

# RF Exposure evaluation

FCC ID: 2A29S-TCST-LVUS

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Mobile Device

## 1. Reference

According to §1.1307(b)(1), systems operating under the provisions of this 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.

According to §1.1310 and §2.1091 RF exposure is calculated.

KDB447498 D01: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies

## 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 <sup>2</sup> ) | 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 <sup>2</sup> )*              | 6                       |
| 30 – 300                                    | 61.4                         | 0.163                        | 1.0                                 | 6                       |
| 300 – 1500                                  | /                            | /                            | f/300                               | 6                       |
| 1500 – 100,000                              | /                            | /                            | 5                                   | 6                       |

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| Frequency Range(MHz)                        | Electric Field Strength(V/m) | Magnetic Field Strength(A/m) | Power Density (mW/cm <sup>2</sup> ) | 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 <sup>2</sup> )*              | 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

### 3. 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

### 4. Antenna Information

TCST-LVUS can only use antennas certificated as follows provided by manufacturer;

| Internal Identification | Antenna Identification in Internal photos | Antenna type and antenna number | Operate frequency band | Maximum antenna gain |
|-------------------------|-------------------------------------------|---------------------------------|------------------------|----------------------|
| ANT1                    | 2.4G Wifi                                 | PCB antenna                     | 2.4GHz – 2.5 GHz       | 2.5 dBi              |

### 5. Standalone MPE Result

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 is 2.5 dBi, the RF power density can be obtained.

| Modulation Type | Max tune up power tolerance(dBm) | Max Output power to antenna (mW) | Antenna Gain (Numeric) | Power Density at R=20cm (mW/cm2) | Limit (mW/cm2) | Result |
|-----------------|----------------------------------|----------------------------------|------------------------|----------------------------------|----------------|--------|
| 802.11b         | 19                               | 79.4328                          | 1.7783                 | 0.0281                           | 1.0000         | Pass   |
| 802.11g         | 22                               | 158.4893                         | 1.7783                 | 0.0561                           | 1.0000         | Pass   |
| 802.11n(HT20)   | 22                               | 158.4893                         | 1.7783                 | 0.0561                           | 1.0000         | Pass   |
| BLE             | 7.0                              | 5.0119                           | 1.7783                 | 0.0018                           | 1.0000         | Pass   |

**Manufacturing tolerance**

| <i>IEEE 802.11b</i>       |            |            |            |
|---------------------------|------------|------------|------------|
| Channel                   | Channel 01 | Channel 06 | Channel 11 |
| Target (dBm)              | 18.0       | 18.0       | 18.0       |
| Tolerance $\pm$ (dB)      | 1.0        | 1.0        | 1.0        |
| <i>IEEE 802.11g</i>       |            |            |            |
| Channel                   | Channel 01 | Channel 06 | Channel 11 |
| Target (dBm)              | 21.0       | 21.0       | 21.0       |
| Tolerance $\pm$ (dB)      | 1.0        | 1.0        | 1.0        |
| <i>IEEE 802.11n(HT20)</i> |            |            |            |
| Channel                   | Channel 01 | Channel 06 | Channel 11 |
| Target (dBm)              | 21.0       | 21.0       | 21.0       |
| Tolerance $\pm$ (dB)      | 1.0        | 1.0        | 1.0        |

| GFSK                 |            |            |            |
|----------------------|------------|------------|------------|
| Channel              | Channel 00 | Channel 19 | Channel 39 |
| Target (dBm)         | 6.0        | 6.0        | 5.0        |
| Tolerance $\pm$ (dB) | 1.0        | 1.0        | 1.0        |

**6. Simultaneous transmission**

Wifi and BLE share the same antenna and cannot transmitting at the same time, no Simultaneous transmission need considered.

**7. 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-----