



Maximum Permissible Exposure Report

1. Product Information

Product Name	:	Radar Level Sensor
Test Model	:	LSR-801L
Additional Model No.	:	LSR-800, LSR-800L, LSR-801, LSR-802, LSR-802N, LSR-802L, LSR-802NL, LSR-803, LSR-803L, LSR-804, LSR-804L, LSR-805, MA-LoRa, LG-100, LG-200, LG-300, LG-50
Model Declaration	:	LSR-801 without LoRa function compare LSR-801L (hardware support while disable LoRa function by software), LSR-800, LSR-801, LSR-802, LSR-802N, LSR-802L, LSR-802NL, LSR-803, LSR-803L, LSR-804, LSR-804L, LSR-805, MA-LoRa, LG-100, LG-200, LG-300, LG-50 hardware version and software version are same as LSR-801L, only model name difference as market requirement.
Power supply	:	Input: DC 24V, 100mA, Max 0.24W
Hardware Version	:	V1.3
Software Version	:	V1.0r60
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	:	Internal Antenna, 0.41dBi (Max.)
LoRa Frequency Range	:	915.0MHz
Modulation Type	:	GFSK
Antenna Description	:	External Antenna, 2.5dBi (Max.)
Level probing radars Frequency Range	:	76-81G
Channel Number	:	1
Modulation Type	:	Frequency Modulation (FMCW)
Antenna Description	:	Integrated patch Antenna; Maximum Peak Values 25.7 dBi
Exposure category	:	General Population/Uncontrolled Environment
EUT Type	:	Production Unit
Device Type	:	Mobile Device



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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 C95.1-2019](#): 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/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/Uncontrolled 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



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5. Antenna Information

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

Internal/External Identification	Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Notes
Internal	Internal Antenna	2400MHz-2500MHz	0.41dBi	BT LE Antenna
External	External Antenna	895MHz-935MHz	2.5dBi	LoRa Antenna
Integrated patch	Integrated patch antenna	76-81GHz	25.7dBi	Level probing radars Antenna

6. Conducted Power

[BT LE 1M]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
GFSK	00	2402	3.55
	19	2440	3.61
	39	2480	3.15

[BT LE 2M]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
GFSK	00	2402	-0.79
	19	2440	-0.87
	39	2480	-1.39

[LoRa]

Mode	Channel (Worst result)	Frequency (MHz)	EIRP (dBm)
GFSK	1	915	-4.31

According to ANSI C63.10 section 9.5 Equations to Calculate EIRP;

$EIRP = E - 104.7 + 20 \log D$

E: is the electric field strength in dBuV/m

EIRP: is the equivalent isotropically radiated power in(dBm)

D: is the specified measurement distance in m

Antenna gain:2.5dBi

[Level Probing Radars]

Mode	Channel (Worst result)	Frequency (GHz)	EIRP (dBm)
Frequency Modulation (FMCW)	1	76-81	6.54

Remark: Antenna gain:25.7dBi

7. Manufacturing Tolerance

[BT LE 1M]

1MGFSK(Peak)			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	3.0	3.0	3.0
Tolerance \pm (dB)	1.0	1.0	1.0

[BT LE 2M]

1MGFSK(Peak)			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	0	0	0
Tolerance \pm (dB)	1.0	1.0	1.0



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[LoRa]

EIRP (GFSK)

Channel	Channel 1
Target (dBm)	-4.00
Tolerance \pm (dB)	1.0

[Level Probing Radars]

EIRP (FMCW)

Channel	Channel 1
Target (dBm)	29.00
Tolerance \pm (dB)	1.0

8. Measurement Results

8.1 Standalone MPE Evaluation

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, $r=20\text{cm}$, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

Modulation Type	Output power (Conducted)		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
BT LE	4.0	2.5119	0.41	1.0990	0.0005	1.0000

Modulation Type	EIRP		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
LoRa	-3.00	0.5012	2.50	1.7783	0.0001	1.0000
Level probing radars	30.00	1000.00	25.70	371.5352	0.1990	1.0000

Remark:

1. Output power including turn-up tolerance;
2. Output power was adjusted 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. $\text{EIRP (dBm)} = \text{Antenna Port Power (dBm)} + \text{Antenna Gain (dBi)}$;
5. $\text{EIRP (dBm)} = \text{ERP (dBm)} + 2.15 \text{ (dBi)}$

8.2 Simultaneous Transmission MPE Evaluation

The EUT equipped with one Bluetooth antenna, LoRa antenna and Level probing radars antenna. Need consider simultaneous transmission. According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations; \sum of MPE ratios ≤ 1.0

Simultaneous Transmission					
BT LE Max MPE ratios	LoRa MPE ratios	Level probing radars MPE ratios	\sum MPE ratios	Limit	Results
0.0005	0.0001	0.1990	0.1996	1.0000	PASS

Remark:

1. Output power including turn-up tolerance;
2. Output power is burst average power;
3. MPE evaluate distance is 20cm from user manual provide by manufacturer;
4. $\text{MPE values} = \text{PG}/4\pi R^2$

9. 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-----



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