



Shenzhen Huaxia Testing Technology Co., Ltd

1F., Block A of Tongsheng Technology Building, Huahui Road, Dalang Street, Longhua District, Shenzhen, China

Telephone: +86-755-26648640

Fax: +86-755-26648637

Website: www.cqa-cert.com

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RF Exposure Evaluation Report

Report No. : CQASZ20210300009EX-04

Applicant: Shenzhen Ranboda Technology Co., Ltd
Address of Applicant: Building F, Hongzhu Yongqi Science Park, Lezhujiao Village, Xixiang Street, Baoan District, Shenzhen, Guangdong, China

Manufacturer: Shenzhen Ranboda Technology Co., Ltd
Address of Manufacturer: Building F, Hongzhu Yongqi Science Park, Lezhujiao Village, Xixiang Street, Baoan District, Shenzhen, Guangdong, China

Equipment Under Test (EUT):

Product: Android TV box

Test Model No.: MARK I

Brand Name: N/A

FCC ID: 2AY9T-MARK

Standards: 47 CFR Part 1.1307
47 CFR Part 1.1310
KDB447498D01 General RF Exposure Guidance v06

Date of Test: Mar. 02, 2021 – Mar. 18, 2021

Date of Issue: Mar. 18, 2021

Test Result : **PASS**

Tested By: Jun Li
(Jun Li)

Reviewed By: Ares Liu
(Ares Liu)

Approved By: Sheek Luo
(Sheek Luo)



1 Version

Revision History Of Report

Report No.	Version	Description	Issue Date
CQASZ20210300009EX-04	Rev.01	Initial report	Mar. 18, 2021

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3 General Information

3.1 Client Information

Applicant:	Shenzhen Ranboda Technology Co., Ltd
Address of Applicant:	Building F, Hongzhu Yongqi Science Park, Lezhujiao Village, Xixiang Street, Baoan District, Shenzhen, Guangdong, China
Manufacturer:	Shenzhen Ranboda Technology Co., Ltd
Address of Manufacturer:	Building F, Hongzhu Yongqi Science Park, Lezhujiao Village, Xixiang Street, Baoan District, Shenzhen, Guangdong, China

3.2 General Description of EUT

Product Name:	Android TV box
Test Model No.:	MARK I
Trade Mark:	/
Hardware Version:	V2040
Software Version:	/
Product Type:	<input type="checkbox"/> Mobile <input type="checkbox"/> Portable <input checked="" type="checkbox"/> Fix Location
Power Supply:	DC 5V from adapter
Adapter Information:	AC/DC ADAPTER MODEL: 05020002 INPUT:110-240V AC 50/60Hz 0.5A OUTPUT: DC 5V 2A

3.3 General Description of BT

Operation Frequency:	2402MHz~2480MHz
Bluetooth Version:	BT-V5.0
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Modulation Type:	GFSK, $\pi/4$ DQPSK, 8DPSK
Transfer Rate:	1Mbps/2Mbps/3Mbps
Number of Channel:	79
Hopping Channel Type:	Adaptive Frequency Hopping systems
Antenna Type:	IPEX antenna
Antenna Gain:	0dBi

3.4 General Description of 2.4G WIFI

Operation Frequency:	IEEE 802.11b/g/n(HT20): 2412MHz to 2462MHz IEEE 802.11n(H40): 2422MHz~2452MHz
Channel Numbers:	IEEE 802.11b/g, IEEE 802.11n HT20: 11 Channels IEEE 802.11n HT40: 7
Channel Separation:	5MHz
Type of Modulation:	IEEE for 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE for 802.11g : OFDM IEEE for 802.11n(HT20): OFDM IEEE for 802.11n(HT40): OFDM

Antenna Type	IPEX antenna
Antenna Gain	0dBi

3.5 General Description of 5G WIFI

Operation Frequency:	5180 ~ 5240 MHz, 5745 ~ 5825 MHz
Channel Numbers:	5180 ~ 5240 MHz: 4 for 802.11n, 802.11ac 2 for 802.11n40 , 802.11ac 40 5745 ~ 5825 MHz: 5 for, 802.11n , 802.11ac 2 for 802.11n40, 802.11ac40
Type of Modulation:	IEEE 802.11n/IEEE 802.11ac: OFDM
Product Type:	<input type="checkbox"/> Mobile <input type="checkbox"/> Portable <input checked="" type="checkbox"/> Fix Location
Antenna Type:	IPEX antenna
Antenna Gain:	0dBi

4 RF Exposure Evaluation

4.1 RF Exposure Compliance Requirement

4.1.1 Limits

According to FCC Part1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in part1.1307(b)

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)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(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

Friis Formula

Friis transmission formula: $Pd = (Pout * G) / (4 * \pi * R^2)$

Where

Pd = power density in mW/cm²

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

R = distance between observation point and center of the radiator in cm

Pd is the limit of MPE, 1 mW/cm². If we know the maximum gain of the antenna and the total power input to

the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

4.1.2 Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

4.1.3 EUT RF Exposure Evaluation standalone operations

1) For BT

Antenna Gain: 3dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 1.0 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Measurement Data

GFSK mode				
Test Channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(2402MHz)	4.517	5±1	6	3.981
Middle(2441MHz)	5.918	6±1	7	5.012
Highest(2480MHz)	4.480	5±1	6	3.981
π/4DQPSK mode				
Lowest(2402MHz)	3.525	4±1	5	3.162
Middle(2441MHz)	4.986	5±1	6	3.981
Highest(2480MHz)	3.580	4±1	5	3.162
8DPSK mode				
Lowest(2402MHz)	3.687	4±1	5	3.162
Middle(2441MHz)	5.146	5±1	6	3.981
Highest(2480MHz)	3.729	4±1	5	3.162

Test worst case

Maximum tune-up Power (mW)	Antenna Gain (dBi)	Power Density at R = 20 cm (mW/cm ²)	Limit	Result
5.012	0	0.000997	1.0	PASS

Note: 1) Refer to report No. : CQASZ20210300009EX-03 for EUT test Max Conducted average Output Power value.

2) $P_d = (P_{out} * G) / (4 * \pi * R^2) = (5.012 * 1.0) / (4 * 3.1416 * 20^2) = 0.000997$

3) EUT Bluetooth module is more than 20cm away from the human body

2)For WIFI:

Antenna Gain: 3dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 1.0 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Measurement Data

802.11b mode					
Test channel	Antenna	Average Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
				(dBm)	(mW)
Lowest(2412MHz)	ANT1	14.00	14±1	15	31.623
Middle(2437MHz)	ANT1	15.35	15±1	16	39.811
Highest(2462MHz)	ANT1	14.10	14±1	15	31.623
802.11g mode					
Test channel	Antenna	Average Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
				(dBm)	(mW)
Lowest(2412MHz)	ANT1	11.41	12±1	13	19.953
Middle(2437MHz)	ANT1	12.30	13±1	14	25.119
Highest(2462MHz)	ANT1	11.63	12±1	13	19.953
802.11n(HT20) SISO mode					
Test channel	Antenna	Average Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
				(dBm)	(mW)
Lowest(2412MHz)	ANT1	10.43	11±1	12	15.849
Middle(2437MHz)	ANT1	11.32	12±1	13	19.953
Highest(2462MHz)	ANT1	10.72	11±1	12	15.849
802.11n(HT40) SISO mode					
Test channel	Antenna	Average Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
				(dBm)	(mW)
Lowest(2422MHz)	ANT1	9.34	10±1	11	12.589
Middle(2437MHz)	ANT1	9.42	10±1	11	12.589
Highest(2452MHz)	ANT1	9.76	10±1	11	12.589

Test worst case

Maximum tune-up Power (mW)	Antenna Gain (dBi)	Power Density at R = 20 cm (mW/cm ²)	Limit	Result
39.811	0	0.00792	1.0	PASS

Note: 1) Refer to report No. : CQASZ20210300017EX-01 for EUT test Max Conducted average Output Power value.

2) $P_d = (P_{out} * G) / (4 * \pi * R^2) = (39.811 * 1.00) / (4 * 3.1416 * 20^2) = 0.00792$

3) EUT wifi2.4G module is more than 20cm away from the human body

2)For 5GWIFI:

Antenna Gain: 0dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 1.0 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Measurement Data

802.11n(HT20) SISO mode					
Test channel	Antenna	Average Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
				(dBm)	(mW)
5180	ANT1	6.32	6±1	7	5.012
5200	ANT1	4.47	5±1	6	3.981
5240	ANT1	4.47	5±1	6	3.981
5745	ANT1	3.14	4±1	5	3.162
5785	ANT1	3.09	4±1	5	3.162
5825	ANT1	3.07	4±1	5	3.162
802.11n(HT40) SISO mode					
Test channel	Antenna	Average Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
				(dBm)	(mW)
5190	ANT1	3.56	3±1	4	2.512
5230	ANT1	2.82	3±1	4	2.512
5755	ANT1	2.13	2±1	3	1.995
5795	ANT1	2.31	2±1	3	1.995

802.11ac(VHT20) SISO mode					
Test channel	Antenna	Average Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
				(dBm)	(mW)
5180	ANT1	4.56	5±1	6	3.981
5200	ANT1	4.42	5±1	6	3.981
5240	ANT1	4.49	5±1	6	3.981
5745	ANT1	2.08	2±1	3	1.995
5785	ANT1	2.39	2±1	3	1.995
5825	ANT1	2.40	2±1	3	1.995
802.11ac(VHT40) SISO mode					
Test channel	Antenna	Average Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
				(dBm)	(mW)
5190	ANT1	3.60	3±1	4	2.512
5230	ANT1	3.35	3±1	4	2.512
5755	ANT1	2.19	2±1	3	1.995
5795	ANT1	2.29	2±1	3	1.995

Test worst case

Maximum tune-up Power (mW)	Antenna Gain (dBi)	Power Density at R = 20 cm (mW/cm ²)	Limit	Result
5.012	0	0.000997	1.0	PASS

Note: 1) Refer to report No. : CQASZ20210300009EX-02 for EUT test Max Conducted average Output Power value.

2) $P_d = (P_{out} * G) / (4 * \pi * R^2) = (5.012 * 1.0) / (4 * 3.1416 * 20^2) = 0.000997$

3) EUT wif-5G module is more than 20cm away from the human body

3) EUT RF Exposure Evaluation simultaneous transmission operations

According to 865664D02 2.2 d) 1):

The sum of the ratios of the spatially averaged results to the applicable frequency dependent MPE limits :

Simultaneous transmission mode	The sum of the ratios	Result
2.4G WIFI + 5G WIFI	0.00792/1+0.000997/1	0.008917<1