

Maximum Permissible Exposure Report

1. Product Information

FCC ID	2AVLJGC388082
Name of EUT	Mobile Radio
Test Model	W2PLUS
Additional Model No.:	W1plus, F8, F8plus, M-7700, W5plus, W8plus, M-9900, A18plus.
Model Declaration	PCB board, structure and internal of these model(s) are the same, so no additional models were tested.
Modulation Type	GMSK for GSM/GPRS; 8-PSK for EDGE; QPSK for UMTS; QPSK, 16QAM for LTE
Antenna Gain	2.0dBi (max.) For GSM 850; 2.0dBi (max.) For GSM 900; 2.0dBi (max.) For DCS 1800; 2.0dBi (max.) For PCS 1900; 2.0dBi for WCDMA Band I; 2.0dBi for WCDMA Band II; 2.0dBi for WCDMA Band IV; 2.0dBi for WCDMA Band V; 2.0dBi for WCDMA Band VIII; 3.0dBi for LTE Band 2; 3.0dBi for LTE Band 4; 3.0dBi for LTE Band 5; 3.0dBi for LTE Band 7; 3.0dBi for LTE Band 12; 3.0dBi for LTE Band 13; 3.0dBi for LTE Band 17; 2.0dBi (max.) For BT and WLAN
Hardware version	MRA58K release-keys
Software version	MT6737N_Android 7.0
GSM/EDGE/GPRS Operation Frequency Band	GSM850/PCS1900/GPRS850/GPRS1900/EDGE850/EDGE1900
UMTS Operation Frequency Band	UMTS FDD Band II/IV/V
LTE Operation Frequency Band	LTE FDD band 2, 4, 5, 7, 12, 13, 17
GSM/EDGE/GPRS	Supported GSM/GPRS/EDGE
GSM Release Version	R99
GSM/EDGE/GPRS Power Class	GSM850:Power Class 4/ PCS1900:Power Class 1
GPRS/EDGE Multislot Class	GPRS/EDGE: Multi-slot Class 12
GPRS operation mode	Class B
WCDMA Release Version	R8
HSDPA Release Version	Release 8
HSUPA Release Version	Release 6
DC-HSUPA Release Version	Not Supported
LTE Release Version	R9
LTE/UMTS Power Class	Class 3
WLAN FCC Modulation Type	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g/n: OFDM(64QAM, 16QAM, QPSK, BPSK)
WLAN FCC Operation frequency	IEEE 802.11b:2412-2462MHz IEEE 802.11g/n20:2412-2462MHz IEEE 802.11n40:2422-2452MHz
Antenna Type	Wifi: Internal antenna BT: Internal antenna GSM: External antenna WCDMA: External antenna LTE: QPSK, External antenna
BT Modulation Type	GFSK, $\pi/4$ -DQPSK, 8-DPSK (BT V4.0)
Extreme temp. Tolerance	-30°C to +75°C
GPS function	Support and only RX
NFC Function	Not Supported
Extreme vol. Limits	10VDC to 24VDC (nominal: 12VDC)
Name of EUT	Mobile Radio
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

ES-D4 can only use antennas certificated as follows provided by manufacturer;

Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Notes
Internal Antenna	2000 MHz – 2500 MHz	2.0 dBi	BT/ WLAN Antenna
External Antenna	600 MHz – 3000 MHz	3.0 dBi	GSM/WCDMA/LTE Antenna

6. Conducted Power

[BT Max Conducted Power]

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)
GFSK BT LE	0	2402	-0.205
	19	2440	-2.201
	39	2480	-0.894
GFSK	0	2402	-0.121
	39	2441	-2.088
	78	2480	-0.750
$\pi/4$ DQPSK	0	2402	-0.849
	39	2441	-2.650
	78	2480	-1.544
8DPSK	0	2402	-0.623
	39	2441	-2.477
	78	2480	-1.293

[2.4GWLAN Max Conducted Power]

Mode	Channel	Frequency(MHz)	Max Conducted Power (dBm)
IEEE 802.11b	1	2412	10.67
	6	2437	10.49
	11	2462	10.94
IEEE 802.11g	1	2412	13.64
	6	2437	13.64
	11	2462	13.86
IEEE 802.11n HT20	1	2412	11.68
	6	2437	11.63
	11	2462	12.03
IEEE 802.11n HT40	3	2422	11.73
	6	2437	11.89
	9	2452	12.04

[GSM Max Average Power]

Test Mode	Channel	Frequency (MHz)	Max Average Power (dBm)
GSM 850	Low	824.2	32.16
	Middle	836.6	32.25
	High	848.8	32.18
GSM 1900	Low	1850.2	29.36
	Middle	1880.0	29.55
	High	1909.8	29.31

[WCDMA Max Average Power]

Test Mode	Channel	Frequency (MHz)	Max Average Power (dBm)
WCDMA Band II	Low	1852.4	23.31
	Middle	1880	23.38
	High	1907.6	23.23
WCDMA Band IV	Low	1712.4	23.14
	Middle	1732.6	23.27
	High	1752.6	23.23
WCDMA Band V	Low	826.4	23.25
	Middle	836.4	23.50
	High	846.6	23.41

[LTE Max Average Power]

Test Mode		Channel	Max Average Power (dBm)
LTE	Band 2	LCH	23.43
		MCH	22.93
		HCH	22.70
	Band 4	LCH	22.96
		MCH	22.44
		HCH	23.00
	Band 5	LCH	23.40
		MCH	22.83
		HCH	23.40
	Band 7	LCH	23.08
		MCH	23.66
		HCH	22.63
	Band 12	LCH	23.47
		MCH	23.55
		HCH	23.57
	Band 13	LCH	23.22
		MCH	23.25
		HCH	23.16
	Band 17	LCH	23.59
		MCH	23.77
		HCH	23.64

7. Manufacturing Tolerance

[BT Max Conducted Power]

Test Mode	Channel	Max Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
GFSK BT LE	LCH	-0.205	-1.0±1.0
	MCH	-2.201	-2.0±1.0
	HCH	-0.894	-1.0±1.0
GFSK	LCH	-0.121	-1.0±1.0
	MCH	-2.088	-2.0±1.0
	HCH	-0.750	-1.0±1.0
$\pi/4$ DQPSK	LCH	-0.849	-1.0±1.0
	MCH	-2.650	-2.0±1.0
	HCH	-1.544	-1.0±1.0
8DPSK	LCH	-0.623	-1.0±1.0
	MCH	-2.477	-2.0±1.0
	HCH	-1.293	-1.0±1.0

[2.4GWLAN Max Conducted Power]

Test Mode	Channel	Max Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
IEEE 802.11b	LCH	10.67	10.0±1.0
	MCH	10.49	10.0±1.0
	HCH	10.94	10.0±1.0
IEEE 802.11g	LCH	13.64	13.0±1.0
	MCH	13.64	13.0±1.0
	HCH	13.86	13.0±1.0
IEEE 802.11n HT20	LCH	11.68	12.0±1.0
	MCH	11.63	12.0±1.0
	HCH	12.03	12.0±1.0
IEEE 802.11n HT40	LCH	11.73	12.0±1.0
	MCH	11.89	12.0±1.0
	HCH	12.04	12.0±1.0

[GSM Max Average Power]

Test Mode	Channel	Max Average Power (dBm)	ANT Max. Tune Up Power (dBm)
GSM 850	LCH	32.16	31.3±1.0
	MCH	32.25	31.4±1.0
	HCH	32.18	31.4±1.0
GSM 1900	LCH	29.36	29.0±1.0
	MCH	29.55	29.0±1.0
	HCH	29.31	29.0±1.0

[WCDMA Max Average Power]

Test Mode	Channel	Max Average Power (dBm)	ANT Max. Tune Up Power (dBm)
WCDMA	Band II	LCH	23.31
		MCH	23.38
		HCH	23.23
	Band IV	Low	23.14
		Middle	23.27
		High	23.23

	Band V	LCH	23.25	23.0±1.0
		MCH	23.50	23.0±1.0
		HCH	23.41	23.0±1.0

<LTE Max Average Power>

Test Mode		Channel	Max Average Power (dBm)	ANT Max. Tune Up Power (dBm)
LTE	Band 2	LCH	23.43	23.0±1.0
		MCH	22.93	23.0±1.0
		HCH	22.70	23.0±1.0
	Band 4	LCH	22.96	23.0±1.0
		MCH	22.44	23.0±1.0
		HCH	23.00	23.0±1.0
	Band 5	LCH	23.40	23.0±1.0
		MCH	22.83	23.0±1.0
		HCH	23.40	23.0±1.0
	Band 7	LCH	23.08	23.0±1.0
		MCH	23.66	23.0±1.0
		HCH	22.63	23.0±1.0
	Band 12	LCH	23.47	23.0±1.0
		MCH	23.55	23.0±1.0
		HCH	23.57	23.0±1.0
	Band 13	LCH	23.22	23.0±1.0
		MCH	23.25	23.0±1.0
		HCH	23.16	23.0±1.0
	Band 17	LCH	23.59	23.0±1.0
		MCH	23.77	23.0±1.0
		HCH	23.64	23.0±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		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
GFSK BT LE	0	1.00	2.0	1.585	0.0003	1.0
GFSK	0	1.00	2.0	1.585	0.0003	1.0
$\pi/4$ DQPSK	0	1.00	2.0	1.585	0.0003	1.0
8DPSK	0	1.00	2.0	1.585	0.0003	1.0
IEEE 802.11b	11.0	12.59	2.0	1.585	0.0040	1.0
IEEE 802.11g	14.0	25.12	2.0	1.585	0.0079	1.0
IEEE 802.11n HT20	13.0	19.95	2.0	1.585	0.0063	1.0
IEEE 802.11n HT40	13.0	19.95	2.0	1.585	0.0063	1.0

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
GSM 850	32.3	1698.24	2.0	1.585	0.5355	1.0
GSM 1900	30.0	1000.00	2.0	1.585	0.3155	1.0
WCDMA Band II	24.0	251.19	2.0	1.585	0.0792	1.0
WCDMA Band V	24.0	251.19	2.0	1.585	0.0792	1.0
LTE Band 2	24.0	251.19	3.0	1.995	0.0997	1.0

LTE Band 4	24.0	251.19	3.0	1.995	0.0997	1.0
LTE Band 5	24.0	251.19	3.0	1.995	0.0997	1.0
LTE Band 7	24.0	251.19	3.0	1.995	0.0997	1.0
LTE Band 12	24.0	251.19	3.0	1.995	0.0997	1.0
LTE Band 13	24.0	251.19	3.0	1.995	0.0997	1.0
LTE Band 17	24.0	251.19	3.0	1.995	0.0997	1.0

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 = $PG/4\pi R^2$

8.2 Simultaneous Transmission MPE

The sample support one BT&2.4G WLAN and another one LTE&WCDMA&GSM 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

Mode	$\sum$ MPE max ratios	Limit	Results
BT + GSM	0.5358	1.0	Pass
BT + WCDMA	0.0795	1.0	Pass
BT + LTE	0.10	1.0	Pass
2.4G WIFI + GSM	0.5434	1.0	Pass
2.4G WIFI + WCDMA	0.0871	1.0	Pass
2.4G WIFI + LTE	0.1076	1.0	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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