

# FCC SAR Test Report

**FCC ID: 2AENAYPZNL**

**Project No.** : 1903T095  
**Equipment** : Smart Tracker By Yepzon  
**Model Name** : YPZNL  
**Applicant** : Yepzon Oy  
**Address** : Finlaysoninkuja 9, 33210 Tampere Finland

**Date of Receipt** : Mar. 25, 2019  
**Date of Test** : Mar. 26, 2019 ~ Apr. 09, 2019  
**Issued Date** : May. 09, 2019  
**Tested by** : BTL Inc.

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**Declaration**

**BTL** represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with standards traceable to international standard(s) and/or national standard(s).

**BTL's** reports apply only to the specific samples tested under conditions. It is manufacture's responsibility to ensure that additional production units of this model are manufactured with the identical electrical and mechanical components. **BTL** shall have no liability for any declarations, inferences or generalizations drawn by the client or others from **BTL** issued reports.

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**BTL's** laboratory quality assurance procedures are in compliance with the **ISO/IEC 17025** requirements, and accredited by the conformity assessment authorities listed in this test report.

**BTL** is not responsible for the sampling stage, so the results only apply to the sample as received.

The information, data and test plan are provided by manufacturer which may affect the validity of results, so it is manufacturer's responsibility to ensure that the apparatus meets the essential requirements of applied standards and in all the possible configurations as representative of its intended use.

**Limitation**

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.

Please note that the measurement uncertainty is provided for informational purpose only and are not use in determining the Pass/Fail results.

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## REPORT ISSUED HISTORY

| Report Version | Description    | Issued Date   |
|----------------|----------------|---------------|
| R00            | Original Issue | May. 09, 2019 |

## 1. GENERAL SUMMARY

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment    | Smart Tracker By Yepzon                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Brand Name   | YEPZ0N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Model Name   | YPZNLT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Manufacturer | VVDN Technologies Pvt. Ltd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Address      | B-22,Infocity Sector-34, Gurgaon-122001, Haryana,India                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Standard(s)  | <b>ANSI Std C95.1-1992</b> Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz - 300 GHz.(IEEE Std C95.1-1991)<br><br><b>IEEE Std 1528-2013</b> Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques<br><br><b>KDB447498 D01</b> General RF Exposure Guidance v06<br><b>KDB248227 D01</b> 802. 11 Wi-Fi SAR v02r02<br><b>KDB865664 D01</b> SAR measurement 100 MHz to 6 GHz v01r04<br><b>KDB865664 D02</b> SAR Reporting v01r02<br><b>KDB690783 D01</b> SAR Listings on Grants v01r03<br><b>KDB941225 D01</b> 3G SAR Procedures v03r01<br><b>KDB941225 D05</b> SAR for LTE Devices v02r05<br><b>KDB941225 D06</b> Hot Spot SAR v02r01 |

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.

The test data, data evaluation, and equipment configuration contained in our test report (Ref No. BTL-FCC SAR-1-1903T095) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of TAF according to the ISO/IEC 17025 quality assessment standard and technical standard(s).

## **2. RF EMISSIONS MEASUREMENT**

### **2.1. TEST FACILITY**

The test facilities used to collect the test data in this report is **SAR room** at the location of No. 68-1, Ln. 169, Sec.2, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan.

### **2.2. MEASUREMENT UNCERTAINTY**

Note: Per KDB865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. The equivalent ratio (1.5/1.6) is applied to extremity and occupational exposure conditions.

### 3. GENERAL INFORMATION

#### 3.1. STATEMENT OF COMPLIANCE

| Equipment Class | Band    | Highest Body SAR-1g (W/kg) | NB-IOT Highest Body SAR-1g (W/kg) | LTE Cat.M1 Highest Body SAR-1g (W/kg) |
|-----------------|---------|----------------------------|-----------------------------------|---------------------------------------|
| PCE             | GSM850  | 0.699                      |                                   |                                       |
|                 | GSM1900 | 0.728                      |                                   |                                       |
|                 | LTE 2   |                            | 0.75                              | 1.273                                 |
|                 | LTE 4   |                            | 0.181                             | 0.64                                  |
|                 | LTE 12  |                            | 0.037                             | 0.264                                 |

Note:

- 1) The device is in compliance with Specific Absorption Rate(SAR)for general population uncontrolled exposure limits according to the FCC rule §2.1093, the ANSI C95.1:1992/IEEE C95.1:1991, the NCRP Report Number 86 for uncontrolled environment and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013.

### 3.2. GENERAL DESCRIPTION OF EUT

|                                    |                                                                                                                                    |                                           |           |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-----------|
| Equipment                          | Smart Tracker By Yepzon                                                                                                            |                                           |           |
| Model Name                         | YPZNLT                                                                                                                             |                                           |           |
| IMEI Code                          | 911658550000300                                                                                                                    |                                           |           |
| IMSI(DEC)                          | 001010123456789                                                                                                                    |                                           |           |
| Modulation                         | GSM(GMSK/8PSK) , LTE_Cat.M1(QPSK/16QAM) , LTE NB-Iot(BPSK_3.75KHz/QPSK_15KHz) , BT(GFSK/ $\pi$ /4-DQPSK/8-DPSK) , WiFi(DSSS/OFDM), |                                           |           |
| Operation<br>Frequency<br>Range(s) | Band                                                                                                                               | TX (MHz)                                  | RX (MHz)  |
|                                    | GSM850                                                                                                                             | 824-849                                   | 869-894   |
|                                    | GSM1900                                                                                                                            | 1850-1910                                 | 1930-1990 |
|                                    | LTE Band 2                                                                                                                         | 1850-1910                                 | 1930-1990 |
|                                    | LTE Band 4                                                                                                                         | 1710-1755                                 | 2110-2155 |
|                                    | LTE Band 12                                                                                                                        | 699-716                                   | 729-746   |
|                                    | Bluetooth                                                                                                                          | 2402-2483.5                               |           |
|                                    | WIFI 2.4G                                                                                                                          | 2412-2462                                 |           |
| Test Channels<br>(low-mid-high):   | Band                                                                                                                               | Channel                                   |           |
|                                    | GSM850                                                                                                                             | 128-188-251                               |           |
|                                    | GSM1900                                                                                                                            | 512-661-810                               |           |
|                                    | LTE Cat.M1_Band 2 BW=20MHz                                                                                                         | 18700-18900-19100                         |           |
|                                    | LTE Cat.M1_Band 4 BW=20MHz                                                                                                         | 20050-20175-20300                         |           |
|                                    | LTE Cat.M1_Band 12 BW=10MHz                                                                                                        | 23060-23095-23130                         |           |
|                                    | LTE NB-Iot_Band2 BW=15KHz                                                                                                          | 18601-18900-19199                         |           |
|                                    | LTE NB-Iot_Band4 BW=15KHz                                                                                                          | 19951-20175-20399                         |           |
|                                    | LTE NB-Iot_Band12 BW=15KHz                                                                                                         | 23011-23095-23179                         |           |
|                                    | WIFI 2.4G                                                                                                                          | 1-6-11                                    |           |
| BLE                                | 0-19-39                                                                                                                            |                                           |           |
| Other Information                  |                                                                                                                                    |                                           |           |
| Battery                            | Model                                                                                                                              | BZ502435                                  |           |
|                                    | Capacitance                                                                                                                        | 450mAh                                    |           |
|                                    | Rated Voltage                                                                                                                      | 3.7V                                      |           |
|                                    | Manufacturer                                                                                                                       | Shenzhen Benzo Energy Technology Co.,Ltd. |           |

| Antenna Information |       |      |             |           |
|---------------------|-------|------|-------------|-----------|
| Brand               | Model | Type | Band        | Gain(dBi) |
| Pulse               | NBLT  | PCB  | GSM850      | -7.27     |
|                     |       |      | GSM1900     | -4.45     |
|                     |       |      | LTE Band 2  | -4.45     |
|                     |       |      | LTE Band 4  | -0.24     |
|                     |       |      | LTE Band 12 | -6.70     |
|                     |       |      | Bluetooth   | -0.16     |
|                     |       |      | WIFI 2.4G   | -0.24     |

### 3.3. LABORATORY ENVIRONMENT

|                                                                                                                                                                                                 |                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Temperature                                                                                                                                                                                     | Min. = 18°C, Max. = 25°C |
| Relative humidity                                                                                                                                                                               | Min. = 30%, Max. = 70%   |
| Ground system resistance                                                                                                                                                                        | < 0.5Ω                   |
| Ambient noise is checked and found very low and in compliance with requirement of standards.<br>Reflection of surrounding objects is minimized and in compliance with requirement of standards. |                          |

### 3.4. MAIN TEST INSTRUMENTS

| Item | Equipment                    | Manufacturer  | Model                 | Serial No. | Cal. Date     | Cal. Interval |
|------|------------------------------|---------------|-----------------------|------------|---------------|---------------|
| 1    | Data Acquisition Electronics | Speag         | DAE4                  | 1486       | Sep. 18, 2018 | 1 Year        |
| 2    | Data Acquisition Electronics | Speag         | DAE4                  | 1561       | Nov. 07, 2018 | 1 Year        |
| 3    | E-field Probe                | Speag         | EX3DV4                | 7520       | Nov. 05, 2018 | 1 Year        |
| 4    | E-field Probe                | Speag         | EX3DV4                | 3901       | Sep. 27, 2018 | 1 Year        |
| 5    | System Validation Dipole     | Speag         | D750V3                | 1095       | Jun. 05, 2018 | 3 Year        |
| 6    | System Validation Dipole     | Speag         | D835V2                | 4d160      | Jun. 05, 2018 | 3 Year        |
| 7    | System Validation Dipole     | Speag         | D1750V2               | 1101       | Jun. 07, 2018 | 3 Year        |
| 8    | System Validation Dipole     | Speag         | D1900V2               | 5d179      | Jun. 07, 2018 | 3 Year        |
| 9    | Twin Sam Phantom             | Speag         | Twin Sam Phantom V5.0 | 1897       | N/A           | N/A           |
| 10   | Radio Communication Analyzer | Anritsu       | MT8821C               | 6261935354 | Feb. 28, 2019 | 1 Year        |
| 11   | Power Meter                  | Anritsu       | ML2495A               | 1128008    | Dec. 06, 2018 | 1 Year        |
| 12   | Power Sensor                 | Anritsu       | MA2411B               | 1126001    | Dec. 06, 2018 | 1 Year        |
| 13   | Power Meter                  | Keysight      | 8990B                 | MY5100051  | Aug. 17, 2018 | 1 Year        |
| 14   | Power Sensor                 | Keysight      | N1923A                | MY58310005 | Aug. 09, 2018 | 1 Year        |
| 15   | ENA Network Analyzer         | Agilent       | E5071C                | MY46524658 | Mar. 16, 2019 | 1 Year        |
| 16   | Signal Generator             | R&S           | SMR40                 | 100502     | Jun. 03, 2019 | 1 Year        |
| 17   | Dielectric Probe Kit         | Agilent       | 85070E                | 2593       | N/A           | N/A           |
| 18   | Low pass filter              | Mini-Circuits | SLP-2950+             | M108294    | N/A           | N/A           |
| 19   | Power Amplifier              | Mini-Circuits | ZVE-2W-272+           | N650001538 | N/A           | N/A           |
| 20   | Power Amplifier              | Mini-Circuits | ZVE-8G+               | N628801631 | N/A           | N/A           |
| 21   | Dielectric Probe Kit         | Agilent       | 85070E                | 2593       | N/A           | N/A           |
| 22   | Dielectric Probe Kit         | Agilent       | 85070E                | 2593       | N/A           | N/A           |

Note:

1. "N/A" denotes no model name, serial No. or calibration specified.
2. \* These test equipments have been recalibrated between the test periods. All these test equipments were within the valid period when the tests were performed.
3. 1) Per KDB865664 D01 requirements for dipole calibration, the test laboratory has adopted three-year extended calibration interval. Each measured dipole is expected to evaluate with the following criteria at least on annual interval in Appendix C.
  - a) There is no physical damage on the dipole;
  - b) System check with specific dipole is within 10% of calibrated value;
  - c) The most recent return-loss result, measured at least annually, deviates by no more than 20% from the previous measurement;
  - d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the previous measurement.
- 2) Network analyzer probe calibration against air, distilled water and a short block performed before measuring liquid parameters.

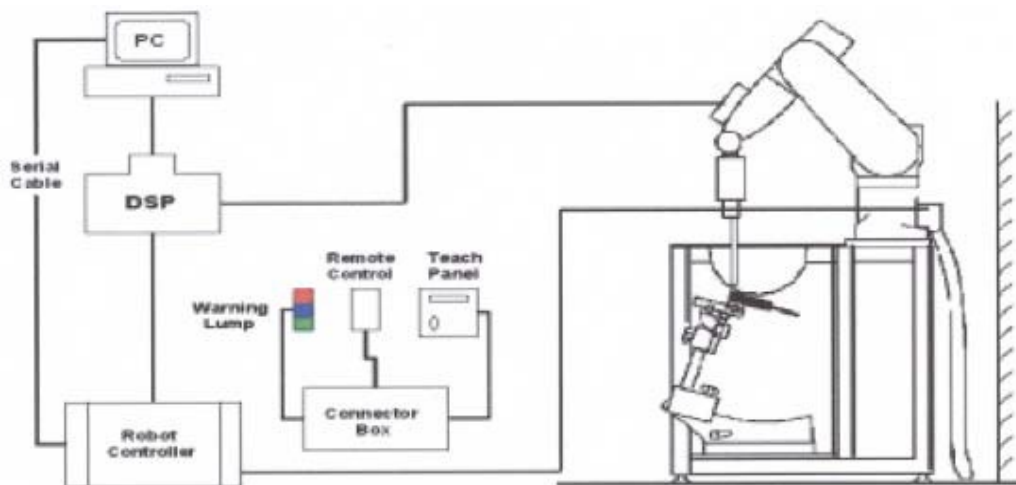
## 4. SAR MEASUREMENTS SYSTEM CONFIGURATION

### 4.1. SAR MEASUREMENT SET-UP

The DASY5 system for performing compliance tests consists of the following items:

1. A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
2. A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
3. A data acquisition electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
4. A unit to operate the optical surface detector which is connected to the EOC.
5. The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.
6. The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows.
7. DASY5 software and SEMCAD data evaluation software.
8. Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
9. The generic twin phantom enabling the testing of left-hand and right-hand usage.
10. The device holder for handheld mobile phones.
11. Tissue simulating liquid mixed according to the given recipes.
12. System validation dipoles allowing to validate the proper functioning of the system.

#### 4.1.1. TEST SETUP LAYOUT

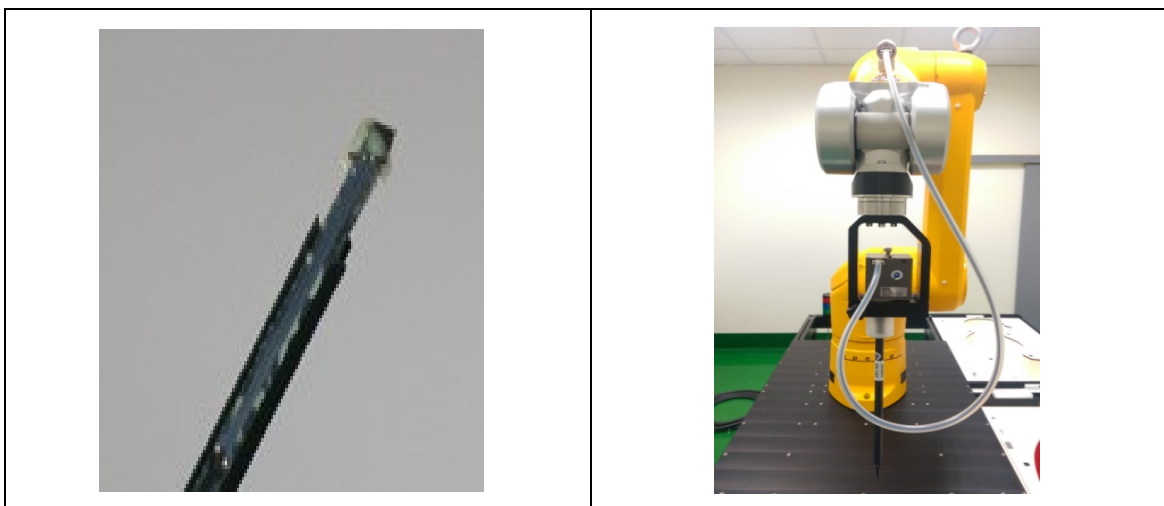


## 4.2. DASY5 E-FIELD PROBE SYSTEM

The SAR measurements were conducted with the dosimetric probe EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

### 4.2.1. EX3DV4 PROBE SPECIFICATION

|               |                                                                                                                                                                           |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Construction  | Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| Calibration   | ISO/IEC 17025 calibration service available                                                                                                                               |
| Frequency     | 10 MHz to 6 GHz<br>Linearity: $\pm 0.2$ dB (30 MHz to 6 GHz)                                                                                                              |
| Directivity   | $\pm 0.3$ dB in HSL (rotation around probe axis)<br>$\pm 0.5$ dB in tissue material (rotation normal to probe axis)                                                       |
| Dynamic Range | 10 $\mu$ W/g to $> 100$ mW/g<br>Linearity: $\pm 0.2$ dB                                                                                                                   |
| Dimensions    | Overall length: 330 mm (Tip: 20 mm)<br>Tip diameter: 2.5 mm (Body: 12 mm) Distance from probe tip to dipole centers: 1.0 mm                                               |



EX3DV4 E-field Probe

#### 4.2.2. E-FIELD PROBE CALIBRATION

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than  $\pm 10\%$ . The spherical isotropy was evaluated and found to be better than  $\pm 0.25\text{dB}$ . The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a wave guide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$\text{SAR} = C \frac{\Delta T}{\Delta t}$$

Where:  $\Delta t$  = Exposure time (30 seconds),

C = Heat capacity of tissue (brain or muscle),

$\Delta T$  = Temperature increase due to RF exposure.

Or 
$$\text{SAR} = \frac{|E|^2 \sigma}{\rho}$$

Where:  $\sigma$  = Simulated tissue conductivity,

$\rho$  = Tissue density ( $\text{kg/m}^3$ ).

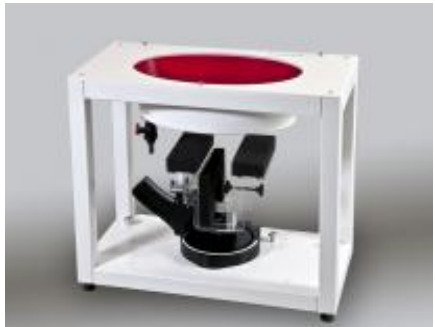
### 4.2.3. OTHER TEST EQUIPMENT

#### 4.2.3.1. Device Holder for Transmitters

**Construction:** Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices (e.g., laptops, cameras, etc.) It is light weight and fits easily on the upper part of the Mounting Device in place of the phone positioner. The extension is fully compatible with the Twin SAM, ELI4 and SAM v6.0 Phantoms.

**Material:** POM, Acrylic glass, Foam

#### 4.2.3.2 Phantom

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                    |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Model           | ELI4 Phantom                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |
| Construction    | Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles. |                                                                                    |
| Shell Thickness | 2±0.1 mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                    |
| Filling Volume  | Approx. 30 liters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                    |
| Dimensions      | Length: 600 mm ; Width: 190mm<br>Height: adjustable feet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                    |
| Available       | Special                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                    |

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                      |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Model           | Twin SAM                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| Construction    | The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot. |                                                                                      |
| Shell Thickness | 2 ± 0.2 mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                      |
| Filling Volume  | Approx. 25 liters                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                      |
| Dimensions      | Length: 1000mm; Width: 500mm<br>Height: adjustable feet                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                      |
| Available       | Special                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                      |

#### 4.2.4. SCANNING PROCEDURE

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max.  $\pm 5\%$ .

The “surface check” measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above  $\pm 0.1\text{mm}$ ). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within  $\pm 30^\circ$ .)

- Area Scan

The “area scan” measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strength is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The standard scan uses large grid spacing for faster measurement. Standard grid spacing for head measurements is 15 mm in x- and y- dimension ( $\leq 2\text{GHz}$ ) · 12 mm in x- and y- dimension (2-4 GHz) and 10mm in x- and y- dimension (4-6GHz). If a finer resolution is needed, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation.

- Zoom Scan

A “zoom scan” measures the field in a volume around the 2D peak SAR value acquired in the previous “coarse” scan. This is a fine grid with maximum scan spatial resolution:  $\Delta x_{\text{zoom}}, \Delta y_{\text{zoom}} \leq 2\text{GHz} - \leq 8\text{mm}$ , 2-4GHz -  $\leq 5\text{ mm}$  and 4-6 GHz -  $\leq 4\text{mm}$ ;  $\Delta z_{\text{zoom}} \leq 3\text{GHz} - \leq 5\text{ mm}$ , 3-4 GHz -  $\leq 4\text{mm}$  and 4-6GHz -  $\leq 2\text{mm}$  where the robot additionally moves the probe along the z-axis away from the bottom of the Phantom. DASY is also able to perform repeated zoom scans if more than 1 peak is found during area scan. In this document, the evaluated peak 1g and 10g averaged SAR values are shown in the 2D-graphics in Appendix B. Test results relevant for the specified standard (see chapter 1.4.) are shown in table form in chapter 7.2.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 2 mm steps. This measurement shows the continuity of the liquid and can - depending in the field strength – also show the liquid depth.

The following table summarizes the area scan and zoom scan resolutions per FCC KDB 865664D01:

| Frequency | Maximun Area Scan resolution<br>( $\Delta x_{area}$ , $\Delta y_{area}$ ) | Maximun Zoom Scan spatial resolution<br>( $\Delta x_{Zoom}$ , $\Delta y_{Zoom}$ ) | Maximun Zoom Scan spatial resolution |                        |                              | Minimum zoom scan volume<br>(x,y,z) |
|-----------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------|------------------------|------------------------------|-------------------------------------|
|           |                                                                           |                                                                                   | Uniform Grid                         | Graded Grad            |                              |                                     |
|           |                                                                           |                                                                                   | $\Delta z_{Zoom}(n)$                 | $\Delta z_{Zoom}(1)^*$ | $\Delta z_{Zoom}(n>1)^*$     |                                     |
| ≤2GHz     | ≤15mm                                                                     | ≤8mm                                                                              | ≤5mm                                 | ≤4mm                   | ≤1.5* $\Delta z_{Zoom}(n-1)$ | ≥30mm                               |
| 2-3GHz    | ≤12mm                                                                     | ≤5mm                                                                              | ≤5mm                                 | ≤4mm                   | ≤1.5* $\Delta z_{Zoom}(n-1)$ | ≥30mm                               |
| 3-4GHz    | ≤12mm                                                                     | ≤5mm                                                                              | ≤4mm                                 | ≤3mm                   | ≤1.5* $\Delta z_{Zoom}(n-1)$ | ≥28mm                               |
| 4-5GHz    | ≤10mm                                                                     | ≤4mm                                                                              | ≤3mm                                 | ≤2.5mm                 | ≤1.5* $\Delta z_{Zoom}(n-1)$ | ≥25mm                               |
| 5-6GHz    | ≤10mm                                                                     | ≤4mm                                                                              | ≤2mm                                 | ≤2mm                   | ≤1.5* $\Delta z_{Zoom}(n-1)$ | ≥22mm                               |

#### 4.2.5. SPATIAL PEAK SAR EVALUATION

The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The basis of the evaluation are the SAR values measured at the points of the fine cube grid consisting of 5 x 5 x 7 points( with 8mm horizontal resolution) or 7 x 7 x 7 points( with 5mm horizontal resolution) or 8 x 8 x 7 points( with 4mm horizontal resolution). The algorithm that finds the maximal averaged volume is separated into three different stages.

- The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting "Graph Evaluated".
- The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.
- All neighboring volumes are evaluated until no neighboring volume with a higher average value is found.

#### Extrapolation

The extrapolation is based on a least square algorithm [W. Gander, Computer mathematic, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

#### Interpolation

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computer mathematic, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff].

#### Volume Averaging

At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

#### Advanced Extrapolation

DASY5 uses the advanced extrapolation option which is able to compensate boundary effects on E-field probes.

## **4.2.6. DATA STORAGE AND EVALUATION**

### **4.2.6.1 Data Storage**

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension "DAE4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm<sup>2</sup>], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

#### 4.2.7. DATA EVALUATION BY SEMCAD

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

|                    |                         |                                       |
|--------------------|-------------------------|---------------------------------------|
| Probe parameters:  | Sensitivity             | Normi, $a_{i0}$ , $a_{i1}$ , $a_{i2}$ |
|                    | Conversion factor       | ConvF <sub>i</sub>                    |
|                    | Diode compression point | Dcp <sub>i</sub>                      |
| Device parameters: | Frequency               | f                                     |
|                    | Crest factor            | cf                                    |
| Media parameters:  | Conductivity            | .                                     |
|                    | Density                 | .                                     |

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multi meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot cf / dcp_i$$

|      |                                            |                  |
|------|--------------------------------------------|------------------|
| With | $V_i$ = compensated signal of channel i    | ( i = x, y, z )  |
|      | $U_i$ = input signal of channel i          | ( i = x, y, z )  |
|      | cf = crest factor of exciting field        | (DASY parameter) |
|      | dcp <sub>i</sub> = diode compression point | (DASY parameter) |

From the compensated input signals the primary field data for each channel can be evaluated:

$$\text{E-field probes: } E_i = ( V_i / \text{Norm}_i \cdot \text{ConvF} )^{1/2}$$

$$\text{H-field probes: } H_i = ( V_i )^{1/2} \cdot ( a_{i0} + a_{i1} f + a_{i2} f^2 ) / f$$

With  $V_i$  = compensated signal of channel i ( i = x, y, z )

$\text{Norm}_i$  = sensor sensitivity of channel i ( i = x, y, z )  
[mV/(V/m)<sup>2</sup>] for E-field Probes

$\text{ConvF}$  = sensitivity enhancement in solution

$a_{ij}$  = sensor sensitivity factors for H-field probes

$f$  = carrier frequency [GHz]

$E_i$  = electric field strength of channel i in V/m

$H_i$  = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{\text{tot}} = (E_x^2 + E_y^2 + E_z^2)^{1/2}$$

The primary field data are used to calculate the derived field units.

$$\text{SAR} = (E_{\text{tot}})^2 \cdot \sigma / (\rho \cdot 1000)$$

With  $\text{SAR}$  = local specific absorption rate in mW/g

$E_{\text{tot}}$  = total field strength in V/m

= conductivity in [mho/m] or [Siemens/m]

= equivalent tissue density in g/cm<sup>3</sup>

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{\text{pwe}} = E_{\text{tot}}^2 / 3770 \text{ or } P_{\text{pwe}} = H_{\text{tot}}^2 \cdot 37.7$$

With  $P_{\text{pwe}}$  = equivalent power density of a plane wave in mW/cm<sup>2</sup>

$E_{\text{tot}}$  = total field strength in V/m

$H_{\text{tot}}$  = total magnetic field strength in A/m

## 5. SYSTEM VERIFICATION PROCEDURE

### 5.1. TISSUE VERIFICATION

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine if the dielectric parameters are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within  $\pm 5\%$  of the target values.

The following materials are used for producing the tissue-equivalent materials.

| Tissue Type | Bactericide | DGBE | HEC | NaCl | Sucrose | Triton X-100 | Water | Diethylene Glycol Mono-hexylether |
|-------------|-------------|------|-----|------|---------|--------------|-------|-----------------------------------|
| Body 750    | 0.2         | -    | 0.2 | 0.8  | 48.8    | -            | 50.0  | -                                 |
| Body 835    | 0.2         | -    | 0.2 | 0.9  | 48.5    | -            | 50.2  | -                                 |
| Body 1750   | -           | 31.0 | -   | 0.2  | -       | -            | 68.8  | -                                 |
| Body 1900   | -           | 29.5 | -   | 0.3  | -       | -            | 70.2  | -                                 |
| Body 2000   | -           | 30.0 | -   | 0.2  | -       | -            | 69.8  | -                                 |
| Body 2450   | -           | 31.4 | -   | 0.1  | -       | -            | 68.5  | -                                 |
| Body 2600   | -           | 31.8 | -   | 0.1  | -       | -            | 68.1  | -                                 |
| Body 5G     | -           | -    | -   | -    | -       | 10.7         | 78.6  | 10.7                              |

Salt: 99+% Pure Sodium Chloride; Sugar: 98+% Pure Sucrose; Water: De-ionized, 16M + resistivity  
 HEC: Hydroxyethyl Cellulose; DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]  
 Triton X-100(ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]ether

| Tissue Verification |                 |                   |                           |                               |                                    |                                        |                                         |                                             |               |
|---------------------|-----------------|-------------------|---------------------------|-------------------------------|------------------------------------|----------------------------------------|-----------------------------------------|---------------------------------------------|---------------|
| Tissue Type         | Frequency (MHz) | Liquid Temp. (°C) | Conductivity ( $\sigma$ ) | Permittivity ( $\epsilon_r$ ) | Targeted Conductivity ( $\sigma$ ) | Targeted Permittivity ( $\epsilon_r$ ) | Deviation Conductivity ( $\sigma$ ) (%) | Deviation Permittivity ( $\epsilon_r$ ) (%) | Date          |
| Body                | 750             | 22.1              | 0.960                     | 56.483                        | 0.96                               | 55.5                                   | 0.00                                    | 1.77                                        | Apr. 08, 2019 |
| Body                | 835             | 22.0              | 0.981                     | 53.997                        | 0.97                               | 55.2                                   | 1.13                                    | -2.18                                       | Mar. 26, 2019 |
| Body                | 1750            | 22.2              | 1.487                     | 54.389                        | 1.49                               | 53.4                                   | -0.20                                   | 1.85                                        | Apr. 03, 2019 |
| Body                | 1750            | 22.1              | 1.481                     | 54.739                        | 1.49                               | 53.4                                   | -0.60                                   | 2.51                                        | Apr. 09, 2019 |
| Body                | 1900            | 22.2              | 1.558                     | 53.307                        | 1.52                               | 53.3                                   | 2.50                                    | 0.01                                        | Mar. 26, 2019 |
| Body                | 1900            | 22.5              | 1.555                     | 53.605                        | 1.52                               | 53.3                                   | 2.30                                    | 0.57                                        | Apr. 03, 2019 |

Note:

- 1) The dielectric parameters of the tissue-equivalent liquid should be measured under similar ambient conditions and within 2 °C of the conditions expected during the SAR evaluation to satisfy protocol requirements.
- 2) KDB 865664 was ensured to be applied for probe calibration frequencies greater than or equal to 50MHz of the EUT frequencies.
- 3) The above measured tissue parameters were used in the DASY software to perform interpolation via the DASY software to determine actual dielectric parameters at the test frequencies. The SAR test plots may slightly differ from the table above since the DASY rounds to three significant digits.

## 5.2. SYSTEM CHECK

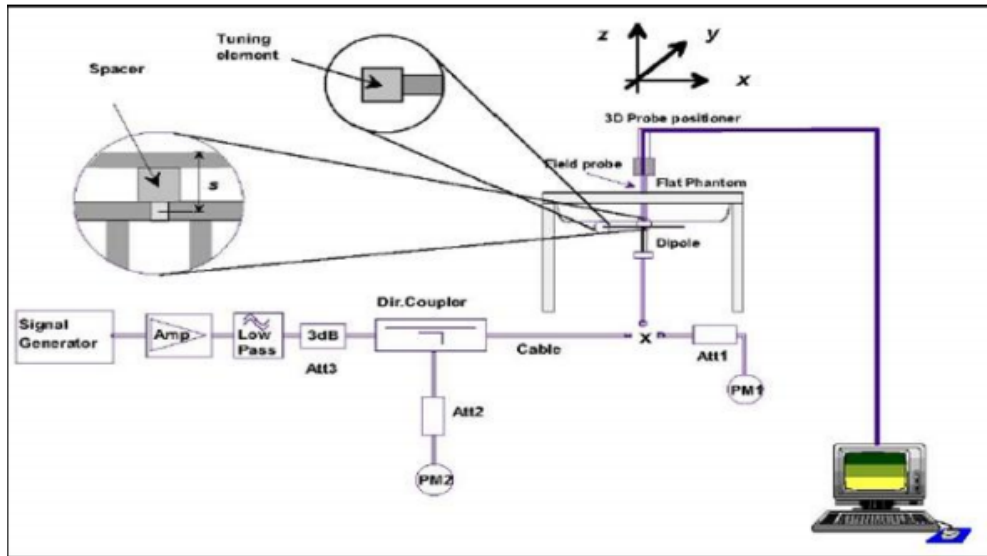
The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system check is performed with tissue equivalent material according to IEEE P1528 (described above). The following table shows system check results for all frequency bands and tissue liquids used during the tests.

| System Check | Date          | Frequency (MHz) | Targeted SAR-1g (W/kg) | Measured SAR-1g (W/kg) | normalized SAR-1g (W/kg) | Deviation (%) | Dipole S/N |
|--------------|---------------|-----------------|------------------------|------------------------|--------------------------|---------------|------------|
| Body         | Apr. 08, 2019 | 750             | 8.51                   | 2.20                   | 8.80                     | 3.41          | 1095       |
| Body         | Mar. 26, 2019 | 835             | 9.53                   | 2.50                   | 10.00                    | 4.93          | 4d160      |
| Body         | Apr. 03, 2019 | 1750            | 37.40                  | 9.76                   | 39.04                    | 4.39          | 1101       |
| Body         | Apr. 09, 2019 | 1750            | 37.40                  | 9.74                   | 38.96                    | 4.17          | 1101       |
| Body         | Mar. 26, 2019 | 1900            | 39.80                  | 9.75                   | 39.00                    | -2.01         | 5d179      |
| Body         | Apr. 03, 2019 | 1900            | 39.80                  | 10.40                  | 41.60                    | 4.52          | 5d179      |

## 5.3. SYSTEM CHECK PROCEDURE

The system check is performed by using a system check dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a plexiglass spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 250 mW(below 3GHz) or 100mW(3-6GHz). To adjust this power a power meter is used. The power sensor is connected to the cable before the system check to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the system check to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test.

System check results have to be equal or near the values determined during dipole calibration (target SAR in table above) with the relevant liquids and test system ( $\pm 10\%$ ).



## 6. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY

### 6.1. SAR MEASUREMENT VARIABILITY

Per KDB865664 D01 SAR measurement 100 MHz to 6 GHz, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. The additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

- 1) Repeated measurement is not required when the original highest measured SAR is  $< 0.80$  W/kg; steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is  $\geq 0.80$  W/kg, repeat that measurement once.
- 3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is  $> 1.20$  or when the original or repeated measurement is  $\geq 1.45$  W/kg (~ 10% from the 1-g SAR limit).
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5$  W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$ .

The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.

The detailed repeated measurement results are shown in Section 8.2.

## 7. OPERATIONAL CONDITIONS DURING TEST

### 7.1. SAR TEST CONFIGURATION

#### 7.1.1. GSM TEST CONFIGURATION

SAR tests for GSM850 and GSM1900, a communication link is set up with a base station by air link. Using 8960 Series the power lever is set to “5” and “0” in SAR of GSM850 and GSM1900. The tests in the band of GSM850 and GSM1900 are performed in the mode of GPRS/EGPRS function. Since the GPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslot is 5. The EGPRS class is 12 for this EUT, it has at most 4 timeslots in uplink, and at most 4 timeslots in downlink, the maximum total timeslot is 5.

When SAR tests for EGPRS mode is necessary, GMSK modulation should be used to minimize SAR measurement error due to higher peak-to-average power (PAR) ratios inherent in 8PSK.

According to specification 3GPP TS 51.010, the maximum power of the GSM can do the power reduction for the multi-slot.

The allowed power reduction in the multi-slot configuration is as following:

| Number of timeslots in uplink assignment |            | Reduction of maximum output power (dB) |              |               |
|------------------------------------------|------------|----------------------------------------|--------------|---------------|
| Band                                     | Time Slots | GPRS (GMSK)                            | EGPRS (GMSK) | EGPRS (8PSK ) |
| GSM850                                   | 1 TX slot  | 0.0                                    | 0.0          | 6.4           |
|                                          | 2 TX slots | 3.0                                    | 3.0          | 9.4           |
|                                          | 3 TX slots | 4.8                                    | 4.8          | 11.2          |
|                                          | 4 TX slots | 6.0                                    | 6.0          | 12.4          |
| GSM1900                                  | 1 TX slot  | 0.0                                    | 0.0          | 4.3           |
|                                          | 2 TX slots | 3.0                                    | 3.0          | 7.3           |
|                                          | 3 TX slots | 4.8                                    | 4.8          | 9.1           |
|                                          | 4 TX slots | 6.0                                    | 6.0          | 10.3          |

### 7.1.2. LTE CAT.M1 TEST CONFIGURATION

SAR for LTE band exposure configurations is measured according to the procedures of KDB 941225 D05 SAR for LTE Devices. The MT8821C WideBand Radio Communication Tester was used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR test were performed with the same number of RB and RB offsets transmitting on all TTI frames(Maximum TTI)

#### 1. Spectrum Plots for RB configurations

A properly configured base station simulator was used for LTE output power measurements and SAR testing. Therefore, spectrum plots for RB configurations were not required to be included in this report.

#### 2. MPR

When MPR is implemented permanently within the UE, regardless of network requirements, only those RB configurations allowed by 3GPP for the channel bandwidth and modulation combinations may be tested with MPR active. Configurations with RB allocations less than the RB thresholds required by 3GPP must be tested without MPR.

The allowed Maximum Power Reduction (MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3EA-1 of the 3GPP TS36.521:

Table 6.2.3EA-1: Maximum Power Reduction (MPR) for Power Class 3

| Modulation | Channel bandwidth / Transmission bandwidth (N <sub>RB</sub> ) |         |       |        |        |        | MPR (dB) |
|------------|---------------------------------------------------------------|---------|-------|--------|--------|--------|----------|
|            | 1.4 MHz                                                       | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |          |
| QPSK       | >2                                                            | >2      | >1    | >4     | -      | -      | ≤ 1      |
| QPSK       | >5                                                            | >5      | -     | -      | -      | -      | ≤ 2      |
| 16 QAM     | ≤ 2                                                           | ≤ 2     | >1    | >3     | -      | -      | ≤ 1      |
| 16QAM      | >2                                                            | >2      | >3    | >5     | -      | -      | ≤ 2      |

### 3. A-MPR

The allowed A-MPR(Additional MPR) values specified below in Table 6.2.4EA-1 of 3GPP TS36.521 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of "NS\_01".

**Table 6.2.4EA-1: Additional Maximum Power Reduction (A-MPR) for category M1 UE**

| Network Signalling value | Requirements (subclause) | E-UTRA Band | Resources Blocks ( $N_{RB}$ ) | A-MPR (dB) |
|--------------------------|--------------------------|-------------|-------------------------------|------------|
| NS_01                    | 6.6.2.1.1                | Table 5.2-1 | Table 5.4.2-1                 | N/A        |
| NS_03                    | 6.6.2.2.1                | 2, 4        | Table 5.4.2-1                 | N/A        |
| NS_04                    | 6.6.2.2.2                | 41          | [TBD]                         | [TBD]      |
| NS_05                    | 6.6.3.3.3.2              | 1           | Table 5.4.2-1                 | N/A        |
| NS_06                    | 6.6.2.2.3                | 12, 13, 14  | Table 5.4.2-1                 | N/A        |
| NS_07                    | 6.6.2.2.3<br>6.6.3.3.3.3 | 13          | Table 6.2.4-2E                |            |
| NS_08                    | 6.6.3.3.3.4              | 19          | Table 5.4.2-1                 | N/A        |
| NS_09                    | 6.6.3.3.3.5              | 21          | Table 5.4.2-1                 | N/A        |
| NS_10                    |                          | 20          | Table 5.4.2-1                 | N/A        |
| NS_12                    | 6.6.3.3.3.7              | 26          | [TBD]                         |            |
| NS_13                    | 6.6.3.3.3.8              | 26          | Table 5.4.2-1                 | N/A        |
| NS_14                    | 6.6.3.3.3.9              | 26          | Table 5.4.2-1                 | N/A        |
| NS_15                    | 6.6.3.3.3.10             | 26          | Table 6.2.4-9                 |            |
| NS_16                    | 6.6.3.3.3.11             | 27          | Table 5.4.2-1                 | N/A        |
| NS_17                    | 6.6.3.3.3.12             | 28          | Table 5.4.2-1                 | N/A        |
| NS_18                    | 6.6.3.3.3.13             | 28          | Table 5.4.2-1                 | N/A        |
| NS_32                    | -                        | -           | -                             | -          |
| NS_35                    | [TBD]                    | 71          | [TBD]                         | [TBD]      |
| NS_38                    | 6.6.3.3.3.27             | 74          | Table 5.4.2-1                 | N/A        |
| NS_39                    | 6.6.3.3.3.28             | 74          | Table 5.4.2-1                 | N/A        |

### 7.1.3. NB-IOT NB1 TEST CONFIGURATION

The Category NB1 for a 3.75 kHz subcarrier spacing, the maximum output power is defined as the average measured power. When the UE does not transmit, the period is at least one time slot (2 ms), excluding the 2304 Ts gap. For a 15 kHz subcarrier spacing, the maximum output power is defined as the average measured power, which is at least one subframe (1 ms).

The initial test configurations of the environmental conditions and test frequencies based on the subset of E-UTRA operating defined. NB-IoT in clause 5.2F. All of these configurations shall be tested with applicable test parameters, and are shown in table 6.2. 2F.4.1-1 of 3GPP TS36.521.

**Table 6.2.2F.4.1-1: Test Configuration Initial Conditions**

|                                                                  |                        |                                         |                    |                           |
|------------------------------------------------------------------|------------------------|-----------------------------------------|--------------------|---------------------------|
| Test Environment as specified in TS 36.508 [7] subclause 8.1.1   |                        | Normal, TL/VL, TL/VH, TH/VL, TH/VH      |                    |                           |
| Test Frequencies as specified in TS 36.508 [7] subclause 8.1.3.1 |                        | Frequency ranges defined in Annex K.1.2 |                    |                           |
| Test Parameters                                                  |                        |                                         |                    |                           |
| Configuration ID                                                 | Downlink Configuration | Uplink Configuration                    |                    |                           |
|                                                                  | N/A                    | Modulation                              | N <sub>tones</sub> | Sub-carrier spacing (kHz) |
| 1 (Note 2)                                                       |                        | BPSK                                    | 1@0                | 3.75                      |
| 2 (Note 3)                                                       |                        | BPSK                                    | 1@47               | 3.75                      |
| 3 (Note 2)                                                       |                        | QPSK                                    | 1@0                | 15                        |
| 4 (Note 3)                                                       |                        | QPSK                                    | 1@11               | 15                        |
| 5 (Note 1)                                                       |                        | QPSK                                    | 3@3                | 15                        |
| Note 1: Applicable to UE supporting UL multi-tone transmissions  |                        |                                         |                    |                           |
| Note 2: only applicable for low range                            |                        |                                         |                    |                           |
| Note 3: only applicable for high range                           |                        |                                         |                    |                           |

#### **4. LTE procedures for SAR testing**

##### **A) Largest channel bandwidth standalone SAR test requirements**

###### **i) QPSK with 1 RB allocation**

Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is  $\leq 0.8$  W/kg, testing of the remaining RB offset configurations and required test channels is not required for 1 RB allocation; otherwise, SAR is required for the remaining required test channels and only for the RB offset configuration with the highest output power for that channel. When the reported SAR of a required test channel is  $> 1.45$  W/kg, SAR is required for all three RB offset configurations for that required test channel.

###### **ii) QPSK with 50% RB allocation**

The procedures required for 1 RB allocation in i) are applied to measure the SAR for QPSK with 50% RB allocation

###### **iii) QPSK with 100% RB allocation**

For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation in i) and ii) are  $\leq 0.8$  W/kg. Otherwise, SAR is measured for the highest output power channel and if the reported SAR is  $> 1.45$  W/kg, the remaining required test channels must also be tested.

###### **iv) Higher order modulations**

For each modulation besides QPSK; e.g., 16-QAM, 64-QAM, apply the QPSK procedures in above sections to determine the QAM configurations that may need SAR measurement. For each configuration identified as required for testing, SAR is required only when the highest maximum output power for the configuration in the higher order modulation is  $> \frac{1}{2}$  dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is  $> 1.45$  W/kg.

##### **B) Other channel bandwidth standalone SAR test requirements**

For the other channel bandwidths used by the device in a frequency band, apply all the procedures required for the largest channel bandwidth in section A) to determine the channels and RB configurations that need SAR testing and only measure SAR when the highest maximum output power of a configuration requiring testing in the smaller channel bandwidth is  $> \frac{1}{2}$  dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the reported SAR of a configuration for the largest channel bandwidth is  $> 1.45$  W/kg.

#### 7.1.4. WIFI TEST CONFIGURATION

For WLAN SAR testing, WLAN engineering testing software installed on the DUT can provide continuous transmitting RF signal.

##### 2.4G

| Mode         | 802.11b | 802.11g | 802.11n HT20 | 802.11n HT40 |
|--------------|---------|---------|--------------|--------------|
| Duty cycle   | 100%    |         |              |              |
| Crest factor | 1       |         |              |              |

For WiFi SAR testing, a communication link is set up with the test mode software for WiFi mode test. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode. The RF signal utilized in SAR measurement has 100% duty cycle and its crest factor is 1. The test procedures in KDB 248227 D01 are applied.

##### 7.1.1.1 2.4G SAR Test Requirements

###### 802.11b DSSS SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either a fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

- 1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is  $\leq 0.8$  W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
- 2) When the reported SAR is  $> 0.8$  W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is  $> 1.2$  W/kg, SAR is required for the third channel; i.e., all channels require testing.

###### 2.4 GHz 802.11g/n OFDM SAR Test Exclusion Requirements

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied. SAR is not required for the following 2.4 GHz OFDM conditions.

- 1) When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.
- 2) When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg.

###### SAR Test Requirements for OFDM configurations

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, each standalone And frequency aggregated band is considered separately for SAR test reduction. In applying the initial test configuration and subsequent test configuration procedures, the 802.11 transmission configuration with the highest specified maximum output power and the channel within a test configuration with the highest measured maximum output power should be clearly distinguished to apply the procedures.

#### **7.1.1.3 OFDM transmission mode and SAR test channel selection**

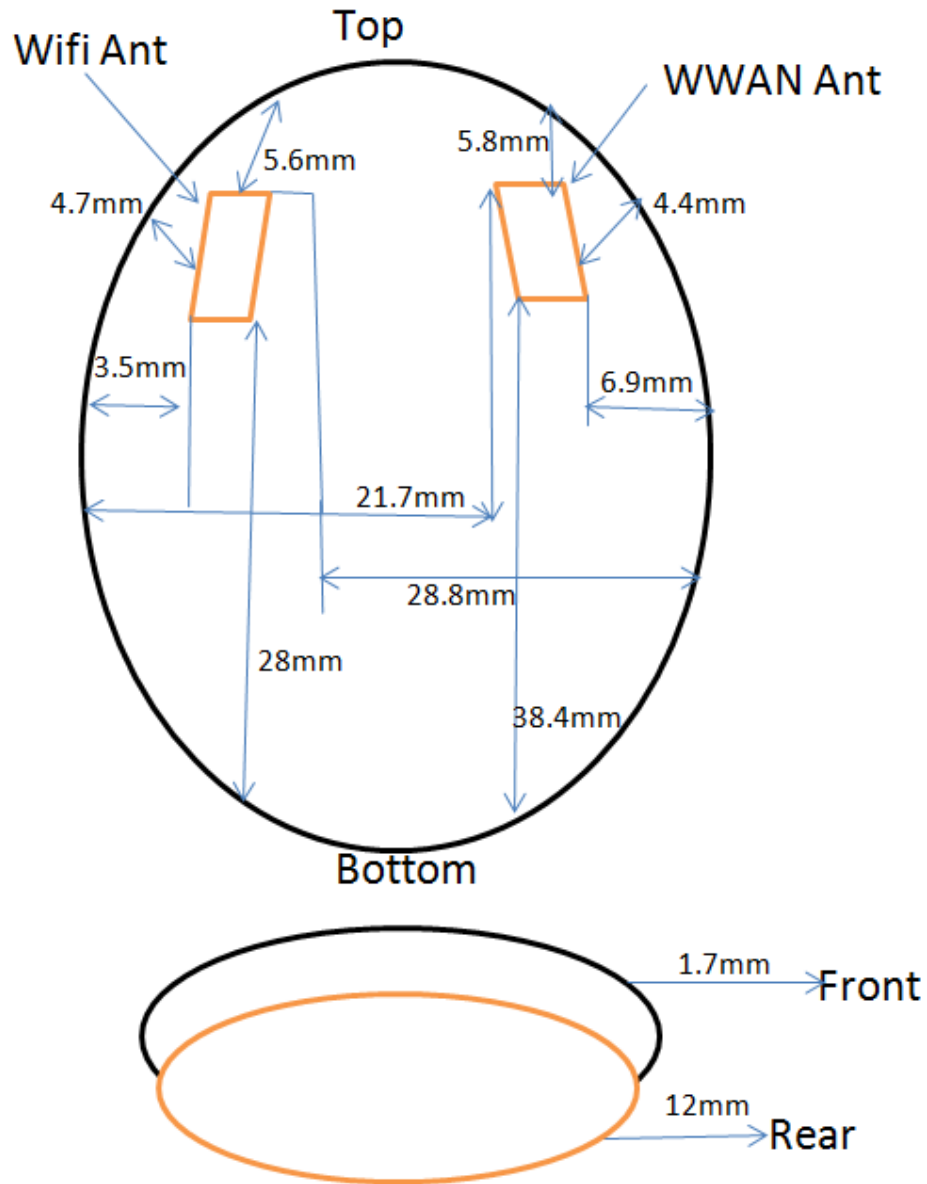
For the 2.4GHz, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations (for example 802.11g and 802.11n, with the same channel bandwidth, modulation, and data rate, etc.). When the maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

#### **7.1.1.4 Initial test configuration procedure**

For OFDM, in both 2.4G bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. If the average RF output powers of the highest identical transmission modes are within 0.25 dB of each other, mid channel of the transmission mode with highest average RF output powers is the initial test channel. Otherwise, the channel of the transmission mode with the highest average RF output power will be the initial test configuration.

When the reported SAR is  $\leq 0.8$  W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is  $\leq 1.2$  W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurement.

## 7.2. TEST POSITION ANTENNA LOCATION



| Antenna | Front Face | Rear Face | Right Side | Left Side | Top Side | Bottom Side |
|---------|------------|-----------|------------|-----------|----------|-------------|
| WWAN    | 1.7mm      | 12mm      | 4.4mm      | 21.7 mm   | 5.8mm    | 38.4 mm     |
| WLAN    | 1.7mm      | 12mm      | 28.8mm     | 3.5 mm    | 5.6 mm   | 28 mm       |

## 8. TEST RESULT

### 8.1. CONDUCTED POWER RESULTS

#### 8.1.1. CONDUCTED POWER MEASUREMENTS OF GSM BAND

| GSM850              |           | Max Burst Average Power (dBm) |                        |           |            | Max Frame Average Power (dBm) |                        |           |            |
|---------------------|-----------|-------------------------------|------------------------|-----------|------------|-------------------------------|------------------------|-----------|------------|
|                     |           | Max.                          | Channel/Frequency(MHz) |           |            | Max.                          | Channel/Frequency(MHz) |           |            |
|                     |           | Tune-up                       | 128/824.2              | 188/836.2 | 251/848.8  | Tune-up                       | 128/824.2              | 188/836.2 | 251/848.8  |
| GPRS/EDGE<br>(GMSK) | 1 Tx Slot | 27.00                         | 26.88                  | 26.93     | 26.92      | 17.81                         | 17.69                  | 17.74     | 17.73      |
|                     | 2 Tx Slot | 27.50                         | 27.07                  | 26.74     | 26.76      | 21.37                         | 20.94                  | 20.61     | 20.63      |
|                     | 3 Tx Slot | 27.50                         | 27.04                  | 26.93     | 26.68      | 23.08                         | 22.62                  | 22.51     | 22.26      |
|                     | 4 Tx Slot | 27.00                         | 26.94                  | 26.84     | 26.53      | 23.82                         | 23.76                  | 23.66     | 23.35      |
| EDGE<br>(8PSK)      | 1 Tx Slot | 25.00                         | 24.84                  | 24.73     | 24.69      | 15.81                         | 15.65                  | 15.54     | 15.50      |
|                     | 2 Tx Slot | 25.00                         | 24.68                  | 24.62     | 24.58      | 18.87                         | 18.55                  | 18.49     | 18.45      |
|                     | 3 Tx Slot | 25.00                         | 24.66                  | 24.52     | 24.43      | 20.58                         | 20.24                  | 20.10     | 20.01      |
|                     | 4 Tx Slot | 25.00                         | 24.51                  | 24.42     | 24.39      | 21.82                         | 21.33                  | 21.24     | 21.21      |
| GSM1900             |           | Max Burst Average Power (dBm) |                        |           |            | Max Frame Average Power (dBm) |                        |           |            |
|                     |           | Max.                          | Channel/Frequency(MHz) |           |            | Max.                          | Channel/Frequency(MHz) |           |            |
|                     |           | Tune-up                       | 512/1850.2             | 661/1880  | 810/1909.8 | Tune-up                       | 512/1850.2             | 661/1880  | 810/1909.8 |
| GPRS/EDGE<br>(GMSK) | 1 Tx Slot | 21.50                         | 21.15                  | 21.11     | 20.09      | 12.31                         | 11.96                  | 11.92     | 10.90      |
|                     | 2 Tx Slot | 21.50                         | 21.11                  | 21.04     | 20.02      | 15.37                         | 14.98                  | 14.91     | 13.89      |
|                     | 3 Tx Slot | 21.50                         | 21.02                  | 20.98     | 19.94      | 17.08                         | 16.60                  | 16.56     | 15.52      |
|                     | 4 Tx Slot | 22.00                         | 21.94                  | 20.86     | 20.07      | 18.82                         | 18.76                  | 17.68     | 16.89      |
| EDGE<br>(8PSK)      | 1 Tx Slot | 19.50                         | 19.34                  | 18.78     | 17.66      | 10.31                         | 10.15                  | 9.59      | 8.47       |
|                     | 2 Tx Slot | 19.50                         | 19.03                  | 18.53     | 17.62      | 13.37                         | 12.90                  | 12.40     | 11.49      |
|                     | 3 Tx Slot | 19.00                         | 18.79                  | 18.32     | 17.13      | 14.58                         | 14.37                  | 13.90     | 12.71      |
|                     | 4 Tx Slot | 18.50                         | 18.46                  | 17.94     | 16.83      | 15.32                         | 15.28                  | 14.76     | 13.65      |

Note:

The conducted power of GSM Band is measured with RMS detector.

### 8.1.2. CONDUCTED POWER MEASUREMENTS OF LTE CAT.M1

| LTE B2/BW=1.4M |                           | Average Conducted Power(dBm) |                        |            |              | LTE B2/BW=3M  |                           | Average Conducted Power(dBm) |                        |            |              |
|----------------|---------------------------|------------------------------|------------------------|------------|--------------|---------------|---------------------------|------------------------------|------------------------|------------|--------------|
| Modulation     | RB Size/Offset / NB Index | Max. Tune-up                 | Channel/Frequency(MHz) |            |              | Modulation    | RB Size/Offset / NB Index | Max. Tune-up                 | Channel/Frequency(MHz) |            |              |
|                |                           |                              | 18607/1850.7           | 18900/1880 | 19193/1909.3 |               |                           |                              | 18615/1851.5           | 18900/1880 | 19185/1908.5 |
| QPSK           | 1/0/0                     | 24.00                        | 23.37                  | 23.67      | 23.15        | QPSK          | 1/0/0                     | 24.00                        | 23.46                  | 23.79      | 23.28        |
|                | 1/5/0                     | 24.00                        | 23.53                  | 23.57      | 22.71        |               | 1/5/1                     | 24.00                        | 23.62                  | 23.66      | 22.80        |
|                | 3/0/0                     | 24.00                        | 23.47                  | 23.52      | 22.68        |               | 3/0/0                     | 24.00                        | 23.56                  | 23.61      | 22.77        |
|                | 3/3/0                     | 24.00                        | 23.41                  | 23.47      | 22.57        |               | 3/3/1                     | 24.00                        | 23.50                  | 23.56      | 22.66        |
|                | 6/0/0                     | 24.00                        | 23.39                  | 23.66      | 23.02        |               | 6/0/0                     | 24.00                        | 23.78                  | 23.69      | 22.96        |
| 16QAM          | 1/0/0                     | 22.50                        | 22.08                  | 22.14      | 21.31        | 16QAM         | 1/0/0                     | 22.50                        | 22.15                  | 22.21      | 21.38        |
|                | 1/4/0                     | 22.50                        | 22.05                  | 22.09      | 21.23        |               | 1/4/1                     | 22.50                        | 22.12                  | 22.16      | 21.30        |
|                | 3/0/0                     | 22.50                        | 21.99                  | 22.04      | 21.20        |               | 3/0/0                     | 22.50                        | 22.06                  | 22.11      | 21.27        |
|                | 3/2/0                     | 22.50                        | 21.93                  | 21.99      | 21.09        |               | 3/2/1                     | 22.50                        | 22.00                  | 22.06      | 21.16        |
|                | 5/0/0                     | 22.00                        | 21.88                  | 21.95      | 21.33        |               | 5/0/0                     | 22.50                        | 21.99                  | 22.08      | 21.46        |
|                | 5/0/1                     | 22.50                        | 21.95                  | 22.02      | 21.40        |               | 5/0/1                     | 22.50                        | 21.95                  | 22.02      | 21.40        |
|                |                           |                              |                        |            |              |               |                           |                              |                        |            |              |
|                |                           |                              |                        |            |              |               |                           |                              |                        |            |              |
|                |                           |                              |                        |            |              |               |                           |                              |                        |            |              |
|                |                           |                              |                        |            |              |               |                           |                              |                        |            |              |
| LTE B2/BW=5M   |                           | Average Conducted Power(dBm) |                        |            |              | LTE B2/BW=10M |                           | Average Conducted Power(dBm) |                        |            |              |
| Modulation     | RB Size/Offset / NB Index | Max. Tune-up                 | Channel/Frequency(MHz) |            |              | Modulation    | RB Size/Offset / NB Index | Max. Tune-up                 | Channel/Frequency(MHz) |            |              |
|                |                           |                              | 18625/1852.5           | 18900/1880 | 19175/1907.5 |               |                           |                              | 18650/1855             | 18900/1880 | 19150/1905   |
| QPSK           | 1/0/0                     | 24.00                        | 23.80                  | 23.86      | 23.03        | QPSK          | 1/0/0                     | 24.00                        | 23.87                  | 23.93      | 23.10        |
|                | 1/0/3                     | 24.00                        | 23.77                  | 23.81      | 22.95        |               | 1/0/3                     | 24.00                        | 23.84                  | 23.88      | 23.02        |
|                | 1/5/0                     | 24.00                        | 23.71                  | 23.76      | 22.92        |               | 1/5/4                     | 24.00                        | 23.78                  | 23.83      | 22.99        |
|                | 1/5/3                     | 24.00                        | 23.65                  | 23.71      | 22.81        |               | 1/5/7                     | 24.00                        | 23.72                  | 23.78      | 22.88        |
|                | 3/0/0                     | 24.00                        | 23.64                  | 23.73      | 23.11        |               | 3/0/0                     | 24.00                        | 23.71                  | 23.80      | 23.18        |
|                | 3/3/3                     | 24.00                        | 23.60                  | 23.67      | 23.05        |               | 3/3/7                     | 24.00                        | 23.67                  | 23.74      | 23.12        |
|                | 6/0/0                     | 24.00                        | 23.48                  | 23.66      | 23.08        |               | 6/0/0                     | 24.00                        | 23.55                  | 23.73      | 23.15        |
|                | 6/0/3                     | 24.00                        | 23.36                  | 23.58      | 22.94        |               | 6/0/7                     | 24.00                        | 23.43                  | 23.65      | 23.01        |
| 16QAM          | 1/0/0                     | 22.50                        | 22.30                  | 22.36      | 21.53        | 16QAM         | 1/0/0                     | 22.50                        | 22.37                  | 22.43      | 21.60        |
|                | 1/0/3                     | 22.50                        | 22.27                  | 22.31      | 21.45        |               | 1/0/3                     | 22.50                        | 22.34                  | 22.38      | 21.52        |
|                | 1/4/0                     | 22.50                        | 22.21                  | 22.26      | 21.42        |               | 1/4/4                     | 22.50                        | 22.28                  | 22.33      | 21.49        |
|                | 1/4/3                     | 22.50                        | 22.15                  | 22.21      | 21.31        |               | 1/4/7                     | 22.50                        | 22.22                  | 22.28      | 21.38        |
|                | 3/0/0                     | 22.50                        | 22.14                  | 22.23      | 21.61        |               | 3/0/0                     | 22.50                        | 22.21                  | 22.30      | 21.68        |
|                | 3/2/3                     | 22.50                        | 22.10                  | 22.17      | 21.55        |               | 3/2/7                     | 22.50                        | 22.17                  | 22.24      | 21.62        |
|                | 5/0/0                     | 22.50                        | 21.98                  | 22.16      | 21.58        |               | 5/0/0                     | 22.50                        | 22.05                  | 22.23      | 21.65        |
|                | 5/0/3                     | 22.50                        | 21.86                  | 22.08      | 21.44        |               | 5/0/7                     | 22.50                        | 21.93                  | 22.15      | 21.51        |

| LTE B2/BW=15M |                           | Average Conducted Power(dBm) |                        |            |              | LTE B2/BW=20M |                           | Average Conducted Power(dBm) |                        |            |            |
|---------------|---------------------------|------------------------------|------------------------|------------|--------------|---------------|---------------------------|------------------------------|------------------------|------------|------------|
| Modulation    | RB Size/Offset / NB Index | Max. Tune-up                 | Channel/Frequency(MHz) |            |              | Modulation    | RB Size/Offset / NB Index | Max. Tune-up                 | Channel/Frequency(MHz) |            |            |
|               |                           |                              | 18675/1857.5           | 18900/1880 | 19125/1902.5 |               |                           |                              | 18700/1860             | 18900/1880 | 19100/1900 |
| QPSK          | 1/0/0                     | 24.50                        | 23.99                  | 24.05      | 23.22        | QPSK          | 1/0/0                     | 24.50                        | 24.06                  | 24.12      | 23.29      |
|               | 1/0/3                     | 24.50                        | 23.96                  | 24.00      | 23.14        |               | 1/0/3                     | 24.50                        | 24.03                  | 24.07      | 23.21      |
|               | 1/5/8                     | 24.50                        | 23.90                  | 23.95      | 23.11        |               | 1/5/12                    | 24.50                        | 23.97                  | 24.02      | 23.18      |
|               | 1/5/11                    | 24.00                        | 23.84                  | 23.90      | 23.00        |               | 1/5/15                    | 24.00                        | 23.91                  | 23.97      | 23.07      |
|               | 3/0/0                     | 24.00                        | 23.83                  | 23.92      | 23.30        |               | 3/0/0                     | 24.00                        | 23.99                  | 23.90      | 23.37      |
|               | 3/3/11                    | 24.00                        | 23.79                  | 23.86      | 23.24        |               | 3/3/15                    | 24.00                        | 23.86                  | 23.93      | 23.31      |
|               | 6/0/0                     | 24.00                        | 23.67                  | 23.85      | 23.27        |               | 6/0/0                     | 24.00                        | 23.74                  | 23.92      | 23.34      |
|               | 6/0/11                    | 24.00                        | 23.55                  | 23.77      | 23.13        |               | 6/0/15                    | 24.00                        | 23.62                  | 23.84      | 23.20      |
| 16QAM         | 1/0/0                     | 23.00                        | 22.49                  | 22.55      | 21.72        | 16QAM         | 1/0/0                     | 23.00                        | 22.56                  | 22.62      | 21.79      |
|               | 1/0/3                     | 23.00                        | 22.46                  | 22.50      | 21.64        |               | 1/0/3                     | 23.00                        | 22.53                  | 22.57      | 21.71      |
|               | 1/4/8                     | 23.00                        | 22.40                  | 22.45      | 21.61        |               | 1/4/12                    | 23.00                        | 22.47                  | 22.52      | 21.68      |
|               | 1/4/11                    | 23.00                        | 22.34                  | 22.40      | 21.50        |               | 1/4/15                    | 23.00                        | 22.41                  | 22.47      | 21.57      |
|               | 3/0/0                     | 22.50                        | 22.33                  | 22.42      | 21.80        |               | 3/0/0                     | 22.50                        | 22.40                  | 22.49      | 21.87      |
|               | 3/2/11                    | 22.50                        | 22.29                  | 22.36      | 21.74        |               | 3/2/15                    | 22.50                        | 22.36                  | 22.43      | 21.81      |
|               | 5/0/0                     | 22.50                        | 22.17                  | 22.35      | 21.77        |               | 5/0/0                     | 22.50                        | 22.24                  | 22.42      | 21.84      |
|               | 5/0/11                    | 22.50                        | 22.05                  | 22.27      | 21.63        |               | 5/0/15                    | 22.50                        | 22.12                  | 22.34      | 21.70      |

| LTE B4/BW=1.4M |                                  | Average Conducted Power(dBm) |                        |                  |                  | LTE B4/BW=3M |                                  | Average Conducted Power(dBm) |                        |                  |                  |
|----------------|----------------------------------|------------------------------|------------------------|------------------|------------------|--------------|----------------------------------|------------------------------|------------------------|------------------|------------------|
| Modula-tion    | RB Size/<br>Offset /<br>NB Index | Max.<br>Tune-up              | Channel/Frequency(MHz) |                  |                  | Modula-tion  | RB Size/<br>Offset /<br>NB Index | Max.<br>Tune-up              | Channel/Frequency(MHz) |                  |                  |
|                |                                  |                              | 19957/<br>1710.7       | 20175/<br>1732.5 | 20393/<br>1754.3 |              |                                  |                              | 19965/<br>1711.5       | 20175/<br>1732.5 | 20385/<br>1753.5 |
| QPSK           | 1/0/0                            | 24.00                        | 23.72                  | 23.11            | 22.71            | QPSK         | 1/0/0                            | 24.00                        | 23.79                  | 23.22            | 22.77            |
|                | 1/5/0                            | 24.00                        | 23.76                  | 23.29            | 22.83            |              | 1/5/1                            | 24.00                        | 23.81                  | 23.20            | 22.80            |
|                | 3/0/0                            | 24.00                        | 23.70                  | 23.19            | 22.72            |              | 3/0/0                            | 24.00                        | 23.85                  | 23.38            | 22.92            |
|                | 3/3/0                            | 24.00                        | 23.69                  | 23.26            | 22.89            |              | 3/3/1                            | 24.00                        | 23.79                  | 23.28            | 22.81            |
|                | 6/0/0                            | 24.00                        | 23.57                  | 23.16            | 22.81            |              | 6/0/0                            | 24.00                        | 23.78                  | 23.35            | 22.98            |
|                |                                  |                              |                        |                  |                  |              | 6/0/1                            | 24.00                        | 23.66                  | 23.25            | 22.90            |
| 16QAM          | 1/0/0                            | 22.50                        | 22.49                  | 21.88            | 21.48            | 16QAM        | 1/0/0                            | 23.00                        | 22.57                  | 22.00            | 21.55            |
|                | 1/4/0                            | 22.50                        | 22.46                  | 22.06            | 21.60            |              | 1/4/1                            | 23.00                        | 22.59                  | 21.98            | 21.58            |
|                | 3/0/0                            | 22.50                        | 22.47                  | 21.96            | 21.49            |              | 3/0/0                            | 23.00                        | 22.63                  | 22.16            | 21.70            |
|                | 3/2/0                            | 22.00                        | 21.53                  | 21.44            | 21.55            |              | 3/2/1                            | 23.00                        | 22.57                  | 22.06            | 21.59            |
|                | 5/0/0                            | 21.50                        | 21.22                  | 21.18            | 21.21            |              | 5/0/0                            | 22.00                        | 21.63                  | 21.54            | 21.65            |
|                |                                  |                              |                        |                  |                  |              | 5/0/1                            | 22.00                        | 21.35                  | 21.23            | 21.29            |

| LTE B4/BW=5M  |                           | Average Conducted Power(dBm) |                        |              |              | LTE B4/BW=10M |                           | Average Conducted Power(dBm) |                        |              |            |
|---------------|---------------------------|------------------------------|------------------------|--------------|--------------|---------------|---------------------------|------------------------------|------------------------|--------------|------------|
| Modulation    | RB Size/Offset / NB Index | Max. Tune-up                 | Channel/Frequency(MHz) |              |              | Modulation    | RB Size/Offset / NB Index | Max. Tune-up                 | Channel/Frequency(MHz) |              |            |
|               |                           |                              | 19975/1712.5           | 20175/1732.5 | 20375/1752.5 |               |                           |                              | 20000/1715             | 20175/1732.5 | 20350/1750 |
| QPSK          | 1/0/0                     | 24.00                        | 23.99                  | 23.52        | 22.94        | QPSK          | 1/0/0                     | 24.50                        | 24.06                  | 23.59        | 23.01      |
|               | 1/0/3                     | 24.00                        | 23.94                  | 23.41        | 22.86        |               | 1/0/3                     | 24.50                        | 24.01                  | 23.48        | 22.93      |
|               | 1/5/0                     | 24.00                        | 23.90                  | 23.33        | 22.88        |               | 1/5/4                     | 24.50                        | 23.97                  | 23.40        | 22.95      |
|               | 1/5/3                     | 24.00                        | 23.92                  | 23.31        | 22.91        |               | 1/5/7                     | 24.50                        | 23.99                  | 23.38        | 22.98      |
|               | 3/0/0                     | 24.00                        | 23.96                  | 23.49        | 23.03        |               | 3/0/0                     | 24.50                        | 24.03                  | 23.56        | 23.10      |
|               | 3/3/3                     | 24.00                        | 23.90                  | 23.39        | 22.92        |               | 3/3/7                     | 24.50                        | 23.97                  | 23.46        | 22.99      |
|               | 6/0/0                     | 24.00                        | 23.89                  | 23.46        | 23.09        |               | 6/0/0                     | 24.50                        | 23.96                  | 23.53        | 23.16      |
|               | 6/0/3                     | 24.00                        | 23.77                  | 23.36        | 23.01        |               | 6/0/7                     | 24.00                        | 23.84                  | 23.43        | 23.08      |
| 16QAM         | 1/0/0                     | 23.00                        | 22.77                  | 22.30        | 21.72        | 16QAM         | 1/0/0                     | 23.00                        | 22.84                  | 22.37        | 21.79      |
|               | 1/0/3                     | 23.00                        | 22.72                  | 22.19        | 21.64        |               | 1/0/3                     | 23.00                        | 22.79                  | 22.26        | 21.71      |
|               | 1/4/0                     | 23.00                        | 22.68                  | 22.11        | 21.66        |               | 1/4/4                     | 23.00                        | 22.75                  | 22.18        | 21.73      |
|               | 1/4/3                     | 23.00                        | 22.70                  | 22.09        | 21.69        |               | 1/4/7                     | 23.00                        | 22.77                  | 22.16        | 21.76      |
|               | 3/0/0                     | 23.00                        | 22.74                  | 22.27        | 21.81        |               | 3/0/0                     | 23.00                        | 22.81                  | 22.34        | 21.88      |
|               | 3/2/3                     | 23.00                        | 22.68                  | 22.17        | 21.70        |               | 3/2/7                     | 23.00                        | 22.75                  | 22.24        | 21.77      |
|               | 5/0/0                     | 22.00                        | 21.74                  | 21.65        | 21.76        |               | 5/0/0                     | 22.00                        | 21.81                  | 21.72        | 21.83      |
|               | 5/0/3                     | 22.00                        | 21.46                  | 21.34        | 21.40        |               | 5/0/7                     | 22.00                        | 21.53                  | 21.41        | 21.47      |
| LTE B4/BW=15M |                           | Average Conducted Power(dBm) |                        |              |              | LTE B4/BW=20M |                           | Average Conducted Power(dBm) |                        |              |            |
| Modulation    | RB Size/Offset / NB Index | Max. Tune-up                 | Channel/Frequency(MHz) |              |              | Modulation    | RB Size/Offset / NB Index | Max. Tune-up                 | Channel/Frequency(MHz) |              |            |
|               |                           |                              | 20025/1717.5           | 20175/1732.5 | 20325/1747.5 |               |                           |                              | 20050/1720             | 20175/1732.5 | 20300/1745 |
| QPSK          | 1/0/0                     | 24.50                        | 24.12                  | 23.65        | 23.07        | QPSK          | 1/0/0                     | 24.50                        | 24.20                  | 23.73        | 23.15      |
|               | 1/0/3                     | 24.50                        | 24.07                  | 23.54        | 22.99        |               | 1/0/3                     | 24.50                        | 24.15                  | 23.62        | 23.07      |
|               | 1/5/8                     | 24.50                        | 24.03                  | 23.46        | 23.01        |               | 1/5/12                    | 24.50                        | 24.11                  | 23.54        | 23.09      |
|               | 1/5/11                    | 24.50                        | 24.05                  | 23.44        | 23.04        |               | 1/5/15                    | 24.50                        | 24.13                  | 23.52        | 23.12      |
|               | 3/0/0                     | 24.50                        | 24.09                  | 23.62        | 23.16        |               | 3/0/0                     | 24.50                        | 24.17                  | 23.70        | 23.24      |
|               | 3/3/11                    | 24.50                        | 24.03                  | 23.52        | 23.05        |               | 3/3/15                    | 24.50                        | 24.11                  | 23.60        | 23.13      |
|               | 6/0/0                     | 24.50                        | 24.02                  | 23.59        | 23.22        |               | 6/0/0                     | 24.50                        | 24.10                  | 23.67        | 23.30      |
|               | 6/0/11                    | 24.00                        | 23.90                  | 23.49        | 23.14        |               | 6/0/15                    | 24.00                        | 23.98                  | 23.57        | 23.22      |
| 16QAM         | 1/0/0                     | 23.00                        | 22.90                  | 22.43        | 21.85        | 16QAM         | 1/0/0                     | 23.00                        | 22.98                  | 22.51        | 21.93      |
|               | 1/0/3                     | 23.00                        | 22.85                  | 22.32        | 21.77        |               | 1/0/3                     | 23.00                        | 22.93                  | 22.40        | 21.85      |
|               | 1/4/8                     | 23.00                        | 22.81                  | 22.24        | 21.79        |               | 1/4/12                    | 23.00                        | 22.89                  | 22.32        | 21.87      |
|               | 1/4/11                    | 23.00                        | 22.83                  | 22.22        | 21.82        |               | 1/4/15                    | 23.00                        | 22.91                  | 22.30        | 21.90      |
|               | 3/0/0                     | 23.00                        | 22.87                  | 22.40        | 21.94        |               | 3/0/0                     | 23.00                        | 22.95                  | 22.48        | 22.02      |
|               | 3/2/11                    | 23.00                        | 22.81                  | 22.30        | 21.83        |               | 3/2/15                    | 23.00                        | 22.89                  | 22.38        | 21.91      |
|               | 5/0/0                     | 22.00                        | 21.87                  | 21.78        | 21.89        |               | 5/0/0                     | 22.00                        | 21.95                  | 21.86        | 21.97      |
|               | 5/0/11                    | 22.00                        | 21.59                  | 21.47        | 21.53        |               | 5/0/15                    | 22.00                        | 21.67                  | 21.55        | 21.61      |

| LTE B12/BW=1.4M |                                  | Average Conducted Power(dBm) |                        |                 |                 | LTE B12/BW=3M   |                               | Average Conducted Power(dBm) |                        |                 |                 |
|-----------------|----------------------------------|------------------------------|------------------------|-----------------|-----------------|-----------------|-------------------------------|------------------------------|------------------------|-----------------|-----------------|
| Modula-<br>tion | RB Size/<br>Offset /<br>NB Index | Max.<br>Tune-up              | Channel/Frequency(MHz) |                 |                 | Modula-<br>tion | RB Size/<br>Offset /<br>Index | Max.<br>Tune-up              | Channel/Frequency(MHz) |                 |                 |
|                 |                                  |                              | 23017/<br>699.7        | 23095/<br>707.5 | 23173/<br>715.3 |                 |                               |                              | 23025/<br>700.5        | 23095/<br>707.5 | 23165/<br>714.5 |
| QPSK            | 1/0/0                            | 23.50                        | 23.03                  | 23.31           | 22.96           | QPSK            | 1/0/0                         | 24.00                        | 23.27                  | 23.55           | 23.20           |
|                 | 1/5/0                            | 23.50                        | 22.92                  | 23.20           | 22.85           |                 | 1/5/1                         | 24.00                        | 23.14                  | 23.42           | 23.07           |
|                 | 3/0/0                            | 23.50                        | 23.07                  | 23.35           | 23.00           |                 | 3/0/0                         | 23.50                        | 23.03                  | 23.31           | 22.96           |
|                 | 3/3/0                            | 23.50                        | 23.11                  | 23.39           | 23.04           |                 | 3/3/1                         | 23.50                        | 23.18                  | 23.46           | 23.11           |
|                 | 6/0/0                            | 23.50                        | 23.05                  | 23.33           | 22.98           |                 | 6/0/0                         | 23.50                        | 23.22                  | 23.50           | 23.15           |
|                 |                                  |                              |                        |                 |                 |                 | 6/0/1                         | 23.50                        | 23.16                  | 23.44           | 23.09           |
| 16QAM           | 1/0/0                            | 22.50                        | 22.00                  | 22.29           | 21.95           | 16QAM           | 1/0/0                         | 22.50                        | 22.11                  | 22.42           | 22.05           |
|                 | 1/4/0                            | 22.50                        | 22.05                  | 22.26           | 22.00           |                 | 1/4/1                         | 22.50                        | 22.07                  | 22.36           | 22.02           |
|                 | 3/0/0                            | 22.50                        | 22.01                  | 22.29           | 22.06           |                 | 3/0/0                         | 22.50                        | 22.12                  | 22.33           | 22.07           |
|                 | 3/2/0                            | 21.50                        | 21.03                  | 21.30           | 20.94           |                 | 3/2/1                         | 22.50                        | 22.08                  | 22.36           | 22.13           |
|                 | 5/0/0                            | 21.50                        | 20.98                  | 21.15           | 20.87           |                 | 5/0/0                         | 21.50                        | 21.10                  | 21.37           | 21.01           |
|                 |                                  |                              |                        |                 |                 |                 | 5/0/1                         | 21.50                        | 21.05                  | 21.22           | 20.94           |
| LTE B12/BW=5M   |                                  | Average Conducted Power(dBm) |                        |                 |                 | LTE B12/BW=10M  |                               | Average Conducted Power(dBm) |                        |                 |                 |
| Modula-<br>tion | RB Size/<br>Offset /<br>NB Index | Max.<br>Tune-up              | Channel/Frequency(MHz) |                 |                 | Modula-<br>tion | RB Size/<br>Offset /<br>Index | Max.<br>Tune-up              | Channel/Frequency(MHz) |                 |                 |
|                 |                                  |                              | 23035/<br>701.5        | 23095/<br>707.5 | 23155/<br>713.5 |                 |                               |                              | 23060/<br>704          | 23095/<br>707.5 | 23130/<br>711   |
| QPSK            | 1/0/0                            | 24.00                        | 23.35                  | 23.63           | 23.28           | QPSK            | 1/0/0                         | 24.00                        | 23.47                  | 23.75           | 23.40           |
|                 | 1/0/3                            | 24.00                        | 23.22                  | 23.50           | 23.15           |                 | 1/0/3                         | 24.00                        | 23.34                  | 23.62           | 23.27           |
|                 | 1/5/0                            | 24.00                        | 23.11                  | 23.39           | 23.04           |                 | 1/5/4                         | 24.00                        | 23.23                  | 23.51           | 23.16           |
|                 | 1/5/3                            | 24.00                        | 23.26                  | 23.54           | 23.19           |                 | 1/5/7                         | 24.00                        | 23.38                  | 23.66           | 23.31           |
|                 | 3/0/0                            | 24.00                        | 23.30                  | 23.58           | 23.23           |                 | 3/0/0                         | 24.00                        | 23.42                  | 23.70           | 23.35           |
|                 | 3/3/3                            | 24.00                        | 23.24                  | 23.52           | 23.17           |                 | 3/3/7                         | 24.00                        | 23.36                  | 23.64           | 23.29           |
|                 | 6/0/0                            | 24.00                        | 23.19                  | 23.53           | 23.34           |                 | 6/0/0                         | 24.00                        | 23.31                  | 23.65           | 23.46           |
|                 | 6/0/3                            | 24.00                        | 23.09                  | 23.41           | 23.22           |                 | 6/0/7                         | 24.00                        | 23.21                  | 23.53           | 23.34           |
| 16QAM           | 1/0/0                            | 23.00                        | 22.19                  | 22.50           | 22.13           | 16QAM           | 1/0/0                         | 23.00                        | 22.31                  | 22.62           | 22.25           |
|                 | 1/0/3                            | 23.00                        | 22.15                  | 22.44           | 22.10           |                 | 1/0/3                         | 23.00                        | 22.27                  | 22.56           | 22.22           |
|                 | 1/4/0                            | 23.00                        | 22.20                  | 22.41           | 22.15           |                 | 1/4/4                         | 23.00                        | 22.32                  | 22.53           | 22.27           |
|                 | 1/4/3                            | 23.00                        | 22.16                  | 22.44           | 22.21           |                 | 1/4/7                         | 23.00                        | 22.28                  | 22.56           | 22.33           |
|                 | 3/0/0                            | 22.00                        | 21.18                  | 21.45           | 21.09           |                 | 3/0/0                         | 22.00                        | 21.30                  | 21.57           | 21.21           |
|                 | 3/2/3                            | 22.00                        | 21.13                  | 21.30           | 21.02           |                 | 3/2/7                         | 22.00                        | 21.25                  | 21.42           | 21.14           |
|                 | 5/0/0                            | 22.00                        | 21.10                  | 21.26           | 21.05           |                 | 5/0/0                         | 22.00                        | 21.22                  | 21.38           | 21.17           |
|                 | 5/0/3                            | 22.00                        | 20.88                  | 21.22           | 20.92           |                 | 5/0/7                         | 22.00                        | 21.00                  | 21.34           | 21.04           |

### 8.1.3. CONDUCTED POWER MEASUREMENTS OF LTE NB-IOT

| LTE B2/BW=3.75KHz |        | Average Conducted Power(dBm) |                        |            |              | LTE B2/BW=15KHz |        | Average Conducted Power(dBm) |                        |            |              |
|-------------------|--------|------------------------------|------------------------|------------|--------------|-----------------|--------|------------------------------|------------------------|------------|--------------|
| Modulation        | Ntones | Max. Tune-up                 | Channel/Frequency(MHz) |            |              | Modulation      | Ntones | Max. Tune-up                 | Channel/Frequency(MHz) |            |              |
|                   |        |                              | 18601/1850.1           | 18900/1880 | 19199/1909.9 |                 |        |                              | 18601/1850.1           | 18900/1880 | 19199/1909.9 |
| BPSK              | 1@0    | 23.00                        | 22.29                  | 23.00      | 22.67        | QPSK            | 1@0    | 23.00                        | 22.48                  | 22.74      | 22.95        |
|                   | 1@11   | 23.00                        | 22.42                  | 22.96      | 22.71        |                 | 1@11   | 23.50                        | 22.85                  | 22.99      | 23.06        |
|                   | 1@47   | 23.00                        | 22.42                  | 22.96      | 22.71        |                 | 3@3    | 24.50                        | 23.70                  | 23.97      | 24.06        |

| LTE B4/BW=3.75KHz |        | Average Conducted Power(dBm) |                        |              |              | LTE B4/BW=15KHz |        | Average Conducted Power(dBm) |                        |              |              |
|-------------------|--------|------------------------------|------------------------|--------------|--------------|-----------------|--------|------------------------------|------------------------|--------------|--------------|
| Modulation        | Ntones | Max. Tune-up                 | Channel/Frequency(MHz) |              |              | Modulation      | Ntones | Max. Tune-up                 | Channel/Frequency(MHz) |              |              |
|                   |        |                              | 19951/1710.1           | 20175/1732.5 | 20399/1754.9 |                 |        |                              | 19951/1710.1           | 20175/1732.5 | 20399/1754.9 |
| BPSK              | 1@0    | 22.50                        | 22.41                  | 22.23        | 22.36        | QPSK            | 1@0    | 22.50                        | 22.14                  | 22.03        | 22.32        |
|                   | 1@11   | 23.00                        | 22.51                  | 22.18        | 22.14        |                 | 1@11   | 23.00                        | 21.98                  | 22.04        | 22.52        |
|                   | 1@47   | 23.00                        | 22.51                  | 22.18        | 22.14        |                 | 3@3    | 23.50                        | 23.41                  | 22.92        | 23.02        |

| LTE B12/BW=3.75KHz |        | Average Conducted Power(dBm) |                        |             |             | LTE B12/BW=15KHz |        | Average Conducted Power(dBm) |                        |             |             |
|--------------------|--------|------------------------------|------------------------|-------------|-------------|------------------|--------|------------------------------|------------------------|-------------|-------------|
| Modulation         | Ntones | Max. Tune-up                 | Channel/Frequency(MHz) |             |             | Modulation       | Ntones | Max. Tune-up                 | Channel/Frequency(MHz) |             |             |
|                    |        |                              | 23011/699.1            | 23095/707.5 | 23179/715.9 |                  |        |                              | 23011/699.1            | 23095/707.5 | 23179/715.9 |
| BPSK               | 1@0    | 22.00                        | 21.74                  | 21.60       | 21.62       | QPSK             | 1@11   | 22.00                        | 21.74                  | 21.70       | 21.60       |
|                    | 1@11   | 22.00                        | 21.71                  | 21.49       | 21.58       |                  | 1@11   | 22.00                        | 21.82                  | 21.53       | 21.58       |
|                    | 1@47   | 22.00                        | 21.71                  | 21.49       | 21.58       |                  | 3@3    | 22.50                        | 22.22                  | 22.18       | 21.92       |

### 8.1.4. CONDUCTED POWER MEASUREMENTS OF BT BAND

| BT  | Tune Up | Average Conducted Power (dBm) |      |      | SAR Test (Yes/No) |
|-----|---------|-------------------------------|------|------|-------------------|
|     |         | CH0                           | CH19 | CH39 |                   |
| BLE | 1.0     | -0.51                         | 0.75 | 0.31 | NO                |

Note:

- 1) The conducted power of BT is measured with RMS detector.
- 2) The BT standalone SAR test exclusion, reference to section 9 for explanation of rationale for exemption of testing.

### 8.1.5. CONDUCTED POWER MEASUREMENTS OF WIFI 2.4G

Conducted power measurement results of WiFi 2.4G

| Mode         | Channel | Frequency (MHz) | Data Rate (Mbps) | Tune-up | Average Power (dBm) | SAR Test (Yes/No) |
|--------------|---------|-----------------|------------------|---------|---------------------|-------------------|
| 802.11b      | 1       | 2412            | 1                | 9.0     | 8.92                | NO                |
|              | 6       | 2437            |                  | 9.0     | 8.50                | NO                |
|              | 11      | 2462            |                  | 9.0     | 7.86                | NO                |
| 802.11g      | 1       | 2412            | 6                | 8.5     | 8.23                | NO                |
|              | 6       | 2437            |                  | 8.5     | 8.20                | NO                |
|              | 11      | 2462            |                  | 8.5     | 8.12                | NO                |
| 802.11n HT20 | 1       | 2412            | 6.5              | 9.0     | 7.49                | NO                |
|              | 6       | 2437            |                  | 9.0     | 8.64                | NO                |
|              | 11      | 2462            |                  | 9.0     | 8.29                | NO                |
| 802.11n HT40 | 3       | 2422            | 13.5             | 8.5     | 6.49                | NO                |
|              | 6       | 2437            |                  | 8.5     | 7.30                | NO                |
|              | 9       | 2452            |                  | 8.5     | 8.34                | NO                |

- Note: 1) The Average conducted power of WiFi is measured with RMS detector.  
 2) The WIFI standalone SAR test exclusion, reference to section 9 for explanation of rationale for exemption of testing.

## 8.2. SAR TEST RESULTS

### General Notes:

- 1) Per KDB447498 D01, all measurement SAR results are scaled to the maximum tune-up tolerance limit to demonstrate compliant.
- 2) Per KDB447498 D01, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:  $\leq 0.8$  W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\leq 100$  MHz. When the maximum output power variation across the required test channels is  $> \frac{1}{2}$  dB, instead of the middle channel, the highest output power channel must be used.
- 3) Per KDB865664 D01, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8$  W/kg; if the deviation among the repeated measurement is  $\leq 20\%$ , and the measured SAR  $< 1.45$  W/kg, only one repeated measurement is required.
- 4) Per KDB865664 D02, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; Plots are also required when the measured SAR is  $> 1.5$  W/kg, or  $> 7.0$  W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for example, to support SAR to peak location separation ratio test exclusion and/or volume scan post-processing.

### GSM Notes:

- 1) Per KDB648474 D04, body-worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
- 2) Per KDB941225 D01, SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power specified for production units, including tune-up tolerance. The data mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested

### LTE notes:

- 1) The LTE test configurations are determined according to KDB941225 D05 SAR for LTE Devices. The general test procedures used for SAR testing can be found in Section 7.1.3.
- 2) A-MPR was disabled for all SAR test by setting NS\_01 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI)

### 8.2.1. SAR MEASUREMENT RESULT

#### 1) SAR test results of GSM separation distance=0.5cm

| Test No. | Band     | Mode   | Channel | Test Position | Maximum Tune-up (dBm) | Conducted Power (dBm) | Power Drift | SAR 1g (W/kg) | Reported 1g SAR (W/kg) |
|----------|----------|--------|---------|---------------|-----------------------|-----------------------|-------------|---------------|------------------------|
| T01      | GSM 850  | GPRS12 | 251     | Front Face    | 25                    | 24.39                 | 0.13        | <b>0.607</b>  | <b>0.699</b>           |
| T02      | GSM 850  | GPRS12 | 251     | Rear Face     | 25                    | 24.39                 | -0.04       | 0.087         | 0.100                  |
| T03      | GSM 850  | GPRS12 | 251     | Left Side     | 25                    | 24.39                 | 0.06        | 0.113         | 0.130                  |
| T04      | GSM 850  | GPRS12 | 251     | Right Side    | 25                    | 24.39                 | -0.01       | 0.032         | 0.037                  |
| T05      | GSM 850  | GPRS12 | 251     | Top Side      | 25                    | 24.39                 | 0.09        | 0.369         | 0.425                  |
| T06      | GSM 850  | GPRS12 | 251     | Bottom Side   | 25                    | 24.39                 | -0.14       | 0.00824       | 0.009                  |
| T10      | GSM 1900 | GPRS12 | 512     | Front Face    | 22                    | 21.94                 | -0.09       | <b>0.718</b>  | <b>0.728</b>           |
| T11      | GSM 1900 | GPRS12 | 512     | Rear Face     | 22                    | 21.94                 | -0.11       | 0.000584      | 0.001                  |
| T12      | GSM 1900 | GPRS12 | 512     | Left Side     | 22                    | 21.94                 | 0.06        | 0.139         | 0.141                  |
| T13      | GSM 1900 | GPRS12 | 512     | Right Side    | 22                    | 21.94                 | -0.07       | 0.0121        | 0.012                  |
| T14      | GSM 1900 | GPRS12 | 512     | Top Side      | 22                    | 21.94                 | 0.04        | 0.375         | 0.380                  |
| T15      | GSM 1900 | GPRS12 | 512     | Bottom Side   | 22                    | 21.94                 | 0.07        | 0.224         | 0.227                  |

#### 2) SAR test results of LTE Cat.M1 separation distance=0.5cm

| Test No. | Band         | Mode    | Channel | RB | offset | NB Index | Test Position | Maximum Tune-up (dBm) | Conducted Power (dBm) | Power Drift | SAR 1g (W/kg) | Reported 1g SAR (W/kg) |
|----------|--------------|---------|---------|----|--------|----------|---------------|-----------------------|-----------------------|-------------|---------------|------------------------|
| T50      | LTE B2_CatM1 | QPSK20M | 18900   | 1  | 0      | 0        | Front Face    | 24.5                  | 24.12                 | 0.01        | 1.11          | 1.211                  |
| T51      | LTE B2_CatM1 | QPSK20M | 18900   | 1  | 0      | 0        | Rear Face     | 24.5                  | 24.12                 | 0.15        | 0.43          | 0.469                  |
| T52      | LTE B2_CatM1 | QPSK20M | 18900   | 1  | 0      | 0        | Left Side     | 24.5                  | 24.12                 | 0.07        | 0.367         | 0.401                  |
| T53      | LTE B2_CatM1 | QPSK20M | 18900   | 1  | 0      | 0        | Right Side    | 24.5                  | 24.12                 | -0.11       | 0.04          | 0.044                  |
| T54      | LTE B2_CatM1 | QPSK20M | 18900   | 1  | 0      | 0        | Top Side      | 24.5                  | 24.12                 | -0.05       | 0.0072        | 0.008                  |
| T55      | LTE B2_CatM1 | QPSK20M | 18900   | 1  | 0      | 0        | Bottom Side   | 24.5                  | 24.12                 | -0.12       | 0.207         | 0.226                  |
| T56      | LTE B2_CatM1 | QPSK20M | 18700   | 1  | 0      | 0        | Front Face    | 24.5                  | 24.06                 | 0.08        | <b>1.15</b>   | <b>1.273</b>           |
| T57      | LTE B2_CatM1 | QPSK20M | 19100   | 1  | 0      | 0        | Front Face    | 24.5                  | 23.29                 | 0.05        | 0.911         | 1.204                  |
| T58      | LTE B2_CatM1 | QPSK20M | 18700   | 1  | 0      | 0        | Front Face    | 24.5                  | 24.06                 | 0.07        | 1.14          | 1.262                  |
| T59      | LTE B2_CatM1 | QPSK20M | 18700   | 3  | 0      | 0        | Front Face    | 24                    | 23.99                 | 0.09        | 1.03          | 1.032                  |
| T60      | LTE B2_CatM1 | QPSK20M | 18700   | 3  | 0      | 0        | Rear Face     | 24                    | 23.99                 | 0.12        | 0.38          | 0.381                  |
| T61      | LTE B2_CatM1 | QPSK20M | 18700   | 3  | 0      | 0        | Left Side     | 24                    | 23.99                 | 0.04        | 0.328         | 0.329                  |
| T62      | LTE B2_CatM1 | QPSK20M | 18700   | 3  | 0      | 0        | Right Side    | 24                    | 23.99                 | -0.08       | 0.046         | 0.046                  |
| T63      | LTE B2_CatM1 | QPSK20M | 18700   | 3  | 0      | 0        | Top Side      | 24                    | 23.99                 | -0.09       | 0.00556       | 0.006                  |
| T64      | LTE B2_CatM1 | QPSK20M | 18700   | 3  | 0      | 0        | Bottom Side   | 24                    | 23.99                 | 0.04        | 0.202         | 0.202                  |
| T65      | LTE B2_CatM1 | QPSK20M | 18900   | 3  | 0      | 0        | Front Face    | 24                    | 23.90                 | 0.07        | <b>1.05</b>   | <b>1.074</b>           |
| T66      | LTE B2_CatM1 | QPSK20M | 19100   | 3  | 0      | 0        | Front Face    | 24                    | 23.37                 | 0.01        | 0.848         | 0.980                  |
| T67      | LTE B2_CatM1 | QPSK20M | 18900   | 3  | 0      | 0        | Front Face    | 24                    | 23.90                 | 0.11        | 1.04          | 1.064                  |
| T101     | LTE B2_CatM1 | QPSK20M | 18900   | 6  | 0      | 0        | Front Face    | 24                    | 23.95                 | 0.06        | 1.03          | 1.042                  |
| T102     | LTE B2_CatM1 | QPSK20M | 18700   | 6  | 0      | 0        | Front Face    | 24                    | 23.74                 | 0.07        | <b>1.12</b>   | <b>1.189</b>           |
| T103     | LTE B2_CatM1 | QPSK20M | 19100   | 6  | 0      | 0        | Front Face    | 24                    | 23.34                 | 0.02        | 0.889         | 1.035                  |
| T104     | LTE B2_CatM1 | QPSK20M | 18700   | 6  | 0      | 0        | Front Face    | 24                    | 23.74                 | 0.11        | 1.11          | 1.178                  |

Note: The value with boldface is the maximum SAR Value of each test band.

| Test No. | Band          | Mode    | Channel | RB | offset | NB Index | Test Position | Maximum Tune-up (dBm) | Conducted Power (dBm) | Power Drift | SAR 1g (W/kg) | Reported 1g SAR (W/kg) |
|----------|---------------|---------|---------|----|--------|----------|---------------|-----------------------|-----------------------|-------------|---------------|------------------------|
| T68      | LTE B4_CatM1  | QPSK20M | 20050   | 1  | 0      | 0        | Front Face    | 24.5                  | 24.2                  | 0.1         | <b>0.594</b>  | <b>0.636</b>           |
| T69      | LTE B4_CatM1  | QPSK20M | 20050   | 1  | 0      | 0        | Rear Face     | 24.5                  | 24.2                  | 0.02        | 0.107         | 0.115                  |
| T70      | LTE B4_CatM1  | QPSK20M | 20050   | 1  | 0      | 0        | Left Side     | 24.5                  | 24.2                  | -0.14       | 0.000601      | 0.001                  |
| T71      | LTE B4_CatM1  | QPSK20M | 20050   | 1  | 0      | 0        | Right Side    | 24.5                  | 24.2                  | 0.06        | 0.041         | 0.044                  |
| T72      | LTE B4_CatM1  | QPSK20M | 20050   | 1  | 0      | 0        | Top Side      | 24.5                  | 24.2                  | -0.04       | 0.000707      | 0.001                  |
| T73      | LTE B4_CatM1  | QPSK20M | 20050   | 1  | 0      | 0        | Bottom Side   | 24.5                  | 24.2                  | 0.07        | 0.124         | 0.133                  |
| T77      | LTE B4_CatM1  | QPSK20M | 20050   | 3  | 0      | 0        | Front Face    | 24.5                  | 24.17                 | -0.05       | <b>0.593</b>  | <b>0.640</b>           |
| T78      | LTE B4_CatM1  | QPSK20M | 20050   | 3  | 0      | 0        | Rear Face     | 24.5                  | 24.17                 | -0.14       | 0.103         | 0.111                  |
| T79      | LTE B4_CatM1  | QPSK20M | 20050   | 3  | 0      | 0        | Left Side     | 24.5                  | 24.17                 | -0.02       | 0.037         | 0.040                  |
| T80      | LTE B4_CatM1  | QPSK20M | 20050   | 3  | 0      | 0        | Right Side    | 24.5                  | 24.17                 | 0.02        | 0.039         | 0.042                  |
| T81      | LTE B4_CatM1  | QPSK20M | 20050   | 3  | 0      | 0        | Top Side      | 24.5                  | 24.17                 | -0.11       | 0.000411      | 0.000                  |
| T82      | LTE B4_CatM1  | QPSK20M | 20050   | 3  | 0      | 0        | Bottom Side   | 24.5                  | 24.17                 | 0.07        | 0.122         | 0.132                  |
| T86      | LTE B12_CatM1 | QPSK10M | 23095   | 1  | 0      | 0        | Front Face    | 24                    | 23.75                 | -0.02       | <b>0.244</b>  | <b>0.258</b>           |
| T87      | LTE B12_CatM1 | QPSK10M | 23095   | 1  | 0      | 0        | Rear Face     | 24                    | 23.75                 | -0.06       | 0.031         | 0.033                  |
| T88      | LTE B12_CatM1 | QPSK10M | 23095   | 1  | 0      | 0        | Left Side     | 24                    | 23.75                 | 0.14        | 0.013         | 0.014                  |
| T89      | LTE B12_CatM1 | QPSK10M | 23095   | 1  | 0      | 0        | Right Side    | 24                    | 23.75                 | 0.05        | 0.059         | 0.062                  |
| T90      | LTE B12_CatM1 | QPSK10M | 23095   | 1  | 0      | 0        | Top Side      | 24                    | 23.75                 | NA          | <0.001        | <0.001                 |
| T91      | LTE B12_CatM1 | QPSK10M | 23095   | 1  | 0      | 0        | Bottom Side   | 24                    | 23.75                 | -0.03       | 0.00526       | 0.006                  |
| T95      | LTE B12_CatM1 | QPSK10M | 23095   | 3  | 0      | 0        | Front Face    | 24                    | 23.70                 | -0.02       | <b>0.246</b>  | <b>0.264</b>           |
| T96      | LTE B12_CatM1 | QPSK10M | 23095   | 3  | 0      | 0        | Rear Face     | 24                    | 23.70                 | 0.04        | 0.034         | 0.036                  |
| T97      | LTE B12_CatM1 | QPSK10M | 23095   | 3  | 0      | 0        | Left Side     | 24                    | 23.70                 | 0.12        | 0.13          | 0.139                  |
| T98      | LTE B12_CatM1 | QPSK10M | 23095   | 3  | 0      | 0        | Right Side    | 24                    | 23.70                 | -0.04       | 0.06          | 0.064                  |
| T99      | LTE B12_CatM1 | QPSK10M | 23095   | 3  | 0      | 0        | Top Side      | 24                    | 23.70                 | NA          | <0.001        | <0.001                 |
| T100     | LTE B12_CatM1 | QPSK10M | 23095   | 3  | 0      | 0        | Bottom Side   | 24                    | 23.70                 | -0.09       | 0.00536       | 0.006                  |

Note:1.The value with boldface is the maximum SAR Value of each test band.

2.The area scan SAR result <0.001,can not find zoom scan cube.

### 3) SAR test results of LTE\_NB-lot\_separation distance=0.5cm

| Test No. | Band        | Mode       | Channel | Ntones | Test Position | Maximum Tune-up (dBm) | Conducted Power (dBm) | Power Drift | SAR 1g (W/kg) | Reported 1g SAR (W/kg) |
|----------|-------------|------------|---------|--------|---------------|-----------------------|-----------------------|-------------|---------------|------------------------|
| T209     | LTE B2_NB1  | QPSK_15KHz | 19199   | 3@3    | Front Face    | 24.5                  | 24.06                 | 0.04        | <b>0.678</b>  | <b>0.750</b>           |
| T210     | LTE B2_NB1  | QPSK_15KHz | 19199   | 3@3    | Rear Face     | 24.5                  | 24.06                 | 0.01        | 0.164         | 0.181                  |
| T211     | LTE B2_NB1  | QPSK_15KHz | 19199   | 3@3    | Left Side     | 24.5                  | 24.06                 | -0.06       | 0.133         | 0.147                  |
| T212     | LTE B2_NB1  | QPSK_15KHz | 19199   | 3@3    | Right Side    | 24.5                  | 24.06                 | -0.14       | 0.00616       | 0.007                  |
| T213     | LTE B2_NB1  | QPSK_15KHz | 19199   | 3@3    | Top Side      | 24.5                  | 24.06                 | 0.05        | 0.103         | 0.114                  |
| T214     | LTE B2_NB1  | QPSK_15KHz | 19199   | 3@3    | Bottom Side   | 24.5                  | 24.06                 | 0.09        | 0.08          | 0.089                  |
| T227     | LTE B4_NB1  | QPSK_15KHz | 19951   | 3@3    | Front Face    | 23.5                  | 23.41                 | 0.1         | <b>0.177</b>  | <b>0.181</b>           |
| T228     | LTE B4_NB1  | QPSK_15KHz | 19951   | 3@3    | Rear Face     | 23.5                  | 23.41                 | -0.08       | 0.000824      | 0.001                  |
| T229     | LTE B4_NB1  | QPSK_15KHz | 19951   | 3@3    | Left Side     | 23.5                  | 23.41                 | -0.14       | 0.041         | 0.042                  |
| T230     | LTE B4_NB1  | QPSK_15KHz | 19951   | 3@3    | Right Side    | 23.5                  | 23.41                 | -0.16       | 0.011         | 0.011                  |
| T231     | LTE B4_NB1  | QPSK_15KHz | 19951   | 3@3    | Top Side      | 23.5                  | 23.41                 | 0.06        | 0.055         | 0.056                  |
| T232     | LTE B4_NB1  | QPSK_15KHz | 19951   | 3@3    | Bottom Side   | 23.5                  | 23.41                 | 0.04        | 0.032         | 0.033                  |
| T245     | LTE B12_NB1 | QPSK_15KHz | 23011   | 3@3    | Front Face    | 22.5                  | 22.22                 | 0           | <b>0.035</b>  | <b>0.037</b>           |
| T246     | LTE B12_NB1 | QPSK_15KHz | 23011   | 3@3    | Rear Face     | 22.5                  | 22.22                 | NA          | <0.001        | <0.001                 |
| T247     | LTE B12_NB1 | QPSK_15KHz | 23011   | 3@3    | Left Side     | 22.5                  | 22.22                 | NA          | <0.001        | <0.001                 |
| T248     | LTE B12_NB1 | QPSK_15KHz | 23011   | 3@3    | Right Side    | 22.5                  | 22.22                 | 0.06        | 0.011         | 0.012                  |
| T249     | LTE B12_NB1 | QPSK_15KHz | 23011   | 3@3    | Top Side      | 22.5                  | 22.22                 | 0.15        | 0.016         | 0.017                  |
| T250     | LTE B12_NB1 | QPSK_15KHz | 23011   | 3@3    | Bottom Side   | 22.5                  | 22.22                 | NA          | <0.001        | <0.001                 |

Note:1.The value with boldface is the maximum SAR Value of each test band.

2.The area scan SAR result <0.001,can not find zoom scan cube.

## 9. STANDALONE SAR TEST EXCLUSION CONSIDERATIONS & ESTIMATED SAR

Per FCC KDB 447498 D01, the 1-g SAR and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances  $\leq 50$  mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})][\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR and  $\leq 7.5$  for product specific 10-g SAR, where:

- $f(\text{GHz})$  is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm is applied to determine SAR test exclusion.

Standalone SAR test exclusion for WIFI and BT

| Mode    | Position | $P_{\text{max}}$<br>(dBm)* | $P_{\text{max}}$<br>(mW) | Distance<br>(mm) | f<br>(GHz) | Calculation<br>Result | SAR<br>Exclusion<br>threshold | Test<br>Requirement<br>(Yes/No) |
|---------|----------|----------------------------|--------------------------|------------------|------------|-----------------------|-------------------------------|---------------------------------|
| 802.11b | Body     | 9                          | 7.94                     | 5                | 2.412      | 2.467                 | 3                             | No                              |
| BT      | Body     | 1                          | 1.26                     | 5                | 2.48       | 0.395                 | 3                             | No                              |

Note: Therefore, WIFI and BT standalone SAR are not required.

When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

- $(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm}) \cdot [\sqrt{f(\text{GHz})}/x] \text{ W/kg}$  for test separation distances  $\leq 50$  mm, where  $x = 7.5$  for 1-g SAR and  $x = 18.75$  for 10-g SAR.
- 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distance is  $> 50$  mm.

According to KDB 447498 D01, when standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR was estimated according to following formula to result in substantially conservative SAR values of  $\leq 0.4 \text{ W/kg}$  to determine simultaneous transmission SAR test exclusion.

$$\text{Estimated SAR} = \frac{\text{Max. Tune up Power}_{(\text{mW})}}{\text{Min. Test Separation Distance}_{(\text{mm})}} \times \frac{\sqrt{f_{(\text{GHz})}}}{7.5}$$

| Mode    | Position | $P_{\text{max}}$<br>(dBm)* | $P_{\text{max}}$<br>(mW) | Distance<br>(mm) | f<br>(GHz) | X   | Estimated<br>1-g SAR<br>(W/kg) |
|---------|----------|----------------------------|--------------------------|------------------|------------|-----|--------------------------------|
| 802.11b | Body     | 9                          | 7.94                     | 5                | 2.412      | 7.5 | 0.33                           |
| BT      | Body     | 1                          | 1.26                     | 5                | 2.48       | 7.5 | 0.053                          |

## 10. MULTIPLE TRANSMITTER EVALUATION

The EUT not support simultaneous transmission.

## APPENDIX

### 1. Test Layout

#### Specific Absorption Rate Test Layout

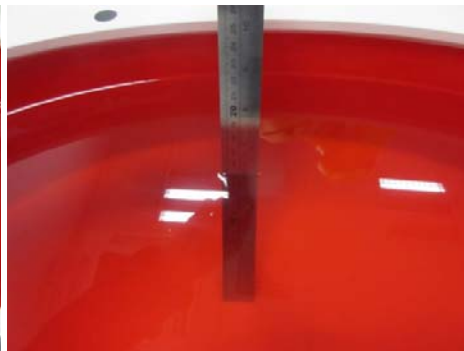


Liquid depth in the flat Phantom ( $\geq 15\text{cm}$  depth)

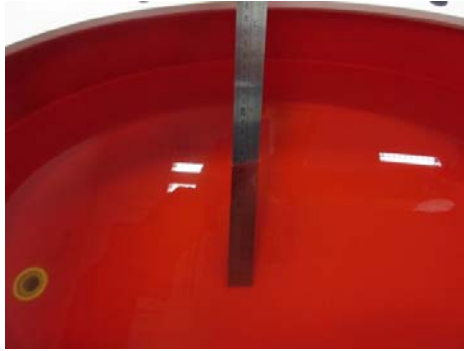
MSL(750MHz)



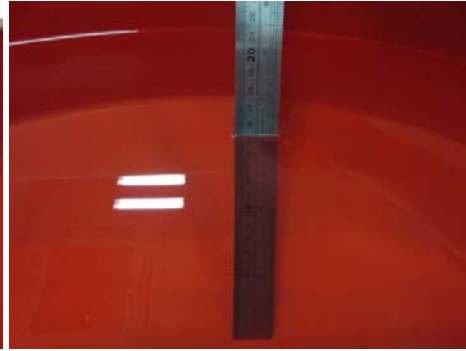
MSL(835MHz)



Body(1750MHz)\_15.6cm



Body(1900~3800MHz)\_15.6cm



## **Appendix A. SAR Plots of System Verification**

(Pls See BTL-FCC SAR-1-1903T095\_Appendix A.)

## **Appendix B. SAR Plots of SAR Measurement**

(Pls See BTL-FCC SAR-1-1903T095\_Appendix B.)

## **Appendix C. Calibration Certificate**

(Pls See BTL-FCC SAR-1-1903T095\_Appendix C.)

## **Appendix D. Photographs of the Test Set-Up**

(Pls See BTL-FCC SAR-1-1903T095\_Appendix D.)

**End of Test Report**