

Maximum Permissible Exposure Report

1. Product Information

FCC ID:	2AG6GH8956
Product name	Cellular Wi-Fi Router
Model number	H8956, H8956-4GSPT, H8956-4GVZW, H8956-NM, H8956-4GEU
Power supply	DC 12V, 1.5A by AC/DC Adapter
Modulation Type	QPSK for UMTS, QPSK, 16QAM for LTE
Antenna Type	SMA Antenna
Antenna Gain	3.0dBi (max.) For all WCDMA Band; 3.0dBi (max.) For all LTE Band; 3.0dBi (max.) For WLAN
Hardware version	V31
Software version	V703SE
UMTS Operation Frequency Band	UMTS FDD Band II/IV/V
LTE Operation Frequency Band	FDD: Band 2, Band 4, Band 5, Band 12, Band 13, Band 25, Band 26, Band 29 (Downlink Only), Band 30 TDD: Band 41
WCDMA Release Version	R99
HSDPA Release Version	Release 9
HSUPA Release Version	Release 6
DC-HSUPA Release Version	Not Supported
LTE Release Version	R7
LTE/UMTS Power Class	Level 3
Extreme temp. Tolerance	-20°C to +60°C
Extreme vol. Limits	108VAC to 132VAC (nominal: 120VAC)
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Mobile Device

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

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

External Identification	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna 0	External Antenna	600 MHz – 2500 MHz	3.0dBi (max.) For all WCDMA and LTE Band
Antenna 1	External Antenna	600 MHz – 2500 MHz	3.0dBi (max.) For all WCDMA and LTE Band
Antenna 2	External Antenna	600 MHz – 2500 MHz	3.0dBi (max.) For WLAN

Note: Antenna 0 is the main antenna for WCDMA and LTE Band, and antenna 1 is the Diversity antenna for WCDMA and LTE Band.

6. Conducted Power

General Note:

1. Per KDB 447498 D01v06, the maximum output power channel is used for SAR testing, further SAR test reduction and MPE.

<2.4GWLAN Max Conducted Power>

Test Mode		Channel	Frequency (MHz)	Max Conducted Power (dBm)
2.4GWLAN	IEEE 802.11b	LCH	2412	17.48
		MCH	2437	17.62
		HCH	2462	17.58
	IEEE 802.11g	LCH	2412	15.26
		MCH	2437	15.21
		HCH	2462	15.66
	IEEE 802.11n HT20	LCH	2412	14.54
		MCH	2437	14.66
		HCH	2462	14.78

<WCDMA Max Conducted Power>

Test Mode		Channel	Frequency (MHz)	Max Conducted Power (dBm)
WCDMA	Band II	LCH	1852.4	23.78
		MCH	1800.0	23.85
		HCH	1907.6	23.79
	Band IV	LCH	1712.4	23.82
		MCH	1732.6	23.81
		HCH	1752.6	23.85
	Band V	LCH	826.4	23.90
		MCH	836.6	23.80
		HCH	846.6	23.73

<LTE Max Conducted Power>

Test Mode		Channel	Frequency (MHz)	Max Conducted Power (dBm)
LTE	Band 2	LCH	1850.7	21.48
		MCH	1880.0	21.47
		HCH	1909.3	21.45
	Band 4	LCH	1710.7	23.25
		MCH	1732.5	23.69
		HCH	1754.3	23.86
	Band 5	LCH	824.7	22.82
		MCH	836.5	22.56
		HCH	848.3	22.78
	Band 12	LCH	699.7	22.97
		MCH	707.5	22.96
		HCH	715.3	22.83
	Band 13	LCH	779.5	22.68
		MCH	782.0	22.63
		HCH	784.5	22.46
	Band 25	LCH	1850.7	22.55
		MCH	1882.5	22.35
		HCH	1914.3	22.82
	Band 26	LCH	814.7	23.71
		MCH	831.5	22.90
		HCH	848.3	23.12
	Band 30	LCH	2307.5	19.87
		MCH	2310.0	19.66
		HCH	2312.5	19.74
	Band 41	LCH	2497.5	19.19
		MCH	2593.0	19.96
		HCH	2687.5	19.92

7. Manufacturing Tolerance

<2.4GWLAN >

Test Mode		Channel	Max Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
2.4GWLAN	IEEE 802.11b	LCH	17.48	17.0±1.0
		MCH	17.62	17.0±1.0
		HCH	17.58	17.0±1.0
	IEEE 802.11g	LCH	15.26	15.0±1.0
		MCH	15.21	15.0±1.0
		HCH	15.66	15.0±1.0
	IEEE 802.11n HT20	LCH	14.54	14.0±1.0
		MCH	14.66	14.0±1.0
		HCH	14.78	14.0±1.0

<WCDMA >

Test Mode		Channel	Max Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
WCDMA	Band II	LCH	23.78	23.0±1.0
		MCH	23.85	23.0±1.0
		HCH	23.79	23.0±1.0
	Band IV	LCH	23.82	23.0±1.0
		MCH	23.81	23.0±1.0
		HCH	23.85	23.0±1.0
	Band V	LCH	23.90	23.0±1.0
		MCH	23.80	23.0±1.0
		HCH	23.73	23.0±1.0

<LTE Max Conducted Power>

Test Mode		Channel	Max Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
LTE	Band 2	LCH	21.48	21.0±1.0
		MCH	21.47	21.0±1.0
		HCH	21.45	21.0±1.0
	Band 4	LCH	23.25	23.0±1.0
		MCH	23.69	23.0±1.0
		HCH	23.86	23.0±1.0
	Band 5	LCH	22.82	22.0±1.0
		MCH	22.56	22.0±1.0
		HCH	22.78	22.0±1.0
	Band 12	LCH	22.97	22.0±1.0
		MCH	22.96	22.0±1.0
		HCH	22.83	22.0±1.0
	Band 13	LCH	22.68	22.0±1.0
		MCH	22.63	22.0±1.0
		HCH	22.46	22.0±1.0
	Band 25	LCH	22.55	22.0±1.0
		MCH	22.35	22.0±1.0
		HCH	22.82	22.0±1.0
	Band 26	LCH	23.71	23.0±1.0
		MCH	22.90	23.0±1.0
		HCH	23.12	23.0±1.0
	Band 30	LCH	19.87	19.0±1.0
		MCH	19.66	19.0±1.0
		HCH	19.74	19.0±1.0
	Band 41	LCH	19.19	19.0±1.0
		MCH	19.96	19.0±1.0
		HCH	19.92	19.0±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 30 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, $r=30\text{cm}$, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

Antenna 2

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11b	18.00	63.0957	3.0000	1.9953	0.0111	1.0000
IEEE 802.11g	16.00	39.8107	3.0000	1.9953	0.0070	1.0000
IEEE 802.11n HT20	15.00	31.6228	3.0000	1.9953	0.0056	1.0000

Antenna 0

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
WCDMA Band II	24.00	251.1886	3.0000	1.9953	0.0443	1.0000
WCDMA Band IV	24.00	251.1886	3.0000	1.9953	0.0443	1.0000
WCDMA Band V	24.00	251.1886	3.0000	1.9953	0.0443	0.5493
LTE Band 2	22.00	158.4893	3.0000	1.9953	0.0280	1.0000
LTE Band 4	24.00	251.1886	3.0000	1.9953	0.0443	1.0000
LTE Band 5	23.00	199.5262	3.0000	1.9953	0.0352	0.5493
LTE Band 12	23.00	199.5262	3.0000	1.9953	0.0352	0.4660
LTE Band 13	23.00	199.5262	3.0000	1.9953	0.0352	0.5180
LTE Band 25	23.00	199.5262	3.0000	1.9953	0.0352	1.0000
LTE Band 26	24.00	251.1886	3.0000	1.9953	0.0443	1.0000
LTE Band 30	20.00	100.0000	3.0000	1.9953	0.0176	1.0000
LTE Band 41	20.00	100.0000	3.0000	1.9953	0.0176	1.0000

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. $MPE\ values = PG/4\pi R^2$
5. MPE limits for WCDMA Band II and LTE Band 2 refer 1850MHz, WCDMA Band IV and LTE Band 4 refer 1710MHz, WCDMA Band V refer 824MHz, LTE Band 12 refer 669MHz, LTE Band 13 refer 777MHz, LTE Band 25 refer 1850MHz, LTE Band 26 refer 814MHz, LTE Band 30 refer 2350MHz and LTE Band 41 refer 2496MHz as it is lowest frequency.

8.2 Simultaneous Transmission MPE

The sample support one 2.4G WLAN and another one LTE and WCDMA transmit antenna, so need consider simultaneous transmission;

Simultaneous transmission MPE

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

$\sum \sum$ of MPE ratios ≤ 1.0

2.4G WLAN+WCDMA			
Mode	$\sum$ MPE ratios	Limit	Results
IEEE 802.11b + WCDMA Band II	0.0554	1.000	Pass
IEEE 802.11b + WCDMA Band IV	0.0554	1.000	Pass
IEEE 802.11b + WCDMA Band V	0.0554	1.000	Pass
IEEE 802.11g + WCDMA Band II	0.0513	1.000	Pass
IEEE 802.11g + WCDMA Band IV	0.0513	1.000	Pass
IEEE 802.11g + WCDMA Band V	0.0513	1.000	Pass
IEEE 802.11n20 + WCDMA Band II	0.0499	1.000	Pass
IEEE 802.11n20 + WCDMA Band IV	0.0499	1.000	Pass
IEEE 802.11n20 + WCDMA Band V	0.0499	1.000	Pass

2.4G WLAN+LTE			
Mode	$\sum$ MPE ratios	Limit	Results
IEEE 802.11b + LTE Band 2	0.0391	1.000	Pass
IEEE 802.11b + LTE Band 4	0.0554	1.000	Pass
IEEE 802.11b + LTE Band 5	0.0463	1.000	Pass
IEEE 802.11b + LTE Band 12	0.0463	1.000	Pass
IEEE 802.11b + LTE Band 13	0.0463	1.000	Pass
IEEE 802.11b + LTE Band 25	0.0463	1.000	Pass
IEEE 802.11b + LTE Band 26	0.0554	1.000	Pass
IEEE 802.11b + LTE Band 30	0.0287	1.000	Pass
IEEE 802.11b + LTE Band 41	0.0287	1.000	Pass
IEEE 802.11g + LTE Band 2	0.0350	1.000	Pass
IEEE 802.11g + LTE Band 4	0.0513	1.000	Pass
IEEE 802.11g + LTE Band 5	0.0422	1.000	Pass
IEEE 802.11g + LTE Band 12	0.0422	1.000	Pass
IEEE 802.11g + LTE Band 13	0.0422	1.000	Pass
IEEE 802.11g + LTE Band 25	0.0422	1.000	Pass
IEEE 802.11g + LTE Band 26	0.0513	1.000	Pass
IEEE 802.11g + LTE Band 30	0.0246	1.000	Pass
IEEE 802.11g + LTE Band 41	0.0246	1.000	Pass
IEEE 802.11n20 + LTE Band 2	0.0336	1.000	Pass
IEEE 802.11n20 + LTE Band 4	0.0499	1.000	Pass
IEEE 802.11n20 + LTE Band 5	0.0408	1.000	Pass
IEEE 802.11n20 + LTE Band 12	0.0408	1.000	Pass
IEEE 802.11n20 + LTE Band 13	0.0408	1.000	Pass
IEEE 802.11n20 + LTE Band 25	0.0408	1.000	Pass
IEEE 802.11n20 + LTE Band 26	0.0499	1.000	Pass
IEEE 802.11n20 + LTE Band 30	0.0232	1.000	Pass
IEEE 802.11n20 + LTE Band 41	0.0232	1.000	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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