



RF EXPOSURE EVALUATION REPORT

APPLICANT : Thundercomm Technology Co., Ltd

PRODUCT NAME : TurboX C450 SOM

MODEL NAME : TurboX C450

BRAND NAME : TurboX

FCC ID : 2AOHHTURBOXC450

STANDARD(S) : FCC 47CFR Part 2(2.1091)

RECEIPT DATE : 2020-10-28

TEST DATE : 2020-11-07 to 2021-03-12

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Change History		
Version	Date	Reason for Change
1.0	2021-04-30	First edition



1. Technical Information

Note: Provide by applicant.

1.1 Applicant and Manufacturer Information

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

1.2 Equipment under Test (EUT) Description

Product Name:	TurboX C450 SOM	
Serial No.:	(N/A, marked #1 by test site)	
Hardware Version:	TURBOX-C450_SOM	
Software Version:	2020.10.22	
Frequency Bands:	Bluetooth	2402MHz-2480MHz
	WLAN 2.4GHz	2412MHz-2462MHz
	WLAN 5GHz	5180MHz-5240MHz
		5260MHz-5320MHz
		5500MHz-5720MHz
		5745MHz-5825MHz
Modulation Mode:	Bluetooth	GFSK(1Mbps), $\pi/4$ -DQPSK(EDR 2Mbps), 8-DPSK(EDR 3Mbps)
	WLAN 2.4GHz	DSSS, OFDM
	WLAN 5GHz	OFDM
Antenna Information:	Bluetooth	
	Antenna Type:	Dipole Antenna
	Antenna Gain:	3.00dBi
	WLAN 2.4GHz	
	Antenna Type:	Dipole Antenna
	Antenna Gain:	3.00dBi



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Antenna Information:	WLAN 5GHz	
	Antenna Type:	Dipole Antenna
	Antenna Gain:	4.00dBi

Note 1: The EUT will not sell with antenna.

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1.3 Applied Reference Documents

Leading reference documents for testing:

Identity	Document Title	Method determination /Remark
FCC 47CFR 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% risk level.		



2. Device Category and RF Exposure Limit

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

Mobile Devices:

47CFR 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 ²)	Averaging time (minutes)
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	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	CH 00	2402	2.89
	CH 19	2440	2.85
	CH 39	2480	2.77
Tune-up Limit			3.50

Mode	Channel	Frequency (MHz)	Average power (dBm)		
			GFSK	$\pi/4$ -DQPSK	8-DPSK
Bluetooth classic	CH 00	2402	11.32	8.98	9.08
	CH 39	2441	11.49	9.13	9.07
	CH 78	2480	11.63	9.34	9.22
Tune-up Limit			12.00	10.00	10.00

2.4GHz WLAN					
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Power	Duty Cycle %
802.11b	CH 1	2412	12.86	13.00	97.88
	CH 6	2437	12.60	13.00	
	CH 11	2462	12.27	13.00	
802.11g	CH 1	2412	11.21	12.00	87.22
	CH 6	2437	10.89	11.00	
	CH 11	2462	10.60	11.00	
802.11n (HT20)	CH 1	2412	11.21	12.00	86.73
	CH 6	2437	11.06	12.00	
	CH 11	2462	10.67	11.00	
802.11n (HT40)	CH 3	2422	11.82	12.00	76.05
	CH 6	2437	11.63	12.00	
	CH 9	2462	11.49	12.00	



5GHz WLAN, 5150MHz-5250MHz					
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Power	Duty Cycle %
802.11a	CH 36	5180	12.09	12.50	87.18
	CH 44	5220	12.21	13.00	
	CH 48	5240	12.26	13.00	
802.11n (HT20)	CH 36	5180	11.04	12.00	86.33
	CH 44	5220	11.05	12.00	
	CH 48	5240	11.32	12.00	
802.11n (HT40)	CH 38	5190	10.45	11.00	86.40
	CH 46	5230	10.52	11.00	
802.11ac (VHT20)	CH 36	5180	9.86	10.50	83.05
	CH 44	5220	9.78	10.00	
	CH 48	5240	10.35	11.00	
802.11ac (VHT40)	CH 38	5190	10.02	11.00	71.22
	CH 46	5230	9.92	10.50	
802.11ac (VHT80)	CH 42	5210	8.49	9.50	55.33

5GHz WLAN, 5250MHz-5350MHz					
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Power	Duty Cycle %
802.11a	CH 52	5260	12.08	12.50	87.18
	CH 60	5300	11.74	12.00	
	CH 64	5320	11.83	12.50	
802.11n (HT20)	CH 52	5260	11.14	12.00	86.33
	CH 60	5300	10.88	11.00	
	CH 64	5320	10.92	11.50	
802.11n (HT40)	CH 54	5270	10.23	11.00	86.40
	CH 62	5310	9.91	10.50	
802.11ac (VHT20)	CH 52	5260	10.14	11.00	83.05
	CH 60	5300	9.85	10.50	
	CH 64	5320	9.82	10.50	
802.11ac (VHT40)	CH 54	5270	9.74	10.50	71.22
	CH 62	5310	9.49	10.50	
802.11ac (VHT80)	CH 58	5290	8.03	8.50	55.33



5GHz WLAN, 5470MHz-5725MHz					
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Power	Duty Cycle %
802.11a	CH 100	5500	11.63	12.00	87.18
	CH 120	5600	12.26	13.00	
	CH 144	5720	11.63	12.00	
802.11n (HT20)	CH 100	5500	10.60	11.00	86.33
	CH 120	5600	11.39	12.00	
	CH 144	5720	10.63	11.00	
802.11n (HT40)	CH 102	5510	9.66	10.50	86.40
	CH 126	5630	10.52	11.00	
	CH 142	5710	9.84	10.50	
802.11ac (VHT20)	CH 100	5500	9.52	10.50	83.05
	CH 120	5600	10.42	11.00	
	CH 144	5720	9.67	10.50	
802.11ac (VHT40)	CH 102	5510	9.17	10.00	71.22
	CH 126	5630	10.08	10.50	
	CH 142	5710	9.45	10.50	
802.11ac (VHT80)	CH 106	5530	7.92	8.50	55.33
	CH 122	5610	8.44	9.00	
	CH 138	5690	8.05	8.50	



5GHz WLAN, 5725MHz-5825MHz					
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Power	Duty Cycle %
802.11a	CH 149	5745	11.26	12.00	87.18
	CH 157	5785	10.95	11.50	
	CH 165	5825	11.14	12.00	
802.11n (HT20)	CH 149	5745	10.43	11.50	86.33
	CH 157	5785	9.94	10.50	
	CH 165	5825	10.26	11.00	
802.11n (HT40)	CH 151	5755	9.10	10.00	86.40
	CH 159	5795	9.01	10.00	
802.11ac (VHT20)	CH 149	5745	9.36	10.00	83.05
	CH 157	5785	8.97	9.50	
	CH 165	5825	9.20	10.00	
802.11ac (VHT40)	CH 151	5755	8.91	9.50	71.22
	CH 159	5795	8.57	9.50	
802.11ac (VHT80)	CH 155	5775	7.19	8.00	55.33

Note 1: According to KDB 447498 Section 4.3, 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.: SZ20100254W01/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 ²)	Limit for MPE (mW/cm ²)
Bluetooth	2480	12.00	3.00	31.62	0.006	1.0
WLAN 2.4GHz	2412	13.00	3.00	39.81	0.008	1.0
WLAN 5GHz	5240	13.00	4.00	50.12	0.010	1.0

Note:

1. According to KDB 447498, SAR test exclusion conditions are 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.
2. For 5GHz WLAN, only the worst case will be used for calculating the power density.
3. MPE calculate method

$$\text{Power Density} = \text{EIRP}/4\pi R^2$$

Where: EIRP = P+G

P = Output Power (dBm)

G = Antenna Gain (dBi)

R = Separation Distance (20cm)

➤ Simultaneous Transmission Assessment:

Multi-Band Simultaneous Transmission Consideration

Simultaneous Transmission Consideration	Position	Applicable Combination
	Body	WLAN 2.4GHz + Bluetooth
		WLAN 5GHz + Bluetooth
		WLAN 2.4GHz + WLAN 5GHz
		WLAN 2.4GHz + WLAN 5GHz + Bluetooth



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 ²)	Limit (mW/cm ²)	Simultaneous Transmission Result
WLAN 2.4GHz + Bluetooth	WLAN 2.4GHz	0.008	1.0	0.014
	Bluetooth	0.006	1.0	
WLAN 5GHz + Bluetooth	WLAN 5GHz	0.010	1.0	0.016
	Bluetooth	0.006	1.0	
WLAN 2.4GHz + WLAN 5GHz	WLAN 2.4GHz	0.008	1.0	0.018
	WLAN 5GHz	0.010	1.0	
WLAN 2.4GHz + WLAN 5GHz + Bluetooth	WLAN 2.4GHz	0.008	1.0	0.024
	WLAN 5GHz	0.010	1.0	
	Bluetooth	0.006	1.0	
Note 1: Formula for result=Power density ₁ / limit ₁ + Power density ₂ / limit ₂ ≤1.				
Note 2: The black bold applicable combination was the worst condition.				

➤ **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

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

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	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.

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