

## Maximum Permissible Exposure Report

### 1. Product Information

FCC ID:	2BHCF-WH3
Product name	WH3 Wireless Hub
Model number	WH3
Power supply	DC 12V from adapter
Adapter information	Model : GMA25-120200-1A Input:100-240V~50/60Hz 1.0A Output:12V---2.0A
Modulation Type	FM for RoLa, QPSK for UMTS, QPSK, 16QAM for LTE
Antenna Type	External Antenna
Antenna Gain	1.83dBi (max.) For RoLa 3.5dBi (max.) For all GSM Band; 3.5dBi (max.) For all WCDMA Band; 3.5dBi (max.) For all LTE Band;
Hardware version	V1.0
Software version	V1.0
Operation Frequency Band	RoLa: 917.1MHz 2G: GSM850, PCS1900 3G: Band II/IV/V 4G: Band 2, Band 4, Band 5, Band 7, Band 12, Band 13, Band 25, Band 26, Band 38, Band 40, Band 41, Band 66
Extreme temp. Tolerance	-20°C to +60°C
Extreme vol. Limits	10.8VDC to 13.2VDC (nominal: 12.0VDC)
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  $\leq 1.0$ . 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 <sup>2</sup> )	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 <sup>2</sup> )*	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 <sup>2</sup> )	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 <sup>2</sup> )*	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
RoLa Antenna	External Antenna	800 MHz – 1000 MHz	1.83dBi (max.) For RoLa
GSM&WCDMA &LTE Antenna	External Antenna	600 MHz – 2500 MHz	3.5dBi (max.) For all GSM, 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.

## &lt; RoLa &gt;

Modulation Type	Channel	Frequency (MHz)	Field Strength (dB $\mu$ V /m)	d (m)	E.R.P. Power (dBm)	E.I.R.P. Power (dBm)
LoRa	1	917.1	88.00	3.0	-7.20	-5.05

## &lt;GSM Max Conducted Power&gt;

Test Mode		Channel	Frequency (MHz)	Max Conducted Power (dBm)
2G	GSM850	LCH	824.2	27.63
		MCH	836.6	27.76
		HCH	848.8	27.96
	PCS1900	LCH	1850.2	28.73
		MCH	1880	28.90
		HCH	1909.8	28.91

## &lt;WCDMA Max Conducted Power&gt;

Test Mode		Channel	Frequency (MHz)	Max Conducted Power (dBm)
WCDMA	Band II	LCH	1852.4	23.15
		MCH	1800.0	22.99
		HCH	1907.6	23.02
	Band IV	LCH	1712.4	22.87
		MCH	1732.6	22.56
		HCH	1752.6	22.73
	Band V	LCH	826.4	23.03
		MCH	836.6	22.96
		HCH	846.6	22.91

## &lt;LTE Max Conducted Power&gt;

Test Mode		Modulation	Max Conducted Power (dBm)
LTE	Band 2	QPSK	22.51
		16QAM	24.19
	Band 4	QPSK	22.55
		16QAM	24.19
	Band 5	QPSK	23.25
		16QAM	24.16
	Band 7	QPSK	22.07
		16QAM	20.85
	Band 12	QPSK	23.13
		16QAM	22.56
	Band 13	QPSK	22.58
		16QAM	23.17
	Band 25	QPSK	22.36
		16QAM	21.40
	Band 26	QPSK	22.81
		16QAM	22.58
	Band 38	QPSK	22.25
		16QAM	21.84
	Band 40	QPSK	22.19
		16QAM	21.4
	Band 41	QPSK	22.06
		16QAM	21.25
	Band 66	QPSK	22.87
		16QAM	22.29

## 7. Manufacturing Tolerance

## &lt; RoLa &gt;

Test Mode	Channel	Max Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
LoRa	1	-5.05	-5.0±1.0

## &lt;GSM &gt;

Test Mode	Channel	Max Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
2G	GSM850	LCH	27.63
		MCH	27.76
		HCH	27.96
	PCS1900	LCH	28.73
		MCH	28.90
		HCH	28.91

## &lt;WCDMA &gt;

Test Mode	Channel	Max Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
WCDMA	Band II	LCH	23.15
		MCH	22.99
		HCH	23.02
	Band IV	LCH	22.87
		MCH	22.56
		HCH	22.73
	Band V	LCH	23.03
		MCH	22.96
		HCH	22.91

## &lt;LTE Max Conducted Power&gt;

Test Mode	Modulation	Max Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
LTE	Band 2	QPSK	22.51
		16QAM	24.19
	Band 4	QPSK	22.55
		16QAM	24.19
	Band 5	QPSK	23.25
		16QAM	24.16
	Band 7	QPSK	22.07
		16QAM	20.85
	Band 12	QPSK	23.13
		16QAM	22.56
	Band 13	QPSK	22.58
		16QAM	23.17
	Band 25	QPSK	22.36
		16QAM	21.40
	Band 26	QPSK	22.81
		16QAM	22.58
	Band 38	QPSK	22.25
		16QAM	21.84
	Band 40	QPSK	22.19
		16QAM	21.4
	Band 41	QPSK	22.06
		16QAM	21.25
	Band 66	QPSK	22.87
		16QAM	22.29

## 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.

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW				
RoLa	-4.00	0.3981	2.0	1.5241	0.0001	0.6114
GSM850	28.00	630.9573	3.5	2.2387	0.2810	0.5495
PCS1900	29.00	794.3282	3.5	2.2387	0.3538	1.0000
WCDMA Band II	24.00	251.1886	3.5	2.2387	0.1119	1.0000
WCDMA Band IV	23.00	199.5262	3.5	2.2387	0.0889	1.0000
WCDMA Band V	24.00	251.1886	3.5	2.2387	0.1119	0.5509
LTE Band 2	25.00	316.2278	3.5	2.2387	0.1408	1.0000
LTE Band 4	25.00	316.2278	3.5	2.2387	0.1408	1.0000
LTE Band 5	25.00	316.2278	3.5	2.2387	0.1408	0.5498
LTE Band 7	23.00	199.5262	3.5	2.2387	0.0889	1.0000
LTE Band 12	24.00	251.1886	3.5	2.2387	0.1119	0.4665
LTE Band 13	24.00	251.1886	3.5	2.2387	0.1119	0.5197
LTE Band 25	23.00	199.5262	3.5	2.2387	0.0889	1.0000
LTE Band 26	23.00	199.5262	3.5	2.2387	0.0889	0.5431
LTE Band 38	23.00	199.5262	3.5	2.2387	0.0889	1.0000
LTE Band 40	23.00	199.5262	3.5	2.2387	0.0889	1.0000
LTE Band 41	23.00	199.5262	3.5	2.2387	0.0889	1.0000
LTE Band 66	23.00	199.5262	3.5	2.2387	0.0889	1.0000

Remark:

1. Output power (Average) 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 =  $PG/4\pi R^2$

### 8.2 Simultaneous Transmission MPE

The sample support one RoLa and another one GSM, LTE and WCDMA transmit antenna, but only with interleaving of packages switched on board level, That means that they don't transmit at the same time. No 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  $\leq 1.0$

## 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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