**FCC 47 CFR Parts 1 & 2**
**Published RF Exposure KDB Procedures**
**IEEE Standard 1528-2013**

**(Class II Permissive Change)**

# SAR EVALUATION REPORT

*For*
**GSM / W-CDMA / LTE Phone + Bluetooth & WLAN (2.4GHz)**

**Model: LGL31L, LG-L31L, L31L**
**FCC ID: ZNFL31L**

**Report Number: 14U17021-5A**
**Issue Date: 4/23/2014**

*Prepared for*
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NVLAP LAB CODE 200065-0

## Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| -- | 4/3/2014 | Initial Issue | -- |
| A | 4/23/2014 | Updated Appendix: 15.1. Photos and Antenna Locations. | Nathan Sousa |

## Table of Contents

# 1. Attestation of Test Results

| | | | | |
|---|---|---|---|---|
| Applicant | LG ELECTRONICS MOBILECOMM U.S.A., INC. | | | |
| DUT description | GSM / W-CDMA / LTE Phone + Bluetooth & WLAN (2.4GHz) | | | |
| Model | LGL31L, LG-L31L, L31L | | | |
| Test device is | An identical prototype | | | |
| Device category | Portable | | | |
| Exposure category | General Population/Uncontrolled Exposure | | | |
| Date tested | 03/24/2014 – 03/27/2014 | | | |
| The highest reported SAR values | RF exposure condition | Licensed | DTS | UNII |
| | Head | 0.470 W/kg | 0.284 W/kg | N/A |
| | Body-worn Accessory | 0.765 W/kg | 0.124 W/kg | N/A |
| | Wi-Fi Direct | N/A | 0.124 W/kg | N/A |
| | Simultaneous Transmission | 0.889 W/kg | | N/A |
| Applicable Standards | FCC 47 CFR Parts 1 & 2<br>Published RF Exposure KDB Procedures, and TCB workshop updates<br>IEEE Standard 1528-2013 | | | |
| Test Results | Pass | | | |

UL Verification Services Inc. 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 Verification Services Inc. 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.

**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 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 any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.

Approved & Released By:

Devin Chang
WiSE Senior Engineer
UL Verification Services Inc.

Prepared By:

Nathan Sousa
WiSE Laboratory Engineer
UL Verification Services Inc.

# 2. Test Methodology

The tests documented in this report were performed in accordance with FCC 47 CFR Parts 1 & 2, IEEE STD 1528-2013, the following FCC Published RF exposure KDB procedures, and TCB workshop updates:

- 447498 D01 General RF Exposure Guidance v05r02
- 648474 D04 Handset SAR v01r02
- 941225 D01 SAR test for 3G devices v02
- 941225 D02 HSPA and 1x Advanced v02r02
- 941225 D03 SAR Test Reduction GSM GPRS EDGE v01
- 941225 D04 SAR for GSM E GPRS Dual Xfer Mode v01
- 941225 D05 SAR for LTE Devices v02r03
- 248227 D01 SAR Meas for 802 11abg v01r02
- 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- 865664 D02 SAR Reporting v01r01
- 690783 D01 SAR Listings on Grants v01r03

# 3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

| 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 F | |

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

# 4. Calibration and Uncertainty

## 4.1. Measuring Instrument Calibration

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.

**Tissue Dielectric Properties**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| PNA Network Analyzer | Agilent | E8363C | MY49030443 | 12/3/2014 |
| Dielectronic Probe kit | SPEAG | DAK-3.5 | 1082 | 9/10/2014 |
| Dielectronic Probe kit | SPEAG | DAK-3.5 Short | SM DAK 200 BA | N/A |
| Thermometer | Control Company | 4242 | 122529162 | 9/19/2014 |

**System Performance Check**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| Synthesized Signal Generator | Agilent | 8665B | 3438A00633 | 6/13/2014 |
| Amplifier | MITEQ | AMF-4D-00400600-50-30P | 1808939 | N/A |
| Directional coupler | Werlatone | C8060-102 | 2710 | N/A |
| DC Power Supply | Sorensen Ametek | XT15-4 | 1319A02778 | N/A |
| Power Meter | HP | 438A | 2822A05684 | 10/10/2014 |
| Power Sensor | Agilent | 8481A | 2237A31744 | 10/2/2014 |
| Power Sensor | Aglient | 8481A | 2349A36506 | 9/30/2014 |
| Synthesized Signal Generator | HP | 8665B | 5744A01084 | 5/7/2014 |
| Amplifier | MITEQ | AMF-4D-00400600-50-30P | 1795093 | N/A |
| Bidirectional coupler | Werlatone | C8060-102 | 2711 | N/A |
| DC Power Supply | Sorensen Ametek | XT20-3 | 1318A00529 | N/A |
| Power Meter | Agilent | N1912A (P-Series) | MY50001018 | 8/23/2014 |
| Power Sensor | Agilent | E9323A | MY53070009 | 4/3/2014 |
| Power Sensor | Aglient | E9323A | US40411556 | 8/9/2014 |
| Thermometer | TRACEABLE | 4242 | 122529162 | 9/19/2014 |
| Data Acquisition Electronics | SPEAG | DAE3 | 427 | 1/21/2015 |
| Data Acquisition Electronics | SPEAG | DAE4 | 1377 | 7/15/2014 |
| Data Acquisition Electronics | SPEAG | DAE4 | 1380 | 7/15/2014 |
| Data Acquisition Electronics | SPEAG | DAE4 | 1343 | 7/24/2014 |
| E-Field Probe | SPEAG | EX3DV4 | 3929 | 6/24/2014 |
| E-Field Probe | SPEAG | EX3DV4 | 3902 | 7/12/2014 |
| E-Field Probe | SPEAG | EX3DV4 | 3936 | 7/22/2014 |
| E-Field Probe | SPEAG | EX3DV4 | 3885 | 9/18/2014 |
| System Validation Dipole | SPEAG | D750V3 | 1024 | 5/28/2014 |
| System Validation Dipole | SPEAG | D835V2 | 4d142 | 9/17/2014 |
| System Validation Dipole | SPEAG | D1750V2 | 1077 | 9/12/2014 |
| System Validation Dipole | SPEAG | D1900V2 | 5d163 | 9/17/2014 |
| System Validation Dipole | SPEAG | D2450V2 | 706 | 5/29/2014 |

**Others**

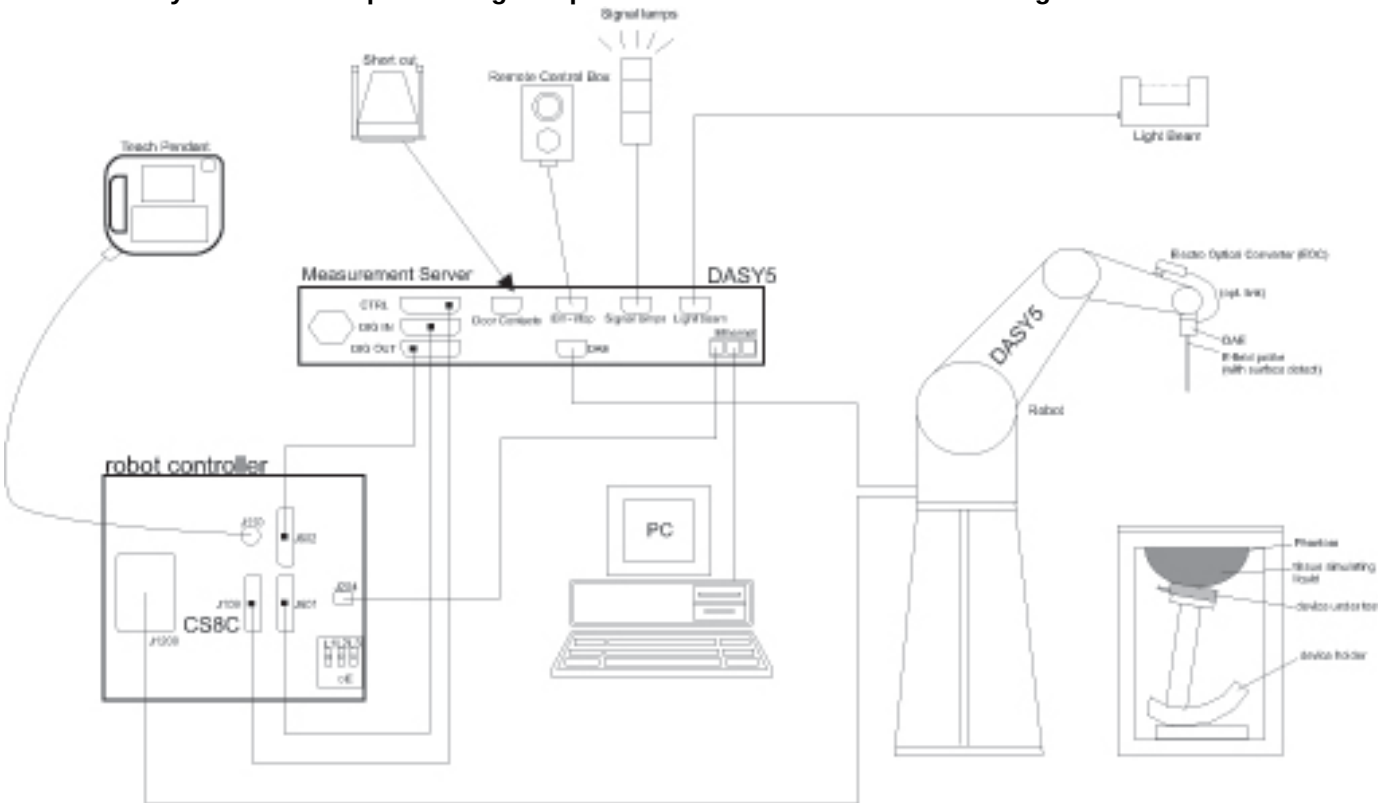
| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| Base Station Simulator | R & S | CMU200 | 117455 | 5/20/2014 |
| Base Station Simulator | R & S | CMU200 | 118715 | 5/20/2014 |
| Base Station Simulator | R & S | CMW500 | 103764-dn | 8/16/2014 |
| Base Station Simulator | R & S | CMW500 | 103766-ly | 8/19/2014 |
| Base Station Simulator | R & S | CMW500 | 107513-be | 7/26/2014 |

## 4.2. 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.

# 5. Measurement System Description and Setup

**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.

# 6. SAR Measurement Procedure

## 6.1. Normal SAR Measurement Procedure

**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 | ½·δ·ln(2) ± 0.5 mm |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location | 30° ± 1° | 20° ± 1° |
| Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$ | ≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm | 3 – 4 GHz: ≤ 12 mm<br>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 ≤ 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: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$ | | | ≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm* | 3 – 4 GHz: ≤ 5 mm*<br>4 – 6 GHz: ≤ 4 mm* |
| Maximum zoom scan spatial resolution, normal to phantom surface | uniform grid: $\Delta z_{Zoom}(n)$ | | ≤ 5 mm | 3 – 4 GHz: ≤ 4 mm<br>4 – 5 GHz: ≤ 3 mm<br>5 – 6 GHz: ≤ 2 mm |
| | graded grid | $\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface | ≤ 4 mm | 3 – 4 GHz: ≤ 3 mm<br>4 – 5 GHz: ≤ 2.5 mm<br>5 – 6 GHz: ≤ 2 mm |
| | | $\Delta z_{Zoom}(n>1)$: between subsequent points | ≤ 1.5·$\Delta z_{Zoom}(n-1)$ | |
| Minimum zoom scan volume | x, y, z | | ≥ 30 mm | 3 – 4 GHz: ≥ 28 mm<br>4 – 5 GHz: ≥ 25 mm<br>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 *reported* 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.

## 6.2.Volume Scan Procedures

**Step 1: Repeat Step 1-4 in Section 6.1**

**Step 2: Volume Scan**
Volume Scans are used to assess peak SAR and averaged SAR measurements in largely extended 3-dimensional volumes within any phantom. This measurement does not need any previous area scan. The grid can be anchored to a user specific point or to the current probe location.

**Step 3: 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.

# 7. Device Under Test

## 7.1. General Information

| | |
|---|---|
| Operating Configuration(s) | Held to head,<br>Body-worn (Voice call) |
| Mobile Hotspot | Wi-Fi Hotspot mode permits the device to share its cellular data connection with other Wi-Fi -enabled devices.<br>☐ Mobile Hotspot (Wi-Fi 2.4 GHz)<br>☐ Mobile Hotspot (Wi-Fi 5 GHz) |
| Wi-Fi Direct | Wi-Fi Direct enabled devices transfer data directly between each other<br>☒ Wi-Fi Direct (Wi-Fi 2.4 GHz)<br>☐ Wi-Fi Direct (Wi-Fi 5 GHz) |
| Device dimension | Overall (Length x Width): 127.5 mm x 66.1mm<br>Overall Diagonal: 135.2mm<br>Display Diagonal: 114mm |
| Back Cover | ☒ Normal Battery Cover<br>☐ Wireless Charger Battery Cover<br>☐ Normal Battery Cover with NFC |
| Accessory | ☒ Headset |
| Battery Options | ☒ Standard – Lithium-ion battery, Rating 3.8 Vdc, 2440 mAh<br>☐ Extended (large capacity) |

## 7.2. Wireless Technologies

| | |
|---|---|
| Wireless Technology and Frequency Bands | GSM: 850 / 1900<br>W-CDMA Band: V / II<br>LTE Band: 4 / 17 (FDD)<br>Wi-Fi: 2.4 GHz<br>Bluetooth: 2.4 GHz |
| Mode | GSM<br>- ☒ Voice (GMSK)<br>- ☒ GPRS (GMSK)<br>- ☒ EGPRS (8PSK)<br>W-CDMA<br>- ☒ UMTS Rel. 99<br>- ☒ HSDPA (Rel. 5)<br>- ☒ HSUPA (Rel. 6)<br>- ☐ DC-HSDPA (Rel. 8)<br>LTE: QPSK, 16QAM<br>Wi-Fi 2.4GHz (802.11b/g/n)<br>- ☒ 802.11b<br>- ☒ 802.11g<br>- ☒ 802.11n (20MHz)<br>Bluetooth Ver. 4.0 (LE) |
| Duty Cycle | GSM Voice: 12.5%; GPRS 1 Slot: 12.5%, 2 Slots: 25%<br>W-CDMA: 100%<br>LTE (FDD): 100%<br>Wi-Fi 802.11b/g/n: 100%) |
| GPRS Multi-Slot Class | ☐ Class 8 - One Up<br>☒ Class 10 - Two Up<br>☐ Class 12 - Four Up<br>☐ Class 33 - Four Up |
| DTM (Dual Transfer Mode) | ☐ Supported |
| VoIP (GPRS) | ☒ Supported |
| SV-LTE & SV-DO | ☐ Supported |

## 7.3. RF Output Power Tolerance

| Upper limit (dB): 0.5 | | RF Output Power (dBm) | |
|---|---|---|---|
| RF Air interface | Mode | Target | Max. tune-up tolerance limit |
| GSM850 | Voice | 33.2 | **33.7** |
| | GPRS 1 slot | 33.2 | **33.7** |
| | GPRS 2 slots | 31.2 | **31.7** |
| | EGPRS 1 slot | 27.2 | **27.7** |
| | EGPRS 2 slots | 27.2 | **27.7** |
| GSM1900 | Voice | 30.2 | **30.7** |
| | GPRS 1 slot | 30.2 | **30.7** |
| | GPRS 2 slots | 28.2 | **28.7** |
| | EGPRS 1 slot | 26.2 | **26.7** |
| | EGPRS 2 slots | 26.2 | **26.7** |
| W-CDMA Band V | R99 | 23.2 | **23.7** |
| | HSDPA | 23.2 | **23.7** |
| | HSUPA | 23.2 | **23.7** |
| W-CDMA Band II | R99 | 23.2 | **23.7** |
| | HSDPA | 23.2 | **23.7** |
| | HSUPA | 23.2 | **23.7** |
| LTE Band 4 | QPSK | 23.7 | **24.2** |
| LTE Band 17 | QPSK | 23.7 | **24.2** |

| Upper limit (dB): 1.0 | | RF Output Power (dBm) | |
|---|---|---|---|
| RF Air interface | Mode | Target | Max. tune-up tolerance limit |
| WiFi 2.4 GHz | 802.11b | 15.7 | **16.7** |
| | 802.11g | 12.0 | **13.0** |
| | 802.11n HT20 | 12.0 | **13.0** |

| Upper limit (dB): 1.5 | | RF Output Power (dBm) | |
|---|---|---|---|
| RF Air interface | Mode | Target | Max. tune-up tolerance limit |
| Bluetooth | | 9.4 | **10.9** |
| Bluetooth LE | | 0.5 | **2.0** |

## 7.4. Simultaneous Transmission Condition

| RF Exposure Condition | Capable Transmit Configurations |
|---|---|
| Head | 1. GSM 850/1900 Voice + Wi-Fi 2.4 GHz<br>2. GSM 850/1900 (GPRS/EDGE) + Wi-Fi 2.4 GHz (VoIP)<br>3. W-CDMA Band V / II+ Wi-Fi 2.4 GHz<br>4. LTE Band 4 / 17 + Wi-Fi 2.4GHz |
| Body-worn Accessory | 1. GSM 850/1900 Voice + Wi-Fi 2.4 GHz<br>2. GSM 850/1900 Voice + BT<br>3. GSM 850/1900 (GPRS/EDGE) + Wi-Fi 2.4 GHz (VoIP)<br>4. GSM 850/1900 (GPRS/EDGE) + BT (VoIP)<br>5. W-CDMA Band V / II + Wi-Fi 2.4 GHz<br>6. W-CDMA Band V / II + BT<br>7. LTE Band 4 / 17 + Wi-Fi 2.4GHz<br>8. LTE Band 4 / 17 + BT |
| Wireless Router (Hotspot) & Wi-Fi Direct | N/A |
| Notes:<br>1. Wi-Fi 2.4GHz and Bluetooth cannot transmit simultaneously.<br>2. Wi-Fi 2.4GHz also supports Wi-Fi Direct. | |

## 7.5. General LTE SAR Test and Reporting Considerations

<table>
<tr><th>Item</th><th colspan="7">Description</th></tr>
<tr><td rowspan="10">Frequency range, Channel Bandwidth, Numbers and Frequencies</td><td rowspan="2">Band 4</td><td colspan="6">Frequency range: 1710 - 1755 MHz</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td></td><td>20 MHz</td><td>15 MHz</td><td>10 MHz</td><td>5 MHz</td><td>3 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td></td><td></td><td>20000/<br>1715</td><td>19975/<br>1712.5</td><td></td><td></td></tr>
<tr><td>Mid</td><td></td><td></td><td>20175/<br>1732.5</td><td>20175/<br>1732.5</td><td></td><td></td></tr>
<tr><td>High</td><td></td><td></td><td>20350/<br>1750</td><td>20375/<br>1752.5</td><td></td><td></td></tr>
<tr><td rowspan="2">Band 17</td><td colspan="6">Frequency range: 704 - 716 MHz</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td></td><td>20 MHz</td><td>15 MHz</td><td>10 MHz</td><td>5 MHz</td><td>3 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td></td><td></td><td>20000/<br>1715</td><td>23755/<br>706.5</td><td></td><td></td></tr>
<tr><td>Mid</td><td></td><td></td><td>23790/<br>710</td><td>23790/<br>710</td><td></td><td></td></tr>
<tr><td>High</td><td></td><td></td><td>20350/<br>1750</td><td>23825/<br>713.5</td><td></td><td></td></tr>
<tr><td>LTE transmitter and antenna implementation</td><td colspan="7">LTE has two Tx/Rx antennas and two Rx only antennas.<br>Refer to Appendix “Antenna Locations and Separation Distances” for antenna locations</td></tr>
<tr><td>Maximum power reduction (MPR)</td><td colspan="7">
Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3
<table>
<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>
<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>
</table>
MPR Built-in by design<br>A-MPR (additional MPR) was disabled during SAR testing
</td></tr>
<tr><td>Power reduction</td><td colspan="7">No</td></tr>
<tr><td>Spectrum plots for RB configurations</td><td colspan="7">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.</td></tr>
</table>

# 8. RF Exposure Conditions

Refer to Appendix "Antenna Locations and Separation Distances" for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

## 8.1. Head Exposure Condition(s)

### For WWAN, LTE and Wi-Fi

| Test Configurations | SAR Required | Note |
|---|---|---|
| Left Touch | Yes | |
| Left Tilt (15°) | Yes | |
| Right Touch | Yes | |
| Right Tilt (15°) | Yes | |

## 8.2. Body-worn Accessory Exposure Condition(s)

### For GSM, W-CDMA and LTE B4 (❶)

| Test Configurations | Antenna-to-edge/surface | SAR Required | Note |
|---|---|---|---|
| Rear | <25 mm | Yes | |
| Front | <25 mm | Yes | |

### For LTE B17 (❷)

| Test Configurations | Antenna-to-edge/surface | SAR Required | Note |
|---|---|---|---|
| Rear | <25 mm | Yes | |
| Front | <25 mm | Yes | |

### For Wi-Fi and Bluetooth (❻)

| Test Configurations | Antenna-to-edge/surface | SAR Required | Note |
|---|---|---|---|
| Rear | <25 mm | Yes | |
| Front | <25 mm | Yes | |

## 8.3. Wi-Fi Direct Exposure Condition(s)

### For Wi-Fi (❻)

| Test Configurations | Antenna-to-edge/surface | SAR Required | Note |
|---|---|---|---|
| Rear | <25 mm | Yes | |
| Front | <25 mm | Yes | |
| Edge 1 (Top) | 3 mm | Yes | |
| Edge 2 (Right) | 54.1 mm | No | SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 648474 D04 Handset SAR v01r01 |
| Edge 3 (Bottom) | 104.5 mm | No | SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 648474 D04 Handset SAR v01r01 |
| Edge 4 (Left | 2 mm | Yes | |

# 9. RF Output Power Measurement

## 9.1. GSM

| Band | Mode | Coding Scheme | Time Slots | Ch No. | Freq. (MHz) | Burst Pwr (dBm) | Frame Pwr (dBm) |
|---|---|---|---|---|---|---|---|
| 850 | GSM (Voice) | CS1 | 1 | 128 | 824.2 | 33.7 | 24.7 |
| | | | | 190 | 836.6 | 33.7 | 24.7 |
| | | | | 251 | 848.8 | 33.6 | 24.6 |
| | GPRS (GMSK) | CS1 | 1 | 128 | 824.2 | 33.7 | 24.7 |
| | | | | 190 | 836.6 | 33.7 | 24.7 |
| | | | | 251 | 848.8 | 33.6 | 24.6 |
| | | | 2 | 128 | 824.2 | **31.2** | 25.2 |
| | | | | 190 | 836.6 | **31.1** | 25.1 |
| | | | | 251 | 848.8 | **30.9** | 24.9 |
| | EGPRS (8PSK) | MCS5 | 1 | 128 | 824.2 | 27.5 | 18.5 |
| | | | | 190 | 836.6 | 27.4 | 18.4 |
| | | | | 251 | 848.8 | 27.4 | 18.4 |
| | | | 2 | 128 | 824.2 | 26.6 | 20.6 |
| | | | | 190 | 836.6 | 26.5 | 20.5 |
| | | | | 251 | 848.8 | 26.5 | 20.5 |

**Notes:**

The worst-case configuration and mode for SAR testing is determined to be as follows:

- Head & Body-worn Accessory: GMSK Voice Mode
- VoIP mode: GMSK (GPRS) mode with 2 time slots, based on the output power measurements above
- SAR is not required for EGPRS (8PSK) mode because its output power is less than that of GPRS Mode

| Band | Mode | Coding Scheme | Time Slots | Ch No. | Freq. (MHz) | Burst Pwr (dBm) | Frame Pwr (dBm) |
|---|---|---|---|---|---|---|---|
| 1900 | GSM (Voice) | CS1 | 1 | 512 | 1850.2 | 30.5 | 21.5 |
| | | | | 661 | 1880.0 | 30.7 | 21.7 |
| | | | | 810 | 1909.8 | 30.7 | 21.7 |
| | GPRS (GMSK) | CS1 | 1 | 512 | 1850.2 | 30.5 | 21.5 |
| | | | | 661 | 1880.0 | 30.7 | 21.7 |
| | | | | 810 | 1909.8 | 30.7 | 21.7 |
| | | | 2 | 512 | 1850.2 | **28.4** | 22.4 |
| | | | | 661 | 1880.0 | **28.6** | 22.6 |
| | | | | 810 | 1909.8 | **28.7** | 22.7 |
| | EGPRS (8PSK) | MCS5 | 1 | 512 | 1850.2 | 25.6 | 16.6 |
| | | | | 661 | 1880.0 | 25.7 | 16.7 |
| | | | | 810 | 1909.8 | 25.7 | 16.7 |
| | | | 2 | 512 | 1850.2 | 24.5 | 18.5 |
| | | | | 661 | 1880.0 | 24.5 | 18.5 |
| | | | | 810 | 1909.8 | 24.5 | 18.5 |

**Notes:**

The worst-case configuration and mode for SAR testing is determined to be as follows:

- Head & Body-worn Accessory: GMSK Voice Mode
- VoIP mode: GMSK (GPRS) mode with 2 time slots, based on the output power measurements above
- SAR is not required for EGPRS (8PSK) mode because its output power is less than that of GPRS Mode

## 9.2. W-CDMA

**Release 99**

The following tests were completed according to the test requirements outlined in section 5.2 of the 3GPP TS34.121-1 specification. The DUT supports power Class 3, which has a nominal maximum output power of 24 dBm (+1.7/-3.7).

| Mode | Subtest | Rel99 |
|---|---|---|
| WCDMA General Settings | Loopback Mode | Test Mode 1 |
| | Rel99 RMC | 12.2kbps RMC |
| | Power Control Algorithm | Algorithm2 |
| | βc/βd | 8/15 |

**Measured Results**

| Band | Mode | UL Ch No. | Freq. (MHz) | Avg Pwr (dBm) |
|---|---|---|---|---|
| W-CDMA Band V | Rel 99 (RMC, 12.2 kbps) | 4132 | 826.4 | 23.7 |
| | | 4183 | 836.6 | 23.7 |
| | | 4233 | 846.6 | 23.6 |
| W-CDMA Band II | Rel 99 (RMC, 12.2 kbps) | 9262 | 1852.4 | 23.7 |
| | | 9400 | 1880.0 | 23.7 |
| | | 9538 | 1907.6 | 23.5 |

**HSDPA**

The following 4 Sub-tests were completed according to Release 5 procedures in section 5.2 of 3GPP TS34.121-1. A summary of these settings are illustrated below:

| | Mode | HSDPA | HSDPA | HSDPA | HSDPA |
|---|---|---|---|---|---|
| | Subtest | 1 | 2 | 3 | 4 |
| W-CDMA General Settings | Loopback Mode | Test Mode 1 | | | |
| | Rel99 RMC | 12.2kbps RMC | | | |
| | HSDPA FRC | H-Set1 | | | |
| | Power Control Algorithm | Algorithm 2 | | | |
| | βc | 2/15 | 12/15 | 15/15 | 15/15 |
| | βd | 15/15 | 15/15 | 8/15 | 4/15 |
| | Bd (SF) | 64 | | | |
| | βc/βd | 2/15 | 12/15 | 15/8 | 15/4 |
| | βhs | 4/15 | 24/15 | 30/15 | 30/15 |
| | MPR (dB) | 0 | 0 | 0.5 | 0.5 |
| HSDPA Specific Settings | $D_{ACK}$ | 8 | | | |
| | $D_{NAK}$ | 8 | | | |
| | DCQI | 8 | | | |
| | Ack-Nack repetition factor | 3 | | | |
| | CQI Feedback (Table 5.2B.4) | 4ms | | | |
| | CQI Repetition Factor (Table 5.2B.4) | 2 | | | |
| | Ahs=βhs/βc | 30/15 | | | |

**Measured Results**

| Band | Mode | UL Ch No. | Freq. (MHz) | Avg Pwr (dBm) |
|---|---|---|---|---|
| W-CDMA Band V | Subtest 1 | 4132 | 826.4 | 23.5 |
| | | 4183 | 836.6 | 23.6 |
| | | 4233 | 846.6 | 23.5 |
| | Subtest 2 | 4132 | 826.4 | 23.6 |
| | | 4183 | 836.6 | 23.6 |
| | | 4233 | 846.6 | 23.6 |
| | Subtest 3 | 4132 | 826.4 | 23.1 |
| | | 4183 | 836.6 | 23.1 |
| | | 4233 | 846.6 | 23.1 |
| | Subtest 4 | 4132 | 826.4 | 23.2 |
| | | 4183 | 836.6 | 23.1 |
| | | 4233 | 846.6 | 23.1 |
| W-CDMA Band II | Subtest 1 | 9262 | 1852.4 | 23.6 |
| | | 9400 | 1880.0 | 23.7 |
| | | 9538 | 1907.6 | 23.5 |
| | Subtest 2 | 9262 | 1852.4 | 23.7 |
| | | 9400 | 1880.0 | 23.7 |
| | | 9538 | 1907.6 | 23.7 |
| | Subtest 3 | 9262 | 1852.4 | 23.1 |
| | | 9400 | 1880.0 | 23.2 |
| | | 9538 | 1907.6 | 23.1 |
| | Subtest 4 | 9262 | 1852.4 | 23.2 |
| | | 9400 | 1880.0 | 23.2 |
| | | 9538 | 1907.6 | 23.1 |

Maximum output power levels that are possible for all subtests reported.

**HSPA (HSDPA & HSUPA)**

The following 5 Sub-tests were completed according to Release 7 procedures in section 5.2 of 3GPP TS34.121. A summary of these settings are illustrated below:

| | Mode | HSPA | | | | |
|---|---|---|---|---|---|---|
| | Subtest | 1 | 2 | 3 | 4 | 5 |
| WCDMA General Settings | Loopback Mode | Test Mode 1 | | | | |
| | Rel99 RMC | 12.2kbps RMC | | | | |
| | HSDPA FRC | H-Set 1 | | | | |
| | HSUPA Test | HSPA | | | | |
| | Power Control Algorithm | Algorithm 2 | | | | Algorithm 1 |
| | βc | 11/15 | 6/15 | 15/15 | 2/15 | 15/15 |
| | βd | 15/15 | 15/15 | 9/15 | 15/15 | 0 |
| | βec | 209/225 | 12/15 | 30/15 | 2/15 | 5/15 |
| | βc/βd | 11/15 | 11/15 | 15/9 | 2/15 | 15/0 |
| | βhs | 22/15 | 12/15 | 30/15 | 4/15 | 5/15 |
| | βed | 1309/225 | 94/75 | 47/15<br>47/15 | 56/75 | 47/15 |
| | CM (dB) | 1 | 3 | 2 | 3 | 1 |
| | MPR (dB) | 0 | 2 | 1 | 2 | 0 |
| HSDPA Specific Settings | DACK | 8 | | | | 0 |
| | DNAK | 8 | | | | 0 |
| | DCQI | 8 | | | | 0 |
| | Ack-Nack repetition factor | 3 | | | | |
| | CQI Feedback (Table 5.2B.4) | 4ms | | | | |
| | CQI Repetition Factor (Table 5.2B.4) | 2 | | | | |
| | Ahs = βhs/βc | 30/15 | | | | |
| HSUPA Specific Settings | E-DPDCCH | 6 | 8 | 8 | 5 | 7 |
| | DHARQ | 0 | 0 | 0 | 0 | 0 |
| | AG Index | 20 | 12 | 15 | 17 | 21 |
| | ETFCI (from 34.121 Table C.11.1.3) | 75 | 67 | 92 | 71 | 81 |
| | Associated Max UL Data Rate kbps | 242.1 | 174.9 | 482.8 | 205.8 | 308.9 |
| | Reference E-TFCIs | 5 | 5 | 2 | 5 | 1 |
| | Reference E-TFCI | 11 | 11 | 11 | 11 | 67 |
| | Reference E-TFCI PO | 4 | 4 | 4 | 4 | 18 |
| | Reference E-TFCI | 67 | 67 | 92 | 67 | 67 |
| | Reference E-TFCI PO | 18 | 18 | 18 | 18 | 18 |
| | Reference E-TFCI | 71 | 71 | 71 | 71 | 71 |
| | Reference E-TFCI PO | 23 | 23 | 23 | 23 | 23 |
| | Reference E-TFCI | 75 | 75 | 75 | 75 | 75 |
| | Reference E-TFCI PO | 26 | 26 | 26 | 26 | 26 |
| | Reference E-TFCI | 81 | 81 | 81 | 81 | 81 |
| | Reference E-TFCI PO | 27 | 27 | 27 | 27 | 27 |
| | Maximum Channelisation Codes | 2xSF2 | | | | SF4 |

**Measured Results**

| Band | Mode | UL Ch No. | Freq. (MHz) | Avg Pwr (dBm) |
|---|---|---|---|---|
| W-CDMA Band V | Subtest 1 | 4132 | 826.4 | 23.5 |
| | | 4183 | 836.6 | 23.1 |
| | | 4233 | 846.6 | 23.5 |
| | Subtest 2 | 4132 | 826.4 | 21.3 |
| | | 4183 | 836.6 | 21.9 |
| | | 4233 | 846.6 | 22.0 |
| | Subtest 3 | 4132 | 826.4 | 22.3 |
| | | 4183 | 836.6 | 22.6 |
| | | 4233 | 846.6 | 22.4 |
| | Subtest 4 | 4132 | 826.4 | 22.3 |
| | | 4183 | 836.6 | 22.4 |
| | | 4233 | 846.6 | 22.2 |
| | Subtest 5 | 4132 | 826.4 | 23.7 |
| | | 4183 | 836.6 | 23.7 |
| | | 4233 | 846.6 | 23.7 |
| W-CDMA Band II | Subtest 1 | 9262 | 1852.4 | 23.1 |
| | | 9400 | 1880.0 | 23.2 |
| | | 9538 | 1907.6 | 23.2 |
| | Subtest 2 | 9262 | 1852.4 | 22.3 |
| | | 9400 | 1880.0 | 22.3 |
| | | 9538 | 1907.6 | 21.7 |
| | Subtest 3 | 9262 | 1852.4 | 22.4 |
| | | 9400 | 1880.0 | 22.6 |
| | | 9538 | 1907.6 | 22.5 |
| | Subtest 4 | 9262 | 1852.4 | 22.1 |
| | | 9400 | 1880.0 | 22.4 |
| | | 9538 | 1907.6 | 22.1 |
| | Subtest 5 | 9262 | 1852.4 | 23.7 |
| | | 9400 | 1880.0 | 23.6 |
| | | 9538 | 1907.6 | 23.6 |

## 9.3. LTE Band

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<br>6.6.3.3.2 | 13 | 10 | Table 6.2.4-2 | Table 6.2.4-2 |
| NS_08 | 6.6.3.3.3 | 19 | 10, 15 | > 44 | ≤ 3 |
| NS_09 | 6.6.3.3.4 | 21 | 10, 15 | > 40 | ≤ 1 |
| | | | | > 55 | ≤ 2 |
| 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 | Meas. MPR | Avg Pwr (dBm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1715 MHz | 1732.5 MHz | 1750 MHz |
| LTE Band 4 | 10 | QPSK | 1 | 0 | 0 | 0 | 24.1 | 24.1 | 24.2 |
| | | | 1 | 25 | 0 | 0 | 24.0 | 24.0 | 24.1 |
| | | | 1 | 49 | 0 | 0 | 24.1 | 24.1 | 24.2 |
| | | | 25 | 0 | 1 | 1 | 23.0 | 22.9 | 22.8 |
| | | | 25 | 12 | 1 | 1 | 23.0 | 22.9 | 22.9 |
| | | | 25 | 25 | 1 | 1 | 23.0 | 22.9 | 22.9 |
| | | | 50 | 0 | 1 | 1 | 22.9 | 23.0 | 22.8 |
| | | 16QAM | 1 | 0 | 1 | 1 | 23.1 | 23.2 | 23.1 |
| | | | 1 | 25 | 1 | 1 | 23.1 | 23.1 | 23.0 |
| | | | 1 | 49 | 1 | 1 | 23.1 | 23.1 | 23.1 |
| | | | 25 | 0 | 2 | 2 | 21.9 | 21.9 | 21.8 |
| | | | 25 | 12 | 2 | 2 | 21.8 | 22.0 | 21.8 |
| | | | 25 | 25 | 2 | 2 | 21.8 | 22.0 | 21.8 |
| | | | 50 | 0 | 2 | 2 | 21.8 | 21.9 | 21.8 |
| Band | BW (MHz) | Mode | RB Allocation | RB offset | Target MPR | Meas. MPR | Avg Pwr (dBm) | | |
| | | | | | | | 1712.5 MHz | 1732.5 MHz | 1752.5 MHz |
| LTE Band 4 | 5 | QPSK | 1 | 0 | 0 | 0 | 24.2 | 24.1 | 24.1 |
| | | | 1 | 12 | 0 | 0 | 24.2 | 24.1 | 24.2 |
| | | | 1 | 24 | 0 | 0 | 24.1 | 24.1 | 24.2 |
| | | | 12 | 0 | 1 | 1 | 23.2 | 23.1 | 23.1 |
| | | | 12 | 6 | 1 | 1 | 23.2 | 23.1 | 23.2 |
| | | | 12 | 11 | 1 | 1 | 23.2 | 23.1 | 23.1 |
| | | | 25 | 0 | 1 | 1 | 23.2 | 23.1 | 23.1 |
| | | 16QAM | 1 | 0 | 1 | 1 | 23.2 | 23.1 | 23.1 |
| | | | 1 | 12 | 1 | 1 | 23.1 | 23.1 | 23.1 |
| | | | 1 | 24 | 1 | 1 | 23.2 | 23.2 | 23.1 |
| | | | 12 | 0 | 2 | 2 | 21.9 | 22.0 | 22.0 |
| | | | 12 | 6 | 2 | 2 | 22.0 | 22.0 | 22.1 |
| | | | 12 | 11 | 2 | 2 | 22.1 | 22.1 | 22.0 |
| | | | 25 | 0 | 2 | 2 | 22.0 | 22.0 | 22.1 |

**LTE Band 17 Measured Results**

| Band | BW (MHz) | Mode | RB Allocation | RB offset | Target MPR | Meas. MPR | Avg Pwr (dBm) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 710 MHz |
| LTE Band 17 | 10 | QPSK | 1 | 0 | 0 | 0 | 24.0 |
| | | | 1 | 25 | 0 | 0 | 24.2 |
| | | | 1 | 49 | 0 | 0 | 24.2 |
| | | | 25 | 0 | 1 | 1 | 22.8 |
| | | | 25 | 12 | 1 | 1 | 23.0 |
| | | | 25 | 25 | 1 | 1 | 23.0 |
| | | | 50 | 0 | 1 | 1 | 23.1 |
| | | 16QAM | 1 | 0 | 1 | 1 | 22.9 |
| | | | 1 | 25 | 1 | 1 | 23.1 |
| | | | 1 | 49 | 1 | 1 | 23.1 |
| | | | 25 | 0 | 2 | 2 | 21.8 |
| | | | 25 | 12 | 2 | 2 | 21.9 |
| | | | 25 | 25 | 2 | 2 | 22.1 |
| | | | 50 | 0 | 2 | 2 | 22.0 |
| Band | BW (MHz) | Mode | RB Allocation | RB offset | Target MPR | Meas. MPR | Avg Pwr (dBm) |
| | | | | | | | 710 MHz |
| LTE Band 17 | 5 | QPSK | 1 | 0 | 0 | 0 | 23.9 |
| | | | 1 | 12 | 0 | 0 | 24.1 |
| | | | 1 | 24 | 0 | 0 | 24.1 |
| | | | 12 | 0 | 1 | 1 | 23.0 |
| | | | 12 | 6 | 1 | 1 | 23.2 |
| | | | 12 | 11 | 1 | 1 | 23.0 |
| | | | 25 | 0 | 1 | 1 | 23.0 |
| | | 16QAM | 1 | 0 | 1 | 1 | 22.8 |
| | | | 1 | 12 | 1 | 1 | 23.0 |
| | | | 1 | 24 | 1 | 1 | 23.1 |
| | | | 12 | 0 | 2 | 2 | 21.9 |
| | | | 12 | 6 | 2 | 2 | 22.1 |
| | | | 12 | 11 | 2 | 2 | 22.0 |
| | | | 25 | 0 | 2 | 2 | 22.0 |

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

Required Test Channels per KDB 248227 D01

| Mode | Band | GHz | Channel | "Default Test Channels" | |
|---|---|---|---|---|---|
| | | | | 802.11b | 802.11g |
| 802.11b/g | 2.4 GHz | **2.412** | 1# | √ | ∇ |
| | | **2.437** | 6 | √ | ∇ |
| | | **2.462** | 11# | √ | ∇ |

**Notes:**
√ = "default test channels"
∇ = possible 802.11g channels with maximum average output ¼ dB ≥ the "default test channels"
# = when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

**Measured Results**

| Band (GHz) | Mode | Data Rate | Ch # | Freq. (MHz) | Avg Pwr (dBm) | SAR Test (Yes/No) |
|---|---|---|---|---|---|---|
| 2.4 (DTS) | 802.11b | 1 Mbps | 1 | 2412 | 15.9 | Yes |
| | | | 6 | 2437 | 15.2 | |
| | | | 11 | 2462 | 14.8 | |
| | 802.11g | 6 Mbps | 1 | 2412 | 13.0 | No |
| | | | 6 | 2437 | 12.6 | |
| | | | 11 | 2462 | 12.3 | |
| | 802.11n (HT20) | MCS0 | 1 | 2412 | 12.7 | No |
| | | | 6 | 2437 | 12.6 | |
| | | | 11 | 2462 | 12.4 | |

**Note(s):**
Per KDB 248227 D01, SAR is not required for 802.11g/HT20 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

**Power measurements to determine worst-case data rates**

| Mode | Ch # | Freq. (MHz) | Data Rate | Avg Pwr (dBm) | SAR test (Yes/No) |
|---|---|---|---|---|---|
| 802.11b | 6 | 2437 | 1 Mbps | 15.9 | Yes |
| | | | 2 Mbps | 15.8 | No |
| | | | 5.5 Mbps | 15.8 | No |
| | | | 11 Mbps | 15.8 | No |

## 9.5. Bluetooth

Maximum tune-up tolerance limit is 10.9 dBm from the rated nominal maximum output power. This power level qualifies for exclusion of SAR testing.

Refer to Standalone SAR Test Exclusion Considerations Section.

# 10. Tissue Dielectric Properties

## IEEE Standard 1528-2013

| Target Frequency (MHz) | Head | |
|---|---|---|
| | $\varepsilon_r$ | $\sigma$ (S/m) |
| 300 | 45.3 | 0.87 |
| 450 | 43.5 | 0.87 |
| *750* | *41.9* | *0.89* |
| 835 | 41.5 | 0.90 |
| 900 | 41.5 | 0.97 |
| 1450 | 40.5 | 1.20 |
| *1500* | *40.4* | *1.23* |
| *1640* | *40.2* | *1.31* |
| *1750* | *40.1* | *1.37* |
| 1800 | 40.0 | 1.40 |
| 1900 | 40.0 | 1.40 |
| 2000 | 40.0 | 1.40 |
| *2100* | *39.8* | *1.49* |
| *2300* | *39.5* | *1.67* |
| 2450 | 39.2 | 1.80 |
| *2600* | *39.0* | *1.96* |
| 3000 | 38.5 | 2.40 |
| *3500* | *37.9* | *2.91* |
| *4000* | *37.4* | *3.43* |
| *4500* | *36.8* | *3.94* |
| *5000* | *36.2* | *4.45* |
| *5200* | *36.0* | *4.66* |
| *5400* | *35.8* | *4.86* |
| *5600* | *35.5* | *5.07* |
| 5800 | 35.3 | 5.27 |
| *6000* | *35.1* | *5.48* |

NOTE—For convenience, permittivity and conductivity values at some frequencies that are not part of the original data from Drossos et al. [B60] or the extension to 5800 MHz are provided (i.e., the values shown in italics). These values were linearly interpolated between the values in this table that are immediately above and below these values, except the values at 6000 MHz that were linearly extrapolated from the values at 3000 MHz and 5800 MHz.

## FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

| Target Frequency (MHz) | Head | | Body | |
|---|---|---|---|---|
| | $\varepsilon_r$ | $\sigma$ (S/m) | $\varepsilon_r$ | $\sigma$ (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 |

## 10.1. Composition of Ingredients for the Tissue Material Used in the SAR Tests

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

| Ingredients (% by weight) | Frequency (MHz) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 450 | | 835 | | 915 | | 1900 | | 2450 | |
| Tissue Type | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body |
| Water | 38.56 | 51.16 | 41.45 | 52.4 | 41.05 | 56.0 | 54.9 | 40.4 | 62.7 | 73.2 |
| Salt (NaCl) | 3.95 | 1.49 | 1.45 | 1.4 | 1.35 | 0.76 | 0.18 | 0.5 | 0.5 | 0.04 |
| Sugar | 56.32 | 46.78 | 56.0 | 45.0 | 56.5 | 41.76 | 0.0 | 58.0 | 0.0 | 0.0 |
| HEC | 0.98 | 0.52 | 1.0 | 1.0 | 1.0 | 1.21 | 0.0 | 1.0 | 0.0 | 0.0 |
| Bactericide | 0.19 | 0.05 | 0.1 | 0.1 | 0.1 | 0.27 | 0.0 | 0.1 | 0.0 | 0.0 |
| Triton X-100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 36.8 | 0.0 |
| DGBE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 44.92 | 0.0 | 0.0 | 26.7 |
| Dielectric Constant | 43.42 | 58.0 | 42.54 | 56.1 | 42.0 | 56.8 | 39.9 | 54.0 | 39.8 | 52.5 |
| Conductivity (S/m) | 0.85 | 0.83 | 0.91 | 0.95 | 1.0 | 1.07 | 1.42 | 1.45 | 1.88 | 1.78 |

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

**MSL/HSL750 (Body and Head liquids for 700 – 800 MHz)**

| Item | Head Tissue Simulation Liquids HSL750<br>Muscle (body) Tissue Simulation Liquids MSL750 |
|---|---|
| Type No | SL AAH 075 |
| Manufacturer | SPEAG |
| The item is composed of the following ingredients: | |
| $H^2O$ | Water, 35 – 58% |
| Sucrese | Sugar, white, refined, 40-60% |
| NaCl | Sodium Chloride, 0-6% |
| Hydroxyethel-cellulsoe | Medium Viscosity (CAS# 9004-62-0), <0.3% |
| Preventol-D7 | Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyyl-3(2H)-isothiazolone, 0.1-0.7% |

**MSL/HSL1750 (Body and Head liquids for 1700 – 1800 MHz)**

| Item | Head Tissue Simulation Liquids HSL1750<br>Muscle (body) Tissue Simulation Liquids MSL1750 |
|---|---|
| Type No | SL AAM 175 |
| Manufacturer | SPEAG |
| -The item is composed of the following ingredients: | |
| $H^2O$ | Water, 52 – 75% |
| C8H18O3 | Diethylene glycol monobutyl ether (DGBE), 25-48% |
| NaCl | Sodium Chloride, <1.0% |

**Simulating Liquids for 5 GHz, Manufactured by SPEAG**

| Ingredients | (% by weight) |
|---|---|
| Water | 78 |
| Mineral oil | 11 |
| Emulsifiers | 9 |
| Additives and Salt | 2 |

## 10.2. Tissue Dielectric Parameter Check Results

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°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.

**SAR Lab 1**

| | Freq. (MHz) | Liquid Parameters | | | Measured | Target | Delta (%) | Limit ±(%) |
|---|---|---|---|---|---|---|---|---|
| 3/24/2014 | Body 1900 | e' | 51.7800 | Relative Permittivity (εr): | 51.78 | 53.30 | -2.85 | 5 |
| | | e'' | 14.5100 | Conductivity (σ): | 1.53 | 1.52 | 0.85 | 5 |
| | Body 1850 | e' | 51.8600 | Relative Permittivity (εr): | 51.86 | 53.30 | -2.70 | 5 |
| | | e'' | 14.2900 | Conductivity (σ): | 1.47 | 1.52 | -3.29 | 5 |
| | Body 1910 | e' | 51.7300 | Relative Permittivity (εr): | 51.73 | 53.30 | -2.95 | 5 |
| | | e'' | 14.5500 | Conductivity (σ): | 1.55 | 1.52 | 1.66 | 5 |
| 3/25/2014 | Head 1900 | e' | 39.1800 | Relative Permittivity (εr): | 39.18 | 40.00 | -2.05 | 5 |
| | | e'' | 13.3700 | Conductivity (σ): | 1.41 | 1.40 | 0.89 | 5 |
| | Head 1850 | e' | 39.3900 | Relative Permittivity (εr): | 39.39 | 40.00 | -1.53 | 5 |
| | | e'' | 13.2200 | Conductivity (σ): | 1.36 | 1.40 | -2.87 | 5 |
| | Head 1910 | e' | 39.1500 | Relative Permittivity (εr): | 39.15 | 40.00 | -2.13 | 5 |
| | | e'' | 13.3900 | Conductivity (σ): | 1.42 | 1.40 | 1.57 | 5 |
| 3/24/2014 | Body 835 | e' | 52.9500 | Relative Permittivity (εr): | 52.95 | 55.20 | -4.08 | 5 |
| | | e'' | 21.4900 | Conductivity (σ): | 1.00 | 0.97 | 2.86 | 5 |
| | Body 820 | e' | 53.0900 | Relative Permittivity (εr): | 53.09 | 55.28 | -3.96 | 5 |
| | | e'' | 21.5600 | Conductivity (σ): | 0.98 | 0.97 | 1.50 | 5 |
| | Body 850 | e' | 52.8100 | Relative Permittivity (εr): | 52.81 | 55.16 | -4.26 | 5 |
| | | e'' | 21.4200 | Conductivity (σ): | 1.01 | 0.99 | 2.56 | 5 |

**SAR Lab 3**

| | Freq. (MHz) | Liquid Parameters | | | Measured | Target | Delta (%) | Limit ±(%) |
|---|---|---|---|---|---|---|---|---|
| 3/24/2014 | Body 2450 | e' | 50.8000 | Relative Permittivity ($\varepsilon_r$): | 50.80 | 52.70 | -3.61 | 5 |
| | | e'' | 14.5800 | Conductivity (σ): | 1.99 | 1.95 | 1.86 | 5 |
| | Body 2410 | e' | 50.9600 | Relative Permittivity ($\varepsilon_r$): | 50.96 | 52.76 | -3.41 | 5 |
| | | e'' | 14.4000 | Conductivity (σ): | 1.93 | 1.91 | 1.16 | 5 |
| | Body 2475 | e' | 50.7000 | Relative Permittivity ($\varepsilon_r$): | 50.70 | 52.67 | -3.74 | 5 |
| | | e'' | 14.6900 | Conductivity (σ): | 2.02 | 1.99 | 1.84 | 5 |
| 3/24/2014 | Head 2450 | e' | 37.6000 | Relative Permittivity ($\varepsilon_r$): | 37.60 | 39.20 | -4.08 | 5 |
| | | e'' | 13.8300 | Conductivity (σ): | 1.88 | 1.80 | 4.67 | 5 |
| | Head 2410 | e' | 37.8100 | Relative Permittivity ($\varepsilon_r$): | 37.81 | 39.28 | -3.74 | 5 |
| | | e'' | 13.7300 | Conductivity (σ): | 1.84 | 1.76 | 4.51 | 5 |
| | Head 2475 | e' | 37.5000 | Relative Permittivity ($\varepsilon_r$): | 37.50 | 39.17 | -4.26 | 5 |
| | | e'' | 13.9000 | Conductivity (σ): | 1.91 | 1.83 | 4.70 | 5 |

**SAR Lab 4**

| | Freq. (MHz) | Liquid Parameters | | | Measured | Target | Delta (%) | Limit ±(%) |
|---|---|---|---|---|---|---|---|---|
| 3/26/2014 | Head 835 | e' | 40.6100 | Relative Permittivity ($\epsilon_r$): | 40.61 | 41.50 | -2.14 | 5 |
| | | e'' | 19.4800 | Conductivity (σ): | 0.90 | 0.90 | 0.49 | 5 |
| | Head 820 | e' | 40.7700 | Relative Permittivity ($\epsilon_r$): | 40.77 | 41.60 | -2.00 | 5 |
| | | e'' | 19.5200 | Conductivity (σ): | 0.89 | 0.90 | -0.94 | 5 |
| | Head 850 | e' | 40.4300 | Relative Permittivity ($\epsilon_r$): | 40.43 | 41.50 | -2.58 | 5 |
| | | e'' | 19.4300 | Conductivity (σ): | 0.92 | 0.92 | 0.36 | 5 |
| 3/27/2014 | Head 1750 | e' | 39.2700 | Relative Permittivity ($\epsilon_r$): | 39.27 | 40.08 | -2.03 | 5 |
| | | e'' | 13.8100 | Conductivity (σ): | 1.34 | 1.37 | -1.84 | 5 |
| | Head 1710 | e' | 39.2700 | Relative Permittivity ($\epsilon_r$): | 39.27 | 40.15 | -2.18 | 5 |
| | | e'' | 13.7100 | Conductivity (σ): | 1.30 | 1.35 | -3.18 | 5 |
| | Head 1755 | e' | 39.2800 | Relative Permittivity ($\epsilon_r$): | 39.28 | 40.08 | -1.99 | 5 |
| | | e'' | 13.8200 | Conductivity (σ): | 1.35 | 1.37 | -1.69 | 5 |
| 3/27/2014 | Head 750 | e' | 40.4900 | Relative Permittivity ($\epsilon_r$): | 40.49 | 41.96 | -3.51 | 5 |
| | | e'' | 21.4500 | Conductivity (σ): | 0.89 | 0.89 | 0.16 | 5 |
| | Head 700 | e' | 41.2200 | Relative Permittivity ($\epsilon_r$): | 41.22 | 42.22 | -2.36 | 5 |
| | | e'' | 21.8400 | Conductivity (σ): | 0.85 | 0.89 | -4.40 | 5 |
| | Head 790 | e' | 39.9800 | Relative Permittivity ($\epsilon_r$): | 39.98 | 41.76 | -4.25 | 5 |
| | | e'' | 21.1900 | Conductivity (σ): | 0.93 | 0.90 | 3.87 | 5 |

# 11. System Performance 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 remeasured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

## 11.1. 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 ± 0.5 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm ± 0.5 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.

## 11.2. Reference SAR Values for System Performance Check

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 (mW/g) | | |
|---|---|---|---|---|---|---|
| | | | | 1g/10g | Head | Body |
| D750V3 | 1024 | 5/28/2013 | 750 | 1g | 8.52 | 8.71 |
| | | | | 10g | 5.58 | 5.71 |
| D835V2 | 4d142 | 9/17/2013 | 835 | 1g | 9.44 | 9.36 |
| | | | | 10g | 6.12 | 6.20 |
| D1750V2 | 1077 | 9/12/2013 | 1750 | 1g | 37.6 | 37.7 |
| | | | | 10g | 20.0 | 20.3 |
| D1900V2 | 5d163 | 9/17/2013 | 1900 | 1g | 40.9 | 40.1 |
| | | | | 10g | 21.2 | 21.2 |
| D2450V2 | 706 | 5/29/2013 | 2450 | 1g | 53.7 | 49.9 |
| | | | | 10g | 25.0 | 23.3 |

## 11.3. System Performance 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 Lab 1**

| Date Tested | System Dipole | | T.S. Liquid | | Measured Results | | | Target (Ref. Value) | Delta ±10 % | Est./Zoom Ratio | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type | Serial # | | | Area Scan | Zoom Scan | Normalize to 1 W | | | | |
| 3/24/2014 | D1900V2 | 5d163 | Body | 1g | 4.30 | 4.28 | 42.80 | 40.10 | **6.73** | 0.47 | 1, 2 |
| | | | | 10g | 2.17 | 2.25 | 22.50 | 21.20 | 6.13 | | |
| 3/25/2014 | D1900V2 | 5d163 | Head | 1g | 4.22 | 4.08 | 40.80 | 40.90 | -0.24 | 3.32 | |
| | | | | 10g | 2.15 | 2.11 | 21.10 | 21.20 | -0.47 | | |
| 3/25/2014 | D835V2 | 4d142 | Body | 1g | 1.00 | 0.97 | 9.67 | 9.36 | **3.31** | 3.30 | 3, 4 |
| | | | | 10g | 0.67 | 0.64 | 6.36 | 6.20 | 2.58 | | |

**SAR Lab 3**

| Date Tested | System Dipole | | T.S. Liquid | | Measured Results | | | Target (Ref. Value) | Delta ±10 % | Est./Zoom Ratio | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type | Serial # | | | Area Scan | Zoom Scan | Normalize to 1 W | | | | |
| 3/24/2014 | D2450V2 | 706 | Body | 1g | 5.33 | 5.32 | 53.20 | 49.90 | **6.61** | 0.19 | 5, 6 |
| | | | | 10g | 2.31 | 2.46 | 24.60 | 23.30 | 5.58 | | |
| 3/24/2014 | D2450V2 | 706 | Head | 1g | 5.24 | 5.21 | 52.10 | 53.70 | -2.98 | 0.57 | |
| | | | | 10g | 2.29 | 2.38 | 23.80 | 25.00 | -4.80 | | |

**SAR Lab 4**

| Date Tested | System Dipole | | T.S. Liquid | | Measured Results | | | Target (Ref. Value) | Delta ±10 % | Est./Zoom Ratio | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type | Serial # | | | Area Scan | Zoom Scan | Normalize to 1 W | | | | |
| 3/26/2014 | D835V2 | 4d142 | Head | 1g | 0.98 | 0.95 | 9.47 | 9.44 | **0.32** | 3.17 | 7, 8 |
| | | | | 10g | 0.66 | 0.62 | 6.20 | 6.12 | 1.31 | | |
| 3/27/2014 | D1750V2 | 1077 | Head | 1g | 3.64 | 3.51 | 35.10 | 37.60 | **-6.65** | 3.57 | 9, 10 |
| | | | | 10g | 1.93 | 1.86 | 18.60 | 20.00 | -7.00 | | |
| 3/27/2014 | D750V2 | 1024 | Head | 1g | 0.84 | 0.81 | 8.06 | 8.50 | **-5.18** | 3.70 | 11, 12 |
| | | | | 10g | 0.57 | 0.53 | 5.26 | 5.60 | -6.07 | | |

**SAR Lab F**

| Date Tested | System Dipole | | T.S. Liquid | | Measured Results | | | Target (Ref. Value) | Delta ±10 % | Est./Zoom Ratio | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type | Serial # | | | Area Scan | Zoom Scan | Normalize to 1 W | | | | |
| 3/24/2014 | D1750V2 | 1077 | Body | 1g | 3.87 | 3.78 | 37.80 | 37.70 | **0.27** | 2.33 | 12, 13 |
| | | | | 10g | 2.01 | 2.03 | 20.30 | 20.30 | 0.00 | | |
| 3/24/2014 | D750V3 | 1024 | Body | 1g | 0.88 | 0.87 | 8.66 | 8.71 | **-0.57** | | 14, 15 |
| | | | | 10g | 0.60 | 0.58 | 5.76 | 5.71 | 0.88 | | |

# 12. SAR Test 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 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:**
Body SAR is also measured for HSPA when the maximum average output of each RF channel with HSPA active is at least ¼ dB higher than that measured without HSPA using 12.2 kbps RMC or the maximum SAR for 12.2 kbps RMC is above 75% of the SAR limit. Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 with power control algorithm 2.

**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.

## 12.1. GSM850

| RF Exposure Conditions | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | Voice | 0 | Left Touch | 190 | 836.6 | 33.7 | 33.7 | 0.323 | **0.323** | 1 |
| | | 0 | Left Tilt | 190 | 836.6 | 33.7 | 33.7 | 0.147 | 0.147 | |
| | | 0 | Right Touch | 190 | 836.6 | 33.7 | 33.7 | 0.251 | 0.251 | |
| | | 0 | Rightt Tilt | 190 | 836.6 | 33.7 | 33.7 | 0.137 | 0.137 | |
| Head VoIP | GPRS 2 Slots | 0 | Left Touch | 190 | 836.6 | 31.7 | 31.1 | 0.356 | **0.409** | 2 |
| | | 0 | Left Tilt | 190 | 836.6 | 31.7 | 31.1 | 0.172 | 0.197 | |
| | | 0 | Right Touch | 190 | 836.6 | 31.7 | 31.1 | 0.280 | 0.321 | |
| | | 0 | Rightt Tilt | 190 | 836.6 | 31.7 | 31.1 | 0.154 | 0.177 | |
| Body-worn | Voice | 15 | Rear | 190 | 836.6 | 31.2 | 31.1 | 0.331 | **0.339** | 3 |
| | | 15 | Front | 190 | 836.6 | 31.2 | 31.1 | 0.230 | 0.235 | |
| Body-worn(VoIP) | GPRS 2 Slots | 15 | Rear | 190 | 836.6 | 31.2 | 31.1 | 0.389 | **0.398** | 4 |
| | | 15 | Front | 190 | 836.6 | 31.2 | 31.1 | 0.255 | 0.261 | |

## 12.2. GSM1900

| RF Exposure Conditions | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | Voice | 0 | Left Touch | 661 | 1880.0 | 30.7 | 30.7 | 0.158 | **0.158** | 5 |
| | | 0 | Left Tilt | 661 | 1880.0 | 30.7 | 30.7 | 0.067 | 0.067 | |
| | | 0 | Right Touch | 661 | 1880.0 | 30.7 | 30.7 | 0.116 | 0.116 | |
| | | 0 | Rightt Tilt | 661 | 1880.0 | 30.7 | 30.7 | 0.057 | 0.057 | |
| Head VoIP | GPRS 2 Slots | 0 | Left Touch | 661 | 1880.0 | 28.7 | 28.6 | 0.191 | **0.195** | 6 |
| | | 0 | Left Tilt | 661 | 1880.0 | 28.7 | 28.6 | 0.065 | 0.067 | |
| | | 0 | Right Touch | 661 | 1880.0 | 28.7 | 28.6 | 0.116 | 0.119 | |
| | | 0 | Rightt Tilt | 661 | 1880.0 | 28.7 | 28.6 | 0.057 | 0.058 | |
| Body-worn | Voice | 15 | Rear | 661 | 1880.0 | 30.7 | 30.7 | 0.192 | **0.192** | 7 |
| | | 15 | Front | 661 | 1880.0 | 30.7 | 30.7 | 0.120 | 0.120 | |
| Body-worn(VoIP) | GPRS 2 Slots | 15 | Rear | 661 | 1880.0 | 28.7 | 28.6 | 0.206 | **0.211** | 8 |
| | | 15 | Front | 661 | 1880.0 | 28.7 | 28.6 | 0.130 | 0.133 | |

## 12.3. W-CDMA Band V

| RF Exposure Conditions | Mode | 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 | 0 | Left Touch | 4183 | 836.6 | 23.7 | 23.7 | 0.337 | **0.337** | 9 |
| | | 0 | Left Tilt | 4183 | 836.6 | 23.7 | 23.7 | 0.165 | 0.165 | |
| | | 0 | Right Touch | 4183 | 836.6 | 23.7 | 23.7 | 0.262 | 0.262 | |
| | | 0 | Rightt Tilt | 4183 | 836.6 | 23.7 | 23.7 | 0.141 | 0.141 | |
| Body-worn | Rel 99 RMC | 15 | Rear | 4183 | 836.6 | 23.7 | 23.7 | 0.352 | **0.352** | 10 |
| | | 15 | Front | 4183 | 836.6 | 23.7 | 23.7 | 0.244 | 0.244 | |

## 12.4. W-CDMA Band II

| RF Exposure Conditions | Mode | 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 | 0 | Left Touch | 9400 | 1880.0 | 23.7 | 23.7 | 0.424 | **0.424** | 11 |
| | | 0 | Left Tilt | 9400 | 1880.0 | 23.7 | 23.7 | 0.141 | 0.141 | |
| | | 0 | Right Touch | 9400 | 1880.0 | 23.7 | 23.7 | 0.241 | 0.241 | |
| | | 0 | Rightt Tilt | 9400 | 1880.0 | 23.7 | 23.7 | 0.124 | 0.124 | |
| Body-worn | Rel 99 RMC | 15 | Rear | 9400 | 1880.0 | 23.7 | 23.7 | 0.386 | **0.386** | 12 |
| | | 15 | Front | 9400 | 1880.0 | 23.7 | 23.7 | 0.257 | 0.257 | |

## 12.5. LTE Band 4 (10 MHz Bandwidth)

| RF Exposure Conditions | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | RB Allocation | RB offest | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | QPSK | 0 | Left Touch | 20175 | 1732.5 | 1 | 0.0 | 24.2 | 24.1 | 0.452 | **0.463** | 13 |
| | | 0 | | | | 25 | 0.0 | 23.2 | 22.9 | 0.359 | 0.385 | |
| | | 0 | Left Tilt | 20175 | 1732.5 | 1 | 0.0 | 24.2 | 24.1 | 0.181 | 0.185 | |
| | | 0 | | | | 25 | 0.0 | 23.2 | 22.9 | 0.147 | 0.158 | |
| | | 0 | Right Touch | 20175 | 1732.5 | 1 | 0.0 | 24.2 | 24.1 | 0.360 | 0.368 | |
| | | 0 | | | | 25 | 0.0 | 23.2 | 22.9 | 0.288 | 0.309 | |
| | | 0 | Rightt Tilt | 20175 | 1732.5 | 1 | 0.0 | 24.2 | 24.1 | 0.191 | 0.195 | |
| | | 0 | | | | 25 | 0.0 | 23.2 | 22.9 | 0.150 | 0.161 | |
| Body-worn | QPSK | 15 | Rear | 20175 | 1732.5 | 1 | 0 | 24.2 | 24.1 | 0.748 | **0.765** | 14 |
| | | 15 | | | | 25 | 0 | 23.2 | 22.9 | 0.584 | 0.626 | |
| | | 15 | Front | 20175 | 1732.5 | 1 | 0 | 24.2 | 24.1 | 0.464 | 0.475 | |
| | | 15 | | | | 25 | 0 | 23.2 | 22.9 | 0.367 | 0.393 | |

## 12.6. LTE Band 17 (10 MHz Bandwidth)

| RF Exposure Conditions | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | RB Allocation | RB offest | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | QPSK | 0 | Left Touch | 23790 | 710.0 | 1 | 25.0 | 24.2 | 24.2 | 0.330 | 0.330 | |
| | | 0 | | | | 25 | 12.0 | 23.2 | 23.0 | 0.256 | 0.268 | |
| | | 0 | Left Tilt | 23790 | 710.0 | 1 | 25.0 | 24.2 | 24.2 | 0.206 | 0.206 | |
| | | 0 | | | | 25 | 12.0 | 23.2 | 23.0 | 0.165 | 0.173 | |
| | | 0 | Right Touch | 23790 | 710.0 | 1 | 25.0 | 24.2 | 24.2 | 0.470 | **0.470** | 15 |
| | | 0 | | | | 25 | 12.0 | 23.2 | 23.0 | 0.363 | 0.380 | |
| | | 0 | Rightt Tilt | 23790 | 710.0 | 1 | 25.0 | 24.2 | 24.2 | 0.230 | 0.230 | |
| | | 0 | | | | 25 | 12.0 | 23.2 | 23.0 | 0.195 | 0.204 | |
| Body-worn | QPSK | 15 | Rear | 23790 | 710.0 | 1 | 25.0 | 24.2 | 24.2 | 0.497 | **0.497** | 16 |
| | | 15 | | | | 25 | 12.0 | 23.2 | 23.0 | 0.387 | 0.405 | |
| | | 15 | Front | 23790 | 710.0 | 1 | 25.0 | 24.2 | 24.2 | 0.322 | 0.322 | |
| | | 15 | | | | 25 | 12.0 | 23.2 | 23.0 | 0.254 | 0.266 | |

## 12.7. Wi-Fi (DTS Band)

| RF Exposure Conditions | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | 802.11b | 0 | Left Touch | 1 | 2412 | 16.7 | 15.9 | 0.141 | 0.170 | |
| | | | Left Tilt | 1 | 2412 | 16.7 | 15.9 | 0.103 | 0.124 | |
| | | | Right Touch | 1 | 2412 | 16.7 | 15.9 | 0.236 | **0.284** | 17 |
| | | | Right Tilt | 1 | 2412 | 16.7 | 15.9 | 0.150 | 0.180 | |
| Body-worn & Wi-Fi Direct | 802.11b | 10 | Rear | 1 | 2412 | 16.7 | 15.9 | 0.103 | **0.124** | 18 |
| | | | Front | 1 | 2412 | 16.7 | 15.9 | 0.050 | 0.060 | |
| Wi-Fi Direct | 802.11b | 10 | Edge 1 | 1 | 2412 | 16.7 | 15.9 | 0.037 | 0.044 | |
| | | | Edge 4 | 1 | 2412 | 16.7 | 15.9 | 0.076 | 0.091 | |

# 12.8. Bluetooth

## 12.8.1. Standalone SAR Test Exclusion Considerations

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

*[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√f(GHz)]* ≤ 3.0, for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

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

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

**Body-worn Accessory Exposure Conditions**

| Max. tune-up tolerance limit | | Min. test separation distance (mm) | Frequency (GHz) | Result |
|---|---|---|---|---|
| (dBm) | (mW) | | | |
| 10.9 | 12 | 15 | 2.480 | 1.3 |

**Conclusion:**

The computed value is < 3; therefore, Bluetooth qualifies for Standalone SAR test exclusion.

## 12.8.2. Estimated SAR

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

- *(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√$f_{(GHz)}$/x]* W/kg for test separation distances ≤ 50 mm;
  where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
- 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.

**Estimated SAR Result for Body-worn Accessory Conditions:**

| Test Configuration | Max. tune-up tolerance limit (mW) | Min. test separation distance (mm) | Frequency (GHz) | Estimated 1-g SAR (W/kg) |
|---|---|---|---|---|
| Rear/Front | 12 | 15 | 2.480 | 0.168 |

# 13. SAR Measurement Variability

In accordance with published RF Exposure KDB procedure 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 W/kg; steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

## 13.1. The Highest Measured SAR Configuration in Each Frequency Band

| Frequency Band (MHz) | Air Interface | Head (W/kg) | Body-worn Accessory (W/kg) | Wi-Fi Direct (W/kg) | Repeated SAR (Yes/No) |
|---|---|---|---|---|---|
| 700 | LTE Band 17 | 0.470 | 0.497 | N/A | No |
| 850 | GSM 850 | 0.356 | 0.389 | N/A | No |
| | WCDMA Band V | | | N/A | No |
| 1750 | LTE Band 4 | 0.452 | 0.748 | N/A | No |
| 1900 | GSM 1900 | | | N/A | No |
| | WCDMA Band II | 0.424 | 0.386 | N/A | No |
| 2400 | Wi-Fi 802.11b/g/n | 0.236 | 0.103 | 0.103 | No |

## 13.2. Repeated Measurement Results

### Head Exposure Condition
Not Applicable.

### Body-worn Accessory Exposure Condition
Not Applicable.

### Wi-Fi Direct Exposure Conditions
Not Applicable.

**Note(s):**
1. Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20.

# 14. 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:

$SAR_1$ 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

$SAR_2$ 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:

$$[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$$

A new threshold of 0.04 is also introduced in the KDB 447498. Thus, in order for a pair of simultaneously 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:

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

## 14.1. Sum of the SAR for GSM850 & Wi-Fi & BT

| RF Exposure conditions | Test Position | | Simultaneous Transmission Scenario | | | ∑ 1-g SAR (mW/g) | SPLSR (Yes/ No) |
|---|---|---|---|---|---|---|---|
| | | | GSM 850 | Wi-Fi (DTS) | Bluetooth | | |
| Head | Left Touch | WWAN + Wi-Fi(DTS) | 0.409 | 0.170 | | 0.579 | No |
| | Left Tilt | WWAN + Wi-Fi(DTS) | 0.197 | 0.124 | | 0.321 | No |
| | Right Touch | WWAN + Wi-Fi(DTS) | 0.321 | 0.284 | | 0.605 | No |
| | Right Tilt | WWAN + Wi-Fi(DTS) | 0.177 | 0.180 | | 0.357 | No |
| Body-worn Accessory | Rear | WWAN + Wi-Fi(DTS) | 0.398 | 0.124 | | 0.522 | No |
| | | WWAN + BT | 0.398 | | 0.168 | 0.566 | No |
| | Front | WWAN + Wi-Fi(DTS) | 0.261 | 0.060 | | 0.321 | No |
| | | WWAN + BT | 0.261 | | 0.168 | 0.429 | No |

**SAR to Peak Location Separation Ratio (SPLSR)**
As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

## 14.2. Sum of the SAR for GSM1900 & Wi-Fi & BT

| RF Exposure conditions | Test Position | | Simultaneous Transmission Scenario | | | ∑ 1-g SAR (mW/g) | SPLSR (Yes/ No) |
|---|---|---|---|---|---|---|---|
| | | | GSM 1900 | Wi-Fi (DTS) | Bluetooth | | |
| Head | Left Touch | WWAN + Wi-Fi(DTS) | 0.195 | 0.170 | | 0.365 | No |
| | Left Tilt | WWAN + Wi-Fi(DTS) | 0.067 | 0.124 | | 0.191 | No |
| | Right Touch | WWAN + Wi-Fi(DTS) | 0.119 | 0.284 | | 0.403 | No |
| | Right Tilt | WWAN + Wi-Fi(DTS) | 0.058 | 0.180 | | 0.238 | No |
| Body-worn Accessory | Rear | WWAN + Wi-Fi(DTS) | 0.211 | 0.124 | | 0.335 | No |
| | | WWAN + BT | 0.211 | | 0.168 | 0.379 | No |
| | Front | WWAN + Wi-Fi(DTS) | 0.133 | 0.060 | | 0.193 | No |
| | | WWAN + BT | 0.133 | | 0.168 | 0.301 | No |

**SAR to Peak Location Separation Ratio (SPLSR)**
As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

## 14.3. Sum of the SAR for WCDMA Band V & Wi-Fi & BT

| RF Exposure conditions | Test Position | | Simultaneous Transmission Scenario | | | ∑ 1-g SAR (mW/g) | SPLSR (Yes/ No) |
|---|---|---|---|---|---|---|---|
| | | | W-CDMA Band V | Wi-Fi (DTS) | Bluetooth | | |
| Head | Left Touch | WWAN + Wi-Fi(DTS) | 0.337 | 0.170 | | 0.507 | No |
| | Left Tilt | WWAN + Wi-Fi(DTS) | 0.165 | 0.124 | | 0.289 | No |
| | Right Touch | WWAN + Wi-Fi(DTS) | 0.262 | 0.284 | | 0.546 | No |
| | Right Tilt | WWAN + Wi-Fi(DTS) | 0.141 | 0.180 | | 0.321 | No |
| Body-worn Accessory | Rear | WWAN + Wi-Fi(DTS) | 0.352 | 0.124 | | 0.476 | No |
| | | WWAN + BT | 0.352 | | 0.168 | 0.520 | No |
| | Front | WWAN + Wi-Fi(DTS) | 0.244 | 0.060 | | 0.304 | No |
| | | WWAN + BT | 0.244 | | 0.168 | 0.412 | No |

**SAR to Peak Location Separation Ratio (SPLSR)**
As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

## 14.4. Sum of the SAR for WCDMA Band II & Wi-Fi & BT

| RF Exposure conditions | Test Position | | Simultaneous Transmission Scenario | | | ∑ 1-g SAR (mW/g) | SPLSR (Yes/ No) |
|---|---|---|---|---|---|---|---|
| | | | W-CDMA Band II | Wi-Fi (DTS) | Bluetooth | | |
| Head | Left Touch | WWAN + Wi-Fi(DTS) | 0.424 | 0.170 | | 0.594 | No |
| | Left Tilt | WWAN + Wi-Fi(DTS) | 0.141 | 0.124 | | 0.265 | No |
| | Right Touch | WWAN + Wi-Fi(DTS) | 0.241 | 0.284 | | 0.525 | No |
| | Right Tilt | WWAN + Wi-Fi(DTS) | 0.124 | 0.180 | | 0.304 | No |
| Body-worn Accessory | Rear | WWAN + Wi-Fi(DTS) | 0.386 | 0.124 | | 0.510 | No |
| | | WWAN + BT | 0.386 | | 0.168 | 0.554 | No |
| | Front | WWAN + Wi-Fi(DTS) | 0.257 | 0.060 | | 0.317 | No |
| | | WWAN + BT | 0.257 | | 0.168 | 0.425 | No |

**SAR to Peak Location Separation Ratio (SPLSR)**
As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

## 14.5. Sum of the SAR for LTE Band 4 & Wi-Fi & BT

| RF Exposure conditions | Test Position | | Simultaneous Transmission Scenario | | | ∑ 1-g SAR (mW/g) | SPLSR (Yes/ No) |
|---|---|---|---|---|---|---|---|
| | | | LTE Band 4 | Wi-Fi (DTS) | Bluetooth | | |
| Head | Left Touch | WWAN + Wi-Fi(DTS) | 0.463 | 0.170 | | 0.633 | No |
| | Left Tilt | WWAN + Wi-Fi(DTS) | 0.185 | 0.124 | | 0.309 | No |
| | Right Touch | WWAN + Wi-Fi(DTS) | 0.368 | 0.284 | | 0.652 | No |
| | Right Tilt | WWAN + Wi-Fi(DTS) | 0.195 | 0.180 | | 0.375 | No |
| Body-worn Accessory | Rear | WWAN + Wi-Fi(DTS) | 0.765 | 0.124 | | **0.889** | No |
| | | WWAN + BT | 0.765 | | 0.168 | 0.933 | No |
| | Front | WWAN + Wi-Fi(DTS) | 0.475 | 0.060 | | 0.535 | No |
| | | WWAN + BT | 0.475 | | 0.168 | 0.643 | No |

**SAR to Peak Location Separation Ratio (SPLSR)**
As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

## 14.6. Sum of the SAR for LTE Band 17 & Wi-Fi & BT

| RF Exposure conditions | Test Position | | Simultaneous Transmission Scenario | | | ∑ 1-g SAR (mW/g) | SPLSR (Yes/ No) |
|---|---|---|---|---|---|---|---|
| | | | LTE Band 17 | Wi-Fi (DTS) | Bluetooth | | |
| Head | Left Touch | WWAN + Wi-Fi(DTS) | 0.330 | 0.170 | | 0.500 | No |
| | Left Tilt | WWAN + Wi-Fi(DTS) | 0.206 | 0.124 | | 0.330 | No |
| | Right Touch | WWAN + Wi-Fi(DTS) | 0.470 | 0.284 | | 0.754 | No |
| | Right Tilt | WWAN + Wi-Fi(DTS) | 0.230 | 0.180 | | 0.410 | No |
| Body-worn Accessory | Rear | WWAN + Wi-Fi(DTS) | 0.497 | 0.124 | | 0.621 | No |
| | | WWAN + BT | 0.467 | | 0.168 | 0.635 | No |
| | Front | WWAN + Wi-Fi(DTS) | 0.322 | 0.060 | | 0.382 | No |
| | | WWAN + BT | 0.322 | | 0.168 | 0.490 | No |

**SAR to Peak Location Separation Ratio (SPLSR)**
As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

# 15. Appendixes

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

**15.1. Photos and Antenna Locations**

**15.2. System Performance Check Plots**

**15.3. Highest SAR Test Plots**

**15.4. Calibration Certificate for E-Field Probe EX3DV4 - SN 3929**

**15.5. Calibration Certificate for E-Field Probe EX3DV4 - SN 3902**

**15.6. Calibration Certificate for E-Field Probe EX3DV3 - SN 3936**

**15.7. Calibration Certificate for E-Field Probe EX3DV4 - SN 3885**

**15.8. Calibration Certificate for D750V3 - SN 1024**

**15.9. Calibration Certificate for D835V2 - SN 4d142**

**15.10. Calibration Certificate for D1750V2 - SN 1077**

**15.11. Calibration Certificate for D1900V2- SN 5d163**

**15.12. Calibration Certificate for D2450V2 - SN 706**

**END OF REPORT**