FCC RF Exposure Evaluation

1. Product Information

FCC ID	2AU8XSMPR
Product name	RK3399 R Player
Test Model	SMPR
Power supply	DC 12V⎓2A from adapter
Modulation Type	GFSK, π/4-DQPSK, 8-DPSK for Bluetooth V4.0 (BDR/EDR) GFSK for Bluetooth V4.0(BT LE) IEEE 802.11b: DSSS(CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM,QPSK,BPSK) IEEE 802.11a/n/ac: OFDM(64QAM, 16QAM, QPSK, BPSK)
Antenna Type	External Antenna
Antenna Gain	2dBi
Hardware version	V1.X
Software version	20190909.012310
FCC Operation frequency	BT&BLE: 2402MHz-2480MHz 2.4G WIFI: 2412MHz-2462MHz 5G WIFI: 5180MHz-5240MHz, 5260MHz-5320MHz
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Mobile Device

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	External Antenna	2402MHz-2480MHz 2412MHz-2462MHz 5180MHz-5240MHz, 5260MHz-5320MHz	2dBi	BT&WLAN Antenna

6. Conducted Power

[BT Max Conducted Power]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
GFSK	0	2402	0.215
	39	2441	-2.017
	78	2480	-0.841
π/4DQPSK	0	2402	-0.532
	39	2441	-2.605
	78	2480	-1.559
8DPSK	0	2402	-0.376
	19	2440	-2.382
	39	2480	-1.238

[BLE Max Conducted Power]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
BT LE	0	2402	0.093
	19	2440	-2.141
	39	2480	-0.849

[2.4GWIFI Max Conducted Power]

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)
11B	1	2412	10.36
	6	2437	10.13
	11	2462	10.67
11G	1	2412	13.28
	6	2437	13.33
	11	2462	13.62
11N20SISO	1	2412	12.19
	6	2437	12.49
	11	2462	12.86
11N40SISO	3	2422	11.71
	6	2437	11.88
	9	2452	12.09

[5.2GWIFI Max Conducted Power]

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)
11A	36	5180	10.91
	40	5200	10.24
	48	5240	8.96
11N20 SISO	36	5180	9.65
	40	5200	9.2
	48	5240	7.93
11N40 SISO	38	5190	9.47
	46	5230	9.19
11AC20 SISO	36	5180	9.62
	40	5200	9.39
	48	5240	9.02
11AC40 SISO	38	5190	9.47
	46	5230	9.28
11AC80 SISO	42	5210	8.97

[5.3GWIFI Max Conducted Power]

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)
11A	52	5260	9.30
	56	5280	7.74
	64	5320	7.01
11N20 SISO	52	5260	9.71
	56	5280	8.13
	64	5320	9.21
11N40 SISO	54	5270	9.32
	62	5310	8.17
11AC20 SISO	52	5260	9.50
	56	5280	8.89
	64	5320	7.89
11AC40 SISO	54	5270	9.12
	62	5310	8.06
11AC80 SISO	58	5290	8.73

7. Manufacturing Tolerance

BT

GFSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	0	-2.0	-1.0
Tolerance ±(dB)	1.0	1.0	1.0
π/4DQPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	0	-2.0	-1.0
Tolerance ±(dB)	1.0	1.0	1.0
8DPSK (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	0	-2.0	-1.0
Tolerance ±(dB)	1.0	1.0	1.0

BLE

BT LE (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	0	-2.0	-1.0
Tolerance ±(dB)	1.0	1.0	1.0

2.4GWIFI

11B (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	10.0	10.0	10.0
Tolerance ±(dB)	1.0	1.0	1.0
11G (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	13.0	13.0	13.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20SISO (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	12.0	12.0	12.0
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

5.2GWIFI

11A (**Average**)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	10.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20 SISO (**Average**)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	9.0	8.0
Tolerance ±(dB)	1.0	1.0	1.0
11N40 SISO (**Average**)			
Channel	Channel 38		Channel 46
Target (dBm)	9.0		9.0
Tolerance ±(dB)	1.0		1.0
11AC20 SISO (**Average**)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	9.0	9.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0
11AC40 SISO (**Average**)			
Channel	Channe38		Channel 46
Target (dBm)	9.0		9.0
Tolerance ±(dB)	1.0		1.0
11AC80 SISO (**Average**)			
Channel	Channel 42		
Target (dBm)	9.0		
Tolerance ±(dB)	1.0		

5.3GWIFI

11A (**Average**)			
Channel	Channel 52	Channel 56	Channel 64
Target (dBm)	9.0	7.0	7.0
Tolerance ±(dB)	1.0	1.0	1.0
11N20 SISO (**Average**)			
Channel	Channel 52	Channel 56	Channel 64
Target (dBm)	10.0	8.0	9.0
Tolerance ±(dB)	1.0	1.0	1.0
11N40 SISO (**Average**)			
Channel	Channel 54		Channel 62
Target (dBm)	9.0		8.0
Tolerance ±(dB)	1.0		1.0
11AC20 SISO (**Average**)			
Channel	Channel 52	Channel 56	Channel 64
Target (dBm)	9.0	9.0	8.0
Tolerance ±(dB)	1.0	1.0	1.0

11AC40 SISO (**Average**)		
Channel	Channe54	Channel 62
Target (dBm)	9.0	8.0
Tolerance ±(dB)	1.0	1.0
11AC80 SISO (**Average**)		
Channel	Channel 58	
Target (dBm)	8.0	
Tolerance ±(dB)	1.0	

8. Measurement Results

8.1 Standalone MPE

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.

BT

Band/Mode	RF output power		Antenna Gain (dBi)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW			
GFSK	1.0	1.26	2	0.0004	1.0000
π/4DQPSK	1.0	1.26	2	0.0004	1.0000
8DPSK	1.0	1.26	2	0.0004	1.0000

BLE

Band/Mode	RF output power		Antenna Gain (dBi)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW			
BT LE	1.0	1.26	2	0.0004	1.0000

2.4GWIFI

Band/Mode	RF output power		Antenna Gain (dBi)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW			
IEEE 802.11b	11.0	12.59	2	0.004	1.0000
IEEE 802.11g	14.0	25.12	2	0.008	1.0000
IEEE 802.11n HT20	13.0	19.95	2	0.006	1.0000
IEEE 802.11n HT40	13.0	19.95	2	0.006	1.0000

5.2GWIFI

Band/Mode	RF output power		Antenna Gain (dBi)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW			
A	11.0	12.59	2	0.004	1.0000
N20 SISO	10.0	10.00	2	0.003	1.0000
N40 SISO	10.0	10.00	2	0.003	1.0000
AC20 SISO	10.0	10.00	2	0.003	1.0000
AC40 SISO	10.0	10.00	2	0.003	1.0000
AC80 SISO	10.0	10.00	2	0.003	1.0000

5.3GWIFI

Band/Mode	RF output power		Antenna Gain (dBi)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW			
A	10.0	10.00	2	0.003	1.0000
N20 SISO	11.0	12.59	2	0.004	1.0000
N40 SISO	10.0	10.00	2	0.003	1.0000
AC20 SISO	10.0	10.00	2	0.003	1.0000
AC40 SISO	10.0	10.00	2	0.003	1.0000
AC80 SISO	9.0	7.94	2	0.003	1.0000

Simultaneous transmit mode

Band/Mode	Max. MPE1 (mW/cm^2)	Max. MPE2 (mW/cm^2)	Total MPE (mW/cm^2)	MPE Limits (mW/cm^2)
BT&2.4GWIFI	0.0004	0.008	0.0084	1.0000
BLE&2.4GWIFI	0.0004	0.008	0.0084	1.0000
BT&5.2GWIFI	0.0004	0.004	0.0044	1.0000
BLE&5.2GWIFI	0.0004	0.004	0.0044	1.0000
BT&5.3GWIFI	0.0004	0.004	0.0044	1.0000
BLE&5.3GWIFI	0.0004	0.004	0.0044	1.0000

Remark:
1. Output power including tune-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer;
3. Bluetooth and WIFI can simultaneous transmit, 2.4G WIFI and 5G WIFI can't simultaneous transmit.

9. Conclusion

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

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