

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-----