FCC RF Exposure Evaluation

1. Product Information

FCCID	:	2AJTU-G2
EUT	:	GNSS RECEIVER
Test Model	:	G2
Additional Model No.	:	T9, T9 Pro, C8, RENO1, R1, K3IMU, K3X, K30 Pro, K58plus, K7, K7X, K8, K8X, K9, K9X, K30, K30X, R93i, T7, T8, C6, C7, C9, P30, G1, G3, G4, G5, G7, G8, G9, S680
Model Declaration	:	PCB board, structure and internal of these model(s) are the same, So no additional models were tested
Power Supply	:	For AC Adapter(model: DAS-45PDA FUS) Input:100-240V~, 50/60Hz, 1.5A Max Output: 5.0V⎓3.0A, 9.0V⎓3.0A, 12.0V⎓3.0A, 15.0V⎓3.0A, 20V⎓2.25A, 45W Max. DC 7.4V by Rechargeable Li-ion Battery, 6800mAh
Hardware Version	:	SC20-K803_V2R0
Software Version	:	1.09.210624.RA40PY
Bluetooth Frequency Range	:	2402MHz ~ 2480MHz
Modulation Type	:	GFSK, π/4-DQPSK, 8-DPSK for Bluetooth V4.2(DSS) GFSK for Bluetooth V4.2 (DTS)
Bluetooth Version	:	V4.2
Antenna Description	:	Internal Antenna, 5.5dBi (max.)
WLAN Frequency Range	:	2412MHz ~ 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 Description	:	Internal Antenna, 5.5dBi (max.)
GSM/EDGE/GPRS Operation Frequency Band	:	GSM850/PCS1900/GPRS850/GPRS1900/EDGE850/EDGE1900
Release Version	:	R99
GPRS Class	:	Class 12
EGPRS Class	:	Class 12
Type Of Modulation	:	GMSK for GSM/GPRS; 8PSK for EGPRS
Antenna Description	:	Internal Antenna 2.0dBi (max.) For GSM 850, PCS 1900
WCDMA Operation Frequency Band	:	WCDMA Band V
Release Version	:	R8
Type Of Modulation	:	WCDMA: QPSK; HSDPA/HSUPA: QPSK
Antenna Description	:	Internal Antenna 2.0dBi (max.) For WCDMA Band V
LTE Operation Frequency Band	:	LTE Band 5/ 7/ 38/41
LTE Release Version	:	R9
Type Of Modulation	:	QPSK/16QAM
Antenna Description	:	Internal Antenna 2.0dBi (max.) For LTE Band 5/7/38/41

Power Class	:	Class 3
NFC Operating Frequency	:	13.56MHz;
Modulation Type	:	ASK
Antenna Description	:	Loop Antenna, 2.0dBi(Max.)
PMR Operating Frequency	:	410 ~ 470MHz
Channel Separation	:	12.5KHz & 25KHz
Modulation Type	:	GMSK
Emission Designator	:	8K25G1D for GMSK Modulation at 12.5KHz Channel Separation 16K4G1D for GMSK Modulation at 25KHz Channel Separation
Antenna Type	:	SMA Antenna
Antenna Gain	:	5.0dBi (max.) for PMR
GPS function	:	Support and only RX
Extreme temp. Tolerance	:	-30°C to +50°C
Extreme vol. Limits	:	6.3VDC to 8.4VDC (nominal: 7.4VDC)
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 0	Internal Antenna	600MHz-2500MHz	5.5dBi	BT&WLAN Antenna
Antenna 1	Internal Antenna	600MHz-3000MHz	2.0dBi	GSM&WCDMA& LTE
Antenna 2	External Antenna	400MHz-500MHz	5.0dBi	UHF Antenna

6. Conducted Power

<BT>

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)	Tune up tolerance (dBm)
GFSK	0	2402	0.89	0±1
	39	2441	-0.31	0±1
	78	2480	0.7	0±1
π/4DQPSK	0	2402	-0.22	0±1
	39	2441	-1.17	0±1
	78	2480	-0.1	0±1
8DPSK	0	2402	0.1	0±1
	39	2441	-0.97	0±1
	78	2480	-0.02	0±1

<BT LE>

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)	Tune up tolerance (dBm)
GFSK	0	2402	0.68	0±1
	19	2440	-0.57	0±1
	39	2480	0.56	0±1

<WLAN>

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)	Tune up tolerance (dBm)
IEEE 802.11b	1	2412	15.29	15±1
	6	2437	14.93	15±1
	11	2462	14.54	15±1
IEEE 802.11g	1	2412	12.37	12±1
	6	2437	12.59	12±1
	11	2462	12.24	12±1
IEEE 802.11n HT20	1	2412	12.43	12±1
	6	2437	12.45	12±1
	11	2462	12.27	12±1
IEEE 802.11n HT40	3	2422	12.67	12±1
	6	2437	12.75	12±1
	9	2452	12.69	12±1

<PMR>

Mode	channel separation	Frequency(MHz)	Max Conducted Power (dBm)	Tune up tolerance (dBm)
GMSK	12.5KHz	410.125	33.633	33±1
		453.125	33.469	33±1
		469.625	33.403	33±1
		410.125	28.502	29±1
		453.125	28.615	29±1
		469.625	28.908	29±1
GMSK	25KHz	410.125	33.712	33±1
		453.125	33.461	33±1
		469.625	33.480	33±1
		410.125	28.154	29±1
		453.125	28.635	29±1
		469.625	29.039	29±1

<GSM>

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)	Tune up tolerance (dBm)
GSM 850	LCH	824.2	32.65	32±1
	MCH	836.6	32.67	32±1
	HCH	848.8	32.66	32±1
PCS 1900	LCH	1850.2	29.64	29±1
	MCH	1880	29.70	29±1
	HCH	1909.8	29.68	29±1

<WCDMA>

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)	Tune up tolerance (dBm)
WCDMA Band V	LCH	826.4	23.46	23±1
	MCH	836.4	23.62	23±1
	HCH	846.6	23.52	23±1

<LTE>

Mode		Channel Frequency (MHz)	Max Conducted Power (dBm)	Tune up tolerance (dBm)
LTE	Band 5	824.7-848.3	21.87	22±1
LTE	Band 7	2510-2560	20.72	21±1
LTE	Band 38	2580-2610	22.16	23±1
LTE	Band 41	2498.5-2687.5	22.53	23±1

7. Measurement Results

7.1 Standalone MPE

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 100 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, r =100cm, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

Antenna 0

Mode	Out Power		Antenna Gain (dBi)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mw			
BT GFSK	1.00	1.2589	5.5	0.0000	1.0000
BT π/4DQPSK	1.00	1.2589	5.5	0.0000	1.0000
B Tπ/4DQPSK	1.00	1.2589	5.5	0.0000	1.0000
BT LE GFSK	1.00	1.2589	5.5	0.0000	1.0000
IEEE 802.11b	16.00	39.8107	5.5	0.0011	1.0000
IEEE 802.11g	13.00	19.9526	5.5	0.0006	1.0000
IEEE 802.11n HT20	13.00	19.9526	5.5	0.0006	1.0000
IEEE 802.11n HT40	13.00	19.9526	5.5	0.0006	1.0000

Antenna 2

Mode	Out Power		Antenna Gain (dBi)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mw			
GMSK(410-470 Hz)	34.00	2511.8864	5.0	0.0632	0.2733

Antenna 1

Mode	Out Power		MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mw		
GSM 850	33.00	1995.2623	0.0252	0.5495
PCS 1900	30.00	1000.0000	0.0126	1.0000
WCDMA Band V	24.00	251.1886	0.0032	0.5509
LTE Band 5	23.00	199.5262	0.0025	0.5498
LTE Band 7	22.00	158.4893	0.0020	1.0000
LTE Band 38	24.00	251.1886	0.0032	1.0000
LTE Band 41	24.00	251.1886	0.0032	1.0000

Remark:
1. *Output power including turn-up tolerance;*
2. *Output power is burst average power;*
3. *MPE values = PG/4πR*
4. *MPE limits for PMR refer 410MHz as it is lowest frequency*

7.2 Simultaneous Transmission MPE

Modulation Type	∑MPE ratios	Limit	Results
PMR + BT Classic	0.0632	1.0	PASS
PMR + BT LE	0.0632	1.0	PASS
802.11b + PMR	0.0643	1.0	PASS
802.11g + PMR	0.0638	1.0	PASS
802.11n(HT20) + PMR	0.0638	1.0	PASS
802.11n(HT40) + PMR	0.0638	1.0	PASS
802.11b + GSM 850	0.0263	1.0	PASS
802.11b + PCS 1900	0.0137	1.0	PASS
802.11g + GSM 850	0.0258	1.0	PASS
802.11g + PCS 1900	0.0132	1.0	PASS
802.11n(HT20) + GSM 850	0.0258	1.0	PASS
802.11n(HT20) + PCS 1900	0.0132	1.0	PASS
802.11n(HT40) + GSM 850	0.0258	1.0	PASS
802.11n(HT40) + PCS 1900	0.0132	1.0	PASS
802.11b + WCDMA Band V	0.0043	1.0	PASS
802.11g + WCDMA Band V	0.0038	1.0	PASS
802.11n(HT20) + WCDMA Band V	0.0038	1.0	PASS
802.11n(HT40) + WCDMA Band V	0.0038	1.0	PASS
802.11b + LTE Band 5	0.0036	1.0	PASS
802.11b + LTE Band 7	0.0031	1.0	PASS
802.11b + LTE Band 38	0.0043	1.0	PASS
802.11b + LTE Band 41	0.0043	1.0	PASS
802.11g + LTE Band 5	0.0031	1.0	PASS
802.11g + LTE Band 7	0.0026	1.0	PASS
802.11g + LTE Band 38	0.0038	1.0	PASS
802.11g + LTE Band 41	0.0038	1.0	PASS
802.11n(HT20) + LTE Band 5	0.0031	1.0	PASS
802.11n(HT20) + LTE Band 7	0.0026	1.0	PASS
802.11n(HT20) + LTE Band 38	0.0038	1.0	PASS
802.11n(HT20) + LTE Band 41	0.0038	1.0	PASS
802.11n(HT40) + LTE Band 5	0.0031	1.0	PASS
802.11n(HT40) + LTE Band 7	0.0026	1.0	PASS
802.11n(HT40) + LTE Band 38	0.0038	1.0	PASS
802.11n(HT40) + LTE Band 41	0.0038	1.0	PASS

Note: The 2.4GWLAN and Bluetooth share the same antenna, so no need consider simultaneous transmission;

8. 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.....