

Maximum Permissible Exposure Report

1. Product Information

EUT : GNSS RECEIVER

Test Model : NET S9

Additional Model No. : T9,T9 pro,R1,RENO 1,C8,G2,G9,K1 pro,K2 pro,K3 pro,K58plus,K8c,RDM10,C8c,T8c,NET S10-mini,R10mini,T8S,K8S,C10,H6,H6plus,NET S9(C),NET S9(T),NET S10,NET S10(C),NET S10(T) ,NET S11,NET S11(C),NET S11(T) ,NET S12,NET S12(C),NET S12(T) ,NET S13,NET S13(C),NET S13(T),MR1,MR2,MR3,MR4,MR5,MR6,MR7,MR8,MR9,MR10,MR11,MR12,MR13

Model Declaration : PCB board, structure and internal of these model(s) are the same, So no additional models were tested

Power Supply : DC 7.4V by Rechargeable Li-ion Battery(13AH)
Recharged by 18.0V=2000mA From Adapter

Hardware Version : SIRIUS500

Software Version : 1.09.200703.R4A5GL

Bluetooth

Frequency Range : 2402MHz ~ 2480MHz

Bluetooth Version : V4.2

Channel Number : 79 channels for Bluetooth V4.2(BDR/EDR)
40 channels for Bluetooth V4.2(BT LE)

Channel Spacing : 1MHz for Bluetooth V4.2(BDR/EDR)
2MHz for Bluetooth V4.2(BT LE)

Modulation Type : GFSK, $\pi/4$ -DQPSK, 8-DPSK for Bluetooth V4.2(BDR/EDR)
GFSK for Bluetooth V4.2(BT LE)

Antenna Description : Internal Antenna, 2.0dBi(Max.)

WIFI(2.4G Band)

Frequency Range : 2412MHz ~ 2462MHz

Channel Spacing : 5MHz

Channel Number : 11 Channel for 20MHz bandwidth(2412~2462MHz)

Modulation Type : 802.11b: DSSS; 802.11g/n: OFDM

Antenna Description : Internal Antenna, 2.0dBi(Max.)

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: BPSK,QPSK,16QAM;
HSDPA/HSUPA:BPSK,QPSK,16QAMAntenna Description : Internal Antenna
6dBi (max.) For WCDMA Band V**LTE**Support Band : ☒ E-UTRA Band 5(U.S.-Band)
☒ E-UTRA Band 7(U.S.-Band)
☒ E-UTRA Band 38(U.S.-Band)
☒ E-UTRA Band 41(U.S.-Band)

LTE Release Version : R9

Type Of Modulation : QPSK/16QAM

Antenna Description : Internal Antenna
6dBi (max.) For E-UTRA Band 5
6dBi (max.) For E-UTRA Band 7
6dBi (max.) For E-UTRA Band 38
6dBi (max.) For E-UTRA Band 41

Power Class : Class 12

GPS function : Support and only RX

Extreme temp. Tolerance : -30°C to +50°C

Extreme vol. Limits : 6.6VDC to 8.4VDC (nominal: 7.4VDC)

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

South Surveying & Mapping 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
Internal Antenna	2400 MHz – 2500 MHz	2.0 dBi	BT/WLAN ANT
Internal Antenna	824~849 MHz	6.0 dBi	WCDMA/LTE Main ANT
Internal Antenna	2500~2570 MHz	6.0 dBi	LTE Main ANT
Internal Antenna	2570~2620 MHz	6.0 dBi	LTE Main ANT
Internal Antenna	2496~2690 MHz	6.0 dBi	LTE Main ANT

6. Conducted Power

[BT Max Peak Conducted Power]

Mode	Channel.	Maximum Peak Output Power [dBm]	Limit [dBm]	Verdict
GFSK	LCH	1.876	21	PASS
	MCH	0.984	21	PASS
	HCH	-0.240	21	PASS
$\pi/4$ DQPSK	LCH	4.133	21	PASS
	MCH	3.227	21	PASS
	HCH	1.966	21	PASS
8DPSK	LCH	4.587	21	PASS
	MCH	3.708	21	PASS
	HCH	2.427	21	PASS

[BLE Max Peak Conducted Power]

Mode	Channel	Conduct Peak Power[dBm]	Limit [dBm]	Verdict
BT LE	LCH	1.704	30	PASS
BT LE	MCH	0.88	30	PASS
BT LE	HCH	-0.39	30	PASS

[2.4GWIFI Max Peak Conducted Power]

Mode	Channel	Meas.Level [dBm]	Limit [dBm]	Verdict
11B	LCH	13.05	30	PASS
	MCH	13.55	30	PASS
	HCH	12.82	30	PASS
11G	LCH	12.68	30	PASS
	MCH	12.88	30	PASS
	HCH	12.04	30	PASS
11N20SISO	LCH	10.45	30	PASS
	MCH	10.87	30	PASS
	HCH	10.43	30	PASS

[WCDMA Max Average Power]

Test Mode	Channel	Frequency (MHz)	Max Average Power (dBm)
WCDMA Band V	Low	826.4	23.22
	Middle	836.4	23.43
	High	846.6	23.19

[LTE Max Average Power]

Test Mode		Channel	Max Average Power (dBm)
LTE	Band 5	LCH	21.00
		MCH	21.00
		HCH	21.00
	Band 7	LCH	21.35
		MCH	22.70
		HCH	21.82
	Band 38	LCH	23.63
		MCH	23.15
		HCH	23.82
	Band 41	LCH	24.13
		MCH	24.02
		HCH	23.85

7. Manufacturing Tolerance

BT			
GFSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	1.0	1.0	0.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
$\pi/4$ DQPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	4.0	3.0	2.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
8DPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	4.0	3.0	2.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

BT LE			
GFSK – BT LE (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	1.0	0.0	0.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

2.4GWIFI			
11B (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	13.0	13.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11G (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
11N20SISO (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	10.0	10.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

[WCDMA Max Average Power]

Test Mode		Channel	Max Average Power (dBm)	ANT Max. Tune Up Power (dBm)
WCDMA	Band V	LCH	23.22	23.0 $\pm$ 1.0
		MCH	23.43	23.0 $\pm$ 1.0
		HCH	23.19	23.0 $\pm$ 1.0

<LTE Max Average Power>

Test Mode		Channel	Max Average Power (dBm)	ANT Max. Tune Up Power (dBm)
LTE	Band 5	LCH	21.00	21.0 $\pm$ 1.0
		MCH	21.00	21.0 $\pm$ 1.0
		HCH	21.00	21.0 $\pm$ 1.0
	Band 7	LCH	21.35	21.0 $\pm$ 1.0
		MCH	22.70	22.0 $\pm$ 1.0
		HCH	21.82	21.0 $\pm$ 1.0
	Band 38	LCH	23.63	23.0 $\pm$ 1.0
		MCH	23.15	23.0 $\pm$ 1.0
		HCH	23.82	23.0 $\pm$ 1.0

	Band 41	LCH	24.13	24.0±1.0
		MCH	24.02	24.0±1.0
		HCH	23.85	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				
BT	5.0	3.1623	2.0	1.5849	0.0010	1.0

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
BLE	2.0	1.5849	2.0	1.5849	0.0005	1.0

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
2.4G WLAN	14.0	25.1189	2.0	1.5849	0.0079	1.0

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
WCDMA Band V	24.0	251.1886	6.0	3.9811	0.1989	0.55
LTE Band 5	22.0	158.4893	6.0	3.9811	0.1255	0.55
LTE Band 7	23.0	199.5262	6.0	3.9811	0.1580	1.0
LTE Band 38	24.0	251.1886	6.0	3.9811	0.1989	1.0
LTE Band 41	25.0	316.2278	6.0	3.9811	0.2505	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. $MPE \text{ values} = PG/4\pi R^2$.

8.2 Simultaneous Transmission MPE

The sample BT/ WIFI Antenna and another one 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;

Σ of MPE ratios ≤ 1.0

Mode	Σ MPE max ratios	Limit	Results
WIFI + WCDMA	0.370	1.0	Pass
WIFI + LTE	0.258	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-----