



Maximum Permissible Exposure Report

1. Product Information

FCC ID	: 2A54OSTMLT01
EUT	: Scorpion M Series Tracking System
Test Model	: STMLT01
Additional Model No.	: STM01,STMTR01,STM02, DTSTM01,DTSTM02
Model Declaration	: PCB board, structure and internal of these model(s) are the same, So no additional models were tested
Power Supply	: Input: DC 12V DC 3.7V by Rechargeable Li-ion Battery, 1050mAh
Hardware Version	: V0208
Software Version	: V0220, Boot v8
Bluetooth	:
Frequency Range	: 2402MHz ~ 2480MHz
Channel Number	: 40 channels for Bluetooth V5.0 (DTS)
Channel Spacing	: 2MHz for Bluetooth V5.0 (DTS)
Modulation Type	: GFSK for Bluetooth V5.0 (DTS)
Bluetooth Version	: V5.0
Antenna Description	: Internal Antenna, 3.5dBi(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 GPRS;GMSK/8PSK for EGPRS
Antenna Description	: Internal Antenna 1.9dBi (max.) For GSM 850 3.0dBi (max.) For PCS 1900
CatM1	:
Support Band	: ☒ CatM1 Band 2(U.S.-Band) ☒ CatM1 Band 4(U.S.-Band) ☒ CatM1 Band 5(U.S.-Band) ☒ CatM1 Band 12(U.S.-Band) ☒ CatM1 Band 13(U.S.-Band)
Release Version	: R13
Type Of Modulation	: QPSK/16QAM



Antenna Description : Internal Antenna
3.0dBi (max.) For CatM1 Band 2
3.0dBi (max.) For CatM1 Band 4
1.9dBi (max.) For CatM1 Band 5
1.9dBi (max.) For CatM1 Band 12
1.9dBi (max.) For CatM1 Band 13

Power Class : Class 3

GPS function : Support and only RX

Extreme temp. : -30°C to +50°C

Tolerance

Extreme vol. Limits : 3.3VDC to 4.2VDC (nominal: 3.7VDC)

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

Only use antennas certificated as follows provided by manufacturer;

Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Notes
Internal Antenna	2400 MHz – 2500 MHz	3.5dBi	BT ANT
Internal Antenna	1850-1910 MHz	3.0dBi	CatM1 ANT
Internal Antenna	1710-1755 MHz	3.0dBi	CatM1 ANT
Internal Antenna	824-849 MHz	1.9dBi	CatM1 ANT
Internal Antenna	699-716 MHz	1.9dBi	CatM1 ANT
Internal Antenna	777-787 MHz	1.9dBi	CatM1 ANT

6. Conducted Power

TestMode	Channel	Result[dBm]
BLE_2M	2402	5.23
	2440	6.8
	2480	4.96

[GSM Max Average Power]

Test Mode	Channel	Frequency (MHz)	Max Average Power (dBm)
PCS 1900	Low	1850.2	29.55
	Middle	1880.0	29.57
	High	1909.8	29.51
GSM 850	Low	824.2	32.52
	Middle	836.6	32.55
	High	848.8	32.50



[CatM1 Max Average Power]

Test Mode		Max Average Power (dBm)
CatM1	Band 2	23.94
	Band 4	22.87
	Band 5	20.86
	Band 12	21.43
	Band 13	21.67

7. Manufacturing Tolerance

[BLE Max Conducted Power]

Test Mode	Channel	Max Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
BLE_2M	2402	5.23	5.0±1.0
	2440	6.8	6.0±1.0
	2480	4.96	4.0±1.0

[GSM Max Average Power]

Test Mode	Channel	Max Average Power (dBm)	ANT Max. Tune Up Power (dBm)
PCS1900	LCH	29.55	29.0±1.0
	MCH	29.57	29.0±1.0
	HCH	29.51	29.0±1.0
GSM850	LCH	32.52	32.0±1.0
	MCH	32.55	32.0±1.0
	HCH	32.50	32.0±1.0

< CatM1 Max Average Power >

Test Mode		Max Average Power (dBm)	ANT Max. Tune Up Power (dBm)
CatM1	Band 2	23.94	23.0±1.0
	Band 4	22.87	22.0±1.0
	Band 5	20.86	20.0±1.0
	Band 12	21.43	21.0±1.0
	Band 13	21.67	21.0±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				
BT	7.0	5.0119	3.5	2.2387	0.0022	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	23.97	249.4595	1.9	1.5488	0.0769	0.55
PCS1900	20.97	125.0259	3.0	1.9953	0.0496	1.0
CatM1 Band 2	24.0	251.1886	3.0	1.9953	0.0997	1.0
CatM1 Band 4	23.0	199.5262	3.0	1.9953	0.0792	1.0
CatM1 Band 5	21.0	125.8925	1.9	1.5488	0.0388	0.55
CatM1 Band 12	22.0	158.4893	1.9	1.5488	0.0488	0.47
CatM1 Band 13	22.0	158.4893	1.9	1.5488	0.0488	0.52

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 = $PG/4\pi R^2$.
5. For GSM, Duty cycle=1/8.

8.2 Simultaneous Transmission MPE

The sample support two BLE Antenna and another one GSM&CatM1 transmit antenna, so need consider simultaneous transmission;

Simultaneous transmission MPE

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

Σ of MPE ratios ≤ 1.0

Mode	Σ MPE max ratios	Limit	Results
BLE + GSM850	0.1560	1.0	Pass
BLE + CatM1 Band 2	0.1019	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.

-----THE END OF REPORT-----