EUT characteristic, WLAN 5GHz and Bluetooth can't transmit simultaneously.
4. According to the EUT characteristic, WLAN 2.4GHz and WLAN 5GHz can't transmit simultaneously.

Conclusion:

According to 47 CFR §1.1307 (b)(3)(i)(B), the RF exposure analysis concludes that the RF Exposure is FCC compliant.

-----THE END-----