FCC RF Exposure Evaluation

1. Product Information

FCC ID:	2AANYINBOX710
Product name	Embedded Computer
Test Model number	INBOX710
Additional Model No.:	INBOX712
Power supply	12Vdc
Modulation Type	**WIFI**: 802.11b : DSSS / 802.11g/n : OFDM
	Bluetooth: GFSK, 8DPSK, π/4 DQPSK
	WCDMA: BPSK
	LTE: QPSK, 16QAM
Antenna Type	Suction cup Antenna
Antenna Gain	For WIFI&Bluetooth: Suction cup Antenna with 3dBi gain. For WCDMA/LTE: Suction cup Antenna. Main antenna: 0dBi. AUX-Only RX: 0dBi
Hardware version	V22
Software version	V1.4
FCC Operation frequency	**WIFI**: 2412MHz~2462MHz
	WCDMA: 826.4 MHz ~ 846.6 MHz (FOR WCDMA 850); 1712.4 MHz ~ 1752.6 MHz (FOR WCDMA 1700); 1852.4 MHz ~ 1907.6 MHz (FOR WCDMA 1900)
	Bluetooth: 2402MHz~2480MHz
	LTE: LTE Band 2: 1850.7 MHz ~ 1909.3 MHz; LTE Band 4: 1710.7 MHz ~ 1754.3 MHz; LTE Band 5: 824.7 MHz ~ 848.3 MHz; LTE Band 7: 2502.5 MHz ~ 2567.5 MHz; LTE Band 12: 699.7 MHz ~ 715.3 MHz; LTE Band 13: 779.5 MHz ~ 784.5 MHz; LTE Band 25: 1850 MHz ~ 1915 MHz; LTE Band 26: 824 MHz ~ 849 MHz &814 MHz ~ 824 MHz; LTE Band 30: 2307.5 MHz ~ 2312.5 MHz; LTE Band 66: 1710.7 MHz ~ 1779.3 MHz
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit

2. Evaluation method and Limit

According to ANSI/IEEE C95.1-1992, the Criteria Listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	*900/f²	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			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/f²	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

The MPE was calculated at **20 cm** to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:
S = Power Density
P = Output Power at Antenna Terminals
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna

Maximum conducted output power (Measured) & Manufacturing tolerance

Specification	Operating Mode	Conducted Output Power (dBm)	Target (dBm)	Tolerance ±(dB)
2.4GWIFI	802.11b	13.81	14	1
	802.11g	14.22	14	1
	802.11n(HT20)	14.13	14	1
Bluetooth BR+EDR	GFSK	3.61	3	1
	π/4 DQPSK	2.78	3	1
	8DPSK	3.12	3	1
Bluetooth LE	GFSK	3.49	3	1
WCDMA	Band II	23.32	23	1
	Band IV	23.34	23	1
	Band V	23.36	23	1
LTE	Band 25/2	23.88	23	1
	Band 66/4	22.97	23	1
	Band 26/5 @824-849MHz	23.70	23	1
	Band 7	23.77	23	1
	Band 12	23.50	23	1
	Band 13	23.33	23	1
	Band 26 @814-824MHz	23.54	23	1
	Band 30	23.90	23	1

Note：
LTE BAND 26 （824-849MHz） overlaps the entire frequency range of LTE BAND 5 (824-849MHz). therefore, test data provided in this report covers BAND 5, as well as BAND 26 subject to Part 22.

LTE BAND 66 （1710-1780MHz） overlaps the entire frequency range of LTE BAND 4(1710-1755MHz). therefore, test data provided in this report covers BAND 66 as well as BAND 4.

LTE BAND 25 （1850-1915MHz） overlaps the entire frequency range of LTE BAND 2 (1850-1910MHz). therefore, test data provided in this report covers BAND 25 as well as BAND 2.

According to KDB Publication 447498 D01, Section 7.2
Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0, according to calculated/estimated, numerically modeled, or measured field strengths or power density. 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 the 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.

3. Conducted Power

3.1 Test Setup Block Diagram for WWAN

3.2 Test Setup Block Diagram for WLAN

3.3 Test Procedure

WWAN:

1) The EUT was directly connected to the Base Station and antenna output port as show in the Block diagram;

2) Reading average power in RMS detector.

WLAN/RLAN

1) The EUT was directly connected to the spectrum analyser and antenna output port as show in the Block diagram;

2) Reading average power in RMS detector.

3.3 Measurement Equipment

Item	Equipment	Manufacturer	Model No.	Inventory No.	Last Cal.	Next Cal.
1	Base Station	R&S	CMW500	164998	2020-01-05	2022-01-04
2	Spectrum Analyzer	Keysight	N9010A	MY56070788	2020-01-05	2022-01-04

4. Evaluation Results

Collocated WWAN and other Wireless								For FCC	
Band	Frequency (MHz)	Antenna Distance (cm)	Antenna Gain in Linear	Maximum Power (dBm)	Maximum EIRP(ERP) (dBm)	Maximum EIRP(ERP) (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)
WCDMA Band II	1852.4	20	1.00	24	24.00	0.251	251.19	0.049	1
WCDMA Band IV	1712.4	20	1.00	24	24.00	0.251	251.19	0.049	1
WCDMA Band V	826.4	20	1.00	24	23.65	0.232	251.19	0.049	0.55
LTE Band 2	1850.7	20	1.00	24	24.00	0.251	251.19	0.049	1
LTE Band 4	1710.7	20	1.00	24	24.00	0.251	251.19	0.049	1
LTE Band 5	824.7	20	1.00	24	23.65	0.232	251.19	0.049	0.55
LTE Band 7	2502.5	20	1.00	24	24.00	0.251	251.19	0.049	1
LTE Band 12	699.7	20	1.00	24	23.65	0.232	251.19	0.049	0.47
LTE Band 13	779.5	20	1.00	24	23.65	0.232	251.19	0.049	0.52
LTE Band 25	1850.7	20	1.00	24	24.00	0.251	251.19	0.049	1
LTE Band 26	814.7	20	1.00	24	23.65	0.232	251.19	0.049	0.54
Band30	2307.5	20	1.00	24	24.00	0.251	251.19	0.049	1
Band 66	1710.7	20	1.00	24	24.00	0.251	251.19	0.049	1
2.4GHz WLAN	2412	20	2.00	15	18.00	0.063	31.62	0.011	1
2.4GHz Bluetooth	2402	20	2.00	4	7.00	0.005	5.01	0.0002	1

For WIFI 2.4G, Bluetooth and LTE WCDMA can transmit simultaneously, the total evaluation result as below:

| No. | Configurations | Maximum MPE Value (mw/cm²) | | | | Limits(mw/cm²) | For FCC | |
		WWAN	WLAN	Bluetooth	Transmit simultaneously		Margin(mw/cm²)	PASS/Fail
1	WCDMA Band 2	0.05	0.01	0.0002	0.0602	1	0.9398	PASS
2	WCDMA Band 4	0.05	0.01	0.0002	0.0602	1	0.9398	PASS
3	WCDMA Band 5	0.09	0.01	0.0002	0.1002	1	0.8998	PASS
4	LTE Band 2	0.05	0.01	0.0002	0.0602	1	0.9398	PASS
5	LTE Band 4	0.05	0.01	0.0002	0.0602	1	0.9398	PASS
6	LTE Band 5	0.09	0.01	0.0002	0.1002	1	0.8998	PASS
7	LTE Band 7	0.05	0.01	0.0002	0.0602	1	0.9398	PASS
8	LTE Band 12	0.11	0.01	0.0002	0.1202	1	0.8798	PASS
9	LTE Band 13	0.09	0.01	0.0002	0.1002	1	0.8998	PASS
10	LTE Band 25	0.05	0.01	0.0002	0.0602	1	0.9398	PASS
11	LTE Band 26	0.09	0.01	0.0002	0.1002	1	0.8998	PASS
12	LTE Band 30	0.05	0.01	0.0002	0.0602	1	0.9398	PASS
13	LTE Band 66	0.05	0.01	0.0002	0.0602	1	0.9398	PASS

Remark:
1. Output power including tune up tolerance;
2. The exposure safety distance is 20cm;
3. *EIRP = EPR + 2.15 (dB)*

5. Conclusion

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

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