



# RF EXPOSURE EVALUATION REPORT

**APPLICANT** : Thundercomm Technology Co., Ltd  
**PRODUCT NAME** : Smart Module  
**MODEL NAME** : C865C, C2130C, C5165C  
**BRAND NAME** : TurboX  
**FCC ID** : 2AOHHTURBOXC865C  
**STANDARD(S)** : 47 CFR Part 2(2.1091)  
**RECEIPT DATE** : 2022-11-11  
**TEST DATE** : 2022-11-27 to 2022-12-05  
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Change History		
Version	Date	Reason for change
1.0	2022-12-27	First edition



# 1. Technical Information

**Note:** Provide by applicant.

## 1.1 Applicant and Manufacturer Information

<b>Applicant:</b>	Thundercomm Technology Co., Ltd
<b>Applicant Address:</b>	Building 4, No. 99, Data Valley Middle Road, Xiantao District, Yubei District, Chongqing, China
<b>Manufacturer:</b>	Thundercomm Technology Co., Ltd
<b>Manufacturer Address:</b>	Building 4, No. 99, Data Valley Middle Road, Xiantao District, Yubei District, Chongqing, China

## 1.2 Equipment under Test (EUT) Description

<b>Product Name:</b>	Smart Module	
<b>Sample No.:</b>	1#, 2#	
<b>Hardware Version:</b>	DT865_DEq_LA-IOB V03	
<b>Software Version:</b>	FlatBuild_Turbox-QCS8250_xx.xx_la1.0.D.userdebug.20221024.1345	
<b>Frequency Bands:</b>	Bluetooth	2402MHz-2480MHz
	WLAN 2.4GHz	2412MHz-2462MHz
	WLAN 5GHz	5180MHz-5240MHz
		5260MHz-5320MHz
		5500MHz-5720MHz
5745MHz-5825MHz		
<b>Modulation Mode:</b>	Bluetooth	GFSK(1Mbps), $\pi/4$ -DQPSK(EDR 2Mbps), 8-DPSK(EDR 3Mbps)
	WLAN 2.4GHz	DSSS, OFDM
	WLAN 5GHz	OFDM



<b>Antenna Information:</b>	Antenna Type A	
	Part No.:	1461531100
	Manufacturer:	MOLEX
	Bluetooth	
	Antenna Type:	Dipole Antenna
	Antenna Gain:	2.6dBi
	WLAN 2.4GHz	
	Antenna Type:	Dipole Antenna
	Antenna Gain:	ANT0: 2.6dBi; ANT1: 2.6dBi
	WLAN 5GHz	
	Antenna Type:	Dipole Antenna
	Antenna Gain:	ANT0: 2.7dBi; ANT1: 2.7dBi
	Antenna Type B	
	Part No.:	ANT0: F-0G-JV-0211-002-00 ANT1: F-0G-JV-0211-001-00
	Manufacturer:	Speed Wireless Technical Co., LTD.
	Bluetooth	
	Antenna Type:	PIFA Antenna
	Antenna Gain:	1.84dBi
	WLAN 2.4GHz	
	Antenna Type:	PIFA Antenna
	Antenna Gain:	ANT0: 1.84dBi; ANT1: 1.42dBi
	WLAN 5GHz	
	Antenna Type:	PIFA Antenna
	Antenna Gain:	ANT0: 3.91dBi; ANT1: 3.42dBi

**Note1:** This is a variant report of original report (Report No.: SZ22030287S01, FCC ID: 2AOHHTURBOXC865C). Based on the similarity between before, made the following changes:

A new antenna is added.

Change the C11201 capacitor, the role is BT power supply filter, does not change the power control, does not affect the RF.

Change the shelf under the shield cover.

Update software version number.

Reduce 2.4G WiFi and 5G WiFi conducted output power.

Except for the differences shown above, the other parts are the same as before. No other changes.

Due to the above changes, we have evaluated and retested part of the conducted output power, the test results were recorded in this report.

**Note2:** The EUT will not sell with the antenna.



### 1.3 Applied Reference Documents

Leading reference documents for testing:

Identity	Document Title	Method Determination /Remark
47 CFR Part 2(2.1091)	Radio Frequency Radiation Exposure Assessment: mobile devices	No deviation
KDB 447498 D01v06	General RF Exposure Guidance	No deviation

**Note 1:** Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

**Note 2:** When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.



## 2. Device Category and RF Exposure Limit

Per user manual, based on 47 CFR 2.1091, this device belongs to mobile device category with General Population/Uncontrolled exposure.

### Mobile Devices:

47 CFR 2.1091(b)

For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. In this context, the term "fixed location" means that the device is physically secured at one location and is not able to be easily moved to another location. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 centimeter separation requirement.

### General Population/Uncontrolled Exposure:

The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category, and the general population/uncontrolled exposure limits apply to these devices.

**Table 1 Limits for Maximum Permissible Exposure (MPE)**

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	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



### 3. RF Output Power

Mode	Channel	Frequency (MHz)	Average Power (dBm)
			GFSK
Bluetooth LE (1Mbps)	CH 00	2402	6.00
	CH 19	2440	7.37
	CH 39	2480	4.54
Tune-up Limit			7.50
Bluetooth LE (2Mbps)	CH 00	2402	6.07
	CH 19	2440	6.58
	CH 39	2480	3.69
Tune-up Limit			7.00

Mode	Channel	Frequency (MHz)	Average Power (dBm)		
			GFSK	$\pi/4$ -DQPSK	8-DPSK
Bluetooth Classic	CH 00	2402	7.80	5.05	5.02
	CH 39	2441	<b>8.56</b>	5.94	5.87
	CH 78	2480	6.22	3.45	3.48
Tune-up Limit			9.00	6.50	6.00



2.4GHz WLAN, ANT1					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11b	CH 1	2412	19.17	19.50	99.26
	CH 6	2437	19.38	19.50	
	CH 11	2462	18.87	19.00	
802.11g	CH 1	2412	17.91	18.00	99.25
	CH 6	2437	18.15	18.50	
	CH 11	2462	17.67	18.00	

2.4GHz WLAN, ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11b	CH 1	2412	19.06	19.50	99.26
	CH 6	2437	19.31	19.50	
	CH 11	2462	18.78	19.00	
802.11g	CH 1	2412	17.84	18.00	99.25
	CH 6	2437	18.02	18.50	
	CH 11	2462	17.40	18.00	





2.4GHz WLAN, ANT1+ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11n (HT20)	CH 1	2412	20.45	20.50	100.00
	CH 6	2437	<b>20.76</b>	21.00	
	CH 11	2462	20.33	20.50	
802.11n (HT40)	CH 3	2422	19.29	19.50	96.32
	CH 6	2437	19.64	20.00	
	CH 9	2462	19.29	19.50	
802.11ax (HEW20)	CH 1	2412	17.78	18.00	99.63
	CH 6	2437	18.20	18.50	
	CH 11	2462	18.13	18.50	
802.11ax (HEW40)	CH 3	2422	18.26	18.50	99.63
	CH 6	2437	17.99	18.50	
	CH 9	2462	18.26	18.50	
802.11ax (HEW20) RU26	CH 1	2412	18.81	19.00	99.61
	CH 6	2437	19.24	19.50	
	CH 11	2462	19.19	19.50	
802.11ax (HEW20) RU52	CH 1	2412	18.92	19.00	99.61
	CH 6	2437	19.40	19.50	
	CH 11	2462	19.29	19.50	
802.11ax (HEW20) RU106	CH 1	2412	19.08	19.50	99.58
	CH 6	2437	19.29	19.50	
	CH 11	2462	19.08	19.50	



5GHz WLAN, ANT1					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11a	CH 36	5180	16.30	16.50	99.00
	CH 44	5220	16.35	16.50	
	CH 48	5240	16.27	16.50	
	CH 52	5260	16.29	16.50	
	CH 60	5300	16.43	16.50	
	CH 64	5320	16.39	16.50	
	CH 100	5500	13.65	14.00	
	CH 120	5600	14.26	14.50	
	CH 144	5720	15.45	16.00	
	CH 149	5745	<b>16.49</b>	16.50	
	CH 157	5785	16.46	16.50	
	CH 165	5825	16.06	16.50	

5GHz WLAN, ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11a	CH 36	5180	15.93	16.50	99.00
	CH 44	5220	16.15	16.50	
	CH 48	5240	16.00	16.50	
	CH 52	5260	16.17	16.50	
	CH 60	5300	<b>16.32</b>	16.50	
	CH 64	5320	16.25	16.50	
	CH 100	5500	12.62	13.00	
	CH 120	5600	12.02	12.50	
	CH 144	5720	13.74	14.00	
	CH 149	5745	16.11	16.50	
	CH 157	5785	16.09	16.50	
	CH 165	5825	16.19	16.50	



5GHz WLAN, ANT1+ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11n (HT20)	CH 36	5180	19.03	19.50	99.63
	CH 44	5220	19.08	19.50	
	CH 48	5240	19.03	19.50	
	CH 52	5260	19.14	19.50	
	CH 60	5300	19.34	19.50	
	CH 64	5320	19.14	19.50	
	CH 100	5500	17.48	18.00	
	CH 120	5600	18.26	18.50	
	CH 144	5720	19.14	19.50	
	CH 149	5745	<b>19.40</b>	19.50	
	CH 157	5785	19.19	19.50	
	CH 165	5825	18.81	19.00	

5GHz WLAN, ANT1+ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11n (HT40)	CH 38	5190	17.78	18.00	99.63
	CH 46	5230	17.92	18.50	
	CH 54	5270	17.78	18.00	
	CH 62	5310	17.32	17.50	
	CH 102	5510	17.40	17.50	
	CH 126	5630	17.63	18.00	
	CH 142	5710	17.56	18.00	
	CH 151	5755	<b>19.96</b>	20.50	
	CH 159	5795	19.49	19.50	



5GHz WLAN, ANT1+ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11ac (VHT20)	CH 36	5180	18.26	18.50	99.63
	CH 44	5220	18.33	18.50	
	CH 48	5240	18.20	18.50	
	CH 52	5260	18.13	18.50	
	CH 60	5300	18.26	18.50	
	CH 64	5320	18.20	18.50	
	CH 100	5500	16.43	16.50	
	CH 120	5600	17.32	17.50	
	CH 144	5720	18.13	18.50	
	CH 149	5745	18.26	18.50	
	CH 157	5785	<b>18.39</b>	18.50	
CH 165	5825	18.13	18.50		

5GHz WLAN, ANT1+ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11ac (VHT40)	CH 38	5190	18.63	19.00	99.63
	CH 46	5230	18.39	18.50	
	CH 54	5270	18.06	18.50	
	CH 62	5310	18.51	19.00	
	CH 102	5510	17.24	17.50	
	CH 126	5630	18.13	18.50	
	CH 142	5710	18.69	19.00	
	CH 151	5755	<b>18.92</b>	19.50	
	CH 159	5795	18.69	19.00	

5GHz WLAN, ANT1+ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11ac (VHT80)	CH 42	5210	16.63	17.00	100.00
	CH 58	5290	17.78	18.00	
	CH 106	5530	15.31	16.00	
	CH 122	5610	15.56	16.00	
	CH 138	5690	16.33	16.50	
	CH 155	5775	<b>18.51</b>	19.00	



5GHz WLAN, ANT1+ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11ax (HEW20)	CH 36	5180	18.20	18.50	99.63
	CH 44	5220	<b>18.33</b>	18.50	
	CH 48	5240	17.99	18.50	
	CH 52	5260	17.99	18.50	
	CH 60	5300	18.20	18.50	
	CH 64	5320	18.20	18.50	
	CH 100	5500	15.31	15.50	
	CH 120	5600	15.44	16.00	
	CH 144	5720	16.63	17.00	
	CH 149	5745	18.26	18.50	
	CH 157	5785	18.13	18.50	
CH 165	5825	17.92	18.50		

5GHz WLAN, ANT1+ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11ax (HEW40)	CH 38	5190	16.33	16.50	99.63
	CH 46	5230	16.43	16.50	
	CH 54	5270	17.16	17.50	
	CH 62	5310	17.08	17.50	
	CH 102	5510	16.99	17.50	
	CH 126	5630	18.06	18.50	
	CH 142	5710	18.63	19.00	
	CH 151	5755	<b>18.92</b>	19.50	
	CH 159	5795	18.45	19.00	

5GHz WLAN, ANT1+ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11ax (HEW80)	CH 42	5210	16.43	17.00	100.00
	CH 58	5290	16.43	17.00	
	CH 106	5530	14.15	14.50	
	CH 122	5610	14.62	15.00	
	CH 138	5690	14.31	14.50	
	CH 155	5775	<b>18.75</b>	19.00	



5GHz WLAN, ANT1+ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11ax (HEW20) RU26	CH 36	5180	10.41	10.50	100.00
	CH 44	5220	10.79	11.00	
	CH 48	5240	11.46	11.50	
	CH 52	5260	10.79	11.00	
	CH 60	5300	11.46	11.50	
	CH 64	5320	10.41	10.50	
	CH 100	5500	9.54	10.00	
	CH 120	5600	9.54	10.00	
	CH 144	5720	11.14	11.50	
	CH 149	5745	<b>11.46</b>	12.00	
	CH 157	5785	10.79	11.00	
	CH 165	5825	10.41	10.50	

5GHz WLAN, ANT1+ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11ax (HEW20) RU52	CH 36	5180	13.22	13.50	100.00
	CH 44	5220	13.01	13.50	
	CH 48	5240	13.22	13.50	
	CH 52	5260	13.22	13.50	
	CH 60	5300	13.42	13.50	
	CH 64	5320	13.42	13.50	
	CH 100	5500	12.30	12.50	
	CH 120	5600	12.30	12.50	
	CH 144	5720	13.01	13.50	
	CH 149	5745	13.62	14.00	
	CH 157	5785	13.80	14.00	
	CH 165	5825	<b>13.80</b>	14.00	



5GHz WLAN, ANT1+ANT2					
Mode	Channel	Frequency (MHz)	Average Power (dBm)	Tune-up Power	Duty Cycle %
802.11ax (HEW20) RU106	CH 36	5180	14.91	15.00	100.00
	CH 44	5220	<b>15.44</b>	15.50	
	CH 48	5240	15.44	15.50	
	CH 52	5260	15.31	15.50	
	CH 60	5300	14.62	15.00	
	CH 64	5320	15.19	15.50	
	CH 100	5500	13.62	14.00	
	CH 120	5600	13.22	14.00	
	CH 144	5720	13.42	14.00	
	CH 149	5745	14.15	14.50	
	CH 157	5785	15.05	15.50	
	CH 165	5825	14.91	15.50	

**Note 1:** According to KDB 447498, MPE assessment is based on source-based time-averaged maximum conducted output power of the RF channel requiring assessment, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions.

**Note 2:** The output power refers to report (Report No.: SZ22030285W01/W02/W03/W04).

## 4. RF Exposure Assessment

### ➤ Standalone Transmission Assessment:

Bands	Frequency (MHz)	Tune-up Power(dBm)	Antenna Gain(dBi)	E.I.R.P. (mW)	Power Density (mW/cm <sup>2</sup> )	Limit for MPE (mW/cm <sup>2</sup> )
Bluetooth	2441	9.00	2.60	14.45	0.003	1.0

### ➤ MIMO Transmission Assessment

Bands	Frequency (MHz)	Tune-up Power(dBm)	Antenna Gain(dBi)	E.I.R.P. (mW)	Power Density (mW/cm <sup>2</sup> )	Limit for MPE (mW/cm <sup>2</sup> )
WLAN 2.4GHz	2437	21.00	2.60	229.09	0.046	1.0
WLAN 5GHz	5755	20.50	3.91	276.06	0.055	1.0

**Note 1:** For 2.4G/5G WLAN, only the worst case will be used for calculating the power density.

**Note 2:** MPE calculate method

$$S = PG/4\pi R^2$$

Where: S= Power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = Time-average maximum tune-up power (in appropriate units, e.g. dBm)

G = numeric gain of the antenna (in appropriate units, e.g. dBi)

R = Separation distance to the centre of radiation of the antenna (20cm)





➤ **Simultaneous Transmission Assessment:**

**Multi-Band Simultaneous Transmission Consideration**

Simultaneous Transmission Consideration	Position	Applicable Combination
	Hand/Body	WLAN 2.4GHz MIMO
		WLAN 5GHz MIMO
		WLAN 2.4GHz MIMO+ WLAN 5GHz MIMO

**Note 1:** This device contains transmitters that may operate simultaneously, therefore simultaneous transmission analysis is required as below.

Applicable Combination	Transmission Bands	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Simultaneous Transmission Result
WLAN 2.4GHz MIMO+ WLAN 5GHz MIMO	WLAN 2.4GHz MIMO	0.046	1.0	0.101
	WLAN 5GHz MIMO	0.055	1.0	
<p><b>Note 1:</b> Formula for result=Power density<sub>1</sub>/ limit<sub>1</sub> + Power density<sub>2</sub>/ limit<sub>2</sub> ≤ 1.</p> <p><b>Note 2:</b> The black bold applicable combination was the worst condition.</p>				

➤ **Conclusion:**

According to 47 CFR 2.1091, this device complies with human exposure basic restrictions.



## Annex A Testing Laboratory Information

### 1. Identification of the Responsible Testing Laboratory

<b>Laboratory Name:</b>	Shenzhen Morlab Communications Technology Co., Ltd.
<b>Laboratory Address:</b>	FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
<b>Telephone:</b>	+86 755 36698555
<b>Facsimile:</b>	+86 755 36698525

### 2. Identification of the Responsible Testing Location

<b>Name:</b>	Shenzhen Morlab Communications Technology Co., Ltd.
<b>Address:</b>	FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

### 3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013 and CISPR Publication 22; the FCC designation number is CN1192, the test firm registration number is 226174.

\_\_\_\_\_ END OF REPORT \_\_\_\_\_