FCC RF Exposure Evaluation

1. Product Information

FCC ID	:	2AWDS-LKS8343A
EUT	:	In-lane Entry Kiosk
Test Model	:	REEF-US-LKS8343A
Power Supply	:	Input: AC 120V, 60Hz Output: DC 12V/24V/48V, 2.7A
Hardware Version	:	/
Software Version	:	/
Bluetooth	:	
Frequency Range	:	2402MHz ~ 2480MHz
Chanel Number	:	79 channels for Bluetooth V4.1(DSS) 40 channels for Bluetooth V4.1(DTS)
Chanel Spacing	:	1MHz for Bluetooth V4.1 (DSS) 2MHz for Bluetooth V4.1 (DTS)
Modulation Type	:	GFSK, π/4-DQPSK, 8-DPSK for Bluetooth V4.1(DSS) GFSK for Bluetooth V4.1(DTS)
Bluetoth Version	:	V4.1
Antenna Description	:	Internal Antenna, 0dBi(Max.)
WIFI(2.4G Band)	:	
Frequency Range	:	2412MHz-2462MHz
Channel Spacing	:	5MHz
Channel Number	:	11 channels for 20MHz bandwidth(2412MHz~2462MHz) 7 channels for 40MHz bandwidth(2422MHz~2452MHz)
Modulation Type	:	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK); IEEE 802.11g/n: OFDM(64QAM, 16QAM, QPSK, BPSK)
Antenna Description	:	Internal Antenna, 0dBi(Max.)
NFC Function	:	13.56MHz
Extreme vol. Limits	:	Extreme 1:10.2VDC to 13.8VDC (nominal: 12.0VDC) Extreme 2:20.4VDC to 27.6VDC (nominal: 24.0VDC) Extreme 3:40.8VDC to 55.2VDC (nominal: 48.0VDC)
Exposure category		General population/uncontrolled environment
EUT Type		Production Unit
Device Type		fixed Devices

2. Evaluation Method

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.
In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modelled or measured field strengths or power density, is ≤ 1.0. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

3. Limit

3. 1 Refer Evaluation Method

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
FCC KDB publication 447498 D01 General 1 RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.
FCC CFR 47 part1 1.1310: Radiofrequency radiation exposure limits.
FCC CFR 47 part2 2.1091: Radiofrequency radiation exposure evaluation: mobile devices

3. 2 Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
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

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 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

4. MPE Calculation Method

Predication of MPE limit at a given distance
Equation from page 18 of OET Bulletin 65, Edition 97-01

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

Where: S=power density
P=power input to antenna
G=power gain of the antenna in the direction of interest relative to an isotropic radiator
R=distance to the center of radiation of the antenna

5. Antenna Information

Artemis Antenna can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Note
Antenna 0	Internal Antenna	2402MHz ~ 2480MHz 2412MHz-2462MHz	0dBi	BT/WIFI Antenna
Antenna 1	Internal Antenna	2412MHz-2462MHz	0dBi	WIFI Antenna

6. Conducted Power

< BT Max Conducted Power >

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)
GFSK	0	2402	0.420
	39	2441	-0.844
	78	2480	-0.720
π/4DQPSK	0	2402	-1.257
	39	2441	-0.707
	78	2480	1.328
8DPSK	0	2402	-0.781
	39	2441	1.460
	78	2480	**1.547**

< BT LE Max Conducted Power >

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)
GFSK	0	2402	-1.79
	19	2440	-1.066
	39	2480	**-0.943**

<2.4GWLAN Max Conducted Power >

Mode	Channel	Meas.Level [dBm]			Limit [dBm]	Verdict
		Ant_0	Ant_1	Sum		
11B	LCH	9.43	11.11	/	30	PASS
	MCH	9.46	11.53	/	30	PASS
	HCH	9.51	11.06	/	30	PASS
11G	LCH	8.54	10.46	/	30	PASS
	MCH	8.62	10.77	/	30	PASS
	HCH	8.76	10.35	/	30	PASS
11N20SISO	LCH	8.45	10.52	12.62	30	PASS
	MCH	8.81	10.92	13.00	30	PASS

	HCH	8.9	10.52	12.80	30	PASS
11N40SISO	LCH	9.11	11.12	13.24	30	PASS
	MCH	9.13	11.39	**13.42**	30	PASS
	HCH	9.1	11.37	13.39	30	PASS

7. Manufacturing Tolerance

<BT>

GFSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	0	0	0
Tolerance ±(dB)	1.0	1.0	1.0
π/4DQPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	-1.0	0	1.0
Tolerance ±(dB)	1.0	1.0	1.0
8DPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	0	1.0	1.0
Tolerance ±(dB)	1.0	1.0	1.0

<BT LE>

GFSK (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	-1.0	-1.0	-1.0
Tolerance ±(dB)	1.0	1.0	1.0

<2.4G WIFI_ANT0>

11B (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	9.0	9.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0
11G (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	8.0	8.0	8.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20SISO (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	8.0	8.0	8.0
Tolerance ±(dB)	1.0	1.0	1.0
11N40SISO (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	9.0	9.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0

<2.4G WIFI_ANT1>

11B (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	11.0	11.0	11.0
Tolerance ±(dB)	1.0	1.0	1.0
11G (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	10.0	10.0	10.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20SISO (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	10.0	10.0	10.0
Tolerance ±(dB)	1.0	1.0	1.0
11N40SISO (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	11.0	11.0	11.0
Tolerance ±(dB)	1.0	1.0	1.0

8. Measurement Results

8.1 Standalone MPE

As declared by the Applicant, the EUT used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, r =20cm, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

*[*Antenna]

<BT>

Band/Mode	RF output power		Antenna Gain (dBi)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW			
GFSK	1.0	1.2589	0	0.0003	1.0000
π/4DQPSK	2.0	1.5849	0	0.0003	1.0000
8DPSK	2.0	1.5849	0	0.0003	1.0000

<BT LE>

Band/Mode	RF output power		Antenna Gain (dBi)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW			
GFSK	0.0	1.0000	0	0.0002	1.0000

<2.4G WIFI_ANT0>

Band/Mode	RF output power		Antenna Gain (dBi)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW			
IEEE 802.11b	10.0	10.0000	0	0.0020	1.0000
IEEE 802.11g	9.0	7.9433	0	0.0016	1.0000
IEEE 802.11n HT20	9.0	7.9433	0	0.0016	1.0000
IEEE 802.11n HT40	10.0	10.0000	0	0.0020	1.0000

<2.4G WIFI_ANT1>

Band/Mode	RF output power		Antenna Gain (dBi)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW			
IEEE 802.11b	12.0	15.8489	0	0.0032	1.0000
IEEE 802.11g	11.0	12.5893	0	0.0025	1.0000
IEEE 802.11n HT20	11.0	12.5893	0	0.0025	1.0000
IEEE 802.11n HT40	12.0	15.8489	0	0.0032	1.0000

Remark:
1. Output power including tune-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer;

8.2 Simultaneous Transmission MPE OF IEEE 802.11n HT20 and IEEE 802.11n HT40(the worst)

Mode	∑ MPE max ratios	Limit	Results
2.4GWIFI_ANT0+ 2.4GWIFI_ANT1(N20)	0.0041	1.0	Pass
2.4GWIFI_ANT0+ 2.4GWIFI_ANT1(N40)	0.0052	1.0	Pass

9. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

.....THE END OF REPORT.....