

Maximum Permissible Exposure Report

1.Product Information

Product Name : Smart Linux Gateway
 Model Number : DSGW-091
 Model Difference Declaration : N/A
 Test Model : DSGW-091
 Power Supply : Input: DC 5V,2A
 Hardware version : 5-1-9-009760
 Software version : V1.0
 Sample ID : TZ220903661-1#&TZ220903661-2#

LoRa

LoRa-Hybrid Mode

Frequency Range : 902.3 – 914.9 MHz
 Channel Number : 64 Channels
 Modulation Technology : LORA

LoRa-DTS Mode

Frequency Range : 923.3 – 927.5 MHz
 Channel Number : 8 Channels
 Modulation Technology : LORA
 Antenna Type And Gain : External Antenna / 2.44 dBi(Max)

Bluetooth

Bluetooth Version : V5.2
 Frequency Range : 2402 – 2480 MHz
 Channel Number : 40 Channels for BLE (DTS)
 Modulation Technology : GFSK for BLE (DTS)
 Data Rates : BLE (DTS): 1Mbps
 Antenna Type And Gain : FPC Antenna / -0.09dBi(Max)

Zigbee

Frequency Range : 2415 – 2480 MHz
 Channel Number : 14 Channels
 Modulation Technology : O-QPSK
 Data Rates : 250 kbps
 Antenna Type And Gain : PCB Antenna / 0.0dBi(Max)

Z-Wave

Frequency Range : 908.4 – 916 MHz
 Channel Number : Channel 1: 908.4MHz / Channel 2: 916MHz
 Modulation Technology : FSK
 Antenna Type And Gain : FPC Antenna / -1.8dBi(Max)

Note 1: Antenna position refer to EUT Photos

Note 2: The above information supplied by the applicant.

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

This Product can only use antennas certificated in section 1 as provided by manufacturer;

6. Conducted Power

LoRa-DTS Mode

Test Mode	Channel	Frequency (MHz)	Measured Peak Output Power (dBm)
Lora-DTS	0	923.3	13.43
	3	925.7	12.94
	7	927.5	13.58

LoRa-Hybrid Mode

Test Mode	Channel	Frequency (MHz)	Measured Peak Output Power (dBm)
LoRa-Hybrid	00	902.3	8.54
	32	908.7	9.73
	63	914.9	8.22

BT-BLE Mode

Test Mode	Channel	Frequency (MHz)	Measured Peak Output Power (dBm)
GFSK(1Mbps)	00	2402	6.64
	19	2440	7.02
	39	2480	7.27

Z-Wave Mode

Test Mode	Channel	Frequency (MHz)	Measured Average Output Power (dBm)
Z-Wave	01	908.4	-5.47
	02	916	-9.02

Zigbee Mode

Test Mode	Channel	Frequency (MHz)	Measured Peak Output Power (dBm)
Zigbee	13	2415	10.96
	18	2440	10.68
	26	2480	10.67

7. Manufacturing Tolerance

LoRa

LoRa-DTS Mode (Peak)			
Channel	Channel 0	Channel 3	Channel 7
Target (dBm)	13.0	12.5	13.0
Tolerance ±(dB)	1.0	1.0	1.0
LoRa-Hybrid Mode (Peak)			
Channel	Channel 0	Channel 32	Channel 63
Target (dBm)	8.0	9.0	7.5
Tolerance ±(dB)	1.0	1.0	1.0

BT-BLE Mode

GFSK(1Mbps) Mode (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	6.0	6.5	7.0
Tolerance ±(dB)	1.0	1.0	1.0

Z-Wave Mode

Z-Wave Mode (Peak)			
Channel	Channel 01	Channel 02	
Target (dBm)	-6.0	-9.5	
Tolerance ±(dB)	1.0	1.0	

Zigbee Mode

Zigbee Mode (Peak)			
Channel	Channel 13	Channel 18	Channel 26
Target (dBm)	10.5	10.0	10.0
Tolerance ±(dB)	1.0	1.0	1.0

8. Measurement Results

8.1 Standalone MPE

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.

Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
LoRa-DTS	10.0	10.0000	2.44	1.7539	0.0035	0.6013
LoRa-Hybrid	14.0	25.1189	2.44	1.7539	0.0088	0.6013
BT-BLE	8.0	6.3096	-0.09	0.9795	0.0012	1.0000
Z-Wave	-5.0	0.3162	-1.8	0.6607	0.0001	0.6013
Zigbee	11.5	14.1254	0.0	1.0000	0.0028	1.0000

Remark:

1. Output power including tune-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer;

8.2 Simultaneous Transmission MPE

Maximum Simultaneous transmission MPE Ratios

Maximum MPE Ratio(mW/cm ²) LoRa	Maximum MPE Ratio (mW/cm ²) BT-BLE	Maximum MPE Ratio (mW/cm ²) Z-Wave	Maximum MPE Ratio (mW/cm ²) Zigbee	ΣMPE Ratio	Limit	Results
0.0146	0.0012	0.0002	0.0028	0.0188	1.00	PASS

9. 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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