

Maximum Permissible Exposure Report

Product Information

Product Name : Outdoor LoRa Gateway
 Model Number : DSGW-014, DSGW-014-x(x:1~8)
 Model Difference Declaration : All the same except for the model name
 Test Model : DSGW-014
 Power Supply : DC 48V supply by POE
 Hardware version : B45161209A
 Software version : V1.0
 Sample ID : TZ230404203-1#&TZ230404203-2#

LoRa

LoRa-Hybrid Mode

Frequency Range : 902.3 – 914.9 MHz
 Channel Number : 64 Channels
 Modulation Technology : LORA
 Antenna Type And Gain : External Antenna /1.2 dBi(Max)

Bluetooth

Bluetooth Version : V2.1
 Operation Frequency : 2402- 2480 MHz
 Channel Number : 79 Channels for Bluetooth BR/EDR(DSS)
 Modulation Technology : GFSK, $\pi/4$ -DQPSK, 8-DPSK for Bluetooth BR/EDR (DSS)
 Data Rates : Bluetooth BR/EDR (DSS): 1/2/3Mbps
 Antenna Type And Gain : External Antenna /3.0 dBi(Max)

WiFi

WLAN : Supported IEEE 802.11a/b/g/n/ac
 IEEE 802.11b:2412-2462MHz
 IEEE 802.11g:2412-2462MHz
 IEEE 802.11n HT20:2412-2462MHz / 5180-5240MHz / 5745-5825MHz
 WLAN FCC Operation Frequency : IEEE 802.11n HT40: 2422-2452MHz / 5190-5230MHz / 5755-5795MHz
 IEEE 802.11a: 5180-5240MHz / 5745-5825MHz
 IEEE 802.11ac VHT20: 5180-5240MHz / 5745-5825MHz
 IEEE 802.11ac VHT40: 5190-5230MHz / 5755-5795MHz
 IEEE 802.11ac VHT80: 5210MHz / 5775MHz
 WLAN Channel Number : 11 Channels for 2412-2462MHz(IEEE 802.11b/g/n HT20)
 7 Channels for 2422-2452MHz(IEEE 802.11n HT40)
 4 Channels for 5180-5240MHz (IEEE 802.11a/ac VHT20/n HT20)
 2 Channels for 5190-5230MHz (IEEE 802.11ac VHT40/n HT40)
 1 Channels for 5210MHz (IEEE 802.11ac VHT80)
 5 Channels for 5745-5825MHz(IEEE 802.11a/ac VHT20/n HT20)
 2 Channels for 5755-5795MHz(IEEE 802.11ac VHT40/n HT40)
 1 Channels for 5775MHz(IEEE 802.11ac VHT80)
 WLAN Modulation Technology : IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK)
 IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK)
 IEEE 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK)

	IEEE 802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK)
	IEEE 802.11ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)
Antenna Type And Gain	3.00dBi (Max.), for TX/RX (WLAN 2.4G Band) : 1.78dBi (Max.), for TX/RX (WLAN 5.2G Band) 2.09dBi (Max.), for TX/RX (WLAN 5.8G Band)

UTRA

UTRA FCC Operation Frequency	WCDMA BAND II (UL: 1850 – 1910 MHz/DL: 1930 – 1990 MHz) WCDMA BAND IV (UL: 1710 – 1755 MHz/DL: 2110 – 2155 MHz) WCDMA BAND V (UL: 824 – 849 MHz/DL: 869 – 894 MHz)
Channel Separation	: 0.2MHz
Modulation Technology	: OFDM (16QAM, QPSK)
Antenna Type And Gain	External Antenna : WCDMA BAND II: 1.8dBi : WCDMA BAND IV: 1.5dBi WCDMA BAND V: -0.6dBi

E-UTRA

E-UTRA FCC Operation Frequency	FDD Band 2 (UL: 1850 – 1910 MHz/DL: 1930 – 1990 MHz) FDD Band 4 (UL: 1710 – 1755 MHz/DL: 2110 – 2155 MHz) FDD Band 5 (UL: 824 – 849 MHz/DL: 869 – 894 MHz) : FDD Band 12(UL: 699 – 716 MHz/DL: 729 – 746 MHz) FDD Band 13(UL: 777 – 787 MHz/DL: 746 – 756 MHz) FDD Band 25(UL: 1850 – 1915 MHz/DL: 1930 – 1995 MHz) FDD Band 26 (UL: 814 – 849 MHz/DL: 859 – 894 MHz)
Channel Separation	: 0.1 MHz
Modulation Technology	: OFDM (16QAM, QPSK)
Antenna Type And Gain	External Antenna FDD Band 2:1.8 dBi FDD Band 4:1.5 dBi : FDD Band 5:-0.6 dBi : FDD Band 12:-1.2 dBi FDD Band 13:-1.1 dBi FDD Band 25:1.8dBi FDD Band 26:-0.6 dBi

Note 1: Antenna position refer to EUT Photos.

Note 2: the above information was 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 as follows provided by manufacturer;

Antenna Gain and type refer to Product information

6. Conducted Power

2.4G Band:
Bluetooth(BDR+EDR)

TestMode	Antenna	Channel	Result[dBm]
DH5	Ant1	2402	5.48
		2441	5.75
		2480	5.83
2DH5	Ant1	2402	5.41
		2441	5.74
		2480	5.83
3DH5	Ant1	2402	5.81
		2441	6.17
		2480	6.36

LoRa

TestMode	Antenna	Channel	Result[dBm]
BLE_1M	Ant1	902.3	8.57
		908.7	9.23
		914.9	7.55

WiFi 2.4GHz Band

TestMode	Antenna	Channel	Result[dBm]
11B	Ant1	2412	17.33
		2437	18.23
		2462	17.48
11G	Ant1	2412	13.75
		2437	14.73
		2462	14.01
11N20SISO	Ant1	2412	14.08
		2437	14.65
		2462	13.84
11N40SISO	Ant1	2422	19.22
		2437	14.85
		2452	14.35

5G Band
UNII-1 Band

TestMode	Antenna	Channel	Result[dBm]
11A	Ant1	5180	12.62
		5200	12.74
		5240	12.45
11N20SISO	Ant1	5180	10.81
		5200	11.38
		5240	12.37
11N40SISO	Ant1	5190	9.93
		5230	10.01
11AC20SISO	Ant1	5180	9.10
		5200	9.64
		5240	10.54
11AC40SISO	Ant1	5190	9.98
		5230	10.22
11AC80SISO	Ant1	5210	11.48

UNII-3 Band

TestMode	Antenna	Channel	Result[dBm]
11A	Ant1	5745	12.51
		5785	11.46
		5825	10.97
11N20SISO	Ant1	5745	12.31
		5785	11.75
		5825	11.17
11N40SISO	Ant1	5755	12.65
		5795	11.91
11AC20SISO	Ant1	5745	12.38
		5785	11.64
		5825	10.81
11AC40SISO	Ant1	5755	12.61
		5795	11.99
11AC80SISO	Ant1	5775	12.78

7. Manufacturing Tolerance

Bluetooth(BDR+EDR)

GFSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	5.0	5.5	5.5
Tolerance \pm (dB)	1.0	1.0	1.0
$\pi/4$ -DQPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	5.0	5.0	5.5
Tolerance \pm (dB)	1.0	1.0	1.0
8-DPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	5.5	5.5	6.0
Tolerance \pm (dB)	1.0	1.0	1.0

LoRa

LoRa-Hybrid Mode (Peak)			
Channel	Channel 0	Channel 33	Channel 64
Target (dBm)	8.0	8.5	7.0
Tolerance \pm (dB)	1.0	1.0	1.0

WiFi 2.4GHz Band – Antenna 1

IEEE 802.11b(Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	17.0	17.5	17.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11g (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	13.5	14.0	13.5
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	13.5	14.0	13.5
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	18.5	14.5	14.0
Tolerance \pm (dB)	1.0	1.0	1.0

UNII-1 Band – Antenna 1

IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	12.0	12.0	12.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.5	11.0	12.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	8.5	9.0	10.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	Channel 46	--
Target (dBm)	9.5	9.5	--
Tolerance \pm (dB)	1.0	1.0	--
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	Channel 46	--
Target (dBm)	9.5	9.5	--
Tolerance \pm (dB)	1.0	1.0	--
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 42	--	--
Target (dBm)	11.0	--	--
Tolerance \pm (dB)	1.0	--	--

UNII-3 Band – Antenna 1

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	12.0	11.0	10.5
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	12.0	11.5	10.5
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	12.0	11.0	10.5
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 151	Channel 159	--
Target (dBm)	12.0	11.5	--
Tolerance \pm (dB)	1.0	1.0	--
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	Channel 159	--
Target (dBm)	12.0	11.5	--
Tolerance \pm (dB)	1.0	1.0	--
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 155	--	--
Target (dBm)	12.5	--	--
Tolerance \pm (dB)	1.0	--	--

For WCDMA and LTE refer to the module test result(FCC ID: XMR201 909EG91NAX)

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				
Bluetooth	7	5.0119	3.0	1.9953	0.0020	1.0000
LoRa	9.5	8.9125	1.2	1.3183	0.0023	0.6015
WiFi 2.4G	19.5	89.1251	3	1.9953	0.0354	1.0000
WiFi UNII-1	13	19.9526	1.78	1.5066	0.0060	1.0000
WiFi UNII-3	13.5	22.3872	2.09	1.6181	0.0072	1.0000
WCDMA BAND II	24	251.1886	1.8	1.5136	0.0757	1.0000
WCDMA BAND IV	24	251.1886	1.5	1.4125	0.0706	1.0000
WCDMA BAND V	24	251.1886	-0.6	0.8710	0.0500	0.5493
LTE Band 2	24.5	281.8383	1.8	1.5136	0.0849	1.0000
LTE Band 4	24.5	281.8383	1.5	1.4125	0.0792	1.0000
LTE Band 5	24.5	281.8383	-0.6	0.8710	0.0561	0.5493
LTE Band 12	24.5	281.8383	-1.2	0.7586	0.0561	0.4660
LTE Band 13	24.5	281.8383	-1.1	0.7762	0.0561	0.5180
LTE Band 25	25	316.2278	1.8	1.5136	0.0953	1.0000
LTE Band 26(Part 22)	25	316.2278	-0.6	0.8710	0.0629	0.5427
LTE Band 26(Part 90)	25	316.2278	-0.6	0.8710	0.0629	0.5493

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) Bluetooth	Maximum MPE Ratio (mW/cm ²) Lora	Maximum MPE Ratio (mW/cm ²) WiFi	Maximum MPE Ratio (mW/cm ²) WCDMA/LTE	ΣMPE Ratio	Limit	Results
0.0020	0.0038	0.0354	0.1204	0.1616	1.0000	PASS

Remark:

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

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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