RF Exposure evaluation

FCC ID: 2BDNA-GS-THINKNODE

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Mobile Device

1. Reference

According to §1.1307(b)(1), systems operating under the provisions of this 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.

According to §1.1310 and §2.1091 RF exposure is calculated.

KDB447498 D01: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies

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

3. 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

4. Antenna Information

RL553 can only use antennas certificated as follows provided by manufacturer;

Antenna No.	Model No. of antenna:	Type of antenna:	Gain of the antenna (Max.)	Frequency range:
LTE	/	PCB antenna	-1.79dBi for E-UTRA Band 2 -4.67dBi for E-UTRA Band 4/66 -11.19dBi for E-UTRA Band 5 -13.20dBi for E-UTRA Band 12 -12.59dBi for E-UTRA Band 13	
2.4GWIFI	/	PCB Antenna	1.49dBi for 2400-2500MHz	
LORA		915MHz ROB ANTENNA	3.97dBi for 902MHz-928MHz	
BT		Chip Antenna	1.32dBi for 2402-2480MHz	

5. Manufacturing Tolerance

LTE	Conducted power(dBm)	Target (dBm)	Tolerance ±(dB)
Band2	24.65	24.0	1.0
Band4	24.19	24.0	1.0
Band5	23.99	23.0	1.0
Band12	24.64	24.0	1.0
Band13	23.53	23.0	1.0
Band66	25.03	24.5	1.0
2.4GWIFI Ant1	25.81	25.0	1.0
2.4GWIFI Ant2	25.25	25.0	1.0
BT	-4.96	-4.0	1.0
BLE	-9.01	-9.0	1.0
Lora	8.073	8.0	1.0

6. Standalone MPE Result

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 is refer to section 4, the RF power density can be obtained.

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
Band2	25.00	316.2278	-1.79	0.6622	0.0417	1.00
Band4	25.00	316.2278	-4.67	0.3412	0.0215	1.00
Band5	24.00	251.1886	-11.19	0.0760	0.0038	0.55
Band12	25.00	316.2278	-13.20	0.0479	0.0030	0.47
Band13	24.00	251.1886	-12.59	0.0551	0.0028	0.52
Band66	25.50	354.8134	-4.67	0.3412	0.0241	1.00
2.4GWIFI Ant1	26.00	398.1072	1.49	1.4093	0.1117	1.00
2.4GWIFI Ant2	26.00	398.1072	1.49	1.4093	0.1117	1.00
BT	-3.00	0.5012	1.32	1.3552	0.0001	1.00
BLE	-8.00	0.1585	1.32	1.3552	0.0000	1.00
Lora	9.00	7.9433	3.97	2.4946	0.0039	0.60

Remark:

1. Output power (Average) including turn-up tolerance;

2. MPE evaluate distance is 20cm from user manual provide by manufacturer.

7. simultaneous MPE Result

LTE MPE (Ratio)	2.4GWIFI Ant 1 MPE (Ratio)	2.4GWIFI Ant 2 MPE (Ratio)	BT MPE (Ratio)	Lora MPE (Ratio)	simultaneous MPE (Ratio)	MPE Limits (Ratio)
0.0417	0.1117	0.1117	0.0001	0.0039	0.2691	1.0000

8. Conclusion

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

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