



RF EXPOSURE EVALUATION REPORT

APPLICANT : Thundercomm Technology Co., Ltd

PRODUCT NAME : TurboX C403 SOM

MODEL NAME : TurboX C403-C

BRAND NAME : TurboX

FCC ID : 2AOHHTURBOXC403C

STANDARD(S) : 47CFR 2.1091
KDB 447498

RECEIPT DATE : 2020-12-29

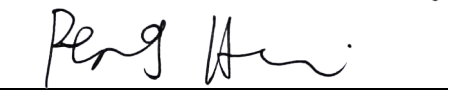
TEST DATE : 2021-01-10 to 2021-02-22

ISSUE DATE : 2021-03-02

Edited by:


Zeng Xiaoying (Rapporteur)

Approved by:


Peng Huarui (Supervisor)

NOTE: This document is issued by MORLAB, the test report shall not be reproduced except in full without prior written permission of the company. The test results apply only to the particular sample(s) tested and to the specific tests carried out which is available on request for validation and information confirmed at our website.





DIRECTORY

1. Technical Information	3
1.1 Applicant and Manufacturer Information	3
1.2 Equipment under Test (EUT) Description	3
1.3 Applied Reference Documents	4
2. Device Category and RF Exposure Limit	5
3. RF Output Power	6
4. RF Exposure Assessment	10
Annex A Testing Laboratory Information	12

Change History		
Version	Date	Reason for Change
1.0	2021-03-02	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 C403 SOM	
Serial No.:	(N/A, marked #1 by test site)	
Hardware Version:	TurboX C403-C V06	
Software Version:	LE1	
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 / WLAN 2.4GHz	
	Antenna Type:	Dipole Antenna
	Antenna Gain:	3.00dBi
	Part No.:	1461530100
	Antenna Manufacture:	MOLEX



Antenna Information:	WLAN 5GHz	
	Antenna Type:	Dipole Antenna
	Antenna Gain:	4.00dBi
	Part No.:	1461530100
	Antenna Manufacture:	MOLEX

Note 1: The EUT will not sell with antenna.

1.3 Applied Reference Documents

Leading reference documents for testing:

No.	Identity	Document Title	Method determination /Remark
1	47 CFR§2.1091	Radio Frequency Radiation Exposure Assessment: mobile devices	No deviation
2	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 (1Mbps)	CH 00	2402	5.81
	CH 19	2440	5.30
	CH 39	2480	7.10
Tune-up Limit			7.50
Bluetooth LE (2Mbps)	CH 00	2402	6.09
	CH 19	2440	5.65
	CH 39	2480	7.58
Tune-up Limit			8.00

Mode	Channel	Frequency (MHz)	Average power (dBm)		
			GFSK	$\pi/4$ -DQPSK	8-DPSK
Bluetooth classic	CH 00	2402	10.70	7.92	7.88
	CH 39	2441	9.74	6.30	6.60
	CH 78	2480	10.29	7.70	7.69
Tune-up Limit			11.50	8.50	8.50

2.4GHz WLAN					
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Power	Duty Cycle %
802.11b	CH 1	2412	16.38	17.00	97.76
	CH 6	2437	16.82	17.50	
	CH 11	2462	17.06	17.50	
802.11g	CH 1	2412	14.91	15.50	98.31
	CH 6	2437	14.86	15.50	
	CH 11	2462	15.06	15.50	
802.11n (HT20)	CH 1	2412	13.65	14.00	98.18
	CH 6	2437	13.67	14.00	
	CH 11	2462	13.28	14.00	
802.11n (HT40)	CH 3	2422	13.93	14.50	94.90
	CH 6	2437	13.83	14.50	
	CH 9	2452	14.10	14.50	



5GHz WLAN					
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Power	Duty Cycle %
802.11a	CH 36	5180	11.94	12.50	97.67
	CH 44	5220	11.85	12.50	
	CH 48	5240	11.65	12.50	
	CH 52	5260	11.30	12.00	
	CH 60	5300	10.67	11.00	
	CH 64	5320	10.73	11.00	
	CH 100	5500	12.13	12.50	
	CH 120	5600	13.56	14.00	
	CH 144	5720	13.33	14.00	
	CH 149	5745	13.37	14.00	
	CH 157	5785	13.35	14.00	
	CH 165	5825	13.56	14.00	

5GHz WLAN					
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Power	Duty Cycle %
802.11n (HT20)	CH 36	5180	10.89	11.50	97.51
	CH 44	5220	10.95	11.50	
	CH 48	5240	10.87	11.50	
	CH 52	5260	10.98	11.50	
	CH 60	5300	9.62	10.50	
	CH 64	5320	9.63	10.50	
	CH 100	5500	10.83	11.50	
	CH 120	5600	12.40	13.00	
	CH 144	5720	12.22	13.00	
	CH 149	5745	12.30	13.00	
	CH 157	5785	12.08	12.50	
	CH 165	5825	11.53	12.50	



5GHz WLAN					
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Power	Duty Cycle %
802.11n (HT40)	CH 38	5190	11.05	11.50	95.87
	CH 46	5230	11.15	11.50	
	CH 54	5270	10.91	11.50	
	CH 62	5310	10.05	10.50	
	CH 102	5510	11.47	12.00	
	CH 126	5630	12.82	13.50	
	CH 142	5710	12.37	13.00	
	CH 151	5755	12.53	13.00	
	CH 159	5795	12.71	13.50	

5GHz WLAN					
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Power	Duty Cycle %
802.11ac (VHT20)	CH 36	5180	10.29	11.00	98.19
	CH 44	5220	9.66	10.50	
	CH 48	5240	9.77	10.50	
	CH 52	5260	9.21	10.00	
	CH 60	5300	8.61	9.00	
	CH 64	5320	8.66	9.00	
	CH 100	5500	10.00	10.50	
	CH 120	5600	11.55	12.00	
	CH 144	5720	11.18	11.50	
	CH 149	5745	10.16	10.50	
	CH 157	5785	10.94	11.50	
	CH 165	5825	10.98	11.50	



5GHz WLAN					
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Power	Duty Cycle %
802.11ac (VHT40)	CH 38	5190	10.30	11.00	96.39
	CH 46	5230	10.51	11.00	
	CH 54	5270	10.52	11.00	
	CH 62	5310	10.31	11.00	
	CH 102	5510	10.59	11.00	
	CH 126	5630	10.72	11.50	
	CH 142	5710	10.87	11.50	
	CH 151	5755	11.09	11.50	
	CH 159	5795	11.41	12.00	

5GHz WLAN					
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Power	Duty Cycle %
802.11ac (VHT80)	CH 42	5210	9.90	10.50	96.39
	CH 58	5290	9.91	10.50	
	CH 106	5530	10.09	10.50	
	CH 122	5610	10.01	10.50	
	CH 138	5690	9.90	10.50	
	CH 155	5775	10.60	11.00	

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.: SZ200120391W01/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	2402	11.50	3.00	28.18	0.006	1.0
WLAN 2.4GHz	2462	17.50	3.00	112.20	0.022	1.0
WLAN 5GHz	5600	14.00	4.00	63.10	0.013	1.0

Note 1: Only the worst case will be used for calculating the power density.

Note 2: MPE calculate method

$$\text{Power Density} = \text{E.I.R.P.} / 4\pi R^2$$

Where: E.I.R.P. = 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
	Hand/Body	WLAN 2.4GHz+ Bluetooth
		WLAN 5GHz+ Bluetooth
		WLAN 2.4GHz+ WLAN 5GHz
		WLAN 5GHz+ WLAN 2.4GHz+ 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/cm²)	Limit (mW/cm²)	Simultaneous Transmission Result
WLAN 2.4GHz+ Bluetooth	WLAN 2.4GHz	0.022	1.0	0.028
	Bluetooth	0.006	1.0	
WLAN 5GHz+ Bluetooth	WLAN 2.4GHz	0.013	1.0	0.019
	Bluetooth	0.006	1.0	
WLAN 2.4GHz+ WLAN 5GHz	WLAN 2.4GHz	0.022	1.0	0.035
	WLAN 5GHz	0.013	1.0	
WLAN 5GHz+ WLAN 2.4GHz+ Bluetooth	WLAN 5GHz	0.013	1.0	0.041
	WLAN 2.4GHz	0.022	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.

_____ END OF REPORT _____