



SAR EVALUATION REPORT

**FCC 47 CFR § 2.1093
IEEE Std 1528-2013**

For
LTE Wrist Device + Bluetooth & WLAN 2.4GHz b/g/n

**FCC ID: A3LSMR765V
Model Name: SM-R765V**

**Report Number: 4787821625-S1V2
Issue Date: 2/9/2017**

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TL-637

Revision History



| Rev. | Date | Revisions | Revised By |
|------|----------|--|---------------|
| V1 | 2/1/2017 | Initial Issue | JeongYeon Won |
| V2 | 2/9/2017 | -Sec 9.3. Revised Mode in table. -Appendix B. Revised Bluetooth plot. -Changed DTS target power. Revised SAR report related to DTS. | JeongYeon Won |
| | | | |
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1. Attestation of Test Results

| | | | | | |
|---|-------------------------------|---|---|--|-----------------|
| Applicant Name | | SAMSUNG ELECTRONICS CO.,LTD. | | | |
| FCC ID | | A3LSMR765V | | | |
| Model Name | | SM-R765V | | | |
| Applicable Standards | | FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013 | | | |
| SAR Limits (W/Kg) | | | | | |
| Exposure Category | | Peak spatial-average(1g of tissue) | | Extremities (hands, wrists, ankles, etc.) (10g of tissue) | |
| General population / Uncontrolled exposure | | 1.6 | | 4.0 | |
| The Highest Reported SAR (W/kg) | | | | | |
| RF Exposure Conditions | | Equipment Class | | | |
| | | Licensed | DTS | U-NII | DSS (BT) |
| Next-to-Mouth 1g SAR | | 1.001 | 0.147 | N/A | 0.021 |
| Extremity (Wrist) 10g SAR | | 1.376 | 0.156 | | 0.048 |
| Simultaneous TX | Next-to-Mouth 1-g SAR | 1.148 | | | 1.022 |
| | Extremity (Wrist) 10-g SAR | 1.532 | | | 1.424 |
| Date Tested | | 1/11/2017 to 1/20/2017 | | | |
| Test Results | | Pass | | | |
| <p>UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.</p> <p>Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. 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 IAS, any agency of the Federal Government, or any agency of any government.</p> | | | | | |
| Approved & Released By: | | | Prepared By: | | |
|  | | |  | | |
| Justin Park Senior Engineer UL Korea, Ltd. Suwon Laboratory | | | JeongYeon Won Laboratory Technician UL Korea, Ltd. Suwon Laboratory | | |

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:

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 690783 D01 SAR Listings on Grants v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 941225 D05 SAR for LTE Devices v02r05

3. Facilities and Accreditation

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

| |
|------------|
| Suwon |
| SAR 1 Room |
| SAR 2 Room |
| SAR 3 Room |

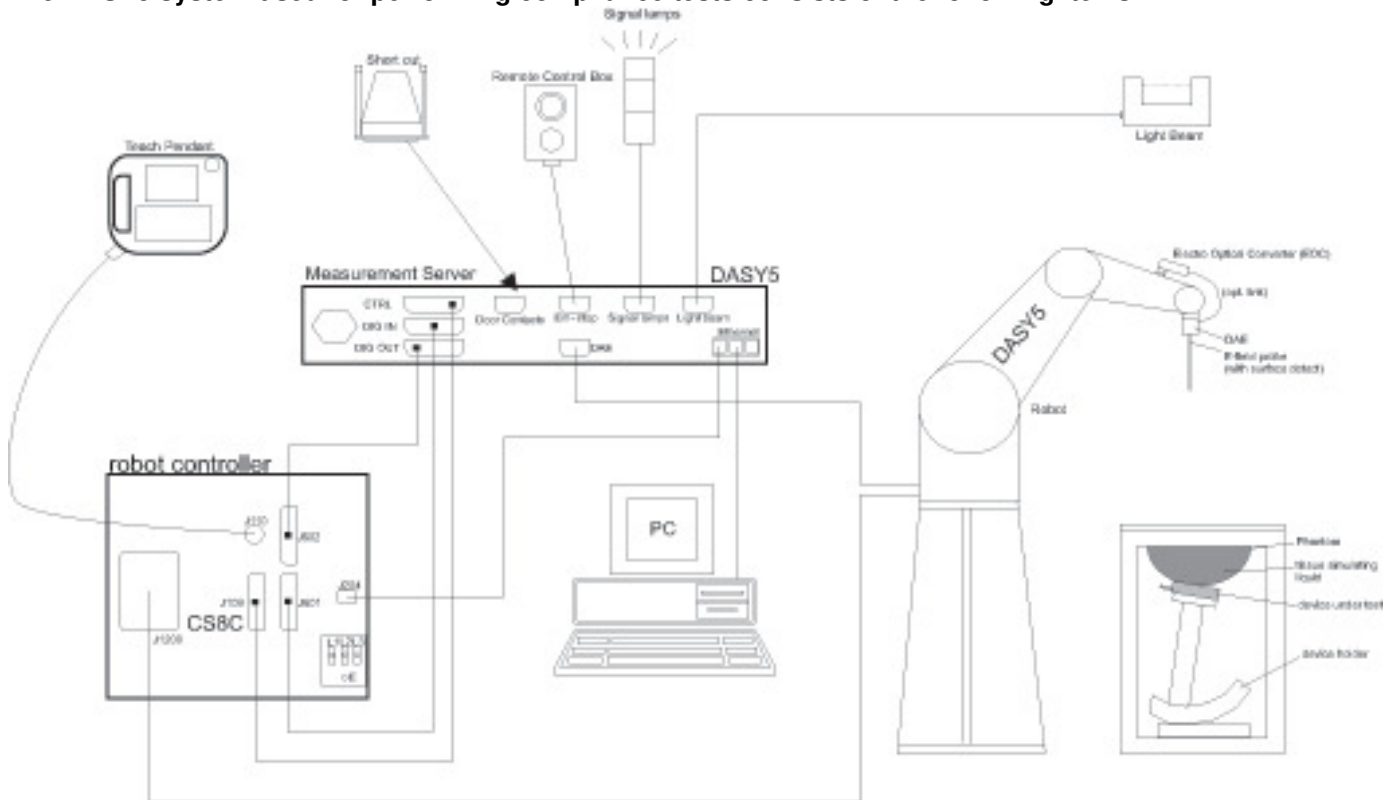
UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637.

The full scope of accreditation can be viewed at <http://www.iasonline.org/PDF/TL/TL-637.pdf>.

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

| | ≤ 3 GHz | > 3 GHz |
|--|--|--|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | 5 ± 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: Δx_{Area} , Δy_{Area} | ≤ 2 GHz: ≤ 15 mm $2 - 3$ GHz: ≤ 12 mm | $3 - 4$ GHz: ≤ 12 mm $4 - 6$ GHz: ≤ 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

| | | ≤ 3 GHz | > 3 GHz | |
|--|---|---|---|--|
| Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$ | | ≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm * | 3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm* | |
| Maximum zoom scan spatial resolution, normal to phantom surface | uniform grid: $\Delta z_{\text{Zoom}}(n)$ | ≤ 5 mm | 3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm | |
| | graded grid | $\Delta z_{\text{Zoom}}(1)$: between 1 st two points closest to phantom surface | ≤ 4 mm | 3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 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 | ≥ 30 mm | 3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm | |
| Note: δ 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 <i>reported</i> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 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.

Step 5: Z-Scan (FCC only)

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation the extrapolated distance should not be larger than the step size in Z-direction.

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.

Dielectric Property Measurements

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---------------------------|--------------|---------------|---------------|---------------|
| Network Analyzer | Agilent | E5071C | MY46522054 | 8-18-2017 |
| Dielectric Assessment Kit | SPEAG | DAK-3.5 | 1196 | 7-26-2017 |
| Shorting block | SPEAG | DAK-3.5 Short | SM DAK 200 BA | N/A |
| Thermometer | LKM | DTM3000 | 3424 | 8-17-2017 |
| Thermometer | Lutron | MHB-382SD | AH.91478 | 8-10-2017 |

System Check

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|-------------------------------------|--------------|-----------------------|------------|---------------|
| MXG Analog Signal Generator | Agilent | N5181A | MY50145882 | 8-16-2017 |
| Power Sensor | Agilent | U2000A | MY54260010 | 8-17-2017 |
| Power Sensor | Agilent | U2000A | MY54260007 | 8-17-2017 |
| Power Amplifier | EXODUS | 1410025-AMP2027-10003 | 10003 | 8-17-2017 |
| Directional Coupler | Agilent | 772D | MY52180193 | 8-17-2017 |
| Directional Coupler | Agilent | 778D | MY52180432 | 8-17-2017 |
| Low Pass Filter | MICROLAB | LA-15N | 03943 | 8-17-2017 |
| Low Pass Filter | FILTRON | L14012FL | 1410003S | 8-17-2017 |
| Attenuator | Agilent | 8491B/003 | MY39269292 | 8-17-2017 |
| Attenuator | Agilent | 8491B/010 | MY39269315 | 8-17-2017 |
| Attenuator | Agilent | 8491B/020 | MY39269298 | 8-17-2017 |
| E-Field Probe (SAR1) | SPEAG | EX3DV4 | 7376 | 8-30-2017 |
| E-Field Probe (SAR2) | SPEAG | EX3DV4 | 7330 | 2-24-2017 |
| E-Field Probe (SAR3) | SPEAG | EX3DV4 | 7314 | 9-27-2017 |
| Data Acquisition Electronics (SAR1) | SPEAG | DAE4 | 1447 | 9-19-2017 |
| Data Acquisition Electronics (SAR2) | SPEAG | DAE4 | 1468 | 9-8-2017 |
| Data Acquisition Electronics (SAR3) | SPEAG | DAE4 | 1494 | 7-18-2017 |
| System Validation Dipole | SPEAG | D750V3 | 1122 | 8-30-2017 |
| System Validation Dipole | SPEAG | D1750V2 | 1125 | 8-26-2017 |
| System Validation Dipole | SPEAG | D2450V2 | 939 | 9-23-2017 |
| Thermometer (SAR1) | Lutron | MHB-382SD | AH.91463 | 8-10-2017 |
| Thermometer (SAR2) | Lutron | MHB-382SD | AH.50215 | 8-17-2017 |
| Thermometer (SAR3) | Lutron | MHB-382SD | AH.50213 | 8-17-2017 |

Others

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|------------------------|--------------|------------|-------------|---------------|
| Base Station Simulator | R & S | CMW500 | 150313 | 8-16-2017 |
| Base Station Simulator | R & S | CMW500 | 150314 | 8-16-2017 |
| Bluetooth Tester | TESCOM | TC-3000C | 3000C000546 | 8-18-2017 |

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, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

6. Device Under Test (DUT) Information

6.1. DUT Description

| | | | |
|---------------------------|--|-------------|------------------------------|
| Intended Use | This device should be restricted to wrist-worn and no other operation configuration should be used | | |
| Device Dimension | Overall (Length x Width): 48.5 mm x 49.0 mm Overall Diagonal: 48.5 mm Display Diagonal: 33.5 mm | | |
| Back Cover | <input checked="" type="checkbox"/> The rechargeable battery is not user accessible. | | |
| Battery Options | <input checked="" type="checkbox"/> The rechargeable battery is not user accessible. | | |
| Wireless Router (Hotspot) | <input checked="" type="checkbox"/> Mobile Hotspot is not supported | | |
| Wi-Fi Direct | Wi-Fi Direct enabled devices transfer data directly between each other <input checked="" type="checkbox"/> Wi-Fi Direct (Wi-Fi 2.4 GHz) | | |
| Test sample information | No. | S/N | Notes |
| | 1 | R3AH8008H8M | Main Conduction |
| | 2 | R3AH8008DPT | Wi-Fi & Bluetooth Conduction |
| | 3 | R3AH8008GVV | SAR |
| | 4 | R3AH8008H2R | SAR |

6.2. Wireless Technologies

| Wireless technologies | Frequency bands | Operating mode | Duty Cycle used for SAR testing |
|-----------------------|--|--|---------------------------------|
| LTE | FDD Band 4 FDD Band 13 | QPSK 16QAM <input checked="" type="checkbox"/> 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 802.11g 802.11n (HT20) | 100% |
| Bluetooth | 2.4 GHz | Version 4.2 LE | 76.88 % (DH5) |

6.3. Nominal and Maximum Output Power

KDB 447498 sec.4.1.(3) at the maximum rated output power and within the tune-up tolerance range specified for the product, but not more than 2 dB lower than the maximum tune-up tolerance limit

| Upper limit (dB): -1.5 ~ 0.5 | | Max. RF Output Power (dBm) | |
|------------------------------|------|----------------------------|------------------------------|
| RF Air interface | Mode | Target | Max. tune-up tolerance limit |
| LTE Band 4 | QPSK | 22.5 | 23.0 |
| LTE Band 13 | QPSK | 23.5 | 24.0 |

| Upper limit (dB): 0.5 | | Max. RF Output Power (dBm) | |
|-----------------------|--------------|----------------------------|------------------------------|
| RF Air interface | Mode | Target | Max. tune-up tolerance limit |
| WiFi 2.4 GHz | 802.11b | 16.0 | 16.5 |
| | 802.11g | 15.0 | 15.5 |
| | 802.11n HT20 | 14.0 | 14.5 |
| Bluetooth | | 14.5 | 15.0 |
| Bluetooth LE | | 4.0 | 4.5 |

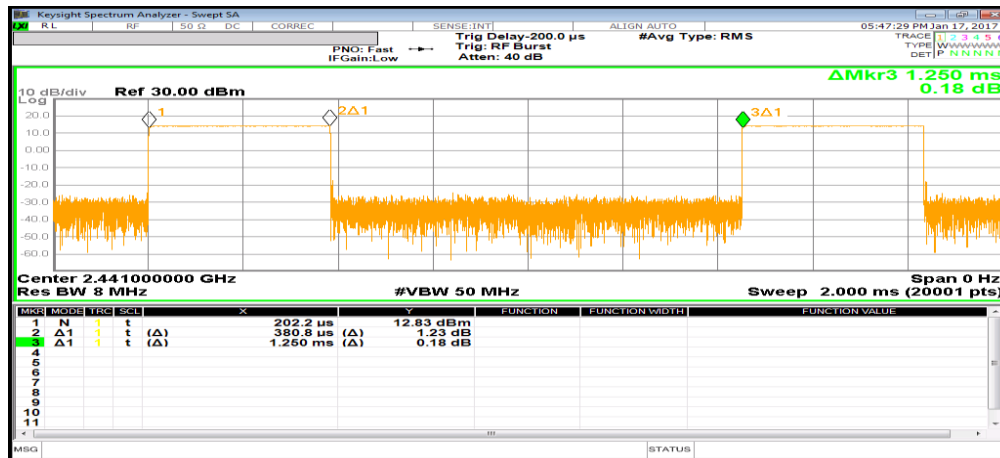
6.4. General LTE SAR Test and Reporting Considerations

| Item | Description | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--------------------------------|------------------|------------------|------------------|------------------|------------------|------------|---|--|--|--|--|--|----------|---------|---------|-------|--------|--------|--------|------|-----|-----|-----|------|------|------|-----|--------|-----|-----|-----|------|------|------|-----|--------|-----|-----|-----|------|------|------|-----|
| Frequency range, Channel Bandwidth, Numbers and Frequencies | Band 4 | Frequency range: 1710-1755 MHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Channel Bandwidth | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 20 MHz | 15 MHz | 10 MHz | 5 MHz | 3 MHz | 1.4 MHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Low | 20050/ 1720 | 20025/ 1717.5 | 20000/ 1715 | 19975/ 1712.5 | 19965/ 1711.5 | 19957/ 1710.7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Mid | 20175/ 1732.5 | 20175/ 1732.5 | 20175/ 1732.5 | 20175/ 1732.5 | 20175/ 1732.5 | 20175/ 1732.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | High | 20300/ 1745 | 20325/ 1747.5 | 20350/ 1750 | 20375/ 1752.5 | 20385/ 1753.5 | 20393/ 1754.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Band 13 | Frequency range: 777 - 787 MHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Channel Bandwidth | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 20 MHz | 15 MHz | 10 MHz | 5 MHz | 3 MHz | 1.4 MHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Low | | | | 23205/ 779.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Mid | | | 23230/ 782 | 23230/ 782 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| High | | | | 23255/ 784.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LTE transmitter and antenna implementation | LTE has 1 Main TX/RX. Refer to Appendix A... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Maximum power reduction (MPR) | <p align="center">Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3</p> <table border="1"> <thead> <tr> <th rowspan="2">Modulation</th> <th colspan="6">Channel bandwidth / Transmission bandwidth (RB)</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> </thead> <tbody> <tr> <td>QPSK</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>≤ 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>> 5</td> <td>> 4</td> <td>> 8</td> <td>> 12</td> <td>> 16</td> <td>> 18</td> <td>≤ 2</td> </tr> </tbody> </table> <p>MPR Built-in by design A-MPR (additional MPR) was disabled during SAR testing</p> | | | | | | | Modulation | Channel bandwidth / Transmission bandwidth (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 |
| Modulation | Channel bandwidth / Transmission bandwidth (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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 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. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

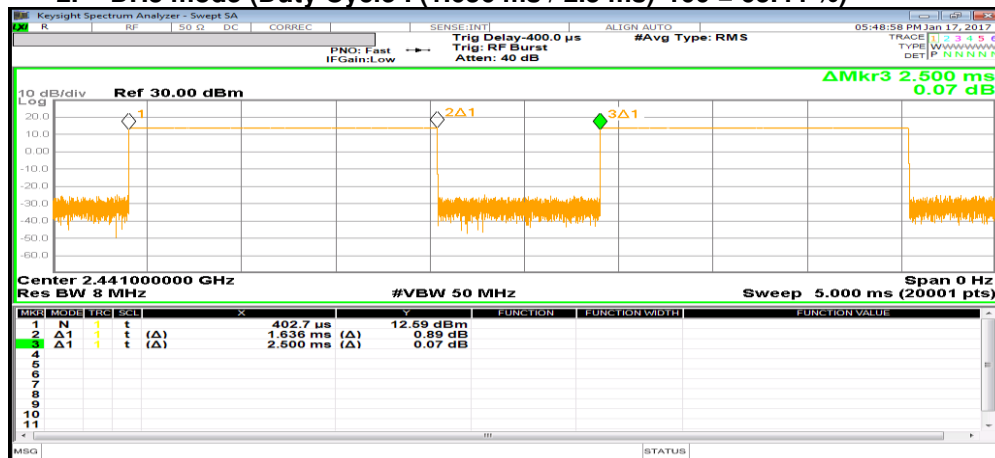
6.5. Bluetooth duty cycle Considerations

Time domain plots

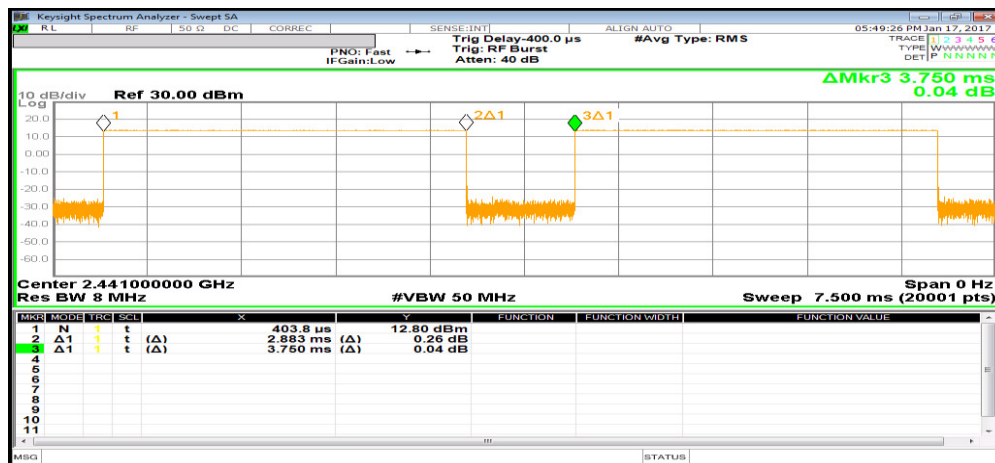
1. DH1 mode (Duty Cycle : $(0.381 \text{ ms} / 1.25 \text{ ms}) * 100 = 30.48 \%$)



2. DH3 mode (Duty Cycle : $(1.636 \text{ ms} / 2.5 \text{ ms}) * 100 = 65.44 \%$)



3. DH5 mode (Duty Cycle : $(2.883 \text{ ms} / 3.75 \text{ ms}) * 100 = 76.88 \%$)



Note(s):

Bluetooth duty cycle was measured using Bluetooth tester equipment with Bluetooth protocol. DH5 mode is highest duty cycle and both Conducted power and SAR test were performed at DH5 mode.

7. RF Exposure Conditions (Test Configurations)

Refer to “SAR Photos and Ant locations” Appendix 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 | Extremity (Hand/Wrist/Ankle) | 0 mm | Rear | N/A | Yes | |
| | Next-to-Mouth | 10 mm | Front | N/A | Yes | |
| WLAN / Bluetooth | Extremity (Hand/Wrist/Ankle) | 0 mm | Rear | N/A | Yes | |
| | Next-to-Mouth | 10 mm | Front | N/A | Yes | |

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.

Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

| Target Frequency (MHz) | Head | | Body | |
|------------------------|--------------|----------------|--------------|----------------|
| | ϵ_r | σ (S/m) | ϵ_r | σ (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 1 Room**

| Date | Freq. (MHz) | Liquid Parameters | | Measured | Target | Delta (%) | Limit ±(%) | |
|------------|-------------|-------------------|---------|---|--------|-----------|------------|---|
| 2017-01-17 | Head 2450 | e' | 38.9100 | Relative Permittivity (ϵ_r): | 38.91 | 39.20 | -0.74 | 5 |
| | | e" | 13.5000 | Conductivity (σ): | 1.84 | 1.80 | 2.17 | 5 |
| | Head 2410 | e' | 39.0400 | Relative Permittivity (ϵ_r): | 39.04 | 39.28 | -0.61 | 5 |
| | | e" | 13.4000 | Conductivity (σ): | 1.80 | 1.76 | 2.00 | 5 |
| | Head 2475 | e' | 38.8300 | Relative Permittivity (ϵ_r): | 38.83 | 39.17 | -0.86 | 5 |
| | | e" | 13.5600 | Conductivity (σ): | 1.87 | 1.83 | 2.14 | 5 |

SAR 2 Room

| Date | Freq. (MHz) | Liquid Parameters | | Measured | Target | Delta (%) | Limit ±(%) | |
|------------|-------------|-------------------|---------|---|--------|-----------|------------|---|
| 2017-01-11 | Body 750 | e' | 55.5500 | Relative Permittivity (ϵ_r): | 55.55 | 55.55 | 0.01 | 5 |
| | | e" | 23.0500 | Conductivity (σ): | 0.96 | 0.96 | -0.19 | 5 |
| | Body 700 | e' | 56.0500 | Relative Permittivity (ϵ_r): | 56.05 | 55.74 | 0.56 | 5 |
| | | e" | 23.5100 | Conductivity (σ): | 0.92 | 0.96 | -4.60 | 5 |
| | Body 790 | e' | 55.1400 | Relative Permittivity (ϵ_r): | 55.14 | 55.39 | -0.46 | 5 |
| | | e" | 22.7000 | Conductivity (σ): | 1.00 | 0.97 | 3.21 | 5 |
| 2017-01-11 | Head 750 | e' | 42.7500 | Relative Permittivity (ϵ_r): | 42.75 | 41.96 | 1.88 | 5 |
| | | e" | 21.4600 | Conductivity (σ): | 0.89 | 0.89 | 0.21 | 5 |
| | Head 700 | e' | 43.4300 | Relative Permittivity (ϵ_r): | 43.43 | 42.22 | 2.87 | 5 |
| | | e" | 21.7900 | Conductivity (σ): | 0.85 | 0.89 | -4.62 | 5 |
| | Head 790 | e' | 42.2200 | Relative Permittivity (ϵ_r): | 42.22 | 41.76 | 1.11 | 5 |
| | | e" | 21.1900 | Conductivity (σ): | 0.93 | 0.90 | 3.87 | 5 |
| 2017-01-16 | Body 2450 | e' | 52.6700 | Relative Permittivity (ϵ_r): | 52.67 | 52.70 | -0.06 | 5 |
| | | e" | 14.3100 | Conductivity (σ): | 1.95 | 1.95 | -0.03 | 5 |
| | Body 2410 | e' | 52.8200 | Relative Permittivity (ϵ_r): | 52.82 | 52.76 | 0.11 | 5 |
| | | e" | 14.2400 | Conductivity (σ): | 1.91 | 1.91 | 0.04 | 5 |
| | Body 2475 | e' | 52.5800 | Relative Permittivity (ϵ_r): | 52.58 | 52.67 | -0.17 | 5 |
| | | e" | 14.3700 | Conductivity (σ): | 1.98 | 1.99 | -0.38 | 5 |
| 2017-01-20 | Body 2450 | e' | 51.7700 | Relative Permittivity (ϵ_r): | 51.77 | 52.70 | -1.76 | 5 |
| | | e" | 14.6400 | Conductivity (σ): | 1.99 | 1.95 | 2.28 | 5 |
| | Body 2410 | e' | 51.8700 | Relative Permittivity (ϵ_r): | 51.87 | 52.76 | -1.69 | 5 |
| | | e" | 14.5600 | Conductivity (σ): | 1.95 | 1.91 | 2.29 | 5 |
| | Body 2475 | e' | 51.7200 | Relative Permittivity (ϵ_r): | 51.72 | 52.67 | -1.80 | 5 |
| | | e" | 14.7100 | Conductivity (σ): | 2.02 | 1.99 | 1.98 | 5 |

SAR 3 Room

| Date | Freq. (MHz) | Liquid Parameters | | Measured | Target | Delta (%) | Limit ±(%) | |
|------------|-------------|-------------------|---------|---|--------|-----------|------------|---|
| 2017-01-16 | Head 1750 | e' | 39.0800 | Relative Permittivity (ϵ_r): | 39.08 | 40.08 | -2.51 | 5 |
| | | e" | 13.6500 | Conductivity (σ): | 1.33 | 1.37 | -2.98 | 5 |
| | Head 1710 | e' | 39.2800 | Relative Permittivity (ϵ_r): | 39.28 | 40.15 | -2.16 | 5 |
| | | e" | 13.5900 | Conductivity (σ): | 1.29 | 1.35 | -4.03 | 5 |
| | Head 1755 | e' | 39.0600 | Relative Permittivity (ϵ_r): | 39.06 | 40.08 | -2.54 | 5 |
| | | e" | 13.6500 | Conductivity (σ): | 1.33 | 1.37 | -2.90 | 5 |
| 2016-01-16 | Body 1750 | e' | 52.7700 | Relative Permittivity (ϵ_r): | 52.77 | 53.44 | -1.26 | 5 |
| | | e" | 14.8000 | Conductivity (σ): | 1.44 | 1.49 | -3.10 | 5 |
| | Body 1710 | e' | 52.9300 | Relative Permittivity (ϵ_r): | 52.93 | 53.54 | -1.15 | 5 |
| | | e" | 14.7600 | Conductivity (σ): | 1.40 | 1.46 | -3.98 | 5 |
| | Body 1755 | e' | 52.7500 | Relative Permittivity (ϵ_r): | 52.75 | 53.43 | -1.27 | 5 |
| | | e" | 14.8000 | Conductivity (σ): | 1.44 | 1.49 | -3.02 | 5 |

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 ±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 ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 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.

Reference Target SAR Values

The reference SAR values can be obtained from the calibration certificate of system validation dipoles

| System Dipole | Serial No. | Cal. Date | Freq. (MHz) | Target SAR Values (W/kg) | | |
|---------------|------------|-----------|-------------|--------------------------|-------|-------|
| | | | | 1g/10g | Head | Body |
| D750V3 | 1122 | 8-30-2016 | 750 | 1g | 8.32 | 8.69 |
| | | | | 10g | 5.41 | 5.72 |
| D1750V2 | 1125 | 8-26-2016 | 1750 | 1g | 36.90 | 37.20 |
| | | | | 10g | 19.50 | 19.80 |
| D2450V2 | 939 | 9-23-2016 | 2450 | 1g | 52.10 | 49.90 |
| | | | | 10g | 24.40 | 23.70 |

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 10% of the manufacturer calibrated dipole SAR target.

SAR 1 Room

| Date Tested | System Dipole | | T.S. Liquid | Measured Results | | Target (Ref. Value) | Delta $\pm 10\%$ | Plot No. | |
|-------------|---------------|----------|-------------|---------------------|------------------|---------------------|------------------|----------|--|
| | Type | Serial # | | Zoom Scan to 100 mW | Normalize to 1 W | | | | |
| 1-17-2017 | D2450V2 | 939 | Head | 1g | 5.27 | 52.70 | 52.10 | 1.15 | |
| | | | | 10g | 2.40 | 24.00 | 24.40 | -1.64 | |

SAR 2 Room

| Date Tested | System Dipole | | T.S. Liquid | Measured Results | | Target (Ref. Value) | Delta $\pm 10\%$ | Plot No. | |
|-------------|---------------|----------|-------------|---------------------|------------------|---------------------|------------------|----------|-----|
| | Type | Serial # | | Zoom Scan to 100 mW | Normalize to 1 W | | | | |
| 1-11-2017 | D750V3 | 1122 | Head | 1g | 0.84 | 8.35 | 8.32 | 0.36 | |
| | | | | 10g | 0.55 | 5.51 | 5.41 | 1.85 | |
| 1-11-2017 | D750V3 | 1122 | Body | 1g | 0.89 | 8.86 | 8.69 | 1.96 | 1,2 |
| | | | | 10g | 0.59 | 5.89 | 5.72 | 2.97 | |
| 1-16-2017 | D2450V2 | 939 | Body | 1g | 5.25 | 52.50 | 49.90 | 5.21 | |
| | | | | 10g | 2.37 | 23.70 | 23.70 | 0.00 | |
| 1-20-2017 | D2450V2 | 939 | Body | 1g | 5.42 | 54.20 | 49.90 | 8.62 | 3,4 |
| | | | | 10g | 2.47 | 24.70 | 23.70 | 4.22 | |

SAR 3 Room

| Date Tested | System Dipole | | T.S. Liquid | Measured Results | | Target (Ref. Value) | Delta $\pm 10\%$ | Plot No. | |
|-------------|---------------|----------|-------------|---------------------|------------------|---------------------|------------------|----------|-----|
| | Type | Serial # | | Zoom Scan to 100 mW | Normalize to 1 W | | | | |
| 1-16-2017 | D1750V2 | 1125 | Head | 1g | 3.37 | 33.70 | 36.90 | -8.67 | |
| | | | | 10g | 1.81 | 18.10 | 19.50 | -7.18 | |
| 1-16-2017 | D1750V2 | 1125 | Body | 1g | 3.39 | 33.90 | 37.20 | -8.87 | 5,6 |
| | | | | 10g | 1.82 | 18.20 | 19.80 | -8.08 | |

9. Conducted Output Power Measurements

9.1. 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 3

| Modulation | Channel bandwidth / Transmission bandwidth (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 |

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 Signalling Value of "NS_01".

Table 6.2.4-1: Additional Maximum Power Reduction (A-MPR)

| Network Signalling value | Requirements (sub-clause) | 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 | NA |
| NS_03 | 6.6.2.2.1 | 2, 4, 10, 23, 25, 35, 36 | 3 | >5 | ≤ 1 |
| | | | 5 | >6 | ≤ 1 |
| | | | 10 | >6 | ≤ 1 |
| | | | 15 | >8 | ≤ 1 |
| | | | 20 | >10 | ≤ 1 |
| NS_04 | 6.6.2.2.2 | 41 | 5 | >6 | ≤ 1 |
| | | | 10, 15, 20 | See Table 6.2.4-4 | |
| NS_05 | 6.6.3.3.1 | 1 | 10,15,20 | ≥ 50 | ≤ 1 |
| NS_06 | 6.6.2.2.3 | 12, 13, 14, 17 | 1.4, 3, 5, 10 | Table 5.6-1 | n/a |
| NS_07 | 6.6.2.2.3 | 13 | 10 | Table 6.2.4-2 | Table 6.2.4-2 |
| | 6.6.3.3.2 | | | | |
| NS_08 | 6.6.3.3.3 | 19 | 10, 15 | > 44 | ≤ 3 |
| | | | | | > 40 |
| NS_09 | 6.6.3.3.4 | 21 | 10, 15 | > 55 | ≤ 2 |
| | | | | Table 6.2.4-3 | Table 6.2.4-3 |
| NS_10 | | 20 | 15, 20 | Table 6.2.4-3 | Table 6.2.4-3 |
| NS_11 | 6.6.2.2.1 | 23 ¹ | 1.4, 3, 5, 10 | Table 6.2.4-5 | Table 6.2.4-5 |
| .. | | | | | |
| NS_32 | - | - | - | - | - |

Note 1: Applies to the lower block of Band 23, i.e. a carrier placed in the 2000-2010 MHz region.

LTE Band 4 Measured Results

| Band | BW (MHz) | Mode | RB Allocation | RB offset | Target MPR | Max. Avg Pwr (dBm) | | |
|------------|----------|-------|---------------|-----------|------------|--------------------|------------|------------|
| | | | | | | 1720 MHz | 1732.5 MHz | 1745 MHz |
| LTE Band 4 | 20 | QPSK | 1 | 0 | 0 | | 22.3 | |
| | | | 1 | 49 | 0 | | 22.3 | |
| | | | 1 | 99 | 0 | | 22.4 | |
| | | | 50 | 0 | 1 | | 21.3 | |
| | | | 50 | 24 | 1 | | 21.3 | |
| | | | 50 | 50 | 1 | | 21.3 | |
| | | | 100 | 0 | 1 | | 21.3 | |
| | | 16QAM | 1 | 0 | 1 | | 21.1 | |
| | | | 1 | 49 | 1 | | 21.2 | |
| | | | 1 | 99 | 1 | | 21.2 | |
| | | | 50 | 0 | 2 | | 20.2 | |
| | | | 50 | 25 | 2 | | 20.2 | |
| | | | 50 | 50 | 2 | | 20.2 | |
| | | | 100 | 0 | 2 | | 20.3 | |
| Band | BW (MHz) | Mode | RB Allocation | RB offset | Target MPR | Max. Avg Pwr (dBm) | | |
| | | | | | | 1717.5 MHz | 1732.5 MHz | 1747.5 MHz |
| LTE Band 4 | 15 | QPSK | 1 | 0 | 0 | 22.6 | 22.3 | 22.3 |
| | | | 1 | 36 | 0 | 22.6 | 22.2 | 22.4 |
| | | | 1 | 74 | 0 | 22.3 | 22.3 | 22.4 |
| | | | 36 | 0 | 1 | 21.6 | 21.3 | 21.3 |
| | | | 36 | 18 | 1 | 21.6 | 21.3 | 21.3 |
| | | | 36 | 37 | 1 | 21.6 | 21.3 | 21.3 |
| | | | 75 | 0 | 1 | 21.6 | 21.3 | 21.3 |
| | | 16QAM | 1 | 0 | 1 | 21.0 | 21.3 | 21.4 |
| | | | 1 | 36 | 1 | 21.1 | 21.2 | 21.5 |
| | | | 1 | 74 | 1 | 20.7 | 21.3 | 21.5 |
| | | | 36 | 0 | 2 | 20.5 | 20.3 | 20.1 |
| | | | 36 | 18 | 2 | 20.5 | 20.3 | 20.2 |
| | | | 36 | 37 | 2 | 20.5 | 20.2 | 20.2 |
| | | | 75 | 0 | 2 | 20.5 | 20.2 | 20.2 |
| Band | BW (MHz) | Mode | RB Allocation | RB offset | Target MPR | Max. Avg Pwr (dBm) | | |
| | | | | | | 1715 MHz | 1732.5 MHz | 1750 MHz |
| LTE Band 4 | 10 | QPSK | 1 | 0 | 0 | 22.8 | 22.4 | 22.2 |
| | | | 1 | 25 | 0 | 22.6 | 22.3 | 22.1 |
| | | | 1 | 49 | 0 | 22.4 | 22.4 | 22.2 |
| | | | 25 | 0 | 1 | 21.6 | 21.3 | 21.2 |
| | | | 25 | 12 | 1 | 21.5 | 21.3 | 21.2 |
| | | | 25 | 25 | 1 | 21.5 | 21.3 | 21.2 |
| | | | 50 | 0 | 1 | 21.6 | 21.3 | 21.2 |
| | | 16QAM | 1 | 0 | 1 | 21.6 | 21.2 | 21.1 |
| | | | 1 | 25 | 1 | 21.6 | 21.0 | 21.1 |
| | | | 1 | 49 | 1 | 21.3 | 21.2 | 21.1 |
| | | | 25 | 0 | 2 | 20.6 | 20.3 | 20.1 |
| | | | 25 | 12 | 2 | 20.5 | 20.2 | 20.2 |
| | | | 25 | 25 | 2 | 20.5 | 20.2 | 20.2 |
| | | | 50 | 0 | 2 | 20.5 | 20.2 | 20.1 |

LTE Band 4 Measured Results (continued)

| Band | BW (MHz) | Mode | RB Allocation | RB offset | Target MPR | Max. Avg Pwr (dBm) | | |
|------------|----------|-------|---------------|-----------|------------|--------------------|------------|------------|
| | | | | | | 1712.5 MHz | 1732.5 MHz | 1752.5 MHz |
| LTE Band 4 | 5 | QPSK | 1 | 0 | 0 | 22.6 | 22.3 | 22.2 |
| | | | 1 | 12 | 0 | 22.7 | 22.4 | 22.4 |
| | | | 1 | 24 | 0 | 22.5 | 22.3 | 22.3 |
| | | | 12 | 0 | 1 | 21.6 | 21.2 | 21.2 |
| | | | 12 | 6 | 1 | 21.6 | 21.2 | 21.3 |
| | | | 12 | 11 | 1 | 21.6 | 21.2 | 21.3 |
| | | 16QAM | 25 | 0 | 1 | 21.5 | 21.2 | 21.2 |
| | | | 1 | 0 | 1 | 21.7 | 21.4 | 21.1 |
| | | | 1 | 12 | 1 | 21.7 | 21.4 | 21.2 |
| | | | 1 | 24 | 1 | 21.6 | 21.4 | 21.2 |
| | | | 12 | 0 | 2 | 20.5 | 20.2 | 20.2 |
| | | | 12 | 6 | 2 | 20.5 | 20.2 | 20.2 |
| LTE Band 4 | 3 | QPSK | 12 | 11 | 2 | 20.4 | 20.2 | 20.2 |
| | | | 25 | 0 | 2 | 20.6 | 20.1 | 20.2 |
| | | | 1 | 0 | 0 | 22.7 | 22.3 | 22.4 |
| | | | 1 | 7 | 0 | 22.5 | 22.4 | 22.4 |
| | | | 1 | 14 | 0 | 22.7 | 22.3 | 22.3 |
| | | | 8 | 0 | 1 | 21.7 | 21.2 | 21.3 |
| | | 16QAM | 8 | 4 | 1 | 21.7 | 21.3 | 21.3 |
| | | | 8 | 7 | 1 | 21.5 | 21.3 | 21.3 |
| | | | 15 | 0 | 1 | 21.7 | 21.2 | 21.3 |
| | | | 1 | 0 | 1 | 21.7 | 21.3 | 21.3 |
| | | | 1 | 7 | 1 | 21.5 | 21.4 | 21.3 |
| | | | 1 | 14 | 1 | 21.7 | 21.2 | 21.2 |
| LTE Band 4 | 1.4 | QPSK | 8 | 0 | 2 | 20.8 | 20.1 | 20.2 |
| | | | 8 | 4 | 2 | 20.6 | 20.1 | 20.2 |
| | | | 8 | 7 | 2 | 20.6 | 20.1 | 20.2 |
| | | | 15 | 0 | 2 | 20.6 | 20.2 | 20.2 |
| | | | 1 | 0 | 0 | 22.6 | 22.2 | 22.3 |
| | | | 1 | 2 | 0 | 22.7 | 22.3 | 22.2 |
| | | 16QAM | 1 | 5 | 0 | 22.8 | 22.3 | 22.2 |
| | | | 3 | 0 | 0 | 22.7 | 22.2 | 22.2 |
| | | | 3 | 1 | 0 | 22.7 | 22.3 | 22.2 |
| | | | 3 | 2 | 0 | 22.7 | 22.3 | 22.2 |
| | | | 6 | 0 | 1 | 21.8 | 21.3 | 21.2 |
| | | | 1 | 0 | 1 | 21.5 | 21.2 | 21.0 |
| 16QAM | 1 | 2 | 1 | 21.5 | 21.3 | 21.0 | | |
| | 1 | 5 | 1 | 21.2 | 21.3 | 21.0 | | |
| | 3 | 0 | 1 | 21.7 | 21.3 | 21.2 | | |
| | 3 | 1 | 1 | 21.6 | 21.2 | 21.2 | | |
| | 3 | 2 | 1 | 21.6 | 21.3 | 21.2 | | |
| | 6 | 0 | 2 | 20.7 | 20.1 | 20.1 | | |

Note(s):

20 MHz Bandwidths 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

LTE Band 13 Measured Results

| Band | BW (MHz) | Mode | RB Allocation | RB offset | Target MPR | Max. Avg Pwr (dBm) |
|-------------|----------|-------|---------------|-----------|------------|--------------------|
| | | | | | | 782 MHz |
| LTE Band 13 | 10 | QPSK | 1 | 0 | 0 | 23.2 |
| | | | 1 | 25 | 0 | 23.1 |
| | | | 1 | 49 | 0 | 23.1 |
| | | | 25 | 0 | 1 | 21.6 |
| | | | 25 | 12 | 1 | 21.6 |
| | | | 25 | 25 | 1 | 21.6 |
| | | | 50 | 0 | 1 | 21.6 |
| | | 16QAM | 1 | 0 | 1 | 21.6 |
| | | | 1 | 25 | 1 | 21.4 |
| | | | 1 | 49 | 1 | 21.5 |
| | | | 25 | 0 | 2 | 20.6 |
| | | | 25 | 12 | 2 | 20.5 |
| | | | 25 | 25 | 2 | 20.5 |
| | | | 50 | 0 | 2 | 20.6 |
| Band | BW (MHz) | Mode | RB Allocation | RB offset | Target MPR | Max. Avg Pwr (dBm) |
| | | | | | | 782 MHz |
| LTE Band 13 | 5 | QPSK | 1 | 0 | 0 | 23.1 |
| | | | 1 | 12 | 0 | 23.1 |
| | | | 1 | 24 | 0 | 23.1 |
| | | | 12 | 0 | 1 | 21.6 |
| | | | 12 | 6 | 1 | 21.5 |
| | | | 12 | 11 | 1 | 21.6 |
| | | | 25 | 0 | 1 | 21.6 |
| | | 16QAM | 1 | 0 | 1 | 21.7 |
| | | | 1 | 12 | 1 | 21.7 |
| | | | 1 | 24 | 1 | 21.8 |
| | | | 12 | 0 | 2 | 20.5 |
| | | | 12 | 6 | 2 | 20.5 |
| | | | 12 | 11 | 2 | 20.5 |
| | | | 25 | 0 | 2 | 20.6 |

Note(s):

10/5 MHz Bandwidths 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

9.2. Wi-Fi 2.4GHz (DTS Band)

Measured Results

| Band (GHz) | Mode | Data Rate | Ch # | Freq. (MHz) | Avg Pwr (dBm) | Max Output Power (dBm) | SAR Test (Yes/No) | Note(s) |
|------------|----------------|-----------|------|-------------|-----------------------|------------------------|-------------------|---------|
| 2.4 | 802.11b | 1 Mbps | 1 | 2412 | 16.2 | 16.5 | Yes | |
| | | | 6 | 2437 | 15.5 | | | |
| | | | 11 | 2462 | 15.9 | | | |
| | 802.11g | 6 Mbps | 1 | 2412 | Not PWR Meas. require | 15.5 | No | 1 |
| | | | 6 | 2437 | | | | |
| | | | 11 | 2462 | | | | |
| | 802.11n (HT20) | 6.5 Mbps | 1 | 2412 | Not PWR Meas. require | 14.5 | No | 1 |
| | | | 6 | 2437 | | | | |
| | | | 11 | 2462 | | | | |

Note(s):

- Output Power and SAR is not required for 802.11g/n HT20 channels 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 ≤ 1.2 W/kg.

9.3. Bluetooth

Measured Results

| Band (GHz) | Mode | Ch # | Freq. (MHz) | Avg Pwr (dBm) |
|------------|--------------------|------|-------------|---------------|
| 2.4 | BDR, GFSK | 0 | 2402 | 14.64 |
| | | 39 | 2441 | 14.51 |
| | | 78 | 2480 | 14.78 |
| | EDR, $\pi/4$ DQPSK | 0 | 2402 | 8.60 |
| | | 39 | 2441 | 8.32 |
| | | 78 | 2480 | 8.55 |
| | EDR, 8-DPSK | 0 | 2402 | 8.60 |
| | | 39 | 2441 | 8.38 |
| | | 78 | 2480 | 8.55 |
| | LE, GFSK | 0 | 2402 | 3.97 |
| | | 19 | 2440 | 4.09 |
| | | 39 | 2480 | 4.02 |

10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

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:

- ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- ≤ 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
- ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

KDB 941225 D05 SAR for LTE Devices:

SAR must be measured with the maximum TTI(transmit time interval) supported by the device in each LTE configuration.

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.

KDB 248227 D01 SAR meas for 802.11 v02:

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:

- ≤ 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 ≤ 0.8 W/kg or all required test positions are tested.
 - 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.
 - 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 ≤ 1.2 W/kg or all required test channels are considered.
 - 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 ≤ 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 ≤ 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. LTE Band 4 (20MHz Bandwidth)

| RF Exposure Conditions | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | RB Allocation | RB offset | Power (dBm) | | 1-g SAR (W/kg) | | 10-g SAR (W/kg) | | Plot No. |
|------------------------|------|------------|---------------|-------|-------------|---------------|-----------|---------------|-------|----------------|--------|-----------------|--------|----------|
| | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | Meas. | Scaled | |
| Next-to-Mouth | QPSK | 10 | Flat / Front | 20175 | 1732.5 | 1 | 99 | 23.0 | 22.4 | 0.866 | 1.001 | | | 1 |
| | | | | | | | | 50 | 0 | 22.0 | 21.3 | 0.324 | 0.380 | |
| Extremity | QPSK | 0 | Flat / Rear | 20175 | 1732.5 | 1 | 99 | 23.0 | 22.4 | | | 1.190 | 1.376 | 2 |
| | | | | | | | | 50 | 0 | 22.0 | 21.3 | | | |

10.2. LTE Band 13 (10MHz Bandwidth)

| RF Exposure Conditions | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | RB Allocation | RB offset | Power (dBm) | | 1-g SAR (W/kg) | | 10-g SAR (W/kg) | | Plot No. |
|------------------------|------|------------|---------------|-------|-------------|---------------|-----------|---------------|-------|----------------|--------|-----------------|--------|----------|
| | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | Meas. | Scaled | |
| Next-to-Mouth | QPSK | 10 | Flat / Front | 23230 | 782.0 | 1 | 0 | 24.0 | 23.2 | 0.014 | 0.017 | | | 3 |
| | | | | | | | | 25 | 0 | 23.0 | 21.6 | 0.009 | 0.013 | |
| Extremity | QPSK | 0 | Flat / Rear | 23230 | 782.0 | 1 | 0 | 24.0 | 23.2 | | | 0.223 | 0.268 | 4 |
| | | | | | | | | 25 | 0 | 23.0 | 21.6 | | | |

10.3. Wi-Fi (DTS Band)

| Frequency Band | Mode | RF Exposure Conditions | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Area Scan Max. SAR (W/kg) | Power (dBm) | | 1-g SAR (W/kg) | | 10-g SAR (W/kg) | | Note | Plot No. |
|----------------|-------------------|------------------------|------------|---------------|-------|-------------|---------------------------|---------------|-------|----------------|--------|-----------------|--------|------|----------|
| | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | Meas. | Scaled | | |
| 2.4GHz | 802.11b 1 Mbps | Next-to-Mouth | 10 | Flat / Front | 1 | 2412.0 | 0.174 | 16.5 | 16.2 | 0.136 | 0.147 | | | 1 | 5 |
| | | Extremity | 0 | Flat / Rear | 1 | 2412.0 | 0.601 | 16.5 | 16.2 | | | 0.144 | 0.156 | 1 | 6 |

Note(s):

- Highest reported SAR is $\leq 0.4/1.0$ W/kg, 1-g and 10-g respectively. Therefore, further SAR measurements within this exposure condition are not required.
- Highest reported SAR is $> 0.4/1.0$ W/kg, 1-g and 10-g respectively. Due to the highest reported SAR for this test position, other test positions in Head exposure condition were evaluated until a SAR $\leq 0.8/2.0$ W/kg, for 1-g and 10-g respectively, was reported.
- Testing for a second channel was required because the reported SAR for this test position was $>0.8/2.0$ W/kg, for 1-g and 10-g respectively.
- Additional testing required in order satisfying FCC simultaneous transmission limit criteria.

10.4. Bluetooth

| Frequency Band | Mode | RF Exposure Conditions | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 1-g SAR (W/kg) | | 10-g SAR (W/kg) | | Plot No. |
|----------------|------|------------------------|------------|---------------|-------|-------------|---------------|-------|----------------|--------|-----------------|--------|----------|
| | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | Meas. | Scaled | |
| 2.4GHz | GFSK | Next-to-Mouth | 10 | Flat / Front | 78 | 2480.0 | 15.0 | 14.8 | 0.020 | 0.021 | | | 7 |
| | | Extremity | 0 | Flat / Rear | 78 | 2480.0 | 15.0 | 14.8 | | | 0.046 | 0.048 | 8 |

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 < 0.80 or 2.0 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is ≥ 0.80 or 2.0 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 ≥ 1.45 or 3.6 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 ≥ 1.5 or 3.75 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 .

Next-to-Mouth

| Frequency Band (MHz) | Air Interface | RF Exposure Conditions | Test Position | Repeated SAR (Yes/No) | Highest Measured SAR (W/kg) | Repeated Measured SAR (W/kg) | Largest to Smallest SAR Ratio |
|----------------------|-------------------|------------------------|---------------|-----------------------|-----------------------------|------------------------------|-------------------------------|
| 750 | LTE Band 13 | Next to Mouth | Flat / Front | No | 0.014 | N/A | N/A |
| 1750 | LTE Band 4 | Next to Mouth | Flat / Front | Yes | 0.866 | 0.905 | 1.05 |
| 2400 | Wi-Fi 802.11b/g/n | Next to Mouth | Flat / Front | No | 0.136 | N/A | N/A |
| | Bluetooth | Next to Mouth | Flat / Front | No | 0.020 | N/A | N/A |

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 not > 1.2 .

Extremity

| Frequency Band (MHz) | Air Interface | RF Exposure Conditions | Test Position | Repeated SAR (Yes/No) | Highest Measured SAR (W/kg) | Repeated Measured SAR (W/kg) | Largest to Smallest SAR Ratio |
|----------------------|-------------------|------------------------------|---------------|-----------------------|-----------------------------|------------------------------|-------------------------------|
| 750 | LTE Band 13 | Extremity (Hand/Wrist/Ankle) | Flat / Rear | No | 0.223 | N/A | N/A |
| 1750 | LTE Band 4 | Extremity (Hand/Wrist/Ankle) | Flat / Rear | No | 1.190 | N/A | N/A |
| 2400 | Wi-Fi 802.11b/g/n | Extremity (Hand/Wrist/Ankle) | Flat / Rear | No | 0.144 | N/A | N/A |
| | Bluetooth | Extremity (Hand/Wrist/Ankle) | Flat / Rear | No | 0.046 | N/A | N/A |

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 not > 1.2 .

12. Simultaneous Transmission SAR Analysis

KDB 447498 D01 General RF Exposure Guidance introduces a new formula for calculating the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

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

Where:

SAR₁ is the highest measured or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

SAR₂ is the highest measured 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:

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

Simultaneous Transmission Condition

| RF Exposure Condition | Item | Capable Transmit Configurations | | |
|---|------|---------------------------------|---|-----|
| Next-to-Mouth | 1 | LTE | + | DTS |
| | 2 | LTE | + | BT |
| Extremity | 3 | LTE | + | DTS |
| | 4 | LTE | + | BT |
| Notes: | | | | |
| 1. VoIP is supported in LTE | | | | |
| 2. DTS Radio cannot transmit simultaneously with Bluetooth Radio. | | | | |

12.1. Sum of the SAR for WWAN & Wi-Fi & BT in Next-to-Mouth

| RF Exposure conditions | ① WWAN | ② DTS | ③ BT | ① + ② WWAN + DTS | | ① + ③ WWAN + BT | |
|------------------------|-----------|----------|---------|---------------------|-----------------|--------------------|-----------------|
| | | | | ∑ 1-g SAR (mW/g) | SPLSR (Yes/ No) | ∑ 1-g SAR (mW/g) | SPLSR (Yes/ No) |
| Next-to-Mouth | 1.001 | 0.147 | 0.021 | 1.148 | No | 1.022 | No |

12.2. Sum of the SAR for WWAN & Wi-Fi & BT in Extremity

| RF Exposure conditions | ① WWAN | ② DTS | ③ BT | ① + ② WWAN + DTS | | ① + ③ WWAN + BT | |
|------------------------|-----------|----------|---------|---------------------|-----------------|--------------------|-----------------|
| | | | | ∑ 10-g SAR (mW/g) | SPLSR (Yes/ No) | ∑ 10-g SAR (mW/g) | SPLSR (Yes/ No) |
| Extremity | 1.376 | 0.156 | 0.048 | 1.532 | No | 1.424 | No |

Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is not required because the either sum of the 1-g SAR is < 1.6 W/kg(10-g SAR is < 4.0 W/kg) or the 1-g SAR SPLSR is < 0.04 (10-g SAR is < 0.1) for all circumstances that require SPLSR calculation.

Appendixes

Refer to separated files for the following appendixes.

4787821625-S1V2 FCC Report SAR_App A_Photos & Ant. Locations

4787821625-S1V2 FCC Report SAR_App B_Highest SAR Test Plots

4787821625-S1V2 FCC Report SAR_App C_System Check Plots

4787821625-S1V2 FCC Report SAR_App D_SAR Tissue Ingredients

4787821625-S1V2 FCC Report SAR_App E_Probe Cal. Certificates

4787821625-S1V2 FCC Report SAR_App F_Dipole Cal. Certificates

END OF REPORT