FCC RF Exposure Evaluation

1. Product Information

Applicant's Name	Pyxis Lab, Inc
Address	21242 Spell Circle Tomball, TX 77375 USA
Product name	Radar Level Sensor
Test Model	PRL-100
Additional Model No.	PRL-101, PRL-102, PRL-103, PRL-200, PRL-300
Model Declaration	PCB board, structure and internal of these model(s) are the same, So no additional models were tested
Power Supply	Input: 5.0V⎓2000mA For AC Adapter Input: 100-240V~, 50/60Hz, 0.6A Adapter Output: 5.0V⎓2000mA DC 3.7V by Rechargeable Li-ion Battery, 10.2Ah
Hardware Version	V1.4
Software Version	V1.0r45
Bluetooth	
Frequency Range	2402MHz~2480MHz
Channel Number	40 channels for Bluetooth V5.0 (DTS)
Channel Spacing	2MHz for Bluetooth V5.0 (DTS)
Modulation Type	GFSK for Bluetooth V5.0 (DTS)
Bluetooth Version	V5.0
Antenna Description	Ceramic Antenna, 2.11dBi(Max.)
NFC	
Operating Frequency	13.56MHz
Modulation Type	ASK
Antenna Description	FPC Antenna, 3.0dBi(Max.)
LoRa	
Frequency Range	915MHz
Channel Number	1 Channel
Modulation Type	CSS
Antenna Description	FPC Antenna, 3.0dBi(Max.)
Radar	
Frequency Range	75-85GHz
Channel Number	1 Channel
Modulation Type	FMCW
Antenna Description	FPC Antenna, 28dBi(Max.)

Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Mobile Devices
Date of Test	December 18, 2024 ~ February 17, 2025
Date of Report	February 18, 2025

2. Evaluation method and Limit

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 C95.1–2019: IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz 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/cm²)	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/f²)*	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/cm²)	Averaging Time (minute)
Limits for Occupational/Uncontrolled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 30	824/f	2.19/f	(180/f²)*	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. Conducted Power

[BLE 2M]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
BLE 2M	0	2402	0.92
	19	2440	0.65
	39	2480	0.63

Test Procedure

TX frequency range: 13.56MHz
Device category: Portable device (Distance: 20cm)
Field Strength: 42.57dBuV/m @3m
EIRP=E-104.8+20logD=42.57-104.8+20log3=-52.69dBm
Maximum Conducted Output Power: -52.69dBm
Turn-up: -52±1

Test Procedure

TX frequency range: 915MHz
Device category: Portable device (Distance: 20cm)
Max. Field Strength: 83.95dBuV/m @3m
EIRP=E-104.8+20logD=83.95-104.8+20log3=-11.33dBm
Maximum Conducted Output Power: -11.33dBm
Turn-up: -11±1

6. Manufacturing Tolerance

[BLE 2M]

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

[Radar]

Frequency(GHz)	75
Target (dBm)	25.0
Tolerance ±(dB)	1.0

7. Evaluation Results

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.

[BLE 2M]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW				
GFSK	1.0	1.2589	2.11	1.6255	0.0004	1.0000

[NFC]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW				
ASK	-51	0.0000079	3.0	1.9953	0.0000000032	0.9789

[LoRa]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW				
Ra-01SH	-10	0.1000	3.0	1.9953	0.000040	0.6100

[Radar]

Modulation Type	Maximum EIRP		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW				
FMCW	25	316.2278	28	630.9573	0.004976	1.0

Remark:
1. Output power including tune up tolerance;
2. Output power was adjust to duty cycle at 100% if measured duty cycle less than 98%;
3. MPE evaluate distance is 20cm from user manual provide by manufacturer.
4.We choose 75000MHz(lowest frequency operate at 75-85GHz Band) to calculate MPE limit as higher frequency will have higher MPE limits

Simultaneous Transmission MPE

BLE Max MPE (Ratio)	NFC Max MPE (Ratio)	LoRa Max MPE (Ratio)	Radar Max MPE (Ratio)	simultaneous MPE (Ratio)	MPE Limits (Ratio)
0.0004	0.0000000033	0.000066	0.004976	0.005442	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.

9. Description of Test Facility

NVLAP Accreditation Code is 600167-0.
FCC Designation Number is CN5024.
CAB identifier is CN0071.
CNAS Registration Number is L4595.
Test Firm Registration Number: 254912

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