Maximum Permissible Exposure Report

1. Product Information

FCC ID	: 2APER-MV03LB
EUT	: Vehicle intelligent terminal
Test Model	: MV03
Additional Model No	: MV03LB, MV04, DS03, DS04, AD04, MV05, MV06
Model Declaration	: PCB board, structure and internal of these model(s) are the same, So no additional models were tested.
Power Supply	: Input: DC 9V~36V,2A
Hardware Version	: PCB-MV03-V13-20200617
Software Version	: MV03_lb_19103_00_system_1.4.7_user
2.4G WLAN	
Frequency Range	: 2412MHz-2462MHz
Channel Number	: 11 Channels for 20MHz bandwidth(2412~2462MHz) 7 Channels for 40MHz bandwidth(2422~2452MHz)
Channel Spacing	: 5MHz
Modulation Type	: IEEE 802.11b: DSSS(CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM,QPSK,BPSK)
Antenna Description	: External antenna, 1.1dBi(Max.)
2G	:
Support Band	: ☒ GSM 900 (EU-Band) ☒ DCS 1800 (EU-Band) ☒ GSM 850 (U.S.-Band) ☒ PCS 1900 (U.S.-Band)
Release Version	: R99
GPRS Class	: Class 12
EGPRS Class	: Class 12
Type Of Modulation	: GMSK for GSM/GPRS; GMSK,8PSK for EGPRS
Antenna Description	: External Antenna; 0.9dBi (max.) For GSM 850; 0.9dBi (max.) For PCS 1900.
3G	:
Support Band	: ☒ WCDMA Band II (U.S.-Band) ☒ WCDMA Band V (U.S.-Band) ☐ WCDMA Band IV (U.S.-Band) ☐ WCDMA Band I (EU-Band) ☐ WCDMA Band VIII (EU-Band)
Release Version	: R8

Type Of Modulation	:	WCDMA: QPSK,16QAM; HSDPA/HSUPA: QPSK,16QAM
Antenna Description	:	External Antenna; 0.9dBi (max.) For WCDMA Band II; 0.9dBi (max.) For WCDMA Band V.
LTE	:	
Support Band	:	☒ E-UTRA Band 2(U.S.-Band) ☒ E-UTRA Band 3(Not U.S.-Band) ☒ E-UTRA Band 4(U.S.-Band) ☒ E-UTRA Band 5(U.S.-Band) ☒ E-UTRA Band 7(U.S.-Band) ☒ E-UTRA Band 28(Not U.S.-Band)
LTE Release Version	:	R13
Type Of Modulation	:	QPSK/16QAM
Antenna Description	:	External Antenna; 0.9dBi (max.) For E-UTRA Band 2; 1.0dBi (max.) For E-UTRA Band 4; 0.9dBi (max.) For E-UTRA Band 5; 0.8dBi (max.) For E-UTRA Band 7;
Power Class	:	Class 3
GPS Receiver	:	
Receive Frequency	:	1575.42MHz
Channel Number	:	1
Exposure category	:	General population/uncontrolled environment
EUT Type	:	Production Unit
Device Type	:	Fixed 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/cm²)	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/f²)*	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/cm²)	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/f²)*	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

Shenzhen Tensor Technology Co., LTD can only use antennas certificated as follows provided by manufacturer;

Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Notes
External Antenna	2400 MHz – 2500 MHz	1.1 dBi	WLAN ANT
External Antenna	1850~1910 MHz	0.9 dBi	GSM/WCDMA/LTE Main ANT
External Antenna	1710~1755 MHz	1.0dBi	LTE Main ANT
External Antenna	824~849 MHz	0.9dBi	GSM/WCDMA/LTE Main ANT
External Antenna	2500~2570 MHz	0.8dBi	LTE Main ANT

6. Conducted Power

[WIFI Max Peak Conducted Power]

Mode	Channel	Meas.Level [dBm]	Limit [dBm]	Verdict
11B	LCH	16.16	30	PASS
	MCH	16.02	30	PASS
	HCH	16.33	30	PASS
11G	LCH	14.75	30	PASS
	MCH	15.04	30	PASS
	HCH	15.33	30	PASS
11N20SISO	LCH	14.29	30	PASS
	MCH	14.70	30	PASS
	HCH	15.00	30	PASS
11N40SISO	LCH	16.20	30	PASS
	MCH	16.39	30	PASS
	HCH	**16.72**	30	PASS

[GSM Max Average Power]

Test Mode	Channel	Frequency (MHz)	Max Average Power (dBm)
PCS 1900	Low	1850.2	29.52
	Middle	1880.0	29.36
	High	1909.8	29.43
GSM 850	Low	824.2	32.75
	Middle	836.6	32.42
	High	848.8	32.36

[WCDMA Max Average Power]

Test Mode	Channel	Frequency (MHz)	Max Average Power (dBm)
WCDMA Band II	Low	1852.4	23.41
	Middle	1880.0	23.74
	High	1907.6	23.41
WCDMA Band V	Low	826.4	23.44
	Middle	836.4	23.36
	High	846.6	23.74

[LTE Max Average Power]

Test Mode		Channel	Max Average Power (dBm)
LTE	Band 2	LCH	23.20
		MCH	23.07
		HCH	23.14
	Band 4	LCH	23.91
		MCH	23.70
		HCH	23.82
	Band 5	LCH	22.85
		MCH	23.55
		HCH	23.51
	Band 7	LCH	24.26
		MCH	24.62
		HCH	24.26

7. Manufacturing Tolerance

[WIFI Max Conducted Power]

Test Mode	Channel	Max Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
WIFI	B	16.33	16.0±1.0
	G	15.33	15.0±1.0
	N 20	15.00	15.0±1.0
	N 40	16.72	16.0±1.0

[GSMMax Average Power]

Test Mode	Channel	Max Average Power (dBm)	ANT Max. Tune Up Power (dBm)
PCS1900	LCH	29.52	29.0±1.0
	MCH	29.36	29.0±1.0
	HCH	29.43	29.0±1.0
GSM850	LCH	32.75	32.0±1.0
	MCH	32.42	32.0±1.0

	HCH	32.36	32.0±1.0

[WCDMA Max Average Power]

Test Mode		Channel	Max Average Power (dBm)	ANT Max. Tune Up Power (dBm)
WCDMA	Band II	LCH	23.41	23.0±1.0
		MCH	23.74	23.0±1.0
		HCH	23.41	23.0±1.0
	Band V	LCH	23.44	23.0±1.0
		MCH	23.36	23.0±1.0
		HCH	23.74	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	23.20	23.0±1.0
		MCH	23.07	23.0±1.0
		HCH	23.14	23.0±1.0
	Band 4	LCH	23.91	23.0±1.0
		MCH	23.70	23.0±1.0
		HCH	23.82	23.0±1.0
	Band 5	LCH	22.85	22.0±1.0
		MCH	23.55	23.0±1.0
		HCH	23.51	23.0±1.0
	Band 7	LCH	24.26	24.0±1.0
		MCH	24.62	24.0±1.0
		HCH	24.26	24.0±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 =20cm, 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				
WLAN	17.0	50.1187	1.1	1.2882	0.0128	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	33.0	1995.2623	0.9	1.2303	0.4883	0.55
PCS1900	30.0	1000.0000	0.9	1.2303	0.2448	1.0
WCDMA Band II	24.0	251.1886	0.9	1.2303	0.0615	1.0
WCDMA Band V	24.0	251.1886	0.9	1.2303	0.0615	0.55
LTE Band 2	24.0	251.1886	0.9	1.2303	0.0615	1.0
LTE Band 4	24.0	251.1886	1.0	1.2589	0.0629	1.0
LTE Band 5	24.0	251.1886	0.9	1.2303	0.0615	0.55
LTE Band 7	25.0	316.2278	0.8	1.2023	0.0756	1.0

Remark:
1. Output power including turn-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer;
3. We choose the lowest frequency operate to calculate MPE limit as higher frequency will have higher MPE limits;
4. MPE values = $PG/4\pi R^2$.

8.2 Simultaneous Transmission MPE

The sample support two WIFI Antenna and another one GSM&&WCDMA& LTE transmit antenna, so need consider simultaneous transmission;
Simultaneous transmission MPE
According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;
∑of MPE ratios ≤ 1.0

Mode	∑ MPE max ratios	Limit	Results
WIFI + GSM	0.901	1.0	Pass
WIFI + WCDMA	0.125	1.0	Pass
WIFI + LTE	0.125	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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