FCC RF Exposure Evaluation

1. Product Information

FCC ID	2AJ5L-SK909
Product name	Abilix Brick Educational Robot
Model number	SK909
Additional Model No.	SK902, SK501, SK509, SK201, SK209
Model Declaration	PCB board, structure and internal of these model(s) are the same, So no additional models were tested
Power supply	For Adapter Input: 100-240V~ 50/60Hz 0.6A Max Output: 8.4V⎓1.0A DC 7.4V by Rechargeable Li-Polymer Battery(1500mAh)
Hardware version	Abilix SKCON2/5/9 V1.5 2019-4-1
Software version	1.0.24.12X
FCC Operation frequency	2412~2462 MHz
Channel Number	11 Channels for 20MHz bandwidth (2412~2462MHz) 9 channels for 40MHz bandwidth(2422~2462MHz)
Modulation Type	IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM,QPSK,BPSK)
Antenna Type	Internal Antenna
Antenna Gain	0.9213dBi(Max.)
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Mobile 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

Internal 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	Internal Antenna	2400MHz-2500MHz	0.9213dBi	WIFI Antenna

6. Conducted Power

<2.4G WIFI>

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)
IEEE 802.11b	1	2412	15.24
	6	2437	15.4
	11	2462	14.83
IEEE 802.11g	1	2412	14.51
	6	2437	14.52
	11	2462	14.03
IEEE 802.11n HT20	1	2412	13.62
	6	2437	13.22
	11	2462	13.53
IEEE 802.11n HT40	3	2422	12.25
	6	2437	12.18
	9	2452	12.62

7. Manufacturing Tolerance

<2.4G WIFI>

11B (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	15.0	15.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0
11G (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	14.0	14.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20SISO (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	13.0	13.0	13.0
Tolerance ±(dB)	1.0	1.0	1.0
11N40SISO (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	12.0	12.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0

8. Measurement Results

8.1 Standalone MPE Evacuation

As declared by the Applicant, the EUT is a wireless device 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.

<2.4G WIFI>

Band/Mode	RF output power		Antenna Gain (dBi)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW			
IEEE 802.11b	16.0	39.8107	1.2363	0.0098	1.0000
IEEE 802.11g	15.0	31.6228	1.2363	0.0078	1.0000
IEEE 802.11n HT20	14.0	25.1189	1.2363	0.0062	1.0000
IEEE 802.11n HT40	13.0	19.9526	1.2363	0.0049	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

The EUT equiped with one antenna. So no need consider simultaneous transmission.

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.....