



## **SAR EVALUATION REPORT**

**IEEE Std 1528-2013**

*For*

**GSM/WCDMA/LTE Phone with BT, DTS/UNII a/b/g/n/ac and NFC**

**FCC ID: A3LSMG398FN**

**Model Name: SM-G398FN/DS, SM-G398FN**

**Report Number: 12810732-S1V2**

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NVLAP LAB CODE 200065-0

**Revision History**

| Rev. | Date      | Revisions                                                                                                                                          | Revised By      |
|------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| V1   | 5/14/2019 | Initial Issue                                                                                                                                      | --              |
| V2   | 5/17/2019 | Section 1: Updated UNII Highest Reported SAR<br>Section 4.3: Updated Cal due dates<br>Appendix A: Updated Antenna Locations and Dist. illustration | Coltyce Sanders |
|      |           |                                                                                                                                                    |                 |
|      |           |                                                                                                                                                    |                 |

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## 1. Attestation of Test Results

|                                               |           |                                                            |       |                                                              |       |
|-----------------------------------------------|-----------|------------------------------------------------------------|-------|--------------------------------------------------------------|-------|
| Applicant Name                                |           | Samsung Electronics Co. Ltd                                |       |                                                              |       |
| FCC ID                                        |           | A3LSMG398FN                                                |       |                                                              |       |
| Model Name                                    |           | SM-G398FN/DS, SM-G398FN                                    |       |                                                              |       |
| Applicable Standards                          |           | Published RF exposure KDB procedures<br>IEEE Std 1528-2013 |       |                                                              |       |
| Exposure Category                             |           | SAR Limits (W/Kg)                                          |       |                                                              |       |
|                                               |           | Peak spatial-average<br>(1g of tissue)                     |       | Extremities (hands, wrists, ankles, etc.)<br>(10g of tissue) |       |
| General population /<br>Uncontrolled exposure |           | 1.6                                                        |       | 4                                                            |       |
| RF Exposure Conditions                        |           | Equipment Class - Highest Reported SAR (W/kg)              |       |                                                              |       |
|                                               |           | PCE                                                        | DTS   | NII                                                          | DSS   |
| Head                                          |           | 0.929                                                      | 0.403 | 0.053                                                        | 0.121 |
| Body-worn                                     |           | 0.692                                                      | 0.066 | 0.682                                                        | 0.015 |
| Hotspot                                       |           | 0.911                                                      | 0.115 | 0.925                                                        | 0.025 |
| Simultaneous TX                               | Head      | 1.198                                                      | 1.198 | 0.982                                                        | 0.982 |
|                                               | Body-worn | 1.243                                                      | 0.758 | 1.243                                                        | 0.708 |
|                                               | Hotspot   | 1.575                                                      | 1.026 | 1.575                                                        | 0.936 |
| Date Tested                                   |           | 4/22/2019 to 5/10/2019                                     |       |                                                              |       |
| Test Results                                  |           | Pass                                                       |       |                                                              |       |

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

|                                                                                     |                                                                                      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Approved & Released By:                                                             | Prepared By:                                                                         |
|  |  |
| Devin Chang<br>Senior Test Engineer<br>UL Verification Services Inc.                | AJ Newcomer<br>Laboratory Engineer<br>UL Verification Services Inc.                  |

## 2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEEE STD 1528-2013, the following FCC Published RF exposure [KDB](#) procedures:

- o 248227 D01 802.11 Wi-Fi SAR v02r02
- o 447498 D01 General RF Exposure Guidance v06
- o 447498 D03 Supplement C Cross-Reference v01
- o 648474 D04 Handset SAR v01r03
- o 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- o 865664 D02 RF Exposure Reporting v01r02
- o 941225 D01 3G SAR Procedures v03r01
- o 941225 D05 SAR for LTE Devices v02r05
- o 941225 D06 Hotspot Mode v02r01

In addition to the above, the following information was used:

- o [TCB workshop](#) October 2015; RF Exposure Procedures (KDB 941225 D05A)
- o [TCB workshop](#) October 2016; RF Exposure Procedures (Bluetooth Duty Factor)
- o [TCB workshop](#) October 2016; RF Exposure Procedures (DUT Holder Perturbations)
- o [TCB workshop](#) May 2017; RF Exposure Procedures (Broadband Liquid Above 3 GHz)

## 3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at

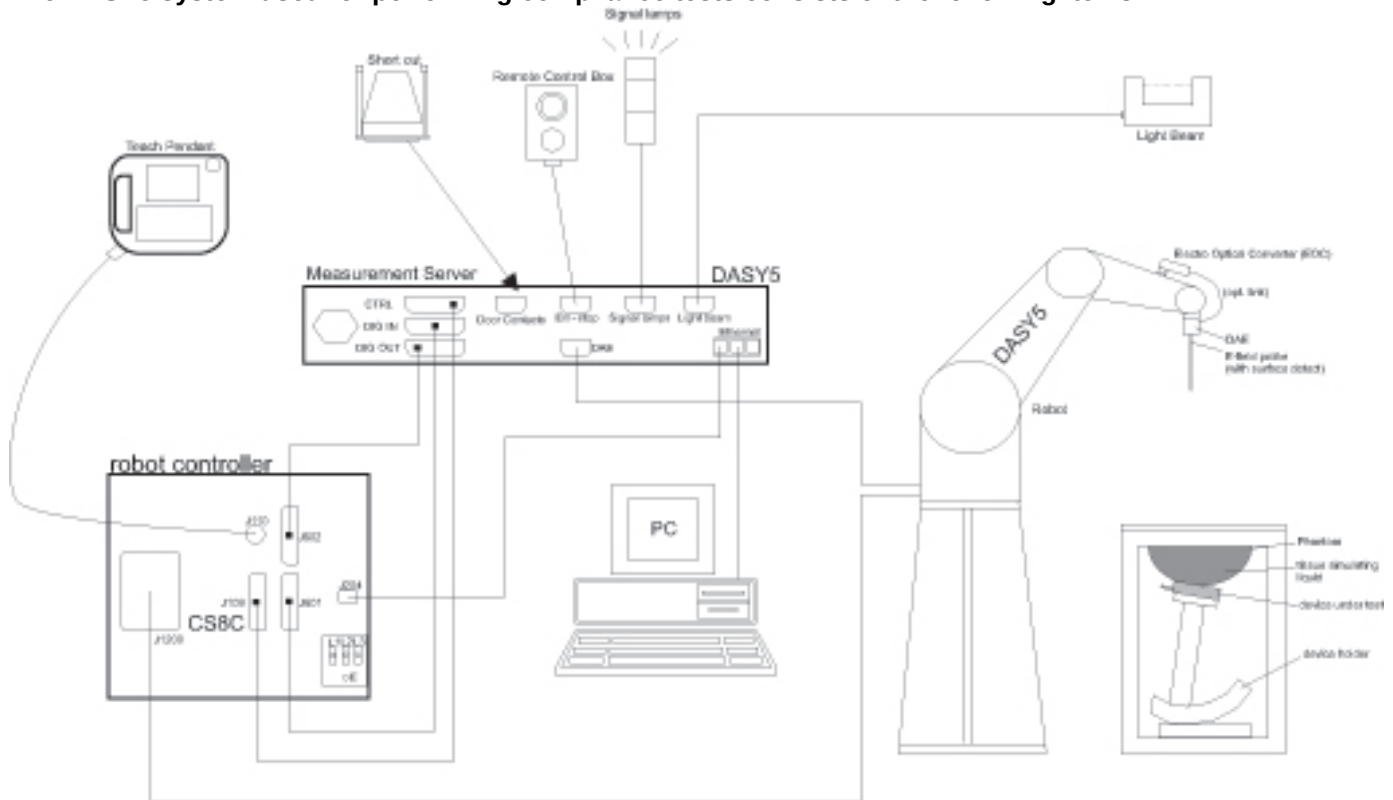
| 47173 Benicia Street | 47266 Benicia Street |
|----------------------|----------------------|
| SAR Lab A            | SAR Lab 1            |
| SAR Lab B            | SAR Lab 2            |
| SAR Lab C            | SAR Lab 3            |
| SAR Lab D            | SAR Lab 4            |
| SAR Lab E            | SAR Lab 5            |
| SAR Lab F            |                      |
| SAR Lab G            |                      |
| SAR Lab H            |                      |

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

## 4. SAR Measurement System & Test Equipment

### 4.1. SAR Measurement System

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



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (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.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

## 4.2. SAR Scan Procedures

### Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

### Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

|                                                                                                        | $\leq 3$ GHz                                                                                                                                                                                                                                                           | $> 3$ GHz                                              |
|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | $5 \pm 1$ mm                                                                                                                                                                                                                                                           | $\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm     |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location              | $30^\circ \pm 1^\circ$                                                                                                                                                                                                                                                 | $20^\circ \pm 1^\circ$                                 |
| Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$                 | $\leq 2$ GHz: $\leq 15$ mm<br>$2 - 3$ GHz: $\leq 12$ mm                                                                                                                                                                                                                | $3 - 4$ GHz: $\leq 12$ mm<br>$4 - 6$ GHz: $\leq 10$ mm |
|                                                                                                        | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device. |                                                        |

**Step 3: Zoom Scan**

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

|                                                                                                                                                                                                                                                                                                             |                                           |                                                                                             | $\leq 3$ GHz                                         | $> 3$ GHz                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------|
| Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$                                                                                                                                                                                                                      |                                           |                                                                                             | $\leq 2$ GHz: $\leq 8$ mm<br>2 – 3 GHz: $\leq 5$ mm* | 3 – 4 GHz: $\leq 5$ mm*<br>4 – 6 GHz: $\leq 4$ mm*                            |
| Maximum zoom scan spatial resolution, normal to phantom surface                                                                                                                                                                                                                                             | uniform grid: $\Delta z_{\text{Zoom}}(n)$ |                                                                                             | $\leq 5$ mm                                          | 3 – 4 GHz: $\leq 4$ mm<br>4 – 5 GHz: $\leq 3$ mm<br>5 – 6 GHz: $\leq 2$ mm    |
|                                                                                                                                                                                                                                                                                                             | graded grid                               | $\Delta z_{\text{Zoom}}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface | $\leq 4$ mm                                          | 3 – 4 GHz: $\leq 3$ mm<br>4 – 5 GHz: $\leq 2.5$ mm<br>5 – 6 GHz: $\leq 2$ mm  |
|                                                                                                                                                                                                                                                                                                             |                                           | $\Delta z_{\text{Zoom}}(n>1)$ : between subsequent points                                   | $\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$         |                                                                               |
| Minimum zoom scan volume                                                                                                                                                                                                                                                                                    | x, y, z                                   |                                                                                             | $\geq 30$ mm                                         | 3 – 4 GHz: $\geq 28$ mm<br>4 – 5 GHz: $\geq 25$ mm<br>5 – 6 GHz: $\geq 22$ mm |
| Note: $\delta$ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.                                                                                                                                                           |                                           |                                                                                             |                                                      |                                                                               |
| * When zoom scan is required and the <u>reported</u> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB 447498 is $\leq 1.4$ W/kg, $\leq 8$ mm, $\leq 7$ mm and $\leq 5$ mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz. |                                           |                                                                                             |                                                      |                                                                               |

**Step 4: Power drift measurement**

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

### 4.3. Test Equipment

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

| Name of Equipment    | Manufacturer      | Type/Model    | Serial No.    | Cal. Due Date |
|----------------------|-------------------|---------------|---------------|---------------|
| Network Analyzer     | R&S               | ZNLE6         | 101273-VA     | 7/16/2019     |
| Dielectric Probe kit | SPEAG             | DAK-3.5       | 1082          | 9/11/2019     |
| Shorting block       | SPEAG             | DAK-3.5 Short | SM DAK 200 BA | 9/11/2019     |
| Thermometer          | Fisher Scientific | Traceable     | 140562250     | 3/5/2020      |

#### System Check

| Name of Equipment            | Manufacturer    | Type/Model             | Serial No. | Cal. Due Date |
|------------------------------|-----------------|------------------------|------------|---------------|
| Signal Generator             | Rhode & Schwarz | SMB100A                | 180970     | 2/13/2020     |
| Power Sensor                 | Rhode & Schwarz | NRP18A                 | 100994     | 2/15/2020     |
| Synthesized Signal Generator | Agilent         | N5181A                 | MY50140610 | 1/31/2020     |
| Power Meter                  | Keysight        | N1912A                 | MY50001018 | 1/30/2020     |
| Power Sensor*                | Agilent         | N1921A                 | MY53020038 | 4/23/2019     |
| Power Sensor                 | Agilent         | N1921A                 | MY52260009 | 2/5/2020      |
| Amplifier                    | MITEQ           | AMF-4D-00400600-50-30P | 1795092    | N/A           |
| Directional coupler          | Werlatone       | C8060-102              | 2149       | N/A           |
| DC Power Supply              | Sorensen        | XT 15-4                | 1817A02680 | N/A           |

#### Note(s):

\*Equipment not used past calibration due date.

#### Lab Equipment

| Name of Equipment                        | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|------------------------------------------|--------------|------------|------------|---------------|
| E-Field Probe (SAR Lab E)                | SPEAG        | EX3DV4     | 3990       | 8/17/2019     |
| E-Field Probe (SAR Lab F)                | SPEAG        | EX3DV4     | 3902       | 5/24/2019     |
| E-Field Probe (SAR Lab G)                | SPEAG        | EX3DV4     | 7463       | 7/20/2019     |
| E-Field Probe (SAR Lab H)                | SPEAG        | EX3DV4     | 7482       | 7/23/2019     |
| Data Acquisition Electronics (SAR Lab E) | SPEAG        | DAE4       | 1357       | 2/13/2020     |
| Data Acquisition Electronics (SAR Lab F) | SPEAG        | DAE4       | 1439       | 7/10/2019     |
| Data Acquisition Electronics (SAR Lab G) | SPEAG        | DAE4       | 1257       | 9/14/2019     |
| Data Acquisition Electronics (SAR Lab H) | SPEAG        | DAE4       | 1239       | 7/11/2019     |
| System Validation Dipole                 | SPEAG        | D835V2     | 4d002      | 11/28/2019    |
| System Validation Dipole                 | SPEAG        | D1900V2    | 5d043      | 11/29/2019    |
| System Validation Dipole                 | SPEAG        | D2450V2    | 899        | 3/22/2020     |
| System Validation Dipole                 | SPEAG        | D5GHzV2    | 1003       | 2/19/2020     |
| System Validation Dipole                 | SPEAG        | D5GHzV2    | 1168       | 11/30/2019    |

#### Other

| Name of Equipment      | Manufacturer | Type/Model           | T Number | Serial No. | Cal. Due Date |
|------------------------|--------------|----------------------|----------|------------|---------------|
| Power Meter            | Agilent      | N1912A               | T1263    | MY55196004 | 1/30/2020     |
| Power Sensor           | Agilent      | N1921A               | T309     | MY52270022 | 2/6/2020      |
| Base Station Simulator | R & S        | CMW500               | T959     | 135384     | 2/16/2020     |
| Base Station Simulator | R & S        | CBT Bluetooth Tester | T438     | 100987     | 2/14/2020     |

## 5. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be  $\leq 30\%$ , for a confidence interval of  $k = 2$ . If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

Therefore, the measurement uncertainty is not required.

## 6. Device Under Test (DUT) Information

### 6.1. DUT Description

|                               |                                                                                                                                                                                                                                                           |                 |                         |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------------|
| Device Dimension              | This is a general size smart phone                                                                                                                                                                                                                        |                 |                         |
| Back Cover                    | Normal Battery Cover                                                                                                                                                                                                                                      |                 |                         |
| Battery Options               | Standard – Lithium-ion battery, Rating 3.85 Vdc, 10.78 Wh                                                                                                                                                                                                 |                 |                         |
| Accessory                     | Headset                                                                                                                                                                                                                                                   |                 |                         |
| Wireless Router (Hotspot)     | Wi-Fi Hotspot mode permits the device to share its cellular data connection with other Wi-Fi-enabled devices.<br><input checked="" type="checkbox"/> Mobile Hotspot (Wi-Fi 2.4 GHz)<br><input checked="" type="checkbox"/> Mobile Hotspot (Wi-Fi 5.8 GHz) |                 |                         |
| Wi-Fi Direct                  | Wi-Fi Direct enabled devices transfer data directly between each other<br><input checked="" type="checkbox"/> Wi-Fi Direct (Wi-Fi 2.4 GHz)<br><input checked="" type="checkbox"/> Wi-Fi Direct (Wi-Fi 5.2/5.8 GHz)                                        |                 |                         |
| Bluetooth Tethering (Hotspot) | BT Tethering mode permits the device to share its cellular data connection with other devices.<br><input checked="" type="checkbox"/> BT Tethering (Bluetooth 2.4 GHz)                                                                                    |                 |                         |
| Test sample information       | <b>S/N</b>                                                                                                                                                                                                                                                | <b>IMEI</b>     | <b>Notes</b>            |
|                               | R38M4043KZX                                                                                                                                                                                                                                               | 356789100001161 | WWAN Conducted          |
|                               | R38M4044P6R                                                                                                                                                                                                                                               | 356789100013117 | WLAN Conducted          |
|                               | R38M40441TE                                                                                                                                                                                                                                               | 356789100006061 | WWAN Radiated           |
|                               | R38M40441LH                                                                                                                                                                                                                                               | 356789100005998 | WWAN Radiated           |
|                               | R38M40441QJ                                                                                                                                                                                                                                               | 356789100006038 | WWAN Radiated           |
|                               | R38M40441XP                                                                                                                                                                                                                                               | 356789100006095 | WWAN Radiated           |
|                               | R38M4044FHW                                                                                                                                                                                                                                               | 356789100010584 | WLAN Radiated           |
|                               | R38M4044F2V                                                                                                                                                                                                                                               | 356789100010436 | WLAN Radiated           |
|                               | R38M40AHTZP                                                                                                                                                                                                                                               | 356789100051968 | WWAN Conducted/Radiated |
| Hardware Version              | REV0.1                                                                                                                                                                                                                                                    |                 |                         |
| Software Version              | G398FN.001                                                                                                                                                                                                                                                |                 |                         |

## 6.2. Wireless Technologies

| Wireless technologies | Frequency bands                                                                                                        | Operating mode                                                                                                   |                                                               | Duty Cycle used for SAR testing                                                                                                                     |
|-----------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| GSM                   | 850<br>1900                                                                                                            | Voice (GMSK)<br>GPRS (GMSK)<br>EDGE (8PSK)                                                                       | GSM Class : B<br>Multi-Slot Class:<br>Class 33 - 4 Up, 5 Down | GSM Voice: 12.5%<br>(E)GPRS: 1 Slot: 12.5%<br>2 Slots: 25%<br>3 Slots: 37.5%<br>4 Slots: 50%                                                        |
|                       | Does this device support DTM (Dual Transfer Mode)? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |                                                                                                                  |                                                               |                                                                                                                                                     |
| W-CDMA (UMTS)         | Band II<br>Band V                                                                                                      | UMTS Rel. 99 (Voice & Data)<br>HSDPA (Cat. 24)<br>HSUPA (Cat. 6)<br>DC-HSDPA (Cat. 24)<br>HSPA+ (Rel. 7) DL only |                                                               | 100%                                                                                                                                                |
| LTE                   | FDD Band 5                                                                                                             | QPSK<br>16QAM<br>Rel. 10 Does not support Carrier Aggregation (CA)                                               |                                                               | 100% (FDD)                                                                                                                                          |
|                       | Does this device support SV-LTE (1xRTT-LTE)? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No       |                                                                                                                  |                                                               |                                                                                                                                                     |
| Wi-Fi                 | 2.4 GHz                                                                                                                | 802.11b<br>802.11g<br>802.11n (HT20)                                                                             |                                                               | 98.67% <sub>(802.11b)</sub> <sup>1</sup>                                                                                                            |
|                       | 5 GHz                                                                                                                  | 802.11a<br>802.11n (HT20)<br>802.11n (HT40)<br>802.11ac (VHT20)<br>802.11ac (VHT40)<br>802.11ac (VHT80)          |                                                               | 92.44% <sub>(802.11a)</sub> <sup>1</sup><br>91.99% <sub>(802.11n 20MHz BW)</sub> <sup>1</sup><br>95.96% <sub>(802.11ac 80MHz BW)</sub> <sup>1</sup> |
|                       | Does this device support bands 5.60 ~ 5.65 GHz? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No    |                                                                                                                  |                                                               |                                                                                                                                                     |
|                       | Does this device support Band gap channel(s)? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No      |                                                                                                                  |                                                               |                                                                                                                                                     |
| Bluetooth             | 2.4 GHz                                                                                                                | BR, EDR, LE                                                                                                      |                                                               | 76.72%                                                                                                                                              |

### Notes:

1. Duty cycle for Wi-Fi is referenced from the DTS and UNII report.

### 6.3. General LTE SAR Test and Reporting Considerations

| Item                                                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                              |        |                         |                 |                 |                 |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--------|-------------------------|-----------------|-----------------|-----------------|------------|---------------------------------------------------------------|--|--|--|--|--|----------|---------|---------|-------|--------|--------|--------|------|-----|-----|-----|------|------|------|-----|--------|-----|-----|-----|------|------|------|-----|--------|-----|-----|-----|------|------|------|-----|--------|-----|-----|-----|------|------|------|-----|--------|-----|-----|-----|------|------|------|-----|---------|-----|--|--|--|--|--|-----|
| Frequency range, Channel Bandwidth, Numbers and Frequencies | Band 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Frequency range: 824 - 849 MHz (BW = 25 MHz) |        |                         |                 |                 |                 |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
|                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Channel Bandwidth                            |        |                         |                 |                 |                 |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
|                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 20 MHz                                       | 15 MHz | 10 MHz <sup>1</sup>     | 5 MHz           | 3 MHz           | 1.4 MHz         |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
|                                                             | Low                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                              |        | 20450/<br>829           | 20425/<br>826.5 | 20415/<br>825.5 | 20407/<br>824.7 |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
|                                                             | Mid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                              |        | <b>20525/<br/>836.5</b> | 20525/<br>836.5 | 20525/<br>836.5 | 20525/<br>836.5 |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
|                                                             | High                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                              |        | 20600/<br>844           | 20625/<br>846.5 | 20635/<br>847.5 | 20643/<br>848.3 |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
| LTE transmitter and antenna implementation                  | Refer to Appendix A.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                              |        |                         |                 |                 |                 |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
| Maximum power reduction (MPR)                               | <div><b>Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3</b></div> <table><tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth (N<sub>RB</sub>)</th><th rowspan="2">MPR (dB)</th></tr><tr><th>1.4 MHz</th><th>3.0 MHz</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th></tr><tr><td>QPSK</td><td>&gt; 5</td><td>&gt; 4</td><td>&gt; 8</td><td>&gt; 12</td><td>&gt; 16</td><td>&gt; 18</td><td>≤ 1</td></tr><tr><td>16 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 1</td></tr><tr><td>16 QAM</td><td>&gt; 5</td><td>&gt; 4</td><td>&gt; 8</td><td>&gt; 12</td><td>&gt; 16</td><td>&gt; 18</td><td>≤ 2</td></tr><tr><td>64 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 2</td></tr><tr><td>64 QAM</td><td>&gt; 5</td><td>&gt; 4</td><td>&gt; 8</td><td>&gt; 12</td><td>&gt; 16</td><td>&gt; 18</td><td>≤ 3</td></tr><tr><td>256 QAM</td><td colspan="6">≥ 1</td><td>≤ 5</td></tr></table> <p>MPR Built-in by design</p> <p>The manufacturer MPR values are always within the 3GPP maximum MPR allowance but may not follow the default MPR values.</p> <p>A-MPR (additional MPR) was disabled during SAR testing</p> |                                              |        |                         |                 |                 |                 | 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 | > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | ≤ 1 | 16 QAM | ≤ 5 | ≤ 4 | ≤ 8 | ≤ 12 | ≤ 16 | ≤ 18 | ≤ 1 | 16 QAM | > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | ≤ 2 | 64 QAM | ≤ 5 | ≤ 4 | ≤ 8 | ≤ 12 | ≤ 16 | ≤ 18 | ≤ 2 | 64 QAM | > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | ≤ 3 | 256 QAM | ≥ 1 |  |  |  |  |  | ≤ 5 |
| 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                                                        | > 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | > 4                                          | > 8    | > 12                    | > 16            | > 18            | ≤ 1             |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
| 16 QAM                                                      | ≤ 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ≤ 4                                          | ≤ 8    | ≤ 12                    | ≤ 16            | ≤ 18            | ≤ 1             |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
| 16 QAM                                                      | > 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | > 4                                          | > 8    | > 12                    | > 16            | > 18            | ≤ 2             |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
| 64 QAM                                                      | ≤ 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ≤ 4                                          | ≤ 8    | ≤ 12                    | ≤ 16            | ≤ 18            | ≤ 2             |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
| 64 QAM                                                      | > 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | > 4                                          | > 8    | > 12                    | > 16            | > 18            | ≤ 3             |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
| 256 QAM                                                     | ≥ 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                              |        |                         |                 |                 | ≤ 5             |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
| Power reduction                                             | No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                              |        |                         |                 |                 |                 |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |
| Spectrum plots for RB configurations                        | A properly configured base station simulator was used for the SAR and power measurements; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                              |        |                         |                 |                 |                 |            |                                                               |  |  |  |  |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |         |     |  |  |  |  |  |     |

#### Notes:

- Maximum bandwidth does not support at least three non-overlapping channels in certain channel bandwidths. When a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing per KDB 941225 D05 SAR for LTE Devices.
- SAR Testing for LTE was performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

## 6.4. Power Back-off and Triggering Distances

This device supports multiple power back-off modes: WWAN (Hotspot), WWAN (Grip Sensor), WWAN (Proxy + RCV), and WLAN (RCV+IR Sensor). Each of the power back-off modes operates within specific exposure conditions for certain technologies.

WWAN (Hotspot), WWAN (Grip Sensor), and WWAN (Proxy + RCV) operate separately. The order of priority for when Power Back-off mode active is: WWAN (Grip Sensor) → WWAN (Proxy + RCV) → WWAN (Hotspot). However, SAR Testing for Hotspot Exposure Condition was performed using WWAN (Hotspot) Power Back-off levels because the WWAN (Hotspot) levels are higher or the same as WWAN (Grip Sensor). For a detailed description of the grip sensor refer to the WWAN sensor triggering distance data shown in the Operational Description.

WLAN back-off power supports an RCV+IR Sensor. This sensor activates in a held to ear exposure condition. When the sensor activates in this exposure condition, the output power level is reduced. For a detailed description of the RCV+IR sensor refer to the WLAN sensor triggering distance data shown in the Operational Description.

For full details on how each power back-off mode operates, refer to the Operational Description.

| Power Back-off mode | Technologies Supported     | Exposure Conditions Active |           |         |                      |
|---------------------|----------------------------|----------------------------|-----------|---------|----------------------|
|                     |                            | Head                       | Body-worn | Hotspot | Product Specific 10g |
| WWAN (Hotspot)      | GSM 1900<br>W-CDMA B2      | N/A                        | N/A       | ✓       | N/A                  |
| WWAN (Grip Sensor)  | GSM 1900<br>W-CDMA B2      | N/A                        | N/A       | N/A     | ✓                    |
| WWAN (Proxy + RCV)  | GSM 1900<br>W-CDMA B2      | ✓                          | N/A       | N/A     | N/A                  |
| WLAN (Proxy +RCV)   | Wi-Fi 2.4GHz<br>Wi-Fi 5GHz | ✓                          | N/A       | N/A     | N/A                  |

### Note(s):

Tune-Up Limits for WWAN (Hotspot), WWAN (Grip Sensor), WWAN (Proxy + RCV), and WLAN (Proxy + RCV) are Reduced Average Powers. Please refer to §9 for all power measurements.

## 7. RF Exposure Conditions (Test Configurations)

Refer to Appendix A for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

| Wireless technologies | RF Exposure Conditions | DUT-to-User Separation | Test Position    | Antenna-to-edge/surface | SAR Required | Note |
|-----------------------|------------------------|------------------------|------------------|-------------------------|--------------|------|
| WWAN                  | Head                   | 0 mm                   | Left Touch       | N/A                     | Yes          |      |
|                       |                        |                        | Left Tilt (15°)  | N/A                     | Yes          |      |
|                       |                        |                        | Right Touch      | N/A                     | Yes          |      |
|                       |                        |                        | Right Tilt (15°) | N/A                     | Yes          |      |
|                       | Body                   | 15 mm                  | Rear             | N/A                     | Yes          |      |
|                       |                        |                        | Front            | N/A                     | Yes          |      |
|                       | Hotspot                | 10 mm                  | Rear             | ≤ 25 mm                 | Yes          |      |
|                       |                        |                        | Front            | ≤ 25 mm                 | Yes          |      |
|                       |                        |                        | Edge 1 (Top)     | > 25 mm                 | No           | 1    |
|                       |                        |                        | Edge 2 (Right)   | > 25 mm                 | No           | 1    |
|                       |                        |                        | Edge 3 (Bottom)  | ≤ 25 mm                 | Yes          |      |
|                       |                        |                        | Edge 4 (Left)    | ≤ 25 mm                 | Yes          |      |
| WLAN                  | Head                   | 0 mm                   | Left Touch       | N/A                     | Yes          |      |
|                       |                        |                        | Left Tilt (15°)  | N/A                     | Yes          |      |
|                       |                        |                        | Right Touch      | N/A                     | Yes          |      |
|                       |                        |                        | Right Tilt (15°) | N/A                     | Yes          |      |
|                       | Body                   | 15 mm                  | Rear             | N/A                     | Yes          |      |
|                       |                        |                        | Front            | N/A                     | Yes          |      |
|                       | Hotspot                | 10 mm                  | Rear             | ≤ 25 mm                 | Yes          |      |
|                       |                        |                        | Front            | ≤ 25 mm                 | Yes          |      |
|                       |                        |                        | Edge 1 (Top)     | ≤ 25 mm                 | Yes          |      |
|                       |                        |                        | Edge 2 (Right)   | > 25 mm                 | No           | 1    |
|                       |                        |                        | Edge 3 (Bottom)  | > 25 mm                 | No           | 1    |
|                       |                        |                        | Edge 4 (Left)    | ≤ 25 mm                 | Yes          |      |

### Notes:

- SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR.

## 8. Dielectric Property Measurements & System Check

### 8.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within  $\pm 2^\circ\text{C}$  of the temperature when the tissue parameters are characterized.

The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.

Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.

The dielectric constant ( $\epsilon_r$ ) and conductivity ( $\sigma$ ) of typical tissue-equivalent media recipes are expected to be within  $\pm 5\%$  of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEEE Std 1528-2013, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for  $\epsilon_r$  and  $\sigma$  may be relaxed to  $\pm 10\%$ . This is limited to frequencies  $\leq 3$  GHz.

#### Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

| Target Frequency (MHz) | Head         |                | Body         |                |
|------------------------|--------------|----------------|--------------|----------------|
|                        | $\epsilon_r$ | $\sigma$ (S/m) | $\epsilon_r$ | $\sigma$ (S/m) |
| 150                    | 52.3         | 0.76           | 61.9         | 0.80           |
| 300                    | 45.3         | 0.87           | 58.2         | 0.92           |
| 450                    | 43.5         | 0.87           | 56.7         | 0.94           |
| 835                    | 41.5         | 0.90           | 55.2         | 0.97           |
| 900                    | 41.5         | 0.97           | 55.0         | 1.05           |
| 915                    | 41.5         | 0.98           | 55.0         | 1.06           |
| 1450                   | 40.5         | 1.20           | 54.0         | 1.30           |
| 1610                   | 40.3         | 1.29           | 53.8         | 1.40           |
| 1800 – 2000            | 40.0         | 1.40           | 53.3         | 1.52           |
| 2450                   | 39.2         | 1.80           | 52.7         | 1.95           |
| 3000                   | 38.5         | 2.40           | 52.0         | 2.73           |
| 5000                   | 36.2         | 4.45           | 49.3         | 5.07           |
| 5100                   | 36.1         | 4.55           | 49.1         | 5.18           |
| 5200                   | 36.0         | 4.66           | 49.0         | 5.30           |
| 5300                   | 35.9         | 4.76           | 48.9         | 5.42           |
| 5400                   | 35.8         | 4.86           | 48.7         | 5.53           |
| 5500                   | 35.6         | 4.96           | 48.6         | 5.65           |
| 5600                   | 35.5         | 5.07           | 48.5         | 5.77           |
| 5700                   | 35.4         | 5.17           | 48.3         | 5.88           |
| 5800                   | 35.3         | 5.27           | 48.2         | 6.00           |

#### IEEE Std 1528-2013

Refer to Table 3 within the IEEE Std 1528-2013

**Dielectric Property Measurements Results:**

| SAR Lab | Date      | Band (MHz) | Tissue Type | Frequency (MHz) | Relative Permittivity ( $\epsilon_r$ ) |        |           | Conductivity ( $\sigma$ ) |        |           |
|---------|-----------|------------|-------------|-----------------|----------------------------------------|--------|-----------|---------------------------|--------|-----------|
|         |           |            |             |                 | Measured                               | Target | Delta (%) | Measured                  | Target | Delta (%) |
| E       | 4/24/2019 | 1900       | Body        | 1900            | 52.97                                  | 53.30  | -0.62     | 1.58                      | 1.52   | 3.95      |
|         |           |            |             | 1850            | 53.00                                  | 53.30  | -0.56     | 1.56                      | 1.52   | 2.76      |
|         |           |            |             | 1920            | 52.87                                  | 53.30  | -0.81     | 1.59                      | 1.52   | 4.54      |
| F       | 4/22/2019 | 5250       | Head        | 5250            | 36.40                                  | 35.93  | 1.30      | 4.51                      | 4.70   | -4.19     |
|         |           |            |             | 5150            | 36.58                                  | 36.05  | 1.48      | 4.40                      | 4.60   | -4.30     |
|         |           |            |             | 5350            | 36.23                                  | 35.82  | 1.15      | 4.62                      | 4.80   | -3.80     |
| F       | 4/22/2019 | 5600       | Head        | 5600            | 35.83                                  | 35.53  | 0.83      | 4.87                      | 5.06   | -3.72     |
|         |           |            |             | 5500            | 35.99                                  | 35.65  | 0.96      | 4.75                      | 4.96   | -4.15     |
|         |           |            |             | 5725            | 35.59                                  | 35.39  | 0.56      | 5.03                      | 5.19   | -3.07     |
| F       | 4/22/2019 | 5750       | Head        | 5750            | 35.56                                  | 35.36  | 0.56      | 5.06                      | 5.21   | -2.93     |
|         |           |            |             | 5700            | 35.66                                  | 35.42  | 0.68      | 5.00                      | 5.16   | -3.15     |
|         |           |            |             | 5850            | 35.41                                  | 35.30  | 0.31      | 5.16                      | 5.27   | -2.07     |
| F       | 4/25/2019 | 2450       | Head        | 2450            | 37.90                                  | 39.20  | -3.32     | 1.83                      | 1.80   | 1.44      |
|         |           |            |             | 2400            | 37.96                                  | 39.30  | -3.40     | 1.79                      | 1.75   | 1.90      |
|         |           |            |             | 2480            | 37.92                                  | 39.16  | -3.17     | 1.85                      | 1.83   | 0.69      |
| F       | 4/25/2019 | 2450       | Body        | 2450            | 51.81                                  | 52.70  | -1.69     | 2.02                      | 1.95   | 3.69      |
|         |           |            |             | 2400            | 51.87                                  | 52.77  | -1.71     | 1.98                      | 1.90   | 4.21      |
|         |           |            |             | 2480            | 51.80                                  | 52.66  | -1.64     | 2.04                      | 1.99   | 2.60      |
| F       | 5/2/2019  | 5600       | Body        | 5600            | 47.07                                  | 48.48  | -2.90     | 5.83                      | 5.76   | 1.13      |
|         |           |            |             | 5500            | 47.29                                  | 48.61  | -2.72     | 5.66                      | 5.64   | 0.31      |
|         |           |            |             | 5725            | 46.76                                  | 48.31  | -3.21     | 6.01                      | 5.91   | 1.77      |
| G       | 4/24/2019 | 835        | Head        | 835             | 39.91                                  | 41.50  | -3.83     | 0.93                      | 0.90   | 3.62      |
|         |           |            |             | 805             | 39.98                                  | 41.68  | -4.08     | 0.92                      | 0.90   | 2.70      |
|         |           |            |             | 850             | 39.86                                  | 41.50  | -3.95     | 0.94                      | 0.92   | 2.50      |
| G       | 4/24/2019 | 835        | Body        | 835             | 55.79                                  | 55.20  | 1.07      | 0.99                      | 0.97   | 2.18      |
|         |           |            |             | 805             | 55.86                                  | 55.33  | 0.95      | 0.98                      | 0.97   | 1.24      |
|         |           |            |             | 850             | 55.74                                  | 55.16  | 1.06      | 1.00                      | 0.99   | 0.96      |
| H       | 4/24/2019 | 1900       | Head        | 1900            | 39.68                                  | 40.00  | -0.80     | 1.38                      | 1.40   | -1.43     |
|         |           |            |             | 1850            | 39.74                                  | 40.00  | -0.65     | 1.35                      | 1.40   | -3.57     |
|         |           |            |             | 1920            | 39.68                                  | 40.00  | -0.80     | 1.40                      | 1.40   | -0.21     |
| H       | 5/2/2019  | 5750       | Body        | 5750            | 46.91                                  | 48.27  | -2.83     | 6.12                      | 5.94   | 3.14      |
|         |           |            |             | 5700            | 47.00                                  | 48.34  | -2.78     | 6.05                      | 5.88   | 2.93      |
|         |           |            |             | 5850            | 46.73                                  | 48.20  | -3.05     | 6.27                      | 6.00   | 4.50      |
| H       | 5/8/2019  | 5250       | Body        | 5250            | 47.69                                  | 48.95  | -2.58     | 5.31                      | 5.35   | -0.86     |
|         |           |            |             | 5150            | 47.82                                  | 49.09  | -2.58     | 5.17                      | 5.24   | -1.23     |
|         |           |            |             | 5350            | 47.49                                  | 48.82  | -2.72     | 5.48                      | 5.47   | 0.17      |
| H       | 5/9/2019  | 1900       | Head        | 1900            | 39.45                                  | 40.00  | -1.37     | 1.44                      | 1.40   | 2.93      |
|         |           |            |             | 1850            | 39.52                                  | 40.00  | -1.20     | 1.42                      | 1.40   | 1.14      |
|         |           |            |             | 1920            | 39.45                                  | 40.00  | -1.37     | 1.46                      | 1.40   | 3.93      |
| H       | 5/9/2019  | 1900       | Body        | 1900            | 53.52                                  | 53.30  | 0.41      | 1.58                      | 1.52   | 3.82      |
|         |           |            |             | 1850            | 53.60                                  | 53.30  | 0.56      | 1.55                      | 1.52   | 1.91      |
|         |           |            |             | 1920            | 53.52                                  | 53.30  | 0.41      | 1.59                      | 1.52   | 4.87      |

## 8.2. System Check

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are re-measured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

### System Performance Check Measurement Conditions:

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0  $\pm$  0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be  $\geq$  15.0 cm for SAR measurements  $\leq$  3 GHz and  $\geq$  10.0 cm for measurements  $>$  3 GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.  
For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (below 3 GHz) and/or 8x8x7 (above 3 GHz) fine cube was chosen for the cube.
- Distance between probe sensors and phantom surface was set to 3 mm.  
For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was 100 mW.
- The results are normalized to 1 W input power.

### System Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within  $\pm 10\%$  of the manufacturer calibrated dipole SAR target. Refer to Appendix B for the SAR System Check Plots.

| SAR Lab | Date      | Tissue Type | Dipole Type<br>Serial #    | Dipole<br>Cal. Due Date | Measured Results for 1g SAR |                     |                        |                     | Measured Results for 10g SAR |                     |                        |                     | Plot No. |
|---------|-----------|-------------|----------------------------|-------------------------|-----------------------------|---------------------|------------------------|---------------------|------------------------------|---------------------|------------------------|---------------------|----------|
|         |           |             |                            |                         | Zoom Scan<br>to 100 mW      | Normalize<br>to 1 W | Target<br>(Ref. Value) | Delta<br>$\pm 10\%$ | Zoom Scan<br>to 100 mW       | Normalize<br>to 1 W | Target<br>(Ref. Value) | Delta<br>$\pm 10\%$ |          |
| E       | 4/24/2019 | Body        | D1900V2 SN:5d043           | 11/29/2019              | 4.170                       | 41.70               | 40.20                  | <b>3.73</b>         | 2.180                        | 21.80               | 20.82                  | 4.71                | 1,2      |
| F       | 4/22/2019 | Head        | D5GH2V2 SN:1003 (5.25 GHz) | 2/19/2020               | 7.520                       | 75.20               | 80.80                  | <b>-6.93</b>        | 2.150                        | 21.50               | 23.30                  | -7.73               | 3,4      |
| F       | 4/22/2019 | Head        | D5GH2V2 SN:1003 (5.60 GHz) | 2/19/2020               | 8.250                       | 82.50               | 82.70                  | <b>-0.24</b>        | 2.340                        | 23.40               | 23.80                  | -1.68               | 5,6      |
| F       | 4/22/2019 | Head        | D5GH2V2 SN:1003 (5.75 GHz) | 2/19/2020               | 7.840                       | 78.40               | 80.70                  | <b>-2.85</b>        | 2.250                        | 22.50               | 23.00                  | -2.17               | 7,8      |
| F       | 4/25/2019 | Head        | D2450V2 SN:899             | 3/22/2020               | 5.340                       | 53.40               | 51.60                  | <b>3.49</b>         | 2.470                        | 24.70               | 24.10                  | 2.49                | 9,10     |
| F       | 4/25/2019 | Body        | D2450V2 SN:899             | 3/22/2020               | 5.110                       | 51.10               | 50.00                  | 2.20                | 2.360                        | 23.60               | 23.50                  | 0.43                |          |
| F       | 5/2/2019  | Body        | D5GH2V2 SN:1168 (5.60 GHz) | 11/30/2019              | 8.130                       | 81.30               | 76.20                  | <b>6.69</b>         | 2.270                        | 22.70               | 21.20                  | 7.08                | 11,12    |
| G       | 4/24/2019 | Head        | D835V2 SN:4d002            | 11/28/2019              | 0.989                       | 9.89                | 9.87                   | 0.20                | 0.647                        | 6.47                | 6.36                   | 1.73                |          |
| G       | 4/24/2019 | Body        | D835V2 SN:4d002            | 11/28/2019              | 1.020                       | 10.20               | 10.07                  | <b>1.29</b>         | 0.677                        | 6.77                | 6.56                   | 3.20                | 13,14    |
| H       | 4/24/2019 | Head        | D1900V2 SN:5d043           | 11/29/2019              | 4.310                       | 43.10               | 41.80                  | 3.11                | 2.230                        | 22.30               | 21.69                  | 2.81                |          |
| H       | 5/2/2019  | Body        | D5GH2V2 SN:1168 (5.75 GHz) | 11/30/2019              | 7.330                       | 73.30               | 70.70                  | <b>3.68</b>         | 2.080                        | 20.80               | 19.70                  | 5.58                | 15,16    |
| H       | 5/8/2019  | Body        | D5GH2V2 SN:1168 (5.25 GHz) | 11/30/2019              | 7.320                       | 73.20               | 71.20                  | <b>2.81</b>         | 2.060                        | 20.60               | 19.90                  | 3.52                | 17,18    |
| H       | 5/9/2019  | Head        | D1900V2 SN:5d043           | 11/29/2019              | 4.190                       | 41.90               | 41.80                  | 0.24                | 2.160                        | 21.60               | 21.69                  | -0.41               |          |
| H       | 5/9/2019  | Body        | D1900V2 SN:5d043           | 11/29/2019              | 4.290                       | 42.90               | 40.20                  | <b>6.72</b>         | 2.210                        | 22.10               | 20.82                  | 6.15                | 19,20    |

## 9. Conducted Output Power Measurements

### 9.1. GSM

#### Per KDB 941225 D01 3G SAR Procedures:

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.

When different maximum output power applies to GSM voice or GPRS/EDGE time slots, GSM voice and GPRS/EDGE time slots should be tested separately to determine compliance by summing the corresponding reported SAR.

The GMSK EDGE configurations are grouped with GPRS and considered with respect to time-averaged maximum output power to determine compliance

#### Per October 2013 TCB Workshop:

When the maximum frame-averaged powers levels are within 0.25 dB of each other, test the configuration with the most number of time slots.

#### Maximum Output Power (Tune-up Limit) for GSM

SAR is not required for EDGE (8PSK) mode because the maximum output power and tune-up limit is  $\leq 1/4$ dB higher than GPRS/EDGE (GMSK) or the adjusted SAR of the highest reported SAR of GPRS/EDGE (GMSK) is  $\leq 1.2$ W/kg.

#### GSM850 Measured Results

| Mode             | Coding Scheme | Time Slots | Ch No. | Freq. (MHz) | Maximum Average Power (dBm) |            |               |            |
|------------------|---------------|------------|--------|-------------|-----------------------------|------------|---------------|------------|
|                  |               |            |        |             | Measured                    |            | Tune-up Limit |            |
|                  |               |            |        |             | Burst Pw r                  | Frame Pw r | Burst Pw r    | Frame Pw r |
| GPRS/EDGE (GMSK) | CS1           | 1          | 128    | 824.2       | 32.5                        | 23.5       | 34.0          | 25.0       |
|                  |               |            | 190    | 836.6       | 32.4                        | 23.4       |               |            |
|                  |               |            | 251    | 848.8       | 32.4                        | 23.4       |               |            |
|                  |               | 2          | 128    | 824.2       | 30.1                        | 24.1       | 31.0          | 25.0       |
|                  |               |            | 190    | 836.6       | 30.2                        | 24.2       |               |            |
|                  |               |            | 251    | 848.8       | 30.3                        | 24.3       |               |            |
|                  |               | 3          | 128    | 824.2       | 28.9                        | 24.6       | 30.0          | 25.7       |
|                  |               |            | 190    | 836.6       | 29.0                        | 24.7       |               |            |
|                  |               |            | 251    | 848.8       | 29.1                        | 24.8       |               |            |
|                  |               | 4          | 128    | 824.2       | 27.8                        | 24.8       | 28.5          | 25.5       |
|                  |               |            | 190    | 836.6       | 27.8                        | 24.8       |               |            |
|                  |               |            | 251    | 848.8       | 27.9                        | 24.9       |               |            |
| EDGE (8PSK)      | MCS5          | 1          | 128    | 824.2       | 26.8                        | 17.8       | 28.0          | 19.0       |
|                  |               |            | 190    | 836.6       | 26.8                        | 17.8       |               |            |
|                  |               |            | 251    | 848.8       | 26.8                        | 17.8       |               |            |
|                  |               | 2          | 128    | 824.2       | 24.9                        | 18.9       | 26.0          | 20.0       |
|                  |               |            | 190    | 836.6       | 24.9                        | 18.9       |               |            |
|                  |               |            | 251    | 848.8       | 24.9                        | 18.9       |               |            |
|                  |               | 3          | 128    | 824.2       | 23.6                        | 19.3       | 24.5          | 20.2       |
|                  |               |            | 190    | 836.6       | 23.6                        | 19.3       |               |            |
|                  |               |            | 251    | 848.8       | 23.6                        | 19.3       |               |            |
|                  |               | 4          | 128    | 824.2       | 22.6                        | 19.6       | 23.0          | 20.0       |
|                  |               |            | 190    | 836.6       | 22.6                        | 19.6       |               |            |
|                  |               |            | 251    | 848.8       | 22.6                        | 19.6       |               |            |

#### Notes:

GPRS/EDGE (GMSK) mode with 3 time slots for Max power, based on the Tune-up Procedure.

**GSM1900 Measured Results**

| Mode             | Coding Scheme | Time Slots | Ch No. | Freq. (MHz) | Maximum Average Power (dBm) |           |               |           | Hotspot/Grip Average Power (dBm) |           |               |           | Proxy+RCV Average Power (dBm) |           |               |           |
|------------------|---------------|------------|--------|-------------|-----------------------------|-----------|---------------|-----------|----------------------------------|-----------|---------------|-----------|-------------------------------|-----------|---------------|-----------|
|                  |               |            |        |             | Measured                    |           | Tune-up Limit |           | Measured                         |           | Tune-up Limit |           | Measured                      |           | Tune-up Limit |           |
|                  |               |            |        |             | Burst Pwr                   | Frame Pwr | Burst Pwr     | Frame Pwr | Burst Pwr                        | Frame Pwr | Burst Pwr     | Frame Pwr | Burst Pwr                     | Frame Pwr | Burst Pwr     | Frame Pwr |
| GPRS/EDGE (GMSK) | CS1           | 1          | 512    | 1850.2      | 29.3                        | 20.3      | 31.0          | 22.0      | 27.8                             | 18.8      | 29.5          | 20.5      | 28.5                          | 19.5      | 30.0          | 21.0      |
|                  |               |            | 661    | 1880.0      | 29.4                        | 20.4      |               |           | 28.0                             | 19.0      |               |           | 28.6                          | 19.6      |               |           |
|                  |               |            | 810    | 1909.8      | 29.4                        | 20.4      |               |           | 28.2                             | 19.1      |               |           | 28.7                          | 19.7      |               |           |
|                  |               | 2          | 512    | 1850.2      | 26.6                        | 20.6      | 28.0          | 22.0      | 25.0                             | 19.0      | 26.5          | 20.5      | 25.6                          | 19.6      | 27.0          | 21.0      |
|                  |               |            | 661    | 1880.0      | 26.9                        | 20.9      |               |           | 25.3                             | 19.3      |               |           | 25.8                          | 19.8      |               |           |
|                  |               |            | 810    | 1909.8      | 27.1                        | 21.1      |               |           | 25.5                             | 19.5      |               |           | 26.0                          | 20.0      |               |           |
|                  |               | 3          | 512    | 1850.2      | 24.7                        | 20.4      | 26.5          | 22.2      | 23.3                             | 19.0      | 25.0          | 20.7      | 24.0                          | 19.7      | 25.5          | 21.2      |
|                  |               |            | 661    | 1880.0      | 24.9                        | 20.6      |               |           | 23.5                             | 19.2      |               |           | 24.0                          | 19.7      |               |           |
|                  |               |            | 810    | 1909.8      | 25.0                        | 20.7      |               |           | 23.7                             | 19.4      |               |           | 24.1                          | 19.8      |               |           |
|                  |               | 4          | 512    | 1850.2      | 23.0                        | 20.0      | 25.0          | 22.0      | 21.5                             | 18.5      | 23.5          | 20.5      | 22.0                          | 19.0      | 24.0          | 21.0      |
|                  |               |            | 661    | 1880.0      | 23.3                        | 20.3      |               |           | 21.6                             | 18.6      |               |           | 22.0                          | 19.0      |               |           |
|                  |               |            | 810    | 1909.8      | 23.5                        | 20.5      |               |           | 21.7                             | 18.7      |               |           | 22.1                          | 19.1      |               |           |
| EDGE (8PSK)      | MCS5          | 1          | 512    | 1850.2      | 25.7                        | 16.7      | 27.0          | 18.0      | 23.5                             | 14.5      | 25.5          | 16.5      | 23.7                          | 14.7      | 26.0          | 17.0      |
|                  |               |            | 661    | 1880.0      | 25.9                        | 16.9      |               |           | 23.5                             | 14.5      |               |           | 23.7                          | 14.7      |               |           |
|                  |               |            | 810    | 1909.8      | 26.0                        | 17.0      |               |           | 23.5                             | 14.5      |               |           | 23.8                          | 14.8      |               |           |
|                  |               | 2          | 512    | 1850.2      | 23.5                        | 17.5      | 25.0          | 19.0      | 23.2                             | 17.2      | 23.5          | 17.5      | 23.4                          | 17.4      | 24.0          | 18.0      |
|                  |               |            | 661    | 1880.0      | 23.7                        | 17.7      |               |           | 23.4                             | 17.4      |               |           | 23.5                          | 17.5      |               |           |
|                  |               |            | 810    | 1909.8      | 23.8                        | 17.8      |               |           | 23.5                             | 17.5      |               |           | 23.6                          | 17.6      |               |           |
|                  |               | 3          | 512    | 1850.2      | 22.0                        | 17.7      | 23.5          | 19.2      | 21.8                             | 17.5      | 22.0          | 17.7      | 21.8                          | 17.5      | 22.5          | 18.2      |
|                  |               |            | 661    | 1880.0      | 22.1                        | 17.8      |               |           | 21.9                             | 17.6      |               |           | 21.9                          | 17.6      |               |           |
|                  |               |            | 810    | 1909.8      | 22.2                        | 17.9      |               |           | 22.0                             | 17.7      |               |           | 22.0                          | 17.7      |               |           |
|                  |               | 4          | 512    | 1850.2      | 20.5                        | 17.5      | 22.5          | 19.5      | 20.3                             | 17.3      | 21.0          | 18.0      | 20.5                          | 17.5      | 21.5          | 18.5      |
|                  |               |            | 661    | 1880.0      | 20.6                        | 17.6      |               |           | 20.5                             | 17.5      |               |           | 20.5                          | 17.5      |               |           |
|                  |               |            | 810    | 1909.8      | 20.6                        | 17.6      |               |           | 20.6                             | 17.6      |               |           | 20.6                          | 17.6      |               |           |

**Notes:**

GPRS/EDGE (GMSK) mode with 3 time slots for Max power, 3 time slots for Hotspot/Grip Sensor Reduced Power and 3 time slots for Proxy+RCV Reduced power, based on the Tune-up Procedure.

## 9.2. W-CDMA

### Per KDB 941225 D01 3G SAR Procedures for W-CDMA:

Maximum output power is verified on the high, middle and low channels and using the appropriate 12.2 kbps RMC with TPC (transmit power control) set to all "1's"

### Release 99 Setup Procedures used to establish the test signals

The following tests were completed according to the test requirements outlined in section 5.2 of the 3GPP TS34.121-1. A summary of these settings is illustrated below:

| Mode                   | Subtest                 | Rel99        |
|------------------------|-------------------------|--------------|
| WCDMA General Settings | Loopback Mode           | Test Mode 2  |
|                        | Rel99 RMC               | 12.2kbps RMC |
|                        | Power Control Algorithm | Algorithm2   |
|                        | $\beta_c/\beta_d$       | 8/15         |

### HSDPA Setup Procedures used to establish the test signals

The following 4 Sub-tests were completed according to procedures in table C.10.1.4 of 3GPP TS 34.121-1. A summary of these settings is illustrated below:

**Table C.10.1.4:  $\beta$  values for transmitter characteristics tests with HS-DPCCH**

| Sub-test | $\beta_c$         | $\beta_d$         | $\beta_d$<br>(SF) | $\beta_c/\beta_d$ | $\beta_{hs}$<br>(Note 1,<br>Note 2) | CM (dB)<br>(Note 3) | MPR (dB)<br>(Note 3) |
|----------|-------------------|-------------------|-------------------|-------------------|-------------------------------------|---------------------|----------------------|
| 1        | 2/15              | 15/15             | 64                | 2/15              | 4/15                                | 0.0                 | 0.0                  |
| 2        | 12/15<br>(Note 4) | 15/15<br>(Note 4) | 64                | 12/15<br>(Note 4) | 24/15                               | 1.0                 | 0.0                  |
| 3        | 15/15             | 8/15              | 64                | 15/8              | 30/15                               | 1.5                 | 0.5                  |
| 4        | 15/15             | 4/15              | 64                | 15/4              | 30/15                               | 1.5                 | 0.5                  |

Note 1:  $\Delta_{ACK}$ ,  $\Delta_{NACK}$  and  $\Delta_{CQI} = 30/15$  with  $\beta_{hs} = 30/15 * \beta_c$ .

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA,  $\Delta_{ACK}$  and  $\Delta_{NACK} = 30/15$  with  $\beta_{hs} = 30/15 * \beta_c$ , and  $\Delta_{CQI} = 24/15$  with  $\beta_{hs} = 24/15 * \beta_c$ .

Note 3: CM = 1 for  $\beta_c/\beta_d = 12/15$ ,  $\beta_{hs}/\beta_c = 24/15$ . For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the  $\beta_c/\beta_d$  ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 11/15$  and  $\beta_d = 15/15$ .

### HSUPA Setup Procedures used to establish the test signals

The following 5 Sub-tests were completed according to procedures in table C.11.1.3 of 3GPP TS 34.121-1. A summary of these settings is illustrated below:

**Table C.11.1.3:  $\beta$  values for transmitter characteristics tests with HS-DPCCH and E-DCH**

| Sub-test | $\beta_c$         | $\beta_d$         | $\beta_d$<br>(SF) | $\beta_c/\beta_d$ | $\beta_{hs}$<br>(Note 1) | $\beta_{ec}$ | $\beta_{ed}$<br>(Note 4)<br>(Note 5)         | $\beta_{ed}$<br>(SF) | $\beta_{ed}$<br>(Codes) | CM<br>(dB)<br>(Note 2) | MPR<br>(dB)<br>(Note 2)<br>(Note 6) | AG<br>Index<br>(Note 5) | E-<br>TFCI |
|----------|-------------------|-------------------|-------------------|-------------------|--------------------------|--------------|----------------------------------------------|----------------------|-------------------------|------------------------|-------------------------------------|-------------------------|------------|
| 1        | 11/15<br>(Note 3) | 15/15<br>(Note 3) | 64                | 11/15<br>(Note 3) | 22/15                    | 209/25       | 1309/225                                     | 4                    | 1                       | 1.0                    | 0.0                                 | 20                      | 75         |
| 2        | 6/15              | 15/15             | 64                | 6/15              | 12/15                    | 12/15        | 94/75                                        | 4                    | 1                       | 3.0                    | 2.0                                 | 12                      | 67         |
| 3        | 15/15             | 9/15              | 64                | 15/9              | 30/15                    | 30/15        | $\beta_{ed1}: 47/15$<br>$\beta_{ed2}: 47/15$ | 4                    | 2                       | 2.0                    | 1.0                                 | 15                      | 92         |
| 4        | 2/15              | 15/15             | 64                | 2/15              | 4/15                     | 2/15         | 56/75                                        | 4                    | 1                       | 3.0                    | 2.0                                 | 17                      | 71         |
| 5        | 15/15             | 0                 | -                 | -                 | 5/15                     | 5/15         | 47/15                                        | 4                    | 1                       | 1.0                    | 0.0                                 | 12                      | 67         |

Note 1: For sub-test 1 to 4,  $\Delta_{ACK}$ ,  $\Delta_{NACK}$  and  $\Delta_{CQI} = 30/15$  with  $\beta_{hs} = 30/15 * \beta_c$ . For sub-test 5,  $\Delta_{ACK}$ ,  $\Delta_{NACK}$  and  $\Delta_{CQI} = 5/15$  with  $\beta_{hs} = 5/15 * \beta_c$ .

Note 2: CM = 1 for  $\beta_c/\beta_d = 12/15$ ,  $\beta_{hs}/\beta_c = 24/15$ . For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPCCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the  $\beta_c/\beta_d$  ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 10/15$  and  $\beta_d = 15/15$ .

Note 4: In case of testing by UE using E-DPCCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 5:  $\beta_{ed}$  can not be set directly; it is set by Absolute Grant Value.

Note 6: For subtests 2, 3 and 4, UE may perform E-DPCCH power scaling at max power which could results in slightly smaller MPR values.

**DC-HSDPA Setup Procedures used to establish the test signals**

The following 4 Sub-tests for DC-HSDPA were completed according to procedures in table C08.1.12 of 3GPP TS 34.121-1. A summary of subtest settings is illustrated below:

**Table C.8.1.12: Fixed Reference Channel H-Set 12**

| Parameter                                                                                                                                              | Unit      | Value |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------|
| Nominal Avg. Inf. Bit Rate                                                                                                                             | kbps      | 60    |
| Inter-TTI Distance                                                                                                                                     | TTI's     | 1     |
| Number of HARQ Processes                                                                                                                               | Processes | 6     |
| Information Bit Payload ( $N_{INF}$ )                                                                                                                  | Bits      | 120   |
| Number Code Blocks                                                                                                                                     | Blocks    | 1     |
| Binary Channel Bits Per TTI                                                                                                                            | Bits      | 960   |
| Total Available SML's in UE                                                                                                                            | SML's     | 19200 |
| Number of SML's per HARQ Proc.                                                                                                                         | SML's     | 3200  |
| Coding Rate                                                                                                                                            |           | 0.15  |
| Number of Physical Channel Codes                                                                                                                       | Codes     | 1     |
| Modulation                                                                                                                                             |           | QPSK  |
| Note 1: The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table.               |           |       |
| Note 2: Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used. |           |       |

**HSPA+ Setup Procedures used to establish the test signals**

DUT supports HSPA+ DL only. Therefore, conducted power measurements is not required.

**Maximum Output Power (Tune-up Limit) for W-CDMA**

SAR measurement is not required for the HSDPA, HSUPA, and DC-HSDPA. When primary mode and the adjusted SAR is  $\leq 1.2$  W/kg and secondary mode is  $\leq \frac{1}{4}$  dB higher than the primary mode.

**W-CDMA Band II Measured Results**

| Mode       |                         | UL Ch No. | Freq. (MHz) | Maximum Average Power (dBm) |     |               | Reduced Average Power (dBm) |     |               |
|------------|-------------------------|-----------|-------------|-----------------------------|-----|---------------|-----------------------------|-----|---------------|
|            |                         |           |             | Measured Pwr                | MPR | Tune-up Limit | Measured Pwr                | MPR | Tune-up Limit |
| Release 99 | Rel 99 (RMC, 12.2 kbps) | 9262      | 1852.4      | 24.0                        | N/A | 24.5          | 22.1                        | N/A | 22.5          |
|            |                         | 9400      | 1880.0      | 24.0                        |     |               | 22.1                        |     |               |
|            |                         | 9538      | 1907.6      | 24.1                        |     |               | 22.2                        |     |               |
| HSDPA      | Subtest 1               | 9262      | 1852.4      | 24.0                        | 0.0 | 24.5          | 22.1                        | 0.0 | 22.7          |
|            |                         | 9400      | 1880.0      | 24.0                        |     |               | 22.1                        |     |               |
|            |                         | 9538      | 1907.6      | 24.1                        |     |               | 22.1                        |     |               |
|            | Subtest 2               | 9262      | 1852.4      | 23.6                        | 0.0 | 24.5          | 22.1                        | 0.0 | 22.7          |
|            |                         | 9400      | 1880.0      | 23.5                        |     |               | 22.1                        |     |               |
|            |                         | 9538      | 1907.6      | 23.6                        |     |               | 22.2                        |     |               |
|            | Subtest 3               | 9262      | 1852.4      | 22.7                        | 0.5 | 24.0          | 22.2                        | 0.5 | 22.2          |
|            |                         | 9400      | 1880.0      | 22.6                        |     |               | 22.2                        |     |               |
|            |                         | 9538      | 1907.6      | 22.7                        |     |               | 22.2                        |     |               |
|            | Subtest 4               | 9262      | 1852.4      | 22.7                        | 0.5 | 24.0          | 22.2                        | 0.5 | 22.2          |
|            |                         | 9400      | 1880.0      | 22.6                        |     |               | 22.2                        |     |               |
|            |                         | 9538      | 1907.6      | 22.7                        |     |               | 22.2                        |     |               |
| HSUPA      | Subtest 1               | 9262      | 1852.4      | 22.6                        | 0.0 | 24.0          | 21.3                        | 0.0 | 22.6          |
|            |                         | 9400      | 1880.0      | 22.6                        |     |               | 21.3                        |     |               |
|            |                         | 9538      | 1907.6      | 22.6                        |     |               | 21.4                        |     |               |
|            | Subtest 2               | 9262      | 1852.4      | 20.6                        | 2.0 | 22.0          | 20.6                        | 2.0 | 20.6          |
|            |                         | 9400      | 1880.0      | 20.6                        |     |               | 20.6                        |     |               |
|            |                         | 9538      | 1907.6      | 20.6                        |     |               | 20.6                        |     |               |
|            | Subtest 3               | 9262      | 1852.4      | 21.7                        | 1.0 | 23.0          | 21.2                        | 1.0 | 21.6          |
|            |                         | 9400      | 1880.0      | 21.6                        |     |               | 21.2                        |     |               |
|            |                         | 9538      | 1907.6      | 21.7                        |     |               | 21.2                        |     |               |
|            | Subtest 4               | 9262      | 1852.4      | 20.6                        | 2.0 | 22.0          | 20.6                        | 2.0 | 20.6          |
|            |                         | 9400      | 1880.0      | 20.6                        |     |               | 20.6                        |     |               |
|            |                         | 9538      | 1907.6      | 20.6                        |     |               | 20.6                        |     |               |
|            | Subtest 5               | 9262      | 1852.4      | 23.5                        | 0.0 | 24.0          | 21.3                        | 0.0 | 22.6          |
|            |                         | 9400      | 1880.0      | 23.5                        |     |               | 21.3                        |     |               |
|            |                         | 9538      | 1907.6      | 23.5                        |     |               | 21.4                        |     |               |
| DC-HSDPA   | Subtest 1               | 9262      | 1852.4      | 23.9                        | 0.0 | 24.5          | 22.1                        | 0.0 | 22.5          |
|            |                         | 9400      | 1880.0      | 24.1                        |     |               | 22.1                        |     |               |
|            |                         | 9538      | 1907.6      | 24.1                        |     |               | 22.1                        |     |               |
|            | Subtest 2               | 9262      | 1852.4      | 23.4                        | 0.0 | 24.5          | 22.1                        | 0.0 | 22.5          |
|            |                         | 9400      | 1880.0      | 23.6                        |     |               | 22.1                        |     |               |
|            |                         | 9538      | 1907.6      | 23.6                        |     |               | 22.2                        |     |               |
|            | Subtest 3               | 9262      | 1852.4      | 22.4                        | 0.5 | 24.0          | 22.0                        | 0.5 | 22.0          |
|            |                         | 9400      | 1880.0      | 22.6                        |     |               | 22.0                        |     |               |
|            |                         | 9538      | 1907.6      | 22.6                        |     |               | 22.0                        |     |               |
|            | Subtest 4               | 9262      | 1852.4      | 22.4                        | 0.5 | 24.0          | 22.0                        | 0.5 | 22.0          |
|            |                         | 9400      | 1880.0      | 22.6                        |     |               | 22.0                        |     |               |
|            |                         | 9538      | 1907.6      | 22.6                        |     |               | 22.0                        |     |               |

**Notes:**

Tune-Up Limits for WWAN (Grip Sensor), WWAN (Hotspot), and WWAN (Proxy+RCV) are the same. Power listed under Reduced Power is representative of all three Power Back-off modes.

**W-CDMA Band V Measured Results**

| Mode       |                         | UL Ch No. | Freq. (MHz) | Maximum Average Power (dBm) |     |               |
|------------|-------------------------|-----------|-------------|-----------------------------|-----|---------------|
|            |                         |           |             | Measured Power              | MPR | Tune-up Limit |
| Release 99 | Rel 99 (RMC, 12.2 kbps) | 4132      | 826.4       | 23.4                        | N/A | 25.0          |
|            |                         | 4183      | 836.6       | 23.4                        |     |               |
|            |                         | 4233      | 846.6       | 23.3                        |     |               |
| HSDPA      | Subtest 1               | 4132      | 826.4       | 23.4                        | 0.0 | 24.0          |
|            |                         | 4183      | 836.6       | 23.4                        |     |               |
|            |                         | 4233      | 846.6       | 23.3                        |     |               |
|            | Subtest 2               | 4132      | 826.4       | 22.7                        | 0.0 | 24.0          |
|            |                         | 4183      | 836.6       | 22.7                        |     |               |
|            |                         | 4233      | 846.6       | 22.7                        |     |               |
|            | Subtest 3               | 4132      | 826.4       | 21.8                        | 0.5 | 23.5          |
|            |                         | 4183      | 836.6       | 21.8                        |     |               |
|            |                         | 4233      | 846.6       | 21.7                        |     |               |
|            | Subtest 4               | 4132      | 826.4       | 21.6                        | 0.5 | 23.5          |
|            |                         | 4183      | 836.6       | 21.7                        |     |               |
|            |                         | 4233      | 846.6       | 21.5                        |     |               |
| HSUPA      | Subtest 1               | 4132      | 826.4       | 20.5                        | 0.0 | 22.0          |
|            |                         | 4183      | 836.6       | 20.6                        |     |               |
|            |                         | 4233      | 846.6       | 20.5                        |     |               |
|            | Subtest 2               | 4132      | 826.4       | 18.7                        | 2.0 | 20.0          |
|            |                         | 4183      | 836.6       | 18.7                        |     |               |
|            |                         | 4233      | 846.6       | 18.6                        |     |               |
|            | Subtest 3               | 4132      | 826.4       | 19.7                        | 1.0 | 21.0          |
|            |                         | 4183      | 836.6       | 19.7                        |     |               |
|            |                         | 4233      | 846.6       | 19.6                        |     |               |
|            | Subtest 4               | 4132      | 826.4       | 18.7                        | 2.0 | 20.0          |
|            |                         | 4183      | 836.6       | 18.7                        |     |               |
|            |                         | 4233      | 846.6       | 18.6                        |     |               |
|            | Subtest 5               | 4132      | 826.4       | 21.7                        | 0.0 | 22.0          |
|            |                         | 4183      | 836.6       | 21.7                        |     |               |
|            |                         | 4233      | 846.6       | 21.6                        |     |               |
| DC-HSDPA   | Subtest 1               | 4132      | 826.4       | 23.4                        | 0.0 | 24.0          |
|            |                         | 4183      | 836.6       | 23.4                        |     |               |
|            |                         | 4233      | 846.6       | 23.3                        |     |               |
|            | Subtest 2               | 4132      | 826.4       | 22.7                        | 0.0 | 24.0          |
|            |                         | 4183      | 836.6       | 22.7                        |     |               |
|            |                         | 4233      | 846.6       | 22.7                        |     |               |
|            | Subtest 3               | 4132      | 826.4       | 21.8                        | 0.5 | 23.5          |
|            |                         | 4183      | 836.6       | 21.8                        |     |               |
|            |                         | 4233      | 846.6       | 21.7                        |     |               |
|            | Subtest 4               | 4132      | 826.4       | 21.6                        | 0.5 | 23.5          |
|            |                         | 4183      | 836.6       | 21.7                        |     |               |
|            |                         | 4233      | 846.6       | 21.5                        |     |               |

### 9.3. LTE

The following tests were conducted according to the test requirements outlined in section 6.2 of the 3GPP TS36.101 specification.

UE Power Class: 3 (23 +/- 2dBm). 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 6.2.3-1 of the 3GPP TS36.101.

**Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3**

| Modulation | Channel bandwidth / Transmission bandwidth ( $N_{RB}$ ) |         |       |        |        |        | MPR (dB) |
|------------|---------------------------------------------------------|---------|-------|--------|--------|--------|----------|
|            | 1.4 MHz                                                 | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |          |
| QPSK       | > 5                                                     | > 4     | > 8   | > 12   | > 16   | > 18   | ≤ 1      |
| 16 QAM     | ≤ 5                                                     | ≤ 4     | ≤ 8   | ≤ 12   | ≤ 16   | ≤ 18   | ≤ 1      |
| 16 QAM     | > 5                                                     | > 4     | > 8   | > 12   | > 16   | > 18   | ≤ 2      |
| 64 QAM     | ≤ 5                                                     | ≤ 4     | ≤ 8   | ≤ 12   | ≤ 16   | ≤ 18   | ≤ 2      |
| 64 QAM     | > 5                                                     | > 4     | > 8   | > 12   | > 16   | > 18   | ≤ 3      |
| 256 QAM    | ≥ 1                                                     |         |       |        |        |        | ≤ 5      |

The allowed A-MPR values specified below in Table 6.2.4.-1 of 3GPP TS36.101 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 6.2.4-1: Additional Maximum Power Reduction (A-MPR)**

| Network Signalling value | Requirements (subclause) | E-UTRA Band | Channel bandwidth (MHz) | Resources Blocks ( $N_{RB}$ ) | A-MPR (dB) |
|--------------------------|--------------------------|-------------|-------------------------|-------------------------------|------------|
| NS_01                    | 6.6.2.1.1                | Table 5.5-1 | 1.4, 3, 5, 10, 15, 20   | Table 5.6-1                   | N/A        |

#### **Maximum Output Power (Tune-up Limit) for LTE**

LTE QPSK configuration has the highest maximum average output power per 3GPP standard.

SAR measurement is not required for the 16QAM. When the highest maximum output power for 16QAM, is ≤ ½ dB higher than the QPSK or when the reported SAR for the QPSK configuration is ≤ 1.45 W/kg.

Please refer to section 6.3. for LTE detail test channels.

**LTE Band 5 Measured Results**

| BW<br>(MHz) | Mode  | RB<br>Allocation | RB<br>offset | Maximum Average Power (dBm) |           |           |     |                  |
|-------------|-------|------------------|--------------|-----------------------------|-----------|-----------|-----|------------------|
|             |       |                  |              |                             | 20525     |           | MPR | Tune-up<br>Limit |
|             |       |                  |              |                             | 836.5 MHz |           |     |                  |
| 10 MHz      | QPSK  | 1                | 0            |                             | 23.4      |           | 0.0 | 25.0             |
|             |       | 1                | 25           |                             | 23.3      |           | 0.0 | 25.0             |
|             |       | 1                | 49           |                             | 23.3      |           | 0.0 | 25.0             |
|             |       | 25               | 0            |                             | 22.3      |           | 1.0 | 24.0             |
|             |       | 25               | 12           |                             | 22.3      |           | 1.0 | 24.0             |
|             |       | 25               | 25           |                             | 22.3      |           | 1.0 | 24.0             |
|             |       | 50               | 0            |                             | 22.3      |           | 1.0 | 24.0             |
|             | 16QAM | 1                | 0            |                             | 22.2      |           | 1.0 | 24.0             |
|             |       | 1                | 25           |                             | 22.2      |           | 1.0 | 24.0             |
|             |       | 1                | 49           |                             | 22.2      |           | 1.0 | 24.0             |
|             |       | 25               | 0            |                             | 21.3      |           | 2.0 | 23.0             |
|             |       | 25               | 12           |                             | 21.3      |           | 2.0 | 23.0             |
|             |       | 25               | 25           |                             | 21.3      |           | 2.0 | 23.0             |
|             |       | 50               | 0            |                             | 21.3      |           | 2.0 | 23.0             |
| BW<br>(MHz) | Mode  | RB<br>Allocation | RB<br>offset | Maximum Average Power (dBm) |           |           |     |                  |
|             |       |                  |              | 20425                       | 20525     | 20625     | MPR | Tune-up<br>Limit |
|             |       |                  |              | 826.5 MHz                   | 836.5 MHz | 846.5 MHz |     |                  |
| 5 MHz       | QPSK  | 1                | 0            | 23.3                        | 23.3      | 23.3      | 0.0 | 25.0             |
|             |       | 1                | 12           | 23.3                        | 23.3      | 23.3      | 0.0 | 25.0             |
|             |       | 1                | 24           | 23.3                        | 23.3      | 23.3      | 0.0 | 25.0             |
|             |       | 12               | 0            | 22.4                        | 22.3      | 22.3      | 1.0 | 24.0             |
|             |       | 12               | 7            | 22.4                        | 22.3      | 22.3      | 1.0 | 24.0             |
|             |       | 12               | 13           | 22.3                        | 22.3      | 22.3      | 1.0 | 24.0             |
|             |       | 25               | 0            | 22.3                        | 22.3      | 22.3      | 1.0 | 24.0             |
|             | 16QAM | 1                | 0            | 22.2                        | 22.2      | 22.2      | 1.0 | 24.0             |
|             |       | 1                | 12           | 22.1                        | 22.2      | 22.1      | 1.0 | 24.0             |
|             |       | 1                | 24           | 22.1                        | 22.2      | 22.1      | 1.0 | 24.0             |
|             |       | 12               | 0            | 21.3                        | 21.3      | 21.3      | 2.0 | 23.0             |
|             |       | 12               | 7            | 21.3                        | 21.3      | 21.3      | 2.0 | 23.0             |
|             |       | 12               | 13           | 21.3                        | 21.2      | 21.3      | 2.0 | 23.0             |
|             |       | 25               | 0            | 21.4                        | 21.3      | 21.4      | 2.0 | 23.0             |
| BW<br>(MHz) | Mode  | RB<br>Allocation | RB<br>offset | Maximum Average Power (dBm) |           |           |     |                  |
|             |       |                  |              | 20415                       | 20525     | 20635     | MPR | Tune-up<br>Limit |
|             |       |                  |              | 825.5 MHz                   | 836.5 MHz | 847.5 MHz |     |                  |
| 3 MHz       | QPSK  | 1                | 0            | 23.4                        | 23.4      | 23.4      | 0.0 | 25.0             |
|             |       | 1                | 8            | 23.4                        | 23.4      | 23.4      | 0.0 | 25.0             |
|             |       | 1                | 14           | 23.3                        | 23.4      | 23.3      | 0.0 | 25.0             |
|             |       | 8                | 0            | 22.3                        | 22.3      | 22.3      | 1.0 | 24.0             |
|             |       | 8                | 4            | 22.2                        | 22.3      | 22.3      | 1.0 | 24.0             |
|             |       | 8                | 7            | 22.2                        | 22.3      | 22.3      | 1.0 | 24.0             |
|             |       | 15               | 0            | 22.3                        | 22.3      | 22.3      | 1.0 | 24.0             |
|             | 16QAM | 1                | 0            | 22.3                        | 22.4      | 22.4      | 1.0 | 24.0             |
|             |       | 1                | 8            | 22.2                        | 22.3      | 22.0      | 1.0 | 24.0             |
|             |       | 1                | 14           | 22.2                        | 22.3      | 22.1      | 1.0 | 24.0             |
|             |       | 8                | 0            | 21.2                        | 21.3      | 21.4      | 2.0 | 23.0             |
|             |       | 8                | 4            | 21.2                        | 21.3      | 21.4      | 2.0 | 23.0             |
|             |       | 8                | 7            | 21.2                        | 21.3      | 21.4      | 2.0 | 23.0             |
|             |       | 15               | 0            | 21.3                        | 21.3      | 21.4      | 2.0 | 23.0             |
| BW<br>(MHz) | Mode  | RB<br>Allocation | RB<br>offset | Maximum Average Power (dBm) |           |           |     |                  |
|             |       |                  |              | 20407                       | 20525     | 20643     | MPR | Tune-up<br>Limit |
|             |       |                  |              | 824.7 MHz                   | 836.5 MHz | 848.3 MHz |     |                  |
| 1.4 MHz     | QPSK  | 1                | 0            | 23.4                        | 23.4      | 23.4      | 0.0 | 25.0             |
|             |       | 1                | 3            | 23.4                        | 23.4      | 23.5      | 0.0 | 25.0             |
|             |       | 1                | 5            | 23.4                        | 23.3      | 23.4      | 0.0 | 25.0             |
|             |       | 3                | 0            | 23.3                        | 23.3      | 23.4      | 0.0 | 25.0             |
|             |       | 3                | 1            | 23.3                        | 23.3      | 23.4      | 0.0 | 25.0             |
|             |       | 3                | 3            | 23.3                        | 23.3      | 23.4      | 0.0 | 25.0             |
|             |       | 6                | 0            | 22.2                        | 22.3      | 22.3      | 1.0 | 24.0             |
|             | 16QAM | 1                | 0            | 22.2                        | 22.2      | 22.2      | 1.0 | 24.0             |
|             |       | 1                | 3            | 22.3                        | 22.1      | 22.2      | 1.0 | 24.0             |
|             |       | 1                | 5            | 22.2                        | 22.3      | 22.2      | 1.0 | 24.0             |
|             |       | 3                | 0            | 22.2                        | 22.2      | 22.4      | 1.0 | 24.0             |
|             |       | 3                | 1            | 22.2                        | 22.2      | 22.4      | 1.0 | 24.0             |
|             |       | 3                | 3            | 22.2                        | 22.2      | 22.4      | 1.0 | 24.0             |
|             |       | 6                | 0            | 21.4                        | 21.2      | 21.4      | 2.0 | 23.0             |

## 9.4. Wi-Fi 2.4GHz (DTS Band)

### Maximum Output Power (Tune-up Limit) for Wi-Fi 2.4 GHz

The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures.

For “Not required”, SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11b/g/n mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.

SAR testing is not required for OFDM mode(s) 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.

### Wi-Fi 2.4GHz Measured Results

| Band            | Mode           | Ch # | Freq. (MHz) | Maximum Average Power (dBm) |         |                   | Reduced Average Power (dBm) |         |                   |
|-----------------|----------------|------|-------------|-----------------------------|---------|-------------------|-----------------------------|---------|-------------------|
|                 |                |      |             | Meas Pwr                    | Tune-up | SAR Test (Yes/No) | Meas Pwr                    | Tune-up | SAR Test (Yes/No) |
| DSSS<br>2.4 GHz | 802.11b        | 1    | 2412        | 14.9                        | 15.0    | Yes               | 11.6                        | 12.0    | Yes               |
|                 |                | 6    | 2437        | 14.8                        | 15.0    |                   | 11.3                        | 12.0    |                   |
|                 |                | 11   | 2462        | 15.0                        | 15.0    |                   | 11.5                        | 12.0    |                   |
|                 |                | 12   | 2467        | 7.5                         | 8.0     |                   | 7.5                         | 8.0     |                   |
|                 |                | 13   | 2472        | 7.8                         | 8.0     |                   | 7.8                         | 8.0     |                   |
| OFDM<br>2.4 GHz | 802.11g        | 1    | 2412        |                             | 15.0    | No                |                             | 12.0    | No                |
|                 |                | 6    | 2437        |                             | 15.0    |                   |                             | 12.0    |                   |
|                 |                | 11   | 2462        |                             | 15.0    |                   |                             | 12.0    |                   |
|                 |                | 12   | 2467        |                             | 8.0     |                   |                             | 8.0     |                   |
|                 |                | 13   | 2472        |                             | 8.0     |                   |                             | 8.0     |                   |
|                 | 802.11n (HT20) | 1    | 2412        |                             | 15.0    | No                |                             | 12.0    | No                |
|                 |                | 6    | 2437        |                             | 15.0    |                   |                             | 12.0    |                   |
|                 |                | 11   | 2462        |                             | 15.0    |                   |                             | 12.0    |                   |
|                 |                | 12   | 2467        |                             | 6.0     |                   |                             | 6.0     |                   |
|                 |                | 13   | 2472        |                             | 6.0     |                   |                             | 6.0     |                   |

#### Note(s):

SAR is not required for channel 12 and 13 because the tune-up limit and the measured output power for these two channels are not greater than those for the default test channels. Refer to KDB 248227 D01 section 3.1

## 9.5. Wi-Fi 5GHz (U-NII Bands)

### **Maximum Output Power (Tune-up Limit) for Wi-Fi 5 GHz**

When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac modes, the channel in the lower order/sequence 802.11 transmission mode is selected.

The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures.

For “Not required”, SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.

When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is  $\leq 1.2$  W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.

**Wi-Fi 5 GHz Measured Results**

| Band               | Mode             | Ch # | Freq. (MHz) | Maximum Average Power (dBm) |         |                   | Reduced Average Power (dBm) |         |                   |
|--------------------|------------------|------|-------------|-----------------------------|---------|-------------------|-----------------------------|---------|-------------------|
|                    |                  |      |             | Meas Pwr                    | Tune-up | SAR Test (Yes/No) | Meas Pwr                    | Tune-up | SAR Test (Yes/No) |
| UNII-1<br>5.2 GHz  | 802.11a          | 36   | 5180        |                             | 15.5    | No                |                             | 12.0    | No                |
|                    |                  | 40   | 5200        |                             | 15.5    |                   |                             | 12.0    |                   |
|                    |                  | 44   | 5220        |                             | 15.5    |                   |                             | 12.0    |                   |
|                    |                  | 48   | 5240        |                             | 15.5    |                   |                             | 12.0    |                   |
|                    | 802.11n (HT20)   | 36   | 5180        | 15.5                        | 16.0    | Yes               |                             | 12.0    | No                |
|                    |                  | 40   | 5200        | 15.3                        | 16.0    |                   |                             | 12.0    |                   |
|                    |                  | 44   | 5220        | 15.7                        | 16.0    |                   |                             | 12.0    |                   |
|                    |                  | 48   | 5240        | 15.5                        | 16.0    |                   |                             | 12.0    |                   |
|                    | 802.11ac (VHT20) | 36   | 5180        |                             | 16.0    | No                |                             | 12.0    | No                |
|                    |                  | 40   | 5200        |                             | 16.0    |                   |                             | 12.0    |                   |
|                    |                  | 44   | 5220        |                             | 16.0    |                   |                             | 12.0    |                   |
|                    |                  | 48   | 5240        |                             | 16.0    |                   |                             | 12.0    |                   |
|                    | 802.11n (HT40)   | 38   | 5190        |                             | 10.0    | No                |                             | 12.0    | No                |
|                    |                  | 46   | 5230        |                             | 15.0    |                   |                             | 12.0    |                   |
|                    | 802.11ac (VHT40) | 38   | 5190        |                             | 10.0    | No                |                             | 12.0    | No                |
|                    |                  | 46   | 5230        |                             | 15.0    |                   |                             | 12.0    |                   |
|                    | 802.11ac (VHT80) | 42   | 5210        |                             | 10.5    | No                | 12.0                        | 12.0    | Yes               |
| Band               | Mode             | Ch # | Freq. (MHz) | Maximum Average Power (dBm) |         |                   | Reduced Average Power (dBm) |         |                   |
|                    |                  |      |             | Meas Pwr                    | Tune-up | SAR Test (Yes/No) | Meas Pwr                    | Tune-up | SAR Test (Yes/No) |
| UNII-2A<br>5.3 GHz | 802.11a          | 52   | 5260        |                             | 14.5    | No                |                             | 12.0    | No                |
|                    |                  | 56   | 5280        |                             | 14.5    |                   |                             | 12.0    |                   |
|                    |                  | 60   | 5300        |                             | 14.5    |                   |                             | 12.0    |                   |
|                    |                  | 64   | 5320        |                             | 14.5    |                   |                             | 12.0    |                   |
|                    | 802.11n (HT20)   | 52   | 5260        | 15.6                        | 16.0    | Yes               |                             | 12.0    | No                |
|                    |                  | 56   | 5280        | 15.5                        | 16.0    |                   |                             | 12.0    |                   |
|                    |                  | 60   | 5300        | 16.0                        | 16.0    |                   |                             | 12.0    |                   |
|                    |                  | 64   | 5320        | 15.8                        | 16.0    |                   |                             | 12.0    |                   |
|                    | 802.11ac (VHT20) | 52   | 5260        |                             | 16.0    | No                |                             | 12.0    | No                |
|                    |                  | 56   | 5280        |                             | 16.0    |                   |                             | 12.0    |                   |
|                    |                  | 60   | 5300        |                             | 16.0    |                   |                             | 12.0    |                   |
|                    |                  | 64   | 5320        |                             | 16.0    |                   |                             | 12.0    |                   |
|                    | 802.11n (HT40)   | 54   | 5270        |                             | 15.0    | No                |                             | 12.0    | No                |
|                    |                  | 62   | 5310        |                             | 10.5    |                   |                             | 12.0    |                   |
|                    | 802.11ac (VHT40) | 54   | 5270        |                             | 15.0    | No                |                             | 12.0    | No                |
|                    |                  | 62   | 5310        |                             | 10.5    |                   |                             | 12.0    |                   |
|                    | 802.11ac (VHT80) | 58   | 5290        |                             | 8.0     | No                | 12.0                        | 12.0    | Yes               |

| Band               | Mode                | Ch # | Freq.<br>(MHz) | Maximum Average Power (dBm) |         |                      | Reduced Average Power (dBm) |         |                      |
|--------------------|---------------------|------|----------------|-----------------------------|---------|----------------------|-----------------------------|---------|----------------------|
|                    |                     |      |                | Meas Pwr                    | Tune-up | SAR Test<br>(Yes/No) | Meas Pwr                    | Tune-up | SAR Test<br>(Yes/No) |
| UNII-2C<br>5.5 GHz | 802.11a             | 100  | 5500           | 15.8                        | 16.0    | Yes                  |                             | 12.0    | No                   |
|                    |                     | 116  | 5580           | 15.4                        | 16.0    |                      |                             | 12.0    |                      |
|                    |                     | 124  | 5620           | 15.8                        | 16.0    |                      |                             | 12.0    |                      |
|                    |                     | 144  | 5720           | 15.9                        | 16.0    |                      |                             | 12.0    |                      |
|                    | 802.11n<br>(HT20)   | 100  | 5500           |                             | 16.0    | No                   |                             | 12.0    | No                   |
|                    |                     | 116  | 5580           |                             | 16.0    |                      |                             | 12.0    |                      |
|                    |                     | 124  | 5620           |                             | 16.0    |                      |                             | 12.0    |                      |
|                    |                     | 144  | 5720           |                             | 16.0    |                      |                             | 12.0    |                      |
|                    | 802.11ac<br>(VHT20) | 100  | 5500           |                             | 16.0    | No                   |                             | 12.0    | No                   |
|                    |                     | 116  | 5580           |                             | 16.0    |                      |                             | 12.0    |                      |
|                    |                     | 124  | 5620           |                             | 16.0    |                      |                             | 12.0    |                      |
|                    |                     | 144  | 5720           |                             | 16.0    |                      |                             | 12.0    |                      |
|                    | 802.11n<br>(HT40)   | 102  | 5510           |                             | 13.0    | No                   |                             | 12.0    | No                   |
|                    |                     | 118  | 5590           |                             | 15.0    |                      |                             | 12.0    |                      |
|                    |                     | 126  | 5630           |                             | 15.0    |                      |                             | 12.0    |                      |
|                    |                     | 142  | 5710           |                             | 15.0    |                      |                             | 12.0    |                      |
|                    | 802.11ac<br>(VHT40) | 102  | 5510           |                             | 13.0    | No                   |                             | 12.0    | No                   |
|                    |                     | 118  | 5590           |                             | 15.0    |                      |                             | 12.0    |                      |
|                    |                     | 126  | 5630           |                             | 15.0    |                      |                             | 12.0    |                      |
|                    |                     | 142  | 5710           |                             | 15.0    |                      |                             | 12.0    |                      |
|                    | 802.11ac<br>(VHT80) | 106  | 5530           |                             | 11.5    | No                   | 11.9                        | 12.0    | Yes                  |
|                    |                     | 122  | 5610           |                             | 14.0    |                      | 12.0                        | 12.0    |                      |
|                    |                     | 138  | 5690           |                             | 14.0    |                      | 11.6                        | 12.0    |                      |
| Band               | Mode                | Ch # | Freq.<br>(MHz) | Maximum Average Power (dBm) |         |                      | Reduced Average Power (dBm) |         |                      |
|                    |                     |      |                | Meas Pwr                    | Tune-up | SAR Test<br>(Yes/No) | Meas Pwr                    | Tune-up | SAR Test<br>(Yes/No) |
| UNII-3<br>5.8 GHz  | 802.11a             | 149  | 5745           | 15.7                        | 16.0    | Yes                  |                             | 12.0    | No                   |
|                    |                     | 157  | 5785           | 15.7                        | 16.0    |                      |                             | 12.0    |                      |
|                    |                     | 165  | 5825           | 15.3                        | 16.0    |                      |                             | 12.0    |                      |
|                    | 802.11n<br>(HT20)   | 149  | 5745           |                             | 16.0    | No                   |                             | 12.0    | No                   |
|                    |                     | 157  | 5785           |                             | 16.0    |                      |                             | 12.0    |                      |
|                    |                     | 165  | 5825           |                             | 16.0    |                      |                             | 12.0    |                      |
|                    | 802.11ac<br>(VHT20) | 149  | 5745           |                             | 16.0    | No                   |                             | 12.0    | No                   |
|                    |                     | 157  | 5785           |                             | 16.0    |                      |                             | 12.0    |                      |
|                    |                     | 165  | 5825           |                             | 16.0    |                      |                             | 12.0    |                      |
|                    | 802.11n<br>(HT40)   | 151  | 5755           |                             | 15.0    | No                   |                             | 12.0    | No                   |
|                    |                     | 159  | 5795           |                             | 15.0    |                      |                             | 12.0    |                      |
|                    | 802.11ac<br>(VHT40) | 151  | 5755           |                             | 15.0    | No                   |                             | 12.0    | No                   |
|                    |                     | 159  | 5795           |                             | 15.0    |                      |                             | 12.0    |                      |
|                    | 802.11ac<br>(VHT80) | 155  | 5775           |                             | 14.0    | No                   | 11.7                        | 12.0    | Yes                  |

## 9.6. Bluetooth

### Maximum Output Power (Tune-up Limit) for Bluetooth

From October 2016 TCB workshop, Power and SAR were measured with the device connected to a call box with hopping disabled using DH5 modulation. The duty cycle value from the device is taken from the Duty Cycle plot below.

SAR measurement is not required for the EDR and LE. When the secondary mode is  $\leq 1/4$  dB higher than the primary mode.

### Bluetooth Measured Results

| Band | Mode               | Ch # | Freq. (MHz) | Maximum Average Power (dBm) |         |                   |
|------|--------------------|------|-------------|-----------------------------|---------|-------------------|
|      |                    |      |             | Meas Pwr                    | Tune-up | SAR Test (Yes/No) |
| 2.4  | BR GFSK            | 0    | 2402        | 9.3                         | 10.0    | Yes               |
|      |                    | 39   | 2441        | 9.2                         | 10.0    |                   |
|      |                    | 78   | 2480        | 9.6                         | 10.0    |                   |
|      | EDR, $\pi/4$ DQPSK | 0    | 2402        | 9.3                         | 10.0    | No                |
|      |                    | 39   | 2441        | 9.2                         | 10.0    |                   |
|      |                    | 78   | 2480        | 9.6                         | 10.0    |                   |
|      | EDR, 8-DPSK        | 0    | 2402        | 9.3                         | 10.0    | No                |
|      |                    | 39   | 2441        | 9.2                         | 10.0    |                   |
|      |                    | 78   | 2480        | 9.6                         | 10.0    |                   |
|      | LE, GFSK           | 0    | 2402        | 4.9                         | 6.5     | No                |
|      |                    | 19   | 2440        | 6.2                         | 6.5     |                   |
|      |                    | 39   | 2480        | 5.7                         | 6.5     |                   |

### Duty Factor Measured Results

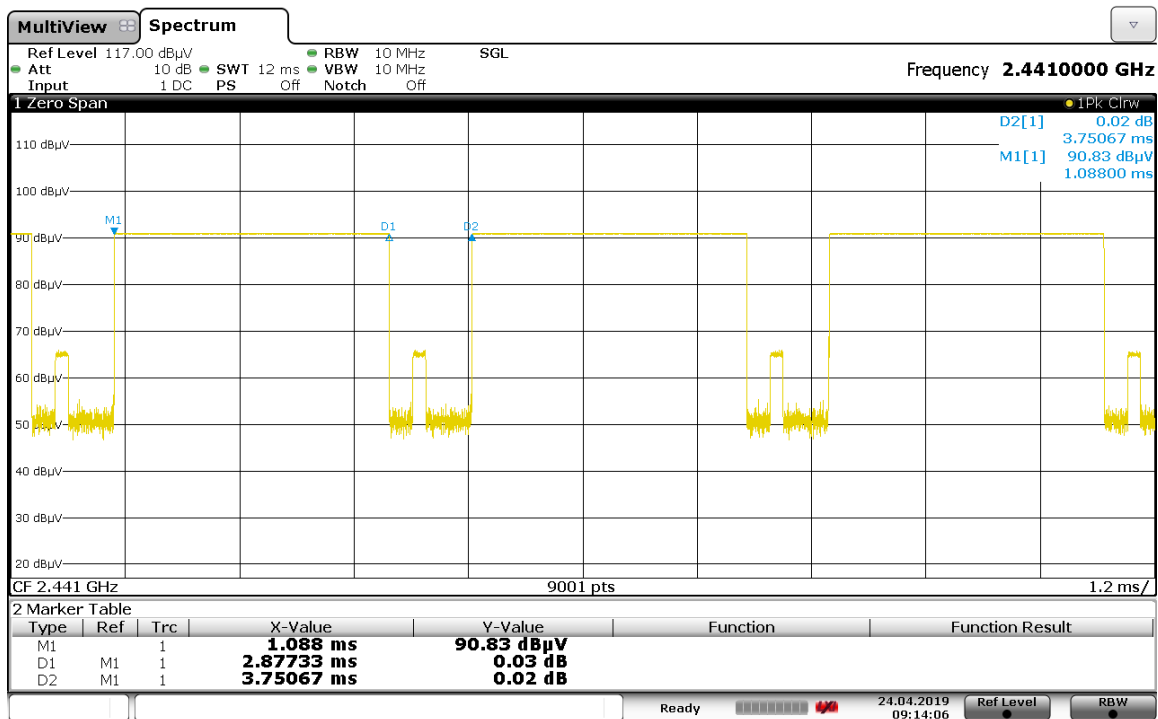
| Mode | Type | T on (ms) | Period (ms) | Duty Cycle | Crest Factor (1/duty cycle) |
|------|------|-----------|-------------|------------|-----------------------------|
| GFSK | DH5  | 2.877     | 3.751       | 76.72%     | 1.30                        |

### Note(s):

Duty Cycle = (T on / period) \* 100%

## Duty Cycle plots

GFSK



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## 10. Measured and Reported (Scaled) SAR Results

### SAR Test Reduction criteria are as follows:

- Reported SAR(W/kg) for WWAN and Bluetooth = Measured SAR \*Tune-up Scaling Factor
- Reported SAR(W/kg) for Wi-Fi = Measured SAR \* Tune-up scaling factor \* Duty Cycle scaling factor
- Duty Cycle scaling factor = 1 / Duty cycle (%)

### KDB 447498 D01 General RF Exposure Guidance:

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
- $\leq 0.6$  W/kg or  $1.5$  W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- $\leq 0.4$  W/kg or  $1.0$  W/kg, for 1-g or 10-g respectively, when the transmission band is  $\geq 200$  MHz

### KDB 648474 D04 Handset SAR:

With headset attached, when the reported SAR for body-worn accessory, measured without a headset connected to the handset, is  $> 1.2$  W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

### KDB 941225 D01 SAR test for 3G devices:

When the maximum output power and tune-up tolerance specified for production units in a secondary mode is  $\leq \frac{1}{4}$  dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is  $\leq 1.2$  W/kg, SAR measurement is not required for the secondary mode.

### KDB 941225 D05 SAR for LTE Devices:

SAR test reduction is applied using the following criteria:

- Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel.
- When the reported SAR is  $> 0.8$  W/kg, testing for other Channels is performed at the highest output power level for 1RB, and 50% RB configuration for that channel.
- Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High Channel when the highest reported SAR for 1 RB and 50% RB are  $> 0.8$  W/kg. Testing for the remaining required channels is not needed because the reported SAR for 100% RB Allocation  $< 1.45$  W/kg.
- Testing for 16-QAM modulation is not required because the reported SAR for QPSK is  $< 1.45$  W/Kg and its output power is not more than 0.5 dB higher than that of QPSK.
- Testing for the other channel bandwidths is not required because the reported SAR for the highest channel bandwidth is  $< 1.45$  W/Kg and its output power is not more than 0.5 dB higher than that of the highest channel bandwidth.
- For LTE bands that do not support at least three non-overlapping channels in certain channel bandwidths, test the available non-overlapping channels instead. When a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing; therefore, the requirement for H, M and L channels may not fully apply.

### KDB 248227 D01 SAR meas for 802.11:

SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS procedure is applied to reduce the number of SAR tests; these are mutually exclusive. For OFDM, an initial test position is only applicable to next to the ear, UMPC mini-tablet and hotspot mode configurations, which is tested using the initial test configuration to facilitate test reduction. For other exposure conditions with a fixed test position, SAR test reduction is determined using only the initial test configuration.

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the initial test position(s) by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The initial test position(s) is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). When the reported SAR for the initial test position is:

- $\leq 0.4$  W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR procedures.
- $> 0.4$  W/kg, SAR is repeated using the same wireless mode test configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position, on the highest maximum output power channel, until the reported SAR is  $\leq 0.8$  W/kg or all required test positions are tested.
  - o For subsequent test positions with equivalent test separation distance or when exposure is dominated by coupling conditions, the position for maximum coupling condition should be tested.
  - o When it is unclear, all equivalent conditions must be tested.
- For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is  $> 0.8$  W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is  $\leq 1.2$  W/kg or all required test channels are considered.
  - o The additional power measurements required for this step should be limited to those necessary for identifying subsequent highest output power channels to apply the test reduction.
- When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is  $\leq 1.2$  W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.
- When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is  $\leq 1.2$  W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR.

To determine the initial test position, Area Scans were performed to determine the position with the *Maximum Value of SAR (measured)*. The position that produced the highest *Maximum Value of SAR* is considered the worst case position; thus used as the initial test position.

**10.1. GSM850**

| RF Exposure Conditions | Mode         | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm)   |       | 1-g SAR (W/kg) |              | Plot No. |
|------------------------|--------------|----------------|------------|---------------|-------|-------------|---------------|-------|----------------|--------------|----------|
|                        |              |                |            |               |       |             | Tune-up Limit | Meas. | Meas.          | Scaled       |          |
| Head                   | GPRS 3 Slots | N/A            | 0          | Left Touch    | 190   | 836.6       | 30.0          | 29.0  | 0.345          | <b>0.434</b> | 1        |
|                        |              |                |            | Left Tilt     | 190   | 836.6       | 30.0          | 29.0  | 0.110          | 0.138        |          |
|                        |              |                |            | Right Touch   | 190   | 836.6       | 30.0          | 29.0  | 0.251          | 0.316        |          |
|                        |              |                |            | Right Tilt    | 190   | 836.6       | 30.0          | 29.0  | 0.110          | 0.138        |          |
| Body-worn              | GPRS 3 Slots | N/A            | 15         | Rear          | 190   | 836.6       | 30.0          | 29.0  | 0.268          | <b>0.337</b> | 2        |
|                        |              |                |            | Front         | 190   | 836.6       | 30.0          | 29.0  | 0.218          | 0.274        |          |
| Hotspot                | GPRS 3 Slots | N/A            | 10         | Rear          | 190   | 836.6       | 30.0          | 29.0  | 0.419          | <b>0.527</b> | 3        |
|                        |              |                |            | Front         | 190   | 836.6       | 30.0          | 29.0  | 0.286          | 0.360        |          |
|                        |              |                |            | Edge 3        | 190   | 836.6       | 30.0          | 29.0  | 0.124          | 0.156        |          |
|                        |              |                |            | Edge 4        | 190   | 836.6       | 30.0          | 29.0  | 0.288          | 0.363        |          |

**10.2. GSM1900**

| RF Exposure Conditions | Mode         | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm)   |       | 1-g SAR (W/kg) |              | Plot No. |
|------------------------|--------------|----------------|------------|---------------|-------|-------------|---------------|-------|----------------|--------------|----------|
|                        |              |                |            |               |       |             | Tune-up Limit | Meas. | Meas.          | Scaled       |          |
| Head                   | GPRS 3 Slots | ON             | 0          | Left Touch    | 512   | 1850.2      | 25.5          | 24.0  | 0.618          | 0.873        |          |
|                        |              |                |            |               | 661   | 1880.0      | 25.5          | 24.0  | 0.658          | <b>0.929</b> | 4        |
|                        |              |                |            |               | 810   | 1909.8      | 25.5          | 24.1  | 0.664          | 0.917        |          |
|                        |              |                |            | Left Tilt     | 661   | 1880.0      | 25.5          | 24.0  | 0.121          | 0.171        |          |
|                        |              |                |            | Right Touch   | 661   | 1880.0      | 25.5          | 24.0  | 0.310          | 0.438        |          |
|                        |              |                |            | Right Tilt    | 661   | 1880.0      | 25.5          | 24.0  | 0.258          | 0.364        |          |
| Body-worn              | GPRS 3 Slots | N/A            | 15         | Rear          | 661   | 1880.0      | 26.5          | 24.9  | 0.388          | 0.561        |          |
|                        |              |                |            | Front         | 661   | 1880.0      | 26.5          | 24.9  | 0.424          | <b>0.613</b> | 5        |
| Hotspot                | GPRS 3 Slots | ON             | 10         | Rear          | 512   | 1850.2      | 25.0          | 23.3  | 0.569          | 0.842        |          |
|                        |              |                |            |               | 661   | 1880.0      | 25.0          | 23.5  | 0.586          | 0.828        |          |
|                        |              |                |            |               | 810   | 1909.8      | 25.0          | 23.7  | 0.522          | 0.704        |          |
|                        |              |                |            | Front         | 512   | 1850.2      | 25.0          | 23.3  | 0.616          | <b>0.911</b> | 6        |
|                        |              |                |            |               | 661   | 1880.0      | 25.0          | 23.5  | 0.579          | 0.818        |          |
|                        |              |                |            |               | 810   | 1909.8      | 25.0          | 23.7  | 0.568          | 0.766        |          |
|                        |              |                |            | Edge 3        | 661   | 1880.0      | 25.0          | 23.5  | 0.160          | 0.226        |          |
|                        |              |                |            | Edge 4        | 512   | 1850.2      | 25.0          | 23.3  | 0.600          | 0.887        |          |
|                        |              |                |            |               | 661   | 1880.0      | 25.0          | 23.5  | 0.627          | 0.886        |          |
|                        |              |                |            |               | 810   | 1909.8      | 25.0          | 23.7  | 0.603          | 0.813        |          |

**10.3. W-CDMA Band II**

| RF Exposure Conditions | Mode                    | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm)   |       | 1-g SAR (W/kg) |              | Plot No. |
|------------------------|-------------------------|----------------|------------|---------------|-------|-------------|---------------|-------|----------------|--------------|----------|
|                        |                         |                |            |               |       |             | Tune-up Limit | Meas. | Meas.          | Scaled       |          |
| Head                   | Rel 99 RMC<br>12.2 kbps | ON             | 0          | Left Touch    | 9262  | 1852.4      | 22.5          | 22.1  | 0.786          | 0.862        | 7        |
|                        |                         |                |            |               | 9400  | 1880.0      | 22.5          | 22.1  | 0.802          | <b>0.879</b> |          |
|                        |                         |                |            |               | 9538  | 1907.6      | 22.5          | 22.2  | 0.767          | 0.822        |          |
|                        |                         |                |            | Left Tilt     | 9400  | 1880.0      | 22.5          | 22.1  | 0.211          | 0.231        |          |
|                        |                         |                |            | Right Touch   | 9400  | 1880.0      | 22.5          | 22.1  | 0.412          | 0.452        |          |
|                        |                         |                |            | Right Tilt    | 9400  | 1880.0      | 22.5          | 22.1  | 0.262          | 0.287        |          |
| Body-worn              | Rel 99 RMC<br>12.2 kbps | N/A            | 15         | Rear          | 9400  | 1880.0      | 24.5          | 24.0  | 0.348          | 0.390        | 8        |
|                        |                         |                |            | Front         | 9400  | 1880.0      | 24.5          | 24.0  | 0.617          | <b>0.692</b> |          |
| Hotspot                | Rel 99 RMC<br>12.2 kbps | ON             | 10         | Rear          | 9262  | 1852.4      | 22.5          | 22.1  | 0.817          | 0.896        | 9        |
|                        |                         |                |            |               | 9400  | 1880.0      | 22.5          | 22.1  | 0.741          | 0.812        |          |
|                        |                         |                |            |               | 9538  | 1907.6      | 22.5          | 22.2  | 0.685          | 0.734        |          |
|                        |                         |                |            | Front         | 9262  | 1852.4      | 22.5          | 22.1  | 0.821          | <b>0.900</b> |          |
|                        |                         |                |            |               | 9400  | 1880.0      | 22.5          | 22.1  | 0.776          | 0.851        |          |
|                        |                         |                |            |               | 9538  | 1907.6      | 22.5          | 22.2  | 0.709          | 0.760        |          |
|                        |                         |                |            | Edge 3        | 9400  | 1880.0      | 22.5          | 22.1  | 0.224          | 0.246        |          |
|                        |                         |                |            | Edge 4        | 9262  | 1852.4      | 22.5          | 22.1  | 0.701          | 0.769        |          |
|                        |                         |                |            |               | 9400  | 1880.0      | 22.5          | 22.1  | 0.736          | 0.807        |          |
|                        |                         |                |            |               | 9538  | 1907.6      | 22.5          | 22.2  | 0.713          | 0.764        |          |

**10.4. W-CDMA Band V**

| RF Exposure Conditions | Mode                    | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm)   |       | 1-g SAR (W/kg) |              | Plot No. |
|------------------------|-------------------------|----------------|------------|---------------|-------|-------------|---------------|-------|----------------|--------------|----------|
|                        |                         |                |            |               |       |             | Tune-up Limit | Meas. | Meas.          | Scaled       |          |
| Head                   | Rel 99 RMC<br>12.2 kbps | N/A            | 0          | Left Touch    | 4183  | 836.6       | 25.0          | 23.4  | 0.392          | <b>0.567</b> | 10       |
|                        |                         |                |            | Left Tilt     | 4183  | 836.6       | 25.0          | 23.4  | 0.155          | 0.224        |          |
|                        |                         |                |            | Right Touch   | 4183  | 836.6       | 25.0          | 23.4  | 0.297          | 0.429        |          |
|                        |                         |                |            | Right Tilt    | 4183  | 836.6       | 25.0          | 23.4  | 0.143          | 0.207        |          |
| Body-worn              | Rel 99 RMC<br>12.2 kbps | N/A            | 15         | Rear          | 4183  | 836.6       | 25.0          | 23.4  | 0.305          | <b>0.441</b> | 11       |
|                        |                         |                |            | Front         | 4183  | 836.6       | 25.0          | 23.4  | 0.278          | 0.402        |          |
| Hotspot                | Rel 99 RMC<br>12.2 kbps | N/A            | 10         | Rear          | 4183  | 836.6       | 25.0          | 23.4  | 0.488          | <b>0.705</b> | 12       |
|                        |                         |                |            | Front         | 4183  | 836.6       | 25.0          | 23.4  | 0.359          | 0.519        |          |
|                        |                         |                |            | Edge 3        | 4183  | 836.6       | 25.0          | 23.4  | 0.165          | 0.238        |          |
|                        |                         |                |            | Edge 4        | 4183  | 836.6       | 25.0          | 23.4  | 0.331          | 0.478        |          |

## 10.5. LTE Band 5 (10MHz Bandwidth)

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position    | Ch #. | Freq. (MHz) | RB Allocation | RB offset | Power (dBm)   |       | 1-g SAR (W/kg) |              | Plot No. |
|------------------------|------|----------------|------------|------------------|-------|-------------|---------------|-----------|---------------|-------|----------------|--------------|----------|
|                        |      |                |            |                  |       |             |               |           | Tune-up Limit | Meas. | Meas.          | Scaled       |          |
| Head                   | QPSK | N/A            | 0          | Left Touch       | 20525 | 836.5       | 1             | 0         | 25.0          | 23.4  | 0.324          | <b>0.468</b> | 13       |
|                        |      |                |            |                  |       |             | 25            | 0         | 24.0          | 22.3  | 0.257          | 0.380        |          |
|                        |      |                |            | Left Tilt (15°)  | 20525 | 836.5       | 1             | 0         | 25.0          | 23.4  | 0.172          | 0.249        |          |
|                        |      |                |            |                  |       |             | 25            | 0         | 24.0          | 22.3  | 0.140          | 0.207        |          |
|                        |      |                |            | Right Touch      | 20525 | 836.5       | 1             | 0         | 25.0          | 23.4  | 0.269          | 0.389        |          |
|                        |      |                |            |                  |       |             | 25            | 0         | 24.0          | 22.3  | 0.208          | 0.308        |          |
|                        |      |                |            | Right Tilt (15°) | 20525 | 836.5       | 1             | 0         | 25.0          | 23.4  | 0.158          | 0.228        |          |
|                        |      |                |            |                  |       |             | 25            | 0         | 24.0          | 22.3  | 0.126          | 0.186        |          |
| Body-worn              | QPSK | N/A            | 15         | Rear             | 20525 | 836.5       | 1             | 0         | 25.0          | 23.4  | 0.317          | <b>0.458</b> | 14       |
|                        |      |                |            |                  |       |             | 25            | 0         | 24.0          | 22.3  | 0.252          | 0.373        |          |
|                        |      |                |            | Front            | 20525 | 836.5       | 1             | 0         | 25.0          | 23.4  | 0.261          | 0.377        |          |
|                        |      |                |            |                  |       |             | 25            | 0         | 24.0          | 22.3  | 0.209          | 0.309        |          |
| Hotspot                | QPSK | N/A            | 10         | Rear             | 20525 | 836.5       | 1             | 0         | 25.0          | 23.4  | 0.450          | <b>0.650</b> | 15       |
|                        |      |                |            |                  |       |             | 25            | 0         | 24.0          | 22.3  | 0.359          | 0.531        |          |
|                        |      |                |            | Front            | 20525 | 836.5       | 1             | 0         | 25.0          | 23.4  | 0.306          | 0.442        |          |
|                        |      |                |            |                  |       |             | 25            | 0         | 24.0          | 22.3  | 0.246          | 0.364        |          |
|                        |      |                |            | Edge 3           | 20525 | 836.5       | 1             | 0         | 25.0          | 23.4  | 0.152          | 0.220        |          |
|                        |      |                |            |                  |       |             | 25            | 0         | 24.0          | 22.3  | 0.122          | 0.180        |          |
|                        |      |                |            | Edge 4           | 20525 | 836.5       | 1             | 0         | 25.0          | 23.4  | 0.250          | 0.361        |          |
|                        |      |                |            |                  |       |             | 25            | 0         | 24.0          | 22.3  | 0.195          | 0.288        |          |

## 10.6. Wi-Fi (DTS Band)

When the 802.11b reported SAR of the highest measured maximum output power channel is  $\leq 0.8$  W/kg, no further SAR testing is required. If SAR is  $> 0.8$  W/kg and  $\leq 1.2$  W/kg, SAR is required for the next highest measured output power channel. Finally, if SAR is  $> 1.2$  W/kg, SAR is required for the third channel.

SAR testing is not required for OFDM mode(s) 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.

| RF Exposure Conditions | Mode           | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Area Scan Max. SAR (W/kg) | Power (dBm)   |       | 1-g SAR (W/kg) |              | Plot No. |
|------------------------|----------------|----------------|------------|---------------|-------|-------------|------------|---------------------------|---------------|-------|----------------|--------------|----------|
|                        |                |                |            |               |       |             |            |                           | Tune-up Limit | Meas. | Meas.          | Scaled       |          |
| Head                   | 802.11b 1 Mbps | ON             | 0          | Left Touch    | 1     | 2412        | 98.67%     | 0.198                     | 12.0          | 11.6  |                |              |          |
|                        |                |                |            | Left Tilt     | 1     | 2412        | 98.67%     | 0.147                     | 12.0          | 11.6  |                |              |          |
|                        |                |                |            | Right Touch   | 1     | 2412        | 98.67%     | <b>0.540</b>              | 12.0          | 11.6  | 0.366          | <b>0.403</b> | 16       |
|                        |                |                |            | Right Tilt    | 1     | 2412        | 98.67%     | 0.294                     | 12.0          | 11.6  | 0.244          | 0.269        |          |
| Body-worn              | 802.11b 1 Mbps | N/A            | 15         | Rear          | 11    | 2462        | 98.67%     | 0.052                     | 15.0          | 15.0  |                |              |          |
|                        |                |                |            | Front         | 11    | 2462        | 98.67%     | <b>0.102</b>              | 15.0          | 15.0  | 0.065          | <b>0.066</b> | 17       |
| Hotspot                | 802.11b 1 Mbps | N/A            | 10         | Rear          | 11    | 2462        | 98.67%     | 0.105                     | 15.0          | 15.0  |                |              |          |
|                        |                |                |            | Front         | 11    | 2462        | 98.67%     | <b>0.166</b>              | 15.0          | 15.0  | 0.113          | <b>0.115</b> | 18       |
|                        |                |                |            | Edge 1        | 11    | 2462        | 98.67%     | 0.086                     | 15.0          | 15.0  |                |              |          |
|                        |                |                |            | Edge 4        | 11    | 2462        | 98.67%     | 0.094                     | 15.0          | 15.0  |                |              |          |

## 10.7. Wi-Fi (U-NII Band)

### UNII-1 & 2A

When the specified maximum output power is the same for both UNII band 1 and UNII band 2A, begin SAR measurement in UNII band 2A; and if the highest reported SAR for UNII band 2A is

- o  $\leq 1.2$  W/kg, SAR is not required for UNII band 1
- o  $> 1.2$  W/kg, both bands should be tested independently for SAR.

| RF Exposure Conditions | Mode           | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Area Scan Max. SAR (W/kg) | Power (dBm)   |       | 1-g SAR (W/kg) |              | Plot No. |
|------------------------|----------------|----------------|------------|---------------|-------|-------------|------------|---------------------------|---------------|-------|----------------|--------------|----------|
|                        |                |                |            |               |       |             |            |                           | Tune-up Limit | Meas. | Meas.          | Scaled       |          |
| Head                   | 802.11ac VHT80 | ON             | 0          | Left Rouch    | 58    | 5290        | 95.96%     | 0.036                     | 12.0          | 12.0  |                |              |          |
|                        |                |                |            | Left Tilt     | 58    | 5290        | 95.96%     | 0.038                     | 12.0          | 12.0  |                |              |          |
|                        |                |                |            | Right Touch   | 58    | 5290        | 95.96%     | <b>0.096</b>              | 12.0          | 12.0  | 0.051          | <b>0.053</b> | 19       |
|                        |                |                |            | Right Tilt    | 58    | 5290        | 95.96%     | 0.041                     | 12.0          | 12.0  |                |              |          |
| Body-w orn             | 802.11n HT20   | N/A            | 15         | Rear          | 60    | 5300        | 91.99%     | <b>1.230</b>              | 16.0          | 16.0  | 0.627          | <b>0.682</b> | 20       |
|                        |                |                |            | Front         | 60    | 5300        | 91.99%     | 0.035                     | 16.0          | 16.0  | 0.015          | 0.016        |          |

### UNII-2C

| RF Exposure Conditions | Mode           | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Area Scan Max. SAR (W/kg) | Power (dBm)   |       | 1-g SAR (W/kg) |              | Plot No. |
|------------------------|----------------|----------------|------------|---------------|-------|-------------|------------|---------------------------|---------------|-------|----------------|--------------|----------|
|                        |                |                |            |               |       |             |            |                           | Tune-up Limit | Meas. | Meas.          | Scaled       |          |
| Head                   | 802.11ac VHT80 | ON             | 0          | Left Touch    | 122   | 5610        | 95.96%     | 0.038                     | 12.0          | 12.0  |                |              |          |
|                        |                |                |            | Left Tilt     | 122   | 5610        | 95.96%     | 0.040                     | 12.0          | 12.0  |                |              |          |
|                        |                |                |            | Right Touch   | 122   | 5610        | 95.96%     | <b>0.080</b>              | 12.0          | 12.0  | 0.032          | <b>0.033</b> | 21       |
|                        |                |                |            | Right Tilt    | 122   | 5610        | 95.96%     | 0.041                     | 12.0          | 12.0  |                |              |          |
| Body-w orn             | 802.11a 6 Mbps | N/A            | 15         | Rear          | 144   | 5720        | 92.44%     | 1.250                     | 16.0          | 15.9  | 0.584          | <b>0.646</b> | 22       |
|                        |                |                |            | Front         | 144   | 5720        | 92.44%     | 0.065                     | 16.0          | 15.9  | 0.059          | 0.065        |          |

### UNII-3

| RF Exposure Conditions | Mode           | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Area Scan Max. SAR (W/kg) | Power (dBm)   |       | 1-g SAR (W/kg) |              | Plot No. |
|------------------------|----------------|----------------|------------|---------------|-------|-------------|------------|---------------------------|---------------|-------|----------------|--------------|----------|
|                        |                |                |            |               |       |             |            |                           | Tune-up Limit | Meas. | Meas.          | Scaled       |          |
| Head                   | 802.11ac VHT80 | ON             | 0          | Left Touch    | 155   | 5775        | 95.96%     | 0.027                     | 12.0          | 11.7  |                |              |          |
|                        |                |                |            | Left Tilt     | 155   | 5775        | 95.96%     | 0.027                     | 12.0          | 11.7  |                |              |          |
|                        |                |                |            | Right Touch   | 155   | 5775        | 95.96%     | <b>0.101</b>              | 12.0          | 11.7  | 0.031          | <b>0.035</b> | 23       |
|                        |                |                |            | Right Tilt    | 155   | 5775        | 95.96%     | 0.027                     | 12.0          | 11.7  |                |              |          |
| Body-w orn             | 802.11a 6 Mbps | N/A            | 15         | Rear          | 157   | 5785        | 92.44%     | <b>1.150</b>              | 16.0          | 15.7  | 0.535          | <b>0.619</b> | 24       |
|                        |                |                |            | Front         | 157   | 5785        | 92.44%     | 0.064                     | 16.0          | 15.7  | 0.018          | 0.021        |          |
| Hotspot                | 802.11a 6 Mbps | N/A            | 10         | Rear          | 149   | 5745        | 92.44%     | 1.500                     | 16.0          | 15.7  | 0.789          | <b>0.925</b> | 25       |
|                        |                |                |            |               | 157   | 5785        | 92.44%     | <b>1.510</b>              | 16.0          | 15.7  | 0.761          | 0.880        |          |
|                        |                |                |            | Front         | 157   | 5785        | 92.44%     | 0.095                     | 16.0          | 15.7  |                |              |          |
|                        |                |                |            | Edge 1        | 157   | 5785        | 92.44%     | 0.196                     | 16.0          | 15.7  |                |              |          |
|                        |                |                |            | Edge 4        | 157   | 5785        | 92.44%     | 0.771                     | 16.0          | 15.7  | 0.330          | 0.382        |          |

**10.8. Bluetooth**

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm)   |       | 1-g SAR (W/kg) |              | Plot No. |
|------------------------|------|----------------|------------|---------------|-------|-------------|---------------|-------|----------------|--------------|----------|
|                        |      |                |            |               |       |             | Tune-up Limit | Meas. | Meas.          | Scaled       |          |
| Head                   | GFSK | N/A            | 0          | Left Touch    | 78    | 2480        | 10.0          | 9.6   | 0.048          | 0.053        |          |
|                        |      |                |            | Left Tilt     | 78    | 2480        | 10.0          | 9.6   | 0.039          | 0.043        |          |
|                        |      |                |            | Right Touch   | 78    | 2480        | 10.0          | 9.6   | 0.110          | <b>0.121</b> | 26       |
|                        |      |                |            | Right Tilt    | 78    | 2480        | 10.0          | 9.6   | 0.091          | 0.100        |          |
| Body-worn              | GFSK | N/A            | 15         | Rear          | 78    | 2480        | 10.0          | 9.6   | 0.006          | 0.006        |          |
|                        |      |                |            | Front         | 78    | 2480        | 10.0          | 9.6   | 0.014          | <b>0.015</b> | 27       |
| Hotspot                | GFSK | N/A            | 10         | Rear          | 78    | 2480        | 10.0          | 9.6   | 0.015          | 0.016        |          |
|                        |      |                |            | Front         | 78    | 2480        | 10.0          | 9.6   | 0.023          | <b>0.025</b> | 28       |
|                        |      |                |            | Edge 1        | 78    | 2480        | 10.0          | 9.6   | 0.010          | 0.011        |          |
|                        |      |                |            | Edge 4        | 78    | 2480        | 10.0          | 9.6   | 0.011          | 0.012        |          |

## 11. SAR Measurement Variability

In accordance with published RF Exposure KDB 865664 D01 SAR measurement 100 MHz to 6 GHz. These 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  $< 0.8$  or  $2 \text{ W/kg}$  (1-g or 10-g respectively); steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is  $\geq 0.8$  or  $2 \text{ W/kg}$  (1-g or 10-g respectively), 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  $\geq 1.45$  or  $3.6 \text{ W/kg}$  ( $\sim 10\%$  from the 1-g or 10-g respective SAR limit).
- 4) Perform a third repeated measurement only if the original, first, or second repeated measurement is  $\geq 1.5$  or  $3.75 \text{ W/kg}$  (1-g or 10-g respectively) and the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$ .

| Frequency Band (MHz) | Air Interface | RF Exposure Conditions | Test Position | Repeated SAR (Yes/No) | Highest Measured SAR (W/kg) | First Repeated      |                               |
|----------------------|---------------|------------------------|---------------|-----------------------|-----------------------------|---------------------|-------------------------------|
|                      |               |                        |               |                       |                             | Measured SAR (W/kg) | Largest to Smallest SAR Ratio |
| 1900                 | WCDMA Band II | Hotspot                | Front         | Yes                   | 0.821                       | 0.808               | 1.02                          |

### Note(s):

Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is  $< 1.20$ .

## 12. Simultaneous Transmission Conditions

| RF Exposure Condition                                               | Item | Capable Transmit Configurations |         |
|---------------------------------------------------------------------|------|---------------------------------|---------|
| Head<br>Body-w orn<br>Hotspot                                       | 1    | GSM(Voice)                      | + DTS   |
|                                                                     | 2    | GSM(Voice)                      | + U-NII |
|                                                                     | 3    | GSM(Voice)                      | + BT    |
|                                                                     | 4    | GSM(GPRS/EDGE)                  | + DTS   |
|                                                                     | 5    | GSM(GPRS/EDGE)                  | + U-NII |
|                                                                     | 6    | GSM(GPRS/EDGE)                  | + BT    |
|                                                                     | 7    | W-CDMA                          | + DTS   |
|                                                                     | 8    | W-CDMA                          | + U-NII |
|                                                                     | 9    | W-CDMA                          | + BT    |
|                                                                     | 10   | LTE                             | + DTS   |
|                                                                     | 11   | LTE                             | + U-NII |
|                                                                     | 12   | LTE                             | + BT    |
| Notes:                                                              |      |                                 |         |
| 1. DTS & UNII (5.8GHz) supports Hotspot.                            |      |                                 |         |
| 2. GPRS/EDGE, W-CDMA, and LTE support Hotspot.                      |      |                                 |         |
| 3. DTS Radio cannot transmit simultaneously with Bluetooth Radio.   |      |                                 |         |
| 4. U-NII Radio cannot transmit simultaneously with Bluetooth Radio. |      |                                 |         |

### 12.1. Simultaneous transmission SAR test exclusion considerations

KDB 447498 D01 General RF Exposure Guidance provides two procedures for determining simultaneous transmission SAR test exclusion: Sum of SAR and SAR to Peak Location Ratio (SPLSR)

#### 12.1.1. Sum of SAR

To qualify for simultaneous transmission SAR test exclusion based upon Sum of SAR the sum of the reported standalone SARs for all simultaneously transmitting antennas shall be below the applicable standalone SAR limit. If the sum of the SARs is above the applicable limit then simultaneous transmission SAR test exclusion may still apply if the requirements of the SAR to Peak Location Ratio (SPLSR) evaluation are met.

#### 12.1.2. SAR to Peak Location Ratio (SPLSR)

KDB 447498 D01 General RF Exposure Guidance explains how to calculate the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

$$SPLSR = (SAR_1 + SAR_2)^{1.5} / Ri$$

Where:

**SAR<sub>1</sub>** is the highest reported or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

**SAR<sub>2</sub>** is the highest reported or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

**Ri** is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of  $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$

In order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

$$(SAR_1 + SAR_2)^{1.5} / Ri \leq 0.04$$

When an individual antenna transmits at on two bands simultaneously, the sum of the highest reported SAR for the frequency bands should be used to determine **SAR<sub>1</sub>** or **SAR<sub>2</sub>**. When SPLSR is necessary, the smallest distance between the peak SAR locations for the antenna pair with respect to the peaks from each antenna should be used.

The antennas in all antenna pairs that do not qualify for simultaneous transmission SAR test exclusion must be tested for SAR compliance, according to the enlarged zoom scan and volume scan post-processing procedures in KDB Publication 865664 D01

**12.2. Sum of the SAR for GSM850 & Wi-Fi & BT**

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) |       |       |       | $\Sigma$ 1-g SAR (W/kg) |       |       |
|------------------------|---------------|-----------------------|-------|-------|-------|-------------------------|-------|-------|
|                        |               | WWAN                  | DTS   | NII   | DSS   | 1+2                     | 1+3   | 1+4   |
|                        |               | 1                     | 2     | 3     | 4     |                         |       |       |
| Head                   | Left Touch    | 0.434                 | 0.269 | 0.053 | 0.053 | 0.703                   | 0.487 | 0.487 |
|                        | Left Tilt     | 0.138                 | 0.269 | 0.053 | 0.043 | 0.407                   | 0.191 | 0.181 |
|                        | Right Touch   | 0.316                 | 0.403 | 0.053 | 0.121 | 0.719                   | 0.369 | 0.437 |
|                        | Right Tilt    | 0.138                 | 0.269 | 0.053 | 0.100 | 0.407                   | 0.191 | 0.238 |
| Body-worn              | Rear          | 0.337                 | 0.066 | 0.682 | 0.006 | 0.403                   | 1.019 | 0.343 |
|                        | Front         | 0.274                 | 0.066 | 0.065 | 0.015 | 0.340                   | 0.339 | 0.290 |
| Hotspot                | Rear          | 0.527                 | 0.115 | 0.925 | 0.016 | 0.642                   | 1.452 | 0.544 |
|                        | Front         | 0.360                 | 0.115 | 0.382 | 0.025 | 0.475                   | 0.742 | 0.385 |
|                        | Edge 1        |                       | 0.115 | 0.382 | 0.011 |                         |       |       |
|                        | Edge 2        |                       |       |       |       |                         |       |       |
|                        | Edge 3        | 0.156                 |       |       |       |                         |       |       |
|                        | Edge 4        | 0.363                 | 0.115 | 0.382 | 0.012 | 0.478                   | 0.744 | 0.375 |

**12.3. Sum of the SAR for GSM 1900 & Wi-Fi & BT**

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) |       |       |       | $\Sigma$ 1-g SAR (W/kg) |       |       |
|------------------------|---------------|-----------------------|-------|-------|-------|-------------------------|-------|-------|
|                        |               | WWAN                  | DTS   | NII   | DSS   | 1+2                     | 1+3   | 1+4   |
|                        |               | 1                     | 2     | 3     | 4     |                         |       |       |
| Head                   | Left Touch    | 0.929                 | 0.269 | 0.053 | 0.053 | 1.198                   | 0.982 | 0.982 |
|                        | Left Tilt     | 0.171                 | 0.269 | 0.053 | 0.043 | 0.440                   | 0.224 | 0.214 |
|                        | Right Touch   | 0.438                 | 0.403 | 0.053 | 0.121 | 0.841                   | 0.491 | 0.558 |
|                        | Right Tilt    | 0.364                 | 0.269 | 0.053 | 0.100 | 0.633                   | 0.417 | 0.464 |
| Body-worn              | Rear          | 0.561                 | 0.066 | 0.682 | 0.006 | 0.627                   | 1.243 | 0.567 |
|                        | Front         | 0.613                 | 0.066 | 0.065 | 0.015 | 0.679                   | 0.678 | 0.628 |
| Hotspot                | Rear          | 0.842                 | 0.115 | 0.925 | 0.016 | 0.957                   | 1.767 | 0.858 |
|                        | Front         | 0.911                 | 0.115 | 0.382 | 0.025 | 1.026                   | 1.293 | 0.936 |
|                        | Edge 1        |                       | 0.115 | 0.382 | 0.011 |                         |       |       |
|                        | Edge 2        |                       |       |       |       |                         |       |       |
|                        | Edge 3        | 0.226                 |       |       |       |                         |       |       |
|                        | Edge 4        | 0.887                 | 0.115 | 0.382 | 0.012 | 1.002                   | 1.269 | 0.900 |

**SAR to Peak Location Separation Ratio (SPLSR)**

| Test Position | Standalone SAR (W/kg) |          | $\Sigma$ 1-g SAR (W/kg) |       | Calculated distance (mm) | SPLSR ( $\leq 0.04$ )       | Volume Scan (Yes/ No) |
|---------------|-----------------------|----------|-------------------------|-------|--------------------------|-----------------------------|-----------------------|
|               | 1                     | 3        |                         |       |                          |                             |                       |
|               | WWAN                  | Wi-Fi 5G |                         |       |                          |                             |                       |
| Rear          | 0.842                 | 0.925    | 1+3                     | 1.767 | 99.0                     | 0.02                        | No                    |
| Mode          |                       | Peak SAR | X                       | Y     | Z                        | d: Calculated distance (mm) |                       |
|               |                       | W/kg     | m                       | m     | m                        |                             |                       |
| WWAN          | 1                     | 0.796    | 0.0255                  | -0.05 | -0.181                   | 1+3                         | 99.0                  |
| U-NII         | 3                     | 1.99     | 0.028                   | 0.049 | -0.18                    |                             |                       |

**12.4. Sum of the SAR for W-CDMA Band II & Wi-Fi & BT**

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) |       |       |       | $\Sigma$ 1-g SAR (W/kg) |       |       |
|------------------------|---------------|-----------------------|-------|-------|-------|-------------------------|-------|-------|
|                        |               | WWAN                  | DTS   | NII   | DSS   | 1+2                     | 1+3   | 1+4   |
|                        |               | 1                     | 2     | 3     | 4     |                         |       |       |
| Head                   | Left Touch    | 0.879                 | 0.269 | 0.053 | 0.053 | 1.148                   | 0.932 | 0.932 |
|                        | Left Tilt     | 0.231                 | 0.269 | 0.053 | 0.043 | 0.500                   | 0.284 | 0.274 |
|                        | Right Touch   | 0.452                 | 0.403 | 0.053 | 0.121 | 0.855                   | 0.505 | 0.572 |
|                        | Right Tilt    | 0.287                 | 0.269 | 0.053 | 0.100 | 0.556                   | 0.340 | 0.387 |
| Body-worn              | Rear          | 0.390                 | 0.066 | 0.682 | 0.006 | 0.456                   | 1.072 | 0.397 |
|                        | Front         | 0.692                 | 0.066 | 0.065 | 0.015 | 0.758                   | 0.757 | 0.708 |
| Hotspot                | Rear          | 0.896                 | 0.115 | 0.925 | 0.016 | 1.011                   | 1.821 | 0.912 |
|                        | Front         | 0.900                 | 0.115 | 0.382 | 0.025 | 1.015                   | 1.282 | 0.925 |
|                        | Edge 1        |                       | 0.115 | 0.382 | 0.011 |                         |       |       |
|                        | Edge 2        |                       |       |       |       |                         |       |       |
|                        | Edge 3        | 0.246                 |       |       |       |                         |       |       |
|                        | Edge 4        | 0.807                 | 0.115 | 0.382 | 0.012 | 0.922                   | 1.189 | 0.819 |

**SAR to Peak Location Separation Ratio (SPLSR)**

| Test Position | Standalone SAR (W/kg) |          | $\Sigma$ 1-g SAR (W/kg) |        | Calculated distance (mm) | SPLSR ( $\leq 0.04$ )       | Volume Scan (Yes/ No) |
|---------------|-----------------------|----------|-------------------------|--------|--------------------------|-----------------------------|-----------------------|
|               | 1                     | 3        |                         |        |                          |                             |                       |
|               | WWAN                  | Wi-Fi 5G |                         |        |                          |                             |                       |
| Rear          | 0.896                 | 0.925    | 1+3                     | 1.821  | 92.0                     | 0.03                        | No                    |
| Mode          |                       | Peak SAR | X                       | Y      | Z                        | d: Calculated distance (mm) |                       |
|               |                       | W/kg     | m                       | m      | m                        |                             |                       |
| WWAN          | 1                     | 1.12     | 0.0295                  | -0.043 | -0.178                   | 1+3                         | 92.0                  |
| U-NII         | 3                     | 1.99     | 0.028                   | 0.049  | -0.18                    |                             |                       |

**12.5. Sum of the SAR for W-CDMA Band V & Wi-Fi & BT**

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) |       |       |       | $\Sigma$ 1-g SAR (W/kg) |       |       |
|------------------------|---------------|-----------------------|-------|-------|-------|-------------------------|-------|-------|
|                        |               | WWAN                  | DTS   | NII   | DSS   | 1+2                     | 1+3   | 1+4   |
|                        |               | 1                     | 2     | 3     | 4     |                         |       |       |
| Head                   | Left Touch    | 0.567                 | 0.269 | 0.053 | 0.053 | 0.835                   | 0.620 | 0.619 |
|                        | Left Tilt     | 0.224                 | 0.269 | 0.053 | 0.043 | 0.493                   | 0.277 | 0.267 |
|                        | Right Touch   | 0.429                 | 0.403 | 0.053 | 0.121 | 0.832                   | 0.482 | 0.550 |
|                        | Right Tilt    | 0.207                 | 0.269 | 0.053 | 0.100 | 0.475                   | 0.260 | 0.306 |
| Body-worn              | Rear          | 0.441                 | 0.066 | 0.682 | 0.006 | 0.507                   | 1.123 | 0.447 |
|                        | Front         | 0.402                 | 0.066 | 0.065 | 0.015 | 0.468                   | 0.467 | 0.417 |
| Hotspot                | Rear          | 0.705                 | 0.115 | 0.925 | 0.016 | 0.820                   | 1.630 | 0.722 |
|                        | Front         | 0.519                 | 0.115 | 0.382 | 0.025 | 0.634                   | 0.901 | 0.544 |
|                        | Edge 1        |                       | 0.115 | 0.382 | 0.011 |                         |       |       |
|                        | Edge 2        |                       |       |       |       |                         |       |       |
|                        | Edge 3        | 0.238                 |       |       |       |                         |       |       |
|                        | Edge 4        | 0.478                 | 0.115 | 0.382 | 0.012 | 0.593                   | 0.860 | 0.491 |

**SAR to Peak Location Separation Ratio (SPLSR)**

| Test Position | Standalone SAR (W/kg) |          | $\Sigma$ 1-g SAR (W/kg) |       | Calculated distance (mm) | SPLSR ( $\leq 0.04$ )       | Volume Scan (Yes/ No) |
|---------------|-----------------------|----------|-------------------------|-------|--------------------------|-----------------------------|-----------------------|
|               | 1                     | 3        |                         |       |                          |                             |                       |
|               | WWAN                  | Wi-Fi 5G |                         |       |                          |                             |                       |
| Rear          | 0.705                 | 0.925    | 1+3                     | 1.630 | 109.5                    | 0.02                        | No                    |
| Mode          |                       | Peak SAR | X                       | Y     | Z                        | d: Calculated distance (mm) |                       |
|               |                       | W/kg     | m                       | m     | m                        |                             |                       |
| WWAN          | 1                     | 0.703    | 0.018                   | -0.06 | -0.18                    | 1+3                         | 109.5                 |
| U-NII         | 3                     | 1.99     | 0.028                   | 0.049 | -0.18                    |                             |                       |

**12.6. Sum of the SAR for LTE Band 5 & Wi-Fi & BT**

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) |       |       |       | $\Sigma$ 1-g SAR (W/kg) |       |       |
|------------------------|---------------|-----------------------|-------|-------|-------|-------------------------|-------|-------|
|                        |               | WWAN                  | DTS   | NII   | DSS   | 1+2                     | 1+3   | 1+4   |
|                        |               | 1                     | 2     | 3     | 4     |                         |       |       |
| Head                   | Left Touch    | 0.468                 | 0.269 | 0.053 | 0.053 | 0.737                   | 0.521 | 0.521 |
|                        | Left Tilt     | 0.249                 | 0.269 | 0.053 | 0.043 | 0.517                   | 0.302 | 0.291 |
|                        | Right Touch   | 0.389                 | 0.403 | 0.053 | 0.121 | 0.792                   | 0.442 | 0.509 |
|                        | Right Tilt    | 0.228                 | 0.269 | 0.053 | 0.100 | 0.497                   | 0.281 | 0.328 |
| Body-worn              | Rear          | 0.458                 | 0.066 | 0.682 | 0.006 | 0.524                   | 1.140 | 0.465 |
|                        | Front         | 0.377                 | 0.066 | 0.065 | 0.015 | 0.443                   | 0.442 | 0.393 |
| Hotspot                | Rear          | 0.650                 | 0.115 | 0.925 | 0.016 | 0.765                   | 1.575 | 0.667 |
|                        | Front         | 0.442                 | 0.115 | 0.382 | 0.025 | 0.557                   | 0.824 | 0.468 |
|                        | Edge 1        |                       | 0.115 | 0.382 | 0.011 |                         |       |       |
|                        | Edge 2        |                       |       |       |       |                         |       |       |
|                        | Edge 3        | 0.220                 |       |       |       |                         |       |       |
|                        | Edge 4        | 0.361                 | 0.115 | 0.382 | 0.012 | 0.476                   | 0.743 | 0.373 |

**Conclusion:**

Simultaneous transmission SAR measurement (Volume Scan) is not required because either the sum of the 1-g SAR is < 1.6 W/kg or the SPLSR is  $\leq 0.04$  for all circumstances that require SPLSR calculation.

## **Appendixes**

**Refer to separated files for the following appendixes.**

**Appendix A: SAR Setup Photos**

**Appendix B: SAR System Check Plots**

**Appendix C: SAR Highest Test Plots**

**Appendix D: SAR Tissue Ingredients**

**Appendix E: SAR Probe Certificates**

**Appendix F: SAR Dipole Certificates**

**END OF REPORT**