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RF Exposure Evaluation Report

Report No.: CQASZ20210801422E-03
Applicant: Shenzhen Inkbird Technology Co., Ltd.
Address of Applicant: Floor 4th East, Building 713, Pengji Industrial Zone, LianTang, Luohu District, Shenzhen, PRC.
Equipment Under Test (EUT):
EUT Name: WI-FI Gateway
Model No.: IBS-M1, IBS-M1S, IBS-M2, IBS-M2S
Test Model No.: IBS-M1
Brand Name: INKBIRD
FCC ID: 2AYZD-IBSM1S
Standards: 47 CFR Part 1.1307
47 CFR Part 2.1093
KDB447498D01 General RF Exposure Guidance v06
Date of Receipt: 2021-08-19
Date of Test: 2021-08-19 to 2021-09-07
Date of Issue: 2021-09-15
Test Result: PASS*

*In the configuration tested, the EUT complied with the standards specified above

Tested By: Lewis Zhou

(Lewis Zhou)

Reviewed By: Rock Huang

(Rock Huang)

Approved By: Jack ai

(Jack ai)



1 Version

Revision History Of Report

Report No.	Version	Description	Issue Date
CQASZ20210801422E-03	Rev.01	Initial report	2021-09-15

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3 General Information

3.1 Client Information

Applicant:	Shenzhen Inkbird Technology Co., Ltd.
Address of Applicant:	Floor 4th East, Building 713, Pengji Industrial Zone, LianTang, Luohu District, Shenzhen, PRC.
Manufacturer:	Shenzhen Inkbird Technology Co., Ltd.
Address of Manufacturer:	Floor 4th East, Building 713, Pengji Industrial Zone, LianTang, Luohu District, Shenzhen, PRC.
Factory:	Shenzhen Inkbird Technology Co., Ltd.
Address of Factory:	Floor 4th East, Building 713, Pengji Industrial Zone, LianTang, Luohu District, Shenzhen, PRC.

3.2 General Description of EUT

Product Name:	WI-FI Gateway	
Model No.:	IBS-M1, IBS-M1S, IBS-M2, IBS-M2S	
Test Model No.:	IBS-M1	
Trade Mark:	INKBIRD	
Hardware Version:	REV3.0	
Software Version:	REV2.1	
Operation Frequency:	2402MHz~2480MHz 433.92MHz	
Bluetooth Version:	BT5.0	
Modulation Type:	433.92MHz:	FSK
	BLE:	GFSK
	WIFI:	802.11b: CCK, DQPSK, DBPSK 802.11g: 64 QAM, 16 QAM, QPSK, BPSK 802.11n: BPSK, QPSK, 16-QAM, 64-QAM
Number of Channel:	433.92MHz:	1
	BLE:	40
	WIFI:	802.11b/g/n (20MHz):11
Product Type:	☐ Mobile ☐ Portable ☒ Fix Location	
Antenna Type:	433.92MHz:	Spring antenna
	BLE:	PCB antenna
	WIFI:	PCB antenna
Antenna Gain:	433.92MHz:	2.5dBi
	BLE:	3dBi
	WIFI:	3dBi
EUT Power Supply:	DC5.0V	

4 MPE 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: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

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

P_d 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

1) For BLE

Measurement Data

GFSK mode				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(2402MHz)	-2.2	-2.0±1	-1.0	0.794
Middle(2440MHz)	-1.55	-1.0±1	0	1.000
Highest(2480MHz)	-1	-1.0±1	0	1.000

The worst case:

Maximum tune-up Power (mW)	Antenna Gain (dBi)	Power Density at R = 20 cm (mW/cm ²)	Limit	Result
1.000	3	0.0004	1.0	PASS

Remark: The Max Conducted Peak Output Power data refer to report Report No.: CQASZ20210801422E-02

2) For 433.92 Mhz

$$e_{irp} = p_t \times g_t = (E \times d)^2 / 30$$

where:

p_t = transmitter output power in watts,

g_t = numeric gain of the transmitting antenna (unitless),

E = electric field strength in V/m, $---10^{((dB\mu V/m)/20)/10^6}$,

d = measurement distance in meters (m)---3m,

$$\text{So } p_t = (E \times d)^2 / 30 / g_t$$

Antenna polarization: Horizontal

Frequency (MHz)	Read Level (dBuV)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
433.92	62.07	16.23	78.3	100.8	-22.5	Peak
433.92	-	-	78.3	80.8	-2.5	Average

Antenna polarization: Vertical

Frequency (MHz)	Read Level (dBuV)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
433.92	62.56	16.17	78.73	100.8	-22.07	Peak
433.92	-	-	78.73	80.8	-2.07	Average

For 433.92MHz wireless:

Field strength = 82.45dBμV/m @3m

Ant. gain 2.5dBi; so Ant numeric gain=1.778

So $P_t = \{ [10^{(78.73/20)} / 10^6 \times 3]^2 / 30 / 1.778 \} \times 1000 \text{mW} = 0.0126 \text{mW}$

The worst case:

Maximum tune-up Power (mW)	Antenna Gain (dBi)	Power Density at R = 20 cm (mW/cm ²)	Limit	Result
0.0126	2.5	0.000004	0.28928	PASS

Remark: The Max Conducted Peak Output Power data refer to report Report No.: CQASZ20210801422E-01

3) For 2.4G wifi

Measurement Data

802.11g mode				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(2412MHz)	22.22	21.5±1	22.5	177.828
Middle(2437MHz)	22.34	21.5±1	22.5	177.828
Highest(2462MHz)	22.24	21.5±1	22.5	177.828

The worst case:

Maximum tune-up Power (mW)	Antenna Gain (dBi)	Power Density at R = 20 cm (mW/cm ²)	Limit	Result
177.828	3	0.07	1.0	PASS

Remark: The Max Conducted Peak Output Power data refer to report FCC ID: 2AFNL-TYWE3S

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 + 433.92MHz + BLE $0.07/1 + 0.000004/0.28928 + 0.0004/1$ $= 0.072 < 1$

--THE END--