# SAR EVALUATION REPORT

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

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

**FCC ID: A3LSMA750FN**
**Model Name: SM-A750FN/DS, SM-A750FN, & SM-A750X**

**Report Number: 12440876-S1V2**
**Issue Date: 9/11/2018**

*Prepared for*
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NVLAP LAB CODE 200065-0

**Revision History**

| Rev. | Date | Revisions | Revised By |
|---|---|---|---|
| V1 | 9/7/2018 | Initial Issue | -- |
| V2 | 9/11/2018 | Added Section 6.6 | Coltyce Sanders |
| | | | |
| | | | |


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# 1. Attestation of Test Results

| | | | | | |
|---|---|---|---|---|---|
| Applicant Name | | Samsung Electronics Co., Ltd. | | | |
| FCC ID | | A3LSMA750FN | | | |
| Model Name | | SM-A750FN/DS, SM-A750FN, & SM-A750X | | | |
| Applicable Standards | | FCC 47 CFR § 2.1093<br>Published RF exposure KDB procedures<br>IEEE Std 1528-2013 | | | |
| Exposure Category | | SAR Limits (W/Kg) | | | |
| | | Peak spatial-average (1g of tissue) | | Extremities (hands, wrists, ankles, etc.) (10g of tissue) | |
| General population / Uncontrolled exposure | | 1.6 | | 4 | |
| RF Exposure Conditions | | Equipment Class - Highest Reported SAR (W/kg) | | | |
| | | PCE | DTS | NII | DSS |
| Head | | 0.496 | 0.283 | 0.835 | <0.10 |
| Body-worn | | 0.389 | 0.245 | 0.367 | N/A |
| Hotspot/Wi-Fi Direct/BT Tethering | | 1.049 | 0.542 | 1.104 | N/A |
| Product Specific 10g SAR | | N/A | N/A | 1.232 | N/A |
| Simultaneous TX | Head | 1.047 | 0.779 | 1.047 | 0.596 |
| | Body-worn | 0.755 | 0.634 | 0.755 | 0.529 |
| | Hotspot/ Wi-Fi Direct/ BT Tethering | 1.591 | 1.591 | 1.250 | 1.259 |
| | Product Specific 10g | N/A | N/A | N/A | N/A |
| Date Tested | | 8/20/2018 to 8/28/2018 | | | |
| 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: | Prepared By: |
|---|---|
| Dave Weaver<br>Operations Leader<br>UL Verification Services Inc. | AJ Newcomer<br>Laboratory Engineer<br>UL Verification Services Inc. |


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# 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
- 447498 D03 Supplement C Cross-Reference v01
- 648474 D04 Handset SAR v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 941225 D01 3G SAR Procedures v03r01
- 941225 D05 SAR for LTE Devices v02r05
- 941225 D05A LTE Rel.10 KDB Inquiry Sheet v01r02
- 941225 D06 Hotspot Mode v02r01
- 941225 D07 UMPC Mini Tablet v01r02

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

- TCB workshop October 2014; Page 37, RF Exposure Procedures Update (Other LTE Considerations)
- TCB workshop October 2015; Page 6, RF Exposure Procedures (KDB 941225 D05A)
- TCB workshop April 2016; Page 13, RF Exposure Procedures (LTE Carrier Aggregation for DL)
- TCB workshop April 2016; Page 22, RF Exposure Procedures (Phablet Procedures)
- TCB workshop October 2016; Page 7, RF Exposure Procedures (Bluetooth Duty Factor)
- TCB workshop October 2016; Page 18, RF Exposure Procedures (DUT Holder Perturbations
- TCB workshop May 2017; Page 9, Broadband Liquid Above 3 GHz
- TCB workshop May 2017; Page 16, Bluetooth Tethering

# 3. Facilities and Accreditation

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

| 47173 Benicia Street | 47266 Benicia Street |
|---|---|
| SAR Lab A | SAR Lab 1 |
| SAR Lab B | SAR Lab 2 |
| SAR Lab C | SAR Lab 3 |
| SAR Lab D | SAR Lab 4 |
| SAR Lab E | SAR Lab 5 |
| SAR Lab F | SAR Lab 6 |
| SAR Lab G | SAR Lab 7 |
| SAR Lab H | SAR Lab 8 |

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


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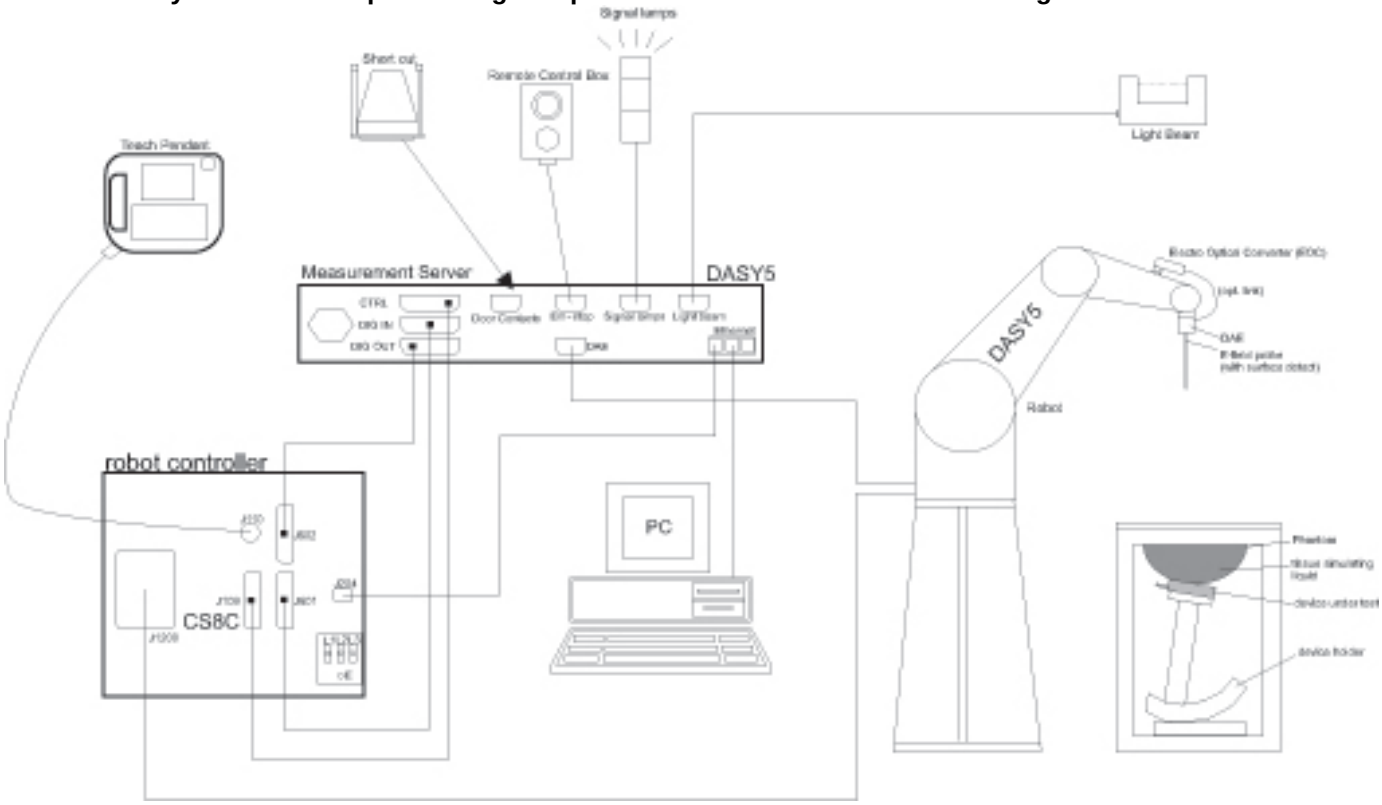
# 4. SAR Measurement System & Test Equipment

## 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.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## 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 | 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. | |


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**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 | $\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$ | |
| 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.


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## 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 |
|---|---|---|---|---|
| Vector Network Analyzer | R&S | ZNLE6 | 101274-MN | 7/16/2019 |
| Dielectric Probe kit | SPEAG | DAK-3.5 | 1082 | 10/17/2018 |
| Shorting Block | SPEAG | DAK-3.5 Short | SM DAK 200 BA | 10/17/2018 |
| Thermometer | Fisher Scientific | Traceable | 140562250 | 11/7/2018 |

**System Check**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| Signal Generator | Agilent | N5181A | MY50140610 | 6/7/2019 |
| Power Meter | Keysight | N1912A | MY55196007 | 7/23/2019 |
| Power Sensor | Agilent | N1921A | MY53020038 | 4/23/2019 |
| Power Sensor | Agilent | N1921A | MY5226009 | 1/8/2019 |
| Amplifier | MITEQ | AMF-4D-00400600-50-30P | 1795093 | N/A |
| Bi-directional coupler | Werlatone, Inc. | C8060-102 | 2149 | N/A |
| DC Power Supply | HP | 6296A | 2841A-05955 | N/A |

**Lab Equipment**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| E-Field Probe (SAR Lab 5) | SPEAG | EX3DV4 | 7498 | 5/4/2019 |
| E-Field Probe (SAR Lab 6) | SPEAG | EX3DV4 | 3885 | 10/24/2018 |
| E-Field Probe (SAR Lab 7) | SPEAG | EX3DV4 | 7500 | 5/4/2019 |
| Data Acquisition Electronics (SAR Lab 5) | SPEAG | DAE4 | 1546 | 5/3/2019 |
| Data Acquisition Electronics (SAR Lab 6) | SPEAG | DAE4 | 1545 | 4/13/2019 |
| Data Acquisition Electronics (SAR Lab 7) | SPEAG | DAE4 | 1547 | 5/3/2019 |
| System Validation Dipole | SPEAG | D835V2 | 4d117 | 5/16/2019 |
| System Validation Dipole | SPEAG | D1750V2 | 1077 | 10/5/2018 |
| System Validation Dipole | SPEAG | D1900V2 | 5d163 | 10/5/2018 |
| System Validation Dipole | SPEAG | D2450V2 | 899 | 3/16/2019 |
| System Validation Dipole | SPEAG | D2600V2 | 1036 | 3/16/2019 |
| System Validation Dipole | SPEAG | D5GHzV2 | 1003 | 3/13/2019 |
| Thermometer (SAR Lab 5/6/7) | Fisher Sceintific | Traceable | 181062300 | 2/26/2019 |

**Other**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| Power Meter | Keysight | N1912A | MY55196015 | 3/1/2019 |
| Power Sensor | Agilent | N1921A | MY53260010 | 10/17/2018 |
| Base Station Simulator | R & S | R & S | 137873-WG | 6/1/2019 |
| Base Station Simulator | R & S | R & S | 137875-DZ | 2/21/2019 |
| PXA Spectrum Analyzer | Keysight | N9030A | MY53311010 | 2/3/2019 |

# 5. Measurement Uncertainty

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


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# 6. Device Under Test (DUT) Information

## 6.1. DUT Description

| | |
|---|---|
| Device Dimension | This is a Phablet Device (display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm)<br>Refer to Appendix A |
| Back Cover | The Back Cover is not removable |
| Battery Options | The rechargeable battery is not user accessible. |
| Accessory | Headset |
| Wireless Router (Hotspot) | Wi-Fi Hotspot mode permits the device to share its cellular data connection with other Wi-Fi-enabled devices.<br>☒ Mobile Hotspot (Wi-Fi 2.4 GHz)<br>☒ Mobile Hotspot (Wi-Fi 5.8 GHz Channel 149 only) |
| 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 5.2 GHz)<br>☒ Wi-Fi Direct (Wi-Fi 5.8 GHz) |
| Bluetooth Tethering | BT Tethering mode permits the device to share its cellular data connection with other BT-enabled devices.<br>☒ BT Tethering (Bluetooth 2.4 GHz) |
| Test Sample Information | **S/N** / **IMEI** / **Notes**<br>R38K70KRQMH / 359979/09/009013/7 / Radiated<br>R38K70KRQVZ / 359979/09/009020/2 / Radiated<br>R38K70KRQWD / 359979/09/009021/0 / Radiated<br>R38K70KRQXF / 359979/09/009022/8 / Radiated<br>R38K70KQHPZ / 359979/09/007695/3 / WWAN Conducted<br>R38K70KQAQM / 359979/09/007465/1 / WWAN Conducted<br>R38K70KQDNN / 359979/09/007562/5 / WLAN Conducted |
| Hardware Version | REV1.0 |
| Software Version | A750FN.001 |


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## 6.2. Wireless Technologies

| Wireless technologies | Frequency bands | Operating Mode | | Duty Cycle used for SAR testing |
|---|---|---|---|---|
| GSM | 850<br>1900 | Voice (GMSK)<br>GPRS (GMSK)<br>EDGE (8PSK) | Multi-Slot Class:<br>Class 33 - 4 Up, 5 Down | GPRS: 2 Slots: 25% |
| | Does this device support DTM (Dual Transfer Mode)? ☐ Yes ☒ No | | | |
| W-CDMA<br>(UMTS) | Band II<br>Band V | UMTS Rel. 99 (Voice & Data)<br>HSDPA (Rel. 9)<br>HSUPA (Rel. 9)<br>HSPA+ (Rel. 9)[6]<br>DC-HSDPA (Rel. 9) | | 100% |
| LTE | FDD Band 5<br>TDD Band 41 | QPSK<br>16QAM<br>Rel. 10 Carrier Aggregation (1 Uplink and 2 Downlinks)[5] | | 100% (FDD)<br>63.3% (TDD)[4] Refer to §6.4 |
| | Does this device support SV-LTE (1xRTT-LTE)? ☐ Yes ☒ No | | | |
| Wi-Fi | 2.4 GHz | 802.11b<br>802.11g<br>802.11n (HT20) | | 802.11b[1]: 99.66% |
| | 5 GHz | 802.11a<br>802.11n (HT20)<br>802.11n (HT40)<br>802.11ac (VHT20)<br>802.11ac (VHT40)<br>802.11ac (VHT80)<br>802.11ac (VHT160) | | 802.11a[2]: 98.28%<br>802.11ac VHT80[2]: 93.23% |
| | Does this device support bands 5.60 ~ 5.65 GHz? ☒ Yes ☐ No | | | |
| | Does this device support Band gap channel(s)? ☒ Yes ☐ No | | | |
| Bluetooth | 2.4 GHz | Version 5.0 LE | | GFSK[3]: 76.78% |

**Notes:**

1. Refer to §9.5 for Measured Duty Cycle.
2. Refer to §9.6 for Measured Duty Cycle.
3. Refer to §9.7 for Measured Duty Cycle
4. This device supports uplink-downlink configuration 0-6. The configuration with the highest duty cycle was used (Subframe Number 0 at 63.3%).
5. For supported Carrier Aggregation combinations, refer to §6.5.
6. Uplink 16QAM is not supported for HSPA+. Only downlink is supported.


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## 6.3. General LTE SAR Test and Reporting Considerations

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Frequency range, Channel Bandwidth, Numbers and Frequencies</td><td>
<table>
<tr><td rowspan="3">Band 5[2]</td><td colspan="6">Frequency range: 824 - 849 MHz (BW = 25 MHz)</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td>20 MHz</td><td>15 MHz</td><td>10 MHz [2]</td><td>5 MHz</td><td>20 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td></td><td></td><td>20450/ 829</td><td>20425/ 826.5</td><td>20415/ 825.5</td><td>20407/ 824.7</td></tr>
<tr><td>Mid</td><td></td><td></td><td>20525/ 836.5</td><td>20525/ 836.5</td><td>20525/ 836.5</td><td>20525/ 836.5</td></tr>
<tr><td>High</td><td></td><td></td><td>20600/ 844</td><td>20625/ 846.5</td><td>20635/ 847.5</td><td>20643/ 848.3</td></tr>
<tr><td rowspan="3">Band 41[1]</td><td colspan="6">Frequency range: 2496 - 2690 MHz (BW = 194 MHz)</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><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 colspan="4">39750 / 2506.0</td><td></td><td></td></tr>
<tr><td>Low-Mid</td><td colspan="4">40185 / 2549.5</td><td></td><td></td></tr>
<tr><td>Mid</td><td colspan="4">40620 / 2593.0</td><td></td><td></td></tr>
<tr><td>Mid-High</td><td colspan="4">41055 / 2636.5</td><td></td><td></td></tr>
<tr><td>High</td><td colspan="4">41490 / 2680.0</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>LTE transmitter and antenna implementation</td><td>Refer to Appendix A.</td></tr>
<tr><td>Maximum power reduction (MPR)</td><td>
Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3
<table>
<tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth ($N_{RB}$)</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>
<tr><td>64 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 3</td></tr>
<tr><td>256 QAM</td><td colspan="6">≥ 1</td><td>≤ 5</td></tr>
</table>
MPR Built-in by design<br>
The manufacturer MPR values are always within the 3GPP maximum MPR allowance but may not follow the default MPR values.<br>
A-MPR (additional MPR) was disabled during SAR testing
</td></tr>
<tr><td>Power reduction</td><td>No</td></tr>
<tr><td>Spectrum plots for RB configurations</td><td>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>

**Notes:**

1. LTE band 41 test channels in accordance with October 2014 TCB workshop for all channels bandwidths. This band was tested using Uplink-Downlink Configuration 0 at 63.3% duty cycle and Special Subframe 7.
2. Maximum bandwidth does not support at least three non-overlapping channels in certain channel bandwidths. When a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing per KDB 941225 D05 SAR for LTE Devices.
3. SAR Testing for LTE was performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).


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## 6.4. LTE (TDD) Considerations

According to KDB 941225 D05 SAR for LTE Devices, for Time-Division Duplex (TDD) systems, SAR must be tested using a fixed periodic duty factor according to the highest transmission duty factor implemented for the device and supported by the defined 3GPP LTE TDD configurations.

LTE TDD Bands support 3GPP TS 36.211 section 4.2 for Type 2 Frame Structure and Table 4.2-2 for uplink-downlink configurations and Table 4.2-1 for Special subframe configurations.

Table 4.2-1: Configuration of special subframe (lengths of DwPTS/GP/UpPTS)

| Special subframe configuration | Normal cyclic prefix in downlink | | | Extended cyclic prefix in downlink | | |
|---|---|---|---|---|---|---|
| | DwPTS | UpPTS | | DwPTS | UpPTS | |
| | | Normal cyclic prefix in uplink | Extended cyclic prefix in uplink | | Normal cyclic prefix in uplink | Extended cyclic prefix in uplink |
| 0 | $6592 \cdot T_s$ | $(1+X) \cdot 2192 \cdot T_s$ | $(1+X) \cdot 2560 \cdot T_s$ | $7680 \cdot T_s$ | $(1+X) \cdot 2192 \cdot T_s$ | $(1+X) \cdot 2560 \cdot T_s$ |
| 1 | $19760 \cdot T_s$ | | | $20480 \cdot T_s$ | | |
| 2 | $21952 \cdot T_s$ | | | $23040 \cdot T_s$ | | |
| 3 | $24144 \cdot T_s$ | | | $25600 \cdot T_s$ | | |
| 4 | $26336 \cdot T_s$ | | | $7680 \cdot T_s$ | $(2+X) \cdot 2192 \cdot T_s$ | $(2+X) \cdot 2560 \cdot T_s$ |
| 5 | $6592 \cdot T_s$ | $(2+X) \cdot 2192 \cdot T_s$ | $(2+X) \cdot 2560 \cdot T_s$ | $20480 \cdot T_s$ | | |
| 6 | $19760 \cdot T_s$ | | | $23040 \cdot T_s$ | | |
| 7 | $21952 \cdot T_s$ | | | $12800 \cdot T_s$ | | |
| 8 | $24144 \cdot T_s$ | | | - | - | - |
| 9 | $13168 \cdot T_s$ | | | - | - | - |
| 10 | $13168 \cdot T_s$ | $13152 \cdot T_s$ | $12800 \cdot T_s$ | - | - | - |

Table 4.2-2: Uplink-downlink configurations & Calculated Duty Cycle

| Uplink-Downlink Configuration | Downlink-to-Uplink Switch-point Periodicity | Subframe Number | | | | | | | | | | Calculated Duty Cycle (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| 0 | 5 ms | D | S | U | U | U | D | S | U | U | U | 63.3% |
| 1 | 5 ms | D | S | U | U | D | D | S | U | U | D | 43.3% |
| 2 | 5 ms | D | S | U | D | D | D | S | U | D | D | 23.3% |
| 3 | 10 ms | D | S | U | U | U | D | D | D | D | D | 31.7% |
| 4 | 10 ms | D | S | U | U | D | D | D | D | D | D | 21.7% |
| 5 | 10 ms | D | S | U | D | D | D | D | D | D | D | 11.7% |
| 6 | 5 ms | D | S | U | U | U | D | S | U | U | D | 53.3% |

Calculated Duty Cycle = Extended cyclic prefix in uplink * ($T_s$) * # of S + # of U / period

**Note(s):**

This device supports uplink-downlink configurations 0-6. The configuration with highest duty cycle was used for SAR Testing: configuration 0 at 63.3%duty cycle and Special Subframe 7.



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## 6.5. LTE Carrier Aggregation

| Combination | CA configuration | Bandwidth (MHz) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PCC | | | | | | SCC | | | | | |
| | | 20 | 15 | 10 | 5 | 3 | 1.4 | 20 | 15 | 10 | 5 | 3 | 1.4 |
| Intra-Band non-contiguous | 41A | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | | |
| Intra-Band contiguous | 41C | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | | |

**Note(s):**
For supported channels, please refer to §6.3.

## 6.6. WLAN Proximity Sensor Test Rationale

When a user makes or receives a voice or VOIP call, the audio of the call is sent through the earpiece at the top of the device so that the device can be used next to the ear. The IR Sensor located at the top of the device is used to detect when the device is in proximity of the user's head in order to optimize the user's device experience, for example, to dim or turn off the screen to save battery life. For this model, an auxiliary function of the IR sensor is for the purpose of RF Safety (i.e. reducing output power for Head SAR compliance).
A reduced power level of the device is called when the IR sensor is activated while in a held-to-ear voice/ VOIP call and the active audio receiver. Therefore, when the IR proximity sensor is active in a held-to-ear user scenario, the output power level is reduced.


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# 7. RF Exposure Conditions (Test Configurations)

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

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

**Notes:**

1. SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR.
2. For Phablet devices: when hotspot mode applies, Product Specific 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.
3. WWAN Main Ant. 2 supports LTE Band 41 only.
4. Cellular Sub Antenna is Rx only.


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**RF Exposure Conditions (Test Configurations) (continued):**

| Wireless technologies | RF Exposure Conditions | DUT-to-User Separation | Test Position | Antenna-to-edge/surface | SAR Required | Note |
|---|---|---|---|---|---|---|
| WLAN & BT | Head | 0 mm | Left Touch | N/A | Yes | |
| | | | Left Tilt (15°) | N/A | Yes | |
| | | | Right Touch | N/A | Yes | |
| | | | Right Tilt (15°) | N/A | Yes | |
| | Body | 15 mm | Rear | N/A | Yes | |
| | | | Front | N/A | Yes | |
| | Hotspot / Wi-Fi Direct (2.4/5.2/5.8 GHz Bands) | 10 mm | Rear | < 25 mm | Yes | |
| | | | Front | < 25 mm | Yes | |
| | | | Edge 1 (Top) | < 25 mm | Yes | |
| | | | Edge 2 (Right) | > 25 mm | No | 1 |
| | | | Edge 3 (Bottom) | > 25 mm | No | 1 |
| | | | Edge 4 (Left) | < 25 mm | Yes | |
| | Product Specifc 10g (2.4 GHz) | 0 mm | Rear | < 25 mm | Yes | 3 |
| | | | Front | < 25 mm | Yes | 3 |
| | | | Edge 1 (Top) | < 25 mm | Yes | 3 |
| | | | Edge 2 (Right) | > 25 mm | No | 1 |
| | | | Edge 3 (Bottom) | > 25 mm | No | 1 |
| | | | Edge 4 (Left) | < 25 mm | Yes | 3 |
| | Product Specifc 10g (5 GHz Bands) | 0 mm | Rear | < 25 mm | Yes | 2 |
| | | | Front | < 25 mm | Yes | 2 |
| | | | Edge 1 (Top) | < 25 mm | Yes | 2 |
| | | | Edge 2 (Right) | > 25 mm | No | 1 |
| | | | Edge 3 (Bottom) | > 25 mm | No | 1 |
| | | | Edge 4 (Left) | < 25 mm | Yes | 2 |

**Notes:**

1. SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR.
2. For Phablet devices: when Hotspot Mode is not supported, Product Specific 10-g SAR is required for all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge in direct contact with a flat phantom, to address interactive hand use exposure conditions.
3. For Phablet devices: when hotspot mode applies, Product Specific 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.


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# 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 ± 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.

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

**Tissue Dielectric Parameters**

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

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



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**Dielectric Property Measurements Results:**

| SAR Lab | Date | Band (MHz) | Tissue Type | Frequency (MHz) | Relative Permittivity (εr) | | | Conductivity (σ) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Measured | Target | Delta | Measured | Target | Delta |
| 5 | 8/20/2018 | 835 | Head | 835 | 40.17 | 41.50 | -3.20 | 0.94 | 0.90 | 4.43 |
| | | | | 805 | 40.19 | 41.68 | -3.57 | 0.93 | 0.90 | 3.83 |
| | | | | 905 | 39.99 | 41.50 | -3.64 | 0.97 | 0.97 | -0.32 |
| 5 | 8/20/2018 | 835 | Body | 835 | 55.18 | 55.20 | -0.04 | 0.99 | 0.97 | 1.95 |
| | | | | 805 | 55.18 | 55.33 | -0.28 | 0.98 | 0.97 | 1.29 |
| | | | | 905 | 55.02 | 55.00 | 0.04 | 1.02 | 1.05 | -2.99 |
| 5 | 8/21/2018 | 2450 | Head | 2450 | 39.51 | 39.20 | 0.79 | 1.79 | 1.80 | -0.83 |
| | | | | 2400 | 39.61 | 39.30 | 0.80 | 1.75 | 1.75 | -0.15 |
| | | | | 2480 | 39.45 | 39.16 | 0.73 | 1.81 | 1.83 | -1.28 |
| 5 | 8/21/2018 | 2450 | Body | 2450 | 51.11 | 52.70 | -3.02 | 2.02 | 1.95 | 3.59 |
| | | | | 2400 | 51.22 | 52.77 | -2.94 | 1.98 | 1.90 | 4.16 |
| | | | | 2480 | 51.06 | 52.66 | -3.04 | 2.05 | 1.99 | 2.90 |
| 5 | 8/22/2018 | 5250 | Head | 5250 | 35.60 | 35.93 | -0.93 | 4.49 | 4.70 | -4.60 |
| | | | | 5150 | 35.78 | 36.05 | -0.74 | 4.38 | 4.60 | -4.82 |
| | | | | 5350 | 35.44 | 35.82 | -1.06 | 4.60 | 4.80 | -4.30 |
| 5 | 8/22/2018 | 5250 | Body | 5250 | 47.28 | 48.95 | -3.42 | 5.37 | 5.35 | 0.28 |
| | | | | 5150 | 47.48 | 49.09 | -3.27 | 5.23 | 5.24 | -0.14 |
| | | | | 5350 | 47.08 | 48.82 | -3.56 | 5.51 | 5.47 | 0.68 |
| 6 | 8/20/2018 | 2600 | Head | 2600 | 38.46 | 39.01 | -1.41 | 1.95 | 1.96 | -0.72 |
| | | | | 2495 | 38.63 | 39.14 | -1.31 | 1.87 | 1.85 | 0.88 |
| | | | | 2690 | 38.28 | 38.90 | -1.59 | 2.02 | 2.06 | -2.01 |
| 6 | 8/20/2018 | 2600 | Body | 2600 | 50.34 | 52.51 | -4.13 | 2.20 | 2.16 | 1.67 |
| | | | | 2495 | 50.51 | 52.64 | -4.05 | 2.10 | 2.01 | 4.26 |
| | | | | 2690 | 50.14 | 52.40 | -4.31 | 2.28 | 2.29 | -0.28 |
| 6 | 8/21/2018 | 1900 | Head | 1900 | 38.31 | 40.00 | -4.22 | 1.42 | 1.40 | 1.21 |
| | | | | 1850 | 38.37 | 40.00 | -4.08 | 1.39 | 1.40 | -0.57 |
| | | | | 1920 | 38.28 | 40.00 | -4.30 | 1.43 | 1.40 | 1.93 |
| 6 | 8/21/2018 | 1900 | Body | 1900 | 51.73 | 53.30 | -2.95 | 1.57 | 1.52 | 3.49 |
| | | | | 1850 | 51.79 | 53.30 | -2.83 | 1.54 | 1.52 | 1.45 |
| | | | | 1920 | 51.70 | 53.30 | -3.00 | 1.59 | 1.52 | 4.28 |
| 6 | 8/22/2018 | 5600 | Head | 5600 | 36.17 | 35.53 | 1.79 | 4.93 | 5.06 | -2.53 |
| | | | | 5500 | 36.34 | 35.65 | 1.94 | 4.82 | 4.96 | -2.84 |
| | | | | 5725 | 35.95 | 35.39 | 1.58 | 5.08 | 5.19 | -2.07 |
| 6 | 8/22/2018 | 5750 | Head | 5750 | 35.90 | 35.36 | 1.52 | 5.11 | 5.21 | -2.01 |
| | | | | 5700 | 36.00 | 35.42 | 1.64 | 5.05 | 5.16 | -2.18 |
| | | | | 5850 | 35.75 | 35.30 | 1.27 | 5.22 | 5.27 | -0.91 |
| 6 | 8/22/2018 | 5600 | Body | 5600 | 47.62 | 48.48 | -1.77 | 5.84 | 5.76 | 1.37 |
| | | | | 5500 | 47.80 | 48.61 | -1.67 | 5.69 | 5.64 | 0.84 |
| | | | | 5725 | 47.39 | 48.31 | -1.90 | 6.03 | 5.91 | 2.09 |
| 6 | 8/22/2018 | 5750 | Body | 5750 | 47.33 | 48.27 | -1.96 | 6.06 | 5.94 | 2.16 |
| | | | | 5700 | 47.44 | 48.34 | -1.87 | 5.99 | 5.88 | 1.93 |
| | | | | 5850 | 47.16 | 48.20 | -2.16 | 6.21 | 6.00 | 3.48 |
| 7 | 8/27/2018 | 1750 | Body | 1750 | 51.96 | 53.44 | -2.77 | 1.51 | 1.49 | 1.60 |
| | | | | 1710 | 52.15 | 53.54 | -2.60 | 1.48 | 1.46 | 1.54 |
| | | | | 1755 | 51.95 | 53.43 | -2.77 | 1.51 | 1.49 | 1.60 |
| 7 | 8/27/2018 | 1900 | Body | 1900 | 53.97 | 53.30 | 1.26 | 1.56 | 1.52 | 2.50 |
| | | | | 1850 | 53.97 | 53.30 | 1.26 | 1.52 | 1.52 | -0.13 |
| | | | | 1920 | 53.97 | 53.30 | 1.26 | 1.57 | 1.52 | 3.55 |


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## 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.

**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. Refer to Appendix B for the SAR System Check Plots.

| SAR Lab | Date | Tissue Type | Dipole Type_Serial # | Dipole Cal. Due Data | Measured Results for 1g SAR | | | | Measured Results for 10g SAR | | | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Zoom Scan to 100 mW | Normalize to 1 W | Target (Ref. Value) | Delta ±10 % | Zoom Scan to 100 mW | Normalize to 1 W | Target (Ref. Value) | Delta ±10 % | |
| 5 | 8/20/2018 | Head | D835V2 SN:4d117 | 5/16/2019 | 0.941 | 9.41 | 9.87 | -4.66 | 0.609 | 6.09 | 6.40 | -1.65 | |
| 5 | 8/20/2018 | Body | D835V2 SN:4d117 | 5/16/2019 | 0.959 | 9.59 | 10.31 | **-6.98** | 0.628 | 6.28 | 6.84 | 4.74 | 1,2 |
| 5 | 8/21/2018 | Head | D2450V2 SN:899 | 3/16/2019 | 5.120 | 51.20 | 51.75 | -1.06 | 2.380 | 23.80 | 24.20 | 9.05 | |
| 5 | 8/21/2018 | Body | D2450V2 SN:899 | 3/16/2019 | 5.240 | 52.40 | 50.55 | **3.66** | 2.430 | 24.30 | 23.20 | 6.34 | 3,4 |
| 5 | 8/22/2018 | Head | D5GHzV2 SN:1003 (5.25 GHz) | 3/13/2019 | 8.720 | 87.20 | 80.60 | **8.19** | 2.530 | 25.30 | 23.20 | 8.31 | 5,6 |
| 5 | 8/22/2018 | Body | D5GHzV2 SN:1003 (5.25 GHz) | 3/13/2019 | 7.780 | 77.80 | 73.60 | 5.71 | 2.180 | 21.80 | 20.50 | -2.96 | |
| 6 | 8/20/2018 | Head | D2600V2 SN:1036 | 3/16/2019 | 5.920 | 59.20 | 54.54 | **8.54** | 2.660 | 26.60 | 24.56 | 4.98 | 7,8 |
| 6 | 8/20/2018 | Body | D2600V2 SN:1036 | 3/16/2019 | 5.500 | 55.00 | 56.13 | -2.01 | 2.430 | 24.30 | 25.04 | -3.05 | |
| 6 | 8/21/2018 | Head | D1900V2 SN:5d163 | 10/5/2018 | 4.090 | 40.90 | 38.77 | **5.49** | 2.110 | 21.10 | 20.10 | -0.43 | 9,10 |
| 6 | 8/21/2018 | Body | D1900V2 SN:5d163 | 10/5/2018 | 4.110 | 41.10 | 42.99 | -4.40 | 2.130 | 21.30 | 21.97 | 7.50 | |
| 6 | 8/22/2018 | Head | D5GHzV2 SN:1003 (5.60 GHz) | 3/13/2019 | 9.000 | 90.00 | 84.50 | **6.51** | 2.580 | 25.80 | 24.00 | 7.50 | 11,12 |
| 6 | 8/22/2018 | Head | D5GHzV2 SN:1003 (5.75 GHz) | 3/13/2019 | 8.380 | 83.80 | 78.40 | **6.89** | 2.410 | 24.10 | 22.20 | 8.56 | 13,14 |
| 6 | 8/22/2018 | Body | D5GHzV2 SN:1003 (5.60 GHz) | 3/13/2019 | 8.270 | 82.70 | 77.70 | 6.44 | 2.310 | 23.10 | 21.70 | 6.45 | |
| 6 | 8/22/2018 | Body | D5GHzV2 SN:1003 (5.75 GHz) | 3/13/2019 | 7.790 | 77.90 | 73.90 | 5.41 | 2.150 | 21.50 | 20.60 | 4.37 | |
| 7 | 8/27/2018 | Body | D1750V2 SN:1077 | 10/5/2018 | 3.960 | 39.60 | 37.34 | 6.05 | 2.100 | 21.00 | 19.98 | 5.11 | 15,16 |
| 7 | 8/27/2018 | Body | D1900V2 SN:5d163 | 10/5/2018 | 4.310 | 43.10 | 42.99 | 0.26 | 2.230 | 22.30 | 21.97 | 1.50 | 17,18 |


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# 9. Conducted Output Power Measurements

## 9.1. GSM

**Per KDB 941225 D01 3G SAR Procedures:**
SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power specified for production units, including tune-up tolerance. The data mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested.
When different maximum output power applies to GSM voice or GPRS/EDGE time slots, GSM voice and GPRS/EDGE time slots should be tested separately to determine compliance by summing the corresponding reported SAR.
The GMSK EDGE configurations are grouped with GPRS and considered with respect to time-averaged maximum output power to determine compliance.

**Per October 2013 TCB Workshop:**
When the maximum frame-averaged powers levels are within 0.25 dB of each other, test the configuration with the most number of time slots.

**GSM850 Measured Results**

| Mode | Coding Scheme | Time Slots | Ch No. | Freq. (MHz) | Maximum Average Power (dBm) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Measured | | Tune-up Limit | |
| | | | | | Burst Pwr | Frame Pwr | Burst Pwr | Frame Pwr |
| GPRS/EDGE (GMSK) | CS1 | 1 | 128 | 824.2 | 33.51 | 24.48 | 34.00 | 24.97 |
| | | | 190 | 836.6 | 33.76 | 24.73 | | |
| | | | 251 | 848.8 | 33.75 | 24.72 | | |
| | | 2 | 128 | 824.2 | 30.26 | 24.24 | 32.00 | **25.98** |
| | | | 190 | 836.6 | 30.37 | 24.35 | | |
| | | | 251 | 848.8 | 30.39 | 24.37 | | |
| | | 3 | 128 | 824.2 | 28.64 | 24.38 | 29.00 | 24.74 |
| | | | 190 | 836.6 | 28.93 | 24.67 | | |
| | | | 251 | 848.8 | 28.94 | 24.68 | | |
| | | 4 | 128 | 824.2 | 27.30 | 24.29 | 28.00 | 24.99 |
| | | | 190 | 836.6 | 27.77 | 24.76 | | |
| | | | 251 | 848.8 | 27.83 | 24.82 | | |
| EDGE (8PSK) | MCS5 | 1 | 128 | 824.2 | 26.82 | 17.79 | 27.00 | 17.97 |
| | | | 190 | 836.6 | 27.00 | 17.97 | | |
| | | | 251 | 848.8 | 26.92 | 17.89 | | |
| | | 2 | 128 | 824.2 | 24.50 | 18.48 | 25.00 | 18.98 |
| | | | 190 | 836.6 | 24.47 | 18.45 | | |
| | | | 251 | 848.8 | 24.50 | 18.48 | | |
| | | 3 | 128 | 824.2 | 22.68 | 18.42 | 24.00 | 19.74 |
| | | | 190 | 836.6 | 23.00 | 18.74 | | |
| | | | 251 | 848.8 | 22.79 | 18.53 | | |
| | | 4 | 128 | 824.2 | 21.00 | 17.99 | 23.00 | 19.99 |
| | | | 190 | 836.6 | 21.31 | 18.30 | | |
| | | | 251 | 848.8 | 21.32 | 18.31 | | |

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

- GPRS/EDGE (GMSK) mode with 2 time slots for Max power, based on the Tune-up Procedure.
- SAR is not required for EDGE (8PSK) mode because the maximum output power and tune-up limit is ≤ 1/4dB higher than GPRS/EDGE (GMSK) or the adjusted SAR of the highest reported SAR of GPRS/EDGE (GMSK) is ≤ 1.2W/kg.


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## GSM1900 Measured Results

| Mode | Coding Scheme | Time Slots | Ch No. | Freq. (MHz) | Maximum Average Power (dBm) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Measured | | Tune-up Limit | |
| | | | | | Burst Pwr | Frame Pwr | Burst Pwr | Frame Pwr |
| GPRS/EDGE (GMSK) | CS1 | 1 | 512 | 1850.2 | 29.85 | 20.82 | 31.00 | 21.97 |
| | | | 661 | 1880.0 | 29.98 | 20.95 | | |
| | | | 810 | 1909.8 | 29.93 | 20.90 | | |
| | | 2 | 512 | 1850.2 | 26.72 | 20.70 | 28.50 | **22.48** |
| | | | 661 | 1880.0 | 27.03 | 21.01 | | |
| | | | 810 | 1909.8 | 27.04 | 21.02 | | |
| | | 3 | 512 | 1850.2 | 25.26 | 21.00 | 26.50 | 22.24 |
| | | | 661 | 1880.0 | 25.70 | 21.44 | | |
| | | | 810 | 1909.8 | 25.66 | 21.40 | | |
| | | 4 | 512 | 1850.2 | 23.93 | 20.92 | 25.00 | 21.99 |
| | | | 661 | 1880.0 | 24.04 | 21.03 | | |
| | | | 810 | 1909.8 | 24.19 | 21.18 | | |
| EDGE (8PSK) | MCS5 | 1 | 512 | 1850.2 | 25.30 | 16.27 | 26.00 | 16.97 |
| | | | 661 | 1880.0 | 25.57 | 16.54 | | |
| | | | 810 | 1909.8 | 25.47 | 16.44 | | |
| | | 2 | 512 | 1850.2 | 22.85 | 16.83 | 24.00 | 17.98 |
| | | | 661 | 1880.0 | 22.93 | 16.91 | | |
| | | | 810 | 1909.8 | 22.76 | 16.74 | | |
| | | 3 | 512 | 1850.2 | 22.88 | 18.62 | 23.50 | 19.24 |
| | | | 661 | 1880.0 | 22.66 | 18.40 | | |
| | | | 810 | 1909.8 | 22.80 | 18.54 | | |
| | | 4 | 512 | 1850.2 | 21.70 | 18.69 | 22.00 | 18.99 |
| | | | 661 | 1880.0 | 21.83 | 18.82 | | |
| | | | 810 | 1909.8 | 21.77 | 18.76 | | |

**Notes:**

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

- GPRS/EDGE (GMSK) mode with 2 time slots for Max power, based on the Tune-up Procedure.
- SAR is not required for EDGE (8PSK) mode because the maximum output power and tune-up limit is ≤ 1/4dB higher than GPRS/EDGE (GMSK) or the adjusted SAR of the highest reported SAR of GPRS/EDGE (GMSK) is ≤ 1.2W/kg.


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## 9.2. W-CDMA

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

The following tests were completed according to the test requirements outlined in section 5.2 of the 3GPP TS34.121-1 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 2 |
| | Rel99 RMC | 12.2kbps RMC |
| | Power Control Algorithm | Algorithm2 |
| | βc/βd | 8/15 |

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

The following 4 Sub-tests were completed according to Release 9 procedures in section 5.2 of 3GPP TS34.121. A summary of these settings are illustrated below:

**Table C.10.2.4: β values for transmitter characteristics tests with HS-DPCCH**

| | 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-Set 1 | | | |
| | Power Control Algorithm | Algorithm 2 | | | |
| | βc | 2/15 | 11/15 | 15/15 | 15/15 |
| | βd | 15/15 | 15/15 | 8/15 | 4/15 |
| | Bd (SF) | 64 | | | |
| | βc/βd | 2/15 | 11/15 | 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 | | | |


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## HSPA (HSDPA & HSUPA) Setup Procedures used to establish the test signals

The following 5 Sub-tests were completed according to Release 9 procedures in table C,11.1.3 of 3GPP TS 34.121-1
A summary of these settings are illustrated below:

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

| | Mode | HSPA | | | | |
|---|---|---|---|---|---|---|
| | Subtest | 1 | 2 | 3 | 4 | 5 |
| WCDMA General Settings | Loopback Mode | Test Mode 1 | | | | |
| | Rel99 RMC | 12.2 kbps 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 | 6/15 | 15/9 | 2/15 | - |
| | βhs | 22/15 | 12/15 | 30/15 | 4/15 | 5/15 |
| | βed | 1309/225 | 94/75 | 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 | 0 |
| | DHARQ | 0 | 0 | 0 | 0 | 0 |
| | AG Index | 20 | 12 | 15 | 17 | 12 |
| | ETFCI (from 34.121 Table C.11.1.3) | 75 | 67 | 92 | 71 | 67 |
| | 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 Channelization Codes | 2xSF2 | | | | SF4 |


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

The following tests were completed according to procedures in section 7.3.13 of 3GPP TS34.108. A summary of these settings are illustrated below:

Downlink Physical Channels are set as per 3GPP TS34.121-1

**Table E.5.0: Levels for HSDPA connection setup**

| Parameter During Connection setup | Unit | Value |
|---|---|---|
| P-CPICH_Ec/Ior | dB | -10 |
| P-CCPCH and SCH_Ec/Ior | dB | -12 |
| PICH _Ec/Ior | dB | -15 |
| HS-PDSCH | dB | off |
| HS-SCCH_1 | dB | off |
| DPCH_Ec/Ior | dB | -5 |
| OCNS_Ec/Ior | dB | -3.1 |

Call is set up as per 3GPP TS34.108 sub clause 7.3.13

The configurations of the fixed reference channels for HSDPA RF tests are described in 3GPP TS 34.121, annex C for FDD and 3GPP TS 34.122.

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

| Parameter | Unit | Value |
|---|---|---|
| Nominal Avg. Inf. Bit Rate | kbps | 60 |
| Inter-TTI Distance | TTI's | 1 |
| Number of HARQ Processes | Processes | 6 |
| Information Bit Payload ( $N_{INF}$ ) | Bits | 120 |
| Number Code Blocks | Blocks | 1 |
| Binary Channel Bits Per TTI | Bits | 960 |
| Total Available SML's in UE | SML's | 19200 |
| Number of SML's per HARQ Proc. | SML's | 3200 |
| Coding Rate | | 0.15 |
| Number of Physical Channel Codes | Codes | 1 |
| Modulation | | QPSK |

Note 1: The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table.
Note 2: Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used.

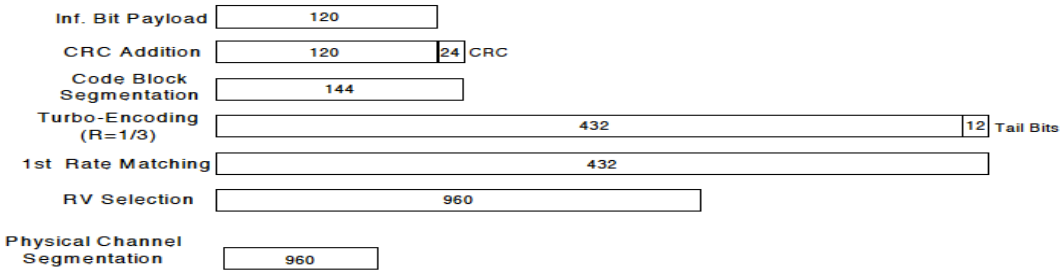


**Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)**

The following 4 Sub-tests for HSDPA were completed according to Release 9 procedures in section 5.2 of 3GPP TS34.121.
A summary of subtest settings are illustrated below:

| | Mode | HSDPA | HSDPA | HSDPA | HSDPA |
|---|---|---|---|---|---|
| | Subtest | 1 | 2 | 3 | 4 |
| WCDMA General Settings | Loopback Mode | Test Mode 1 | | | |
| | Rel99 RMC | 12.2kbps RMC | | | |
| | HSDPA FRC | H-Set 1 | | | |
| | Power Control Algorithm | Algorithm2 | | | |
| | βc | 2/15 | 11/15 | 15/15 | 15/15 |
| | βd | 15/15 | 15/15 | 8/15 | 4/15 |
| | βd (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 | DACK | 8 | | | |
| | DNAK | 8 | | | |
| | DCQI | 8 | | | |
| | Ack-Nack Repetition factor | 3 | | | |
| | CQI Feedback | 4ms | | | |
| | CQI Repetition Factor | 2 | | | |
| | Ahs = βhs/ βc | 30/15 | | | |

## HSPA+ Release 9

Since 16QAM is not used for uplink, RF conducted power measurements are not required for HSPA+.


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## W-CDMA Band II Measured Results

| Mode | | UL Ch No. | Freq. (MHz) | Maximum Average Power (dBm) | | |
|---|---|---|---|---|---|---|
| | | | | Measured Pwr | MPR | Tune-up Limit |
| Release 99 | Rel 99 (RMC, 12.2 kbps) | 9262 | 1852.4 | 23.47 | N/A | 24.50 |
| | | 9400 | 1880.0 | 23.59 | | |
| | | 9538 | 1907.6 | 23.77 | | |
| HSDPA | Subtest 1 | 9262 | 1852.4 | 22.75 | 0 | 23.00 |
| | | 9400 | 1880.0 | 22.84 | | |
| | | 9538 | 1907.6 | 22.76 | | |
| | Subtest 2 | 9262 | 1852.4 | 22.55 | 0 | 23.00 |
| | | 9400 | 1880.0 | 22.66 | | |
| | | 9538 | 1907.6 | 22.74 | | |
| | Subtest 3 | 9262 | 1852.4 | 21.51 | 0.5 | 22.50 |
| | | 9400 | 1880.0 | 21.64 | | |
| | | 9538 | 1907.6 | 21.80 | | |
| | Subtest 4 | 9262 | 1852.4 | 21.54 | 0.5 | 22.50 |
| | | 9400 | 1880.0 | 21.65 | | |
| | | 9538 | 1907.6 | 21.79 | | |
| HSUPA | Subtest 1 | 9262 | 1852.4 | 21.44 | 0 | 23.00 |
| | | 9400 | 1880.0 | 21.60 | | |
| | | 9538 | 1907.6 | 21.75 | | |
| | Subtest 2 | 9262 | 1852.4 | 19.58 | 2 | 21.00 |
| | | 9400 | 1880.0 | 19.72 | | |
| | | 9538 | 1907.6 | 19.83 | | |
| | Subtest 3 | 9262 | 1852.4 | 20.58 | 1 | 22.00 |
| | | 9400 | 1880.0 | 20.68 | | |
| | | 9538 | 1907.6 | 20.79 | | |
| | Subtest 4 | 9262 | 1852.4 | 19.58 | 2 | 21.00 |
| | | 9400 | 1880.0 | 19.72 | | |
| | | 9538 | 1907.6 | 19.83 | | |
| | Subtest 5 | 9262 | 1852.4 | 22.48 | 0 | 23.00 |
| | | 9400 | 1880.0 | 22.56 | | |
| | | 9538 | 1907.6 | 22.66 | | |
| DC-HSDPA | Subtest 1 | 9262 | 1852.4 | 22.75 | 0 | 23.00 |
| | | 9400 | 1880.0 | 22.97 | | |
| | | 9538 | 1907.6 | 22.82 | | |
| | Subtest 2 | 9262 | 1852.4 | 22.55 | 0 | 23.00 |
| | | 9400 | 1880.0 | 22.66 | | |
| | | 9538 | 1907.6 | 22.74 | | |
| | Subtest 3 | 9262 | 1852.4 | 21.51 | 0.5 | 22.50 |
| | | 9400 | 1880.0 | 21.64 | | |
| | | 9538 | 1907.6 | 21.80 | | |
| | Subtest 4 | 9262 | 1852.4 | 21.54 | 0.5 | 22.50 |
| | | 9400 | 1880.0 | 21.65 | | |
| | | 9538 | 1907.6 | 21.79 | | |

**Notes:**

Refer to W-CDMA MPR Attestation Letter for HSUPA MPR Explanation.



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## W-CDMA Band V Measured Results

| Mode | | UL Ch No. | Freq. (MHz) | Maximum Average Power (dBm) | | |
|---|---|---|---|---|---|---|
| | | | | Measured Pwr | MPR | Tune-up Limit |
| Release 99 | Rel 99 (RMC, 12.2 kbps) | 4132 | 826.4 | 24.33 | N/A | 25.00 |
| | | 4183 | 836.6 | 24.35 | | |
| | | 4233 | 846.6 | 24.34 | | |
| HSDPA | Subtest 1 | 4132 | 826.4 | 23.36 | 0 | 23.50 |
| | | 4183 | 836.6 | 23.35 | | |
| | | 4233 | 846.6 | 23.26 | | |
| | Subtest 2 | 4132 | 826.4 | 22.35 | 0 | 23.50 |
| | | 4183 | 836.6 | 22.40 | | |
| | | 4233 | 846.6 | 22.35 | | |
| | Subtest 3 | 4132 | 826.4 | 21.22 | 0.5 | 23.00 |
| | | 4183 | 836.6 | 21.20 | | |
| | | 4233 | 846.6 | 21.17 | | |
| | Subtest 4 | 4132 | 826.4 | 21.22 | 0.5 | 23.00 |
| | | 4183 | 836.6 | 21.20 | | |
| | | 4233 | 846.6 | 21.17 | | |
| HSUPA | Subtest 1 | 4132 | 826.4 | 20.31 | 2 | 21.50 |
| | | 4183 | 836.6 | 20.29 | | |
| | | 4233 | 846.6 | 20.26 | | |
| | Subtest 2 | 4132 | 826.4 | 18.20 | 4 | 19.50 |
| | | 4183 | 836.6 | 18.28 | | |
| | | 4233 | 846.6 | 18.31 | | |
| | Subtest 3 | 4132 | 826.4 | 21.20 | 1 | 22.50 |
| | | 4183 | 836.6 | 21.27 | | |
| | | 4233 | 846.6 | 21.24 | | |
| | Subtest 4 | 4132 | 826.4 | 18.20 | 4 | 19.50 |
| | | 4183 | 836.6 | 18.28 | | |
| | | 4233 | 846.6 | 18.31 | | |
| | Subtest 5 | 4132 | 826.4 | 23.38 | 0 | 23.50 |
| | | 4183 | 836.6 | 23.39 | | |
| | | 4233 | 846.6 | 23.38 | | |
| DC-HSDPA | Subtest 1 | 4132 | 826.4 | 23.36 | 0 | 23.50 |
| | | 4183 | 836.6 | 23.35 | | |
| | | 4233 | 846.6 | 23.26 | | |
| | Subtest 2 | 4132 | 826.4 | 22.35 | 0 | 23.50 |
| | | 4183 | 836.6 | 22.40 | | |
| | | 4233 | 846.6 | 22.35 | | |
| | Subtest 3 | 4132 | 826.4 | 21.22 | 0.5 | 23.00 |
| | | 4183 | 836.6 | 21.20 | | |
| | | 4233 | 846.6 | 21.17 | | |
| | Subtest 4 | 4132 | 826.4 | 21.22 | 0.5 | 23.00 |
| | | 4183 | 836.6 | 21.20 | | |
| | | 4233 | 846.6 | 21.17 | | |

**Notes:**

Refer to W-CDMA MPR Attestation Letter for HSUPA MPR Explanation.



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## 9.3. LTE

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

UE Power Class: 3 (23 +/- 2dBm). The allowed Maximum Power Reduction (MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1 of the 3GPP TS36.101.

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

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


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The allowed A-MPR values specified below in Table 6.2.4.-1 of 3GPP TS36.101 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of “NS_01”.

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

| Network Signalling value | Requirements (subclause) | E-UTRA Band | Channel bandwidth (MHz) | Resources Blocks ($N_{RB}$) | A-MPR (dB) |
|---|---|---|---|---|---|
| NS_01 | 6.6.2.1.1 | Table 5.5-1 | 1.4, 3, 5, 10, 15, 20 | Table 5.6-1 | N/A |
| NS_03 | 6.6.2.2.1 | 2, 4,10, 23, 25, 35, 36, 66, 70 | 3 | >5 | ≤ 1 |
| | | | 5 | >6 | ≤ 1 |
| | | | 10 | >6 | ≤ 1 |
| | | | 15 | >8 | ≤ 1 |
| | | | 20 | >10 | ≤ 1 |
| NS_04 | 6.6.2.2.2, 6.6.3.3.19 | 41 | 5, 10, 15, 20 | Table 6.2.4-4, Table 6.2.4-4a | |
| NS_05 | 6.6.3.3.1 | 1 | 10,15,20 | ≥ 50 (NOTE1) | ≤ 1 (NOTE1) |
| | | | 15, 20 | Table 6.2.4-18 (NOTE2) | |
| | | 65 (NOTE 3) | 10,15,20 | ≥ 50 | ≤ 1 (NOTE 1) |
| | | | 15,20 | Table 6.2.4-18 (NOTE 2) | |
| 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 6.6.3.3.2 | 13 | 10 | 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 | |
| NS_11 | 6.6.2.2.1 6.6.3.3.13 | 23 | 1.4, 3, 5, 10, 15, 20 | Table 6.2.4-5 | |
| NS_12 | 6.6.3.3.5 | 26 | 1.4, 3, 5, 10, 15 | Table 6.2.4-6 | |
| NS_13 | 6.6.3.3.6 | 26 | 5 | Table 6.2.4-7 | |
| NS_14 | 6.6.3.3.7 | 26 | 10, 15 | Table 6.2.4-8 | |
| NS_15 | 6.6.3.3.8 | 26 | 1.4, 3, 5, 10, 15 | Table 6.2.4-9 Table 6.2.4-10 | |
| NS_16 | 6.6.3.3.9 | 27 | 3, 5, 10 | Table 6.2.4-11, Table 6.2.4-12, Table 6.2.4-13 | |
| NS_17 | 6.6.3.3.10 | 28 | 5, 10 | Table 5.6-1 | N/A |
| NS_18 | 6.6.3.3.11 | 28 | 5 | ≥ 2 | ≤ 1 |
| | | | 10, 15, 20 | ≥ 1 | ≤ 4 |
| NS_19 | 6.6.3.3.12 | 44 | 10, 15, 20 | Table 6.2.4-14 | |
| NS_20 | 6.2.2 6.6.2.2.1 6.6.3.3.14 | 23 | 5, 10, 15, 20 | Table 6.2.4-15 | |
| NS_21 | 6.6.2.2.1 6.6.3.3.15 | 30 | 5, 10 | Table 6.2.4-16 | |
| NS_22 | 6.6.3.3.16 | 42, 43 | 5, 10, 15, 20 | Table 6.2.4-17 | |
| NS_23 | 6.6.3.3.17 | 42, 43 | 5, 10, 15, 20 | N/A | |
| NS_24 | 6.6.3.3.20 | 65 (NOTE 4) | 5, 10, 15, 20 | Table 6.2.4-19 | |
| NS_25 | 6.6.3.3.21 | 65 (NOTE 4) | 5, 10, 15, 20 | Table 6.2.4-20 | |
| NS_26 | 6.6.3.3.22 | 68 | 10, 15 | Table 6.2.4-21 | |
| NS_27 | 6.6.2.2.5, 6.6.3.3.23 | 48 | 5, 10, 15, 20 | Table 6.2.4-22 | |
| NS_28 | 6.2.2A, 6.6.3.3.24 | 46 (NOTE 5) | 20 | Table 6.2.4-23 | |
| NS_29 | 6.2.2A, 6.6.2.3.1a, 6.6.3.3.25 | 46 (NOTE 5) | 20 | Table 6.2.4-24 | |
| NS_30 | 6.2.2A, 6.6.3.3.26 | 46 (NOTE 5) | 20 | Table 6.2.4-25 | |
| NS_31 | 6.2.2A, 6.6.3.3.27 | 46 (NOTE 5) | 20 | Table 6.2.4-26 | |
| | | | | | |
| NS_32 | - | - | - | - | - |

NOTE 1: Applicable when the lower edge of the assigned E-UTRA UL channel bandwidth frequency is larger than or equal to the upper edge of PHS band (1915.7 MHz) + 4 MHz + the channel BW assigned, where channel BW is as defined in subclause 5.6. A-MPR for


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**LTE Band 5 Measured Results**

| BW (MHz) | Mode | RB Allocation | RB offset | Maximum Average Power (dBm) | | | MPR | Tune-up Limit |
|---|---|---|---|---|---|---|---|---|
| | | | | [redacted] | 20525 | [redacted] | | |
| | | | | | 836.5 MHz | | | |
| 10 MHz | QPSK | 1 | 0 | | 24.30 | | 0 | 25 |
| | | 1 | 25 | | 24.29 | | 0 | 25 |
| | | 1 | 49 | | 24.29 | | 0 | 25 |
| | | 25 | 0 | | 23.23 | | 1 | 24 |
| | | 25 | 12 | | 23.22 | | 1 | 24 |
| | | 25 | 25 | | 23.23 | | 1 | 24 |
| | | 50 | 0 | | 23.21 | | 1 | 24 |
| | 16QAM | 1 | 0 | | 23.42 | | 1 | 24 |
| | | 1 | 25 | | 23.44 | | 1 | 24 |
| | | 1 | 49 | | 23.39 | | 1 | 24 |
| | | 25 | 0 | | 22.22 | | 2 | 23 |
| | | 25 | 12 | | 22.19 | | 2 | 23 |
| | | 25 | 25 | | 22.18 | | 2 | 23 |
| | | 50 | 0 | | 22.13 | | 2 | 23 |

| BW (MHz) | Mode | RB Allocation | RB offset | Maximum Average Power (dBm) | | | MPR | Tune-up Limit |
|---|---|---|---|---|---|---|---|---|
| | | | | 20425 | 20525 | 20625 | | |
| | | | | 826.5 MHz | 836.5 MHz | 846.5 MHz | | |
| 5 MHz | QPSK | 1 | 0 | 23.64 | 23.81 | 23.83 | 0 | 25 |
| | | 1 | 12 | 23.61 | 23.83 | 23.76 | 0 | 25 |
| | | 1 | 24 | 23.59 | 23.84 | 23.66 | 0 | 25 |
| | | 12 | 0 | 22.60 | 22.73 | 22.73 | 1 | 24 |
| | | 12 | 7 | 22.60 | 22.69 | 22.72 | 1 | 24 |
| | | 12 | 13 | 22.58 | 22.69 | 22.68 | 1 | 24 |
| | | 25 | 0 | 22.59 | 22.68 | 22.67 | 1 | 24 |
| | 16QAM | 1 | 0 | 22.55 | 22.60 | 22.61 | 1 | 24 |
| | | 1 | 12 | 22.56 | 22.62 | 22.55 | 1 | 24 |
| | | 1 | 24 | 22.53 | 22.63 | 22.50 | 1 | 24 |
| | | 12 | 0 | 21.59 | 21.68 | 21.75 | 2 | 23 |
| | | 12 | 7 | 21.56 | 21.68 | 21.72 | 2 | 23 |
| | | 12 | 13 | 21.55 | 21.68 | 21.69 | 2 | 23 |
| | | 25 | 0 | 21.56 | 21.66 | 21.68 | 2 | 23 |


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**LTE Band 5 Measured Results (continued)**

| BW (MHz) | Mode | RB Allocation | RB offset | Maximum Average Power (dBm) | | | MPR | Tune-up Limit |
|---|---|---|---|---|---|---|---|---|
| | | | | 20415 | 20525 | 20635 | | |
| | | | | 825.5 MHz | 836.5 MHz | 847.5 MHz | | |
| 3 MHz | QPSK | 1 | 0 | 23.73 | 23.76 | 23.79 | 0 | 25 |
| | | 1 | 8 | 23.73 | 23.77 | 23.75 | 0 | 25 |
| | | 1 | 14 | 23.73 | 23.75 | 23.66 | 0 | 25 |
| | | 8 | 0 | 22.62 | 22.68 | 22.71 | 1 | 24 |
| | | 8 | 4 | 22.61 | 22.67 | 22.69 | 1 | 24 |
| | | 8 | 7 | 22.59 | 22.70 | 22.70 | 1 | 24 |
| | | 15 | 0 | 22.56 | 22.65 | 22.65 | 1 | 24 |
| | 16QAM | 1 | 0 | 22.65 | 22.62 | 22.73 | 1 | 24 |
| | | 1 | 8 | 22.61 | 22.70 | 22.55 | 1 | 24 |
| | | 1 | 14 | 22.51 | 22.77 | 22.56 | 1 | 24 |
| | | 8 | 0 | 21.45 | 21.72 | 21.65 | 2 | 23 |
| | | 8 | 4 | 21.47 | 21.70 | 21.64 | 2 | 23 |
| | | 8 | 7 | 21.47 | 21.71 | 21.59 | 2 | 23 |
| | | 15 | 0 | 21.47 | 21.61 | 21.58 | 2 | 23 |

| BW (MHz) | Mode | RB Allocation | RB offset | Maximum Average Power (dBm) | | | MPR | Tune-up Limit |
|---|---|---|---|---|---|---|---|---|
| | | | | 20407 | 20525 | 20643 | | |
| | | | | 824.7 MHz | 836.5 MHz | 848.3 MHz | | |
| 1.4 MHz | QPSK | 1 | 0 | 23.62 | 23.65 | 23.72 | 0 | 25 |
| | | 1 | 3 | 23.59 | 23.65 | 23.68 | 0 | 25 |
| | | 1 | 5 | 23.63 | 23.68 | 23.67 | 0 | 25 |
| | | 3 | 0 | 23.59 | 23.73 | 23.64 | 0 | 25 |
| | | 3 | 1 | 23.59 | 23.76 | 23.63 | 0 | 25 |
| | | 3 | 3 | 23.60 | 23.78 | 23.60 | 0 | 25 |
| | | 6 | 0 | 22.54 | 22.66 | 22.58 | 1 | 24 |
| | 16QAM | 1 | 0 | 22.54 | 22.75 | 22.39 | 1 | 24 |
| | | 1 | 3 | 22.45 | 22.81 | 22.24 | 1 | 24 |
| | | 1 | 5 | 22.56 | 22.78 | 22.35 | 1 | 24 |
| | | 3 | 0 | 22.50 | 22.80 | 22.47 | 1 | 24 |
| | | 3 | 1 | 22.50 | 22.76 | 22.50 | 1 | 24 |
| | | 3 | 3 | 22.52 | 22.76 | 22.51 | 1 | 24 |
| | | 6 | 0 | 21.59 | 21.58 | 21.71 | 2 | 23 |


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## LTE Band 41 Measured Results

| BW (MHz) | Mode | RB Allocation | RB offset | Maximum Average Power (dBm) | | | | | MPR | Tune-up Limit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 39750 | 40185 | 40620 | 41055 | 41490 | | |
| | | | | 2506 MHz | 2549.5 MHz | 2593 MHz | 2636.5 MHz | 2680 MHz | | |
| 20 MHz | QPSK | 1 | 0 | 23.53 | 23.62 | 23.55 | 23.38 | 23.10 | 0 | 24.5 |
| | | 1 | 49 | 23.59 | 23.62 | 23.53 | 23.39 | 23.17 | 0 | 24.5 |
| | | 1 | 99 | 23.63 | 23.51 | 23.61 | 23.39 | 23.24 | 0 | 24.5 |
| | | 50 | 0 | 22.54 | 22.56 | 22.56 | 22.38 | 22.21 | 1 | 23.5 |
| | | 50 | 24 | 22.56 | 22.57 | 22.56 | 22.40 | 22.24 | 1 | 23.5 |
| | | 50 | 50 | 22.55 | 22.56 | 22.58 | 22.39 | 22.26 | 1 | 23.5 |
| | | 100 | 0 | 22.54 | 22.56 | 22.56 | 22.40 | 22.23 | 1 | 23.5 |
| | 16QAM | 1 | 0 | 22.37 | 22.33 | 22.34 | 22.09 | 22.43 | 1 | 23.5 |
| | | 1 | 49 | 22.50 | 22.49 | 22.22 | 22.26 | 22.04 | 1 | 23.5 |
| | | 1 | 99 | 22.27 | 22.73 | 22.43 | 22.21 | 22.54 | 1 | 23.5 |
| | | 50 | 0 | 21.49 | 21.54 | 21.60 | 21.30 | 21.16 | 2 | 22.5 |
| | | 50 | 24 | 21.52 | 21.56 | 21.62 | 21.38 | 21.23 | 2 | 22.5 |
| | | 50 | 50 | 21.57 | 21.55 | 21.63 | 21.37 | 21.21 | 2 | 22.5 |
| | | 100 | 0 | 21.58 | 21.56 | 21.61 | 21.36 | 21.21 | 2 | 22.5 |
| BW (MHz) | Mode | RB Allocation | RB offset | Maximum Average Power (dBm) | | | | | MPR | Tune-up Limit |
| | | | | 39750 | 40185 | 40620 | 41055 | 41490 | | |
| | | | | 2506 MHz | 2549.5 MHz | 2593 MHz | 2636.5 MHz | 2680 MHz | | |
| 15 MHz | QPSK | 1 | 0 | 23.09 | 23.03 | 23.01 | 22.85 | 22.69 | 0 | 24.5 |
| | | 1 | 37 | 23.14 | 23.04 | 23.09 | 22.85 | 22.70 | 0 | 24.5 |
| | | 1 | 74 | 23.16 | 23.03 | 23.01 | 22.87 | 22.73 | 0 | 24.5 |
| | | 36 | 0 | 22.08 | 22.11 | 22.09 | 21.91 | 21.76 | 1 | 23.5 |
| | | 36 | 20 | 22.11 | 22.10 | 22.09 | 21.93 | 21.77 | 1 | 23.5 |
| | | 36 | 39 | 22.12 | 22.11 | 22.12 | 21.92 | 21.80 | 1 | 23.5 |
| | | 75 | 0 | 22.11 | 22.12 | 22.10 | 21.93 | 21.78 | 1 | 23.5 |
| | 16QAM | 1 | 0 | 21.58 | 21.95 | 22.11 | 21.54 | 22.11 | 1 | 23.5 |
| | | 1 | 37 | 22.02 | 21.99 | 22.00 | 21.57 | 21.78 | 1 | 23.5 |
| | | 1 | 74 | 22.05 | 21.79 | 21.81 | 21.71 | 21.71 | 1 | 23.5 |
| | | 36 | 0 | 21.10 | 21.08 | 21.01 | 20.94 | 20.77 | 2 | 22.5 |
| | | 36 | 20 | 21.09 | 21.12 | 21.01 | 20.89 | 20.82 | 2 | 22.5 |
| | | 36 | 39 | 21.08 | 21.13 | 21.07 | 20.94 | 20.76 | 2 | 22.5 |
| | | 75 | 0 | 21.08 | 21.14 | 21.05 | 20.88 | 20.83 | 2 | 22.5 |


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## LTE Band 41 Measured Results (continued)

| BW (MHz) | Mode | RB Allocation | RB offset | Maximum Average Power (dBm) | | | | | MPR | Tune-up Limit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 39750 | 40185 | 40620 | 41055 | 41490 | | |
| | | | | 2506 MHz | 2549.5 MHz | 2593 MHz | 2636.5 MHz | 2680 MHz | | |
| 10 MHz | QPSK | 1 | 0 | 23.59 | 23.56 | 23.57 | 23.36 | 23.11 | 0 | 24.5 |
| | | 1 | 25 | 23.60 | 23.56 | 23.63 | 23.39 | 23.14 | 0 | 24.5 |
| | | 1 | 49 | 23.62 | 23.55 | 23.63 | 23.41 | 23.18 | 0 | 24.5 |
| | | 25 | 0 | 22.58 | 22.56 | 22.57 | 22.40 | 22.19 | 1 | 23.5 |
| | | 25 | 12 | 22.58 | 22.57 | 22.59 | 22.41 | 22.22 | 1 | 23.5 |
| | | 25 | 25 | 22.59 | 22.57 | 22.61 | 22.42 | 22.24 | 1 | 23.5 |
| | | 50 | 0 | 22.57 | 22.56 | 22.60 | 22.42 | 22.24 | 1 | 23.5 |
| | 16QAM | 1 | 0 | 22.36 | 22.64 | 22.38 | 22.15 | 22.38 | 1 | 23.5 |
| | | 1 | 25 | 22.37 | 22.65 | 22.40 | 22.15 | 22.42 | 1 | 23.5 |
| | | 1 | 49 | 22.41 | 22.66 | 22.39 | 22.20 | 22.43 | 1 | 23.5 |
| | | 25 | 0 | 21.58 | 21.61 | 21.57 | 21.44 | 21.22 | 2 | 22.5 |
| | | 25 | 12 | 21.60 | 21.62 | 21.61 | 21.44 | 21.25 | 2 | 22.5 |
| | | 25 | 25 | 21.61 | 21.61 | 21.62 | 21.44 | 21.27 | 2 | 22.5 |
| | | 50 | 0 | 21.59 | 21.63 | 21.61 | 21.44 | 21.27 | 2 | 22.5 |
| BW (MHz) | Mode | RB Allocation | RB offset | Maximum Average Power (dBm) | | | | | MPR | Tune-up Limit |
| | | | | 39750 | 40185 | 40620 | 41055 | 41490 | | |
| | | | | 2506 MHz | 2549.5 MHz | 2593 MHz | 2636.5 MHz | 2680 MHz | | |
| 5 MHz | QPSK | 1 | 0 | 23.08 | 22.76 | 22.95 | 22.59 | 22.71 | 0 | 24.5 |
| | | 1 | 12 | 23.08 | 22.71 | 22.97 | 22.59 | 22.73 | 0 | 24.5 |
| | | 1 | 24 | 23.07 | 22.73 | 23.00 | 22.61 | 22.73 | 0 | 24.5 |
| | | 12 | 0 | 22.06 | 21.75 | 22.06 | 21.58 | 21.73 | 1 | 23.5 |
| | | 12 | 7 | 22.05 | 21.74 | 22.07 | 21.57 | 21.71 | 1 | 23.5 |
| | | 12 | 13 | 22.06 | 21.74 | 22.08 | 21.57 | 21.70 | 1 | 23.5 |
| | | 25 | 0 | 22.04 | 21.72 | 22.08 | 21.56 | 21.72 | 1 | 23.5 |
| | 16QAM | 1 | 0 | 21.93 | 21.16 | 21.65 | 21.27 | 21.38 | 1 | 23.5 |
| | | 1 | 12 | 21.92 | 21.15 | 21.65 | 21.26 | 21.38 | 1 | 23.5 |
| | | 1 | 24 | 21.94 | 21.16 | 21.69 | 21.30 | 21.41 | 1 | 23.5 |
| | | 12 | 0 | 20.95 | 20.69 | 20.97 | 20.49 | 20.78 | 2 | 22.5 |
| | | 12 | 7 | 20.93 | 20.68 | 20.97 | 20.49 | 20.77 | 2 | 22.5 |
| | | 12 | 13 | 20.94 | 20.68 | 20.98 | 20.48 | 20.77 | 2 | 22.5 |
| | | 25 | 0 | 21.05 | 20.76 | 21.05 | 20.57 | 20.75 | 2 | 22.5 |


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## 9.4. LTE Carrier Aggregation

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

For inter-band carrier aggregation with uplink assigned to one E-UTRA band (Table 5.6A-1), the requirements in subclause 6.2.3 apply.

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands, the requirements in subclause 6.2.3 apply for each uplink component carrier.

For intra-band contiguous carrier aggregation the allowed Maximum Power Reduction (MPR) for the maximum output power applicable to the DUT in table below. In case the modulation format is different on different component carriers then the MPR is determined by the rules applied to higher order of those modulations.

| Modulation | CA bandwidth Class B and C / Smallest Component Carrier Transmission Bandwidth Configuration | | | | MPR (dB) |
|---|---|---|---|---|---|
| | 25 RB | 50 RB | 75 RB | 100 RB | |
| QPSK | > 8 and ≤ 25 | > 12 and ≤ 50 | > 16 and ≤ 75 | > 18 and ≤ 100 | ≤ 1 |
| QPSK | > 25 | > 50 | > 75 | > 100 | ≤ 2 |
| 16 QAM | ≤ 8 | ≤ 12 | ≤ 16 | ≤ 18 | ≤ 1 |
| 16 QAM | > 8 and ≤ 25 | > 12 and ≤ 50 | > 16 and ≤ 75 | > 18 and ≤ 100 | ≤ 2 |
| 16 QAM | > 25 | > 50 | > 75 | > 100 | ≤ 3 |
| 64 QAM | ≤ 8 and allocation wholly contained within a single CC | ≤ 12 and allocation wholly contained within a single CC | ≤ 16 and allocation wholly contained within a single CC | ≤ 18 and allocation wholly contained within a single CC | ≤ 2 |
| 64 QAM | > 8 or allocation extends across two CC's | > 12 or allocation extends across two CC's | > 16 or allocation extends across two CC's | > 18 or allocation extends across two CC's | ≤ 3 |

For PUCCH and SRS transmissions, the allowed MPR is according to that specified for PUSCH WPDK modulation for the corresponding transmission bandwidth.


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For intra-band contiguous carrier aggregation bandwidth class C with non-contiguous resource allocation, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2A-1 is specified as follows

$$MPR = CEIL\{\min(M_A, M_{IM5}), 0.5\}$$

Where $M_A$ is defined as follows

$$M_A = \begin{cases} 8.2 & ;0 \le A < 0.025 \\ 9.2 - 40A & ;0.025 \le A < 0.05 \\ 8 - 16A & ;0.05 \le A < 0.25 \\ 4.83 - 3.33A & ;0.25 \le A \le 0.4 \\ 3.83 - 0.83A & ;0.4 \le A \le 1 \end{cases}$$

and $M_{IM5}$ is defined as follows

$$M_{IM5} = \begin{cases} 4.5 & ; \Delta_{IM5} < 1.5 * BW_{Channel_CA} \\ 6.0 & ; 1.5 * BW_{Channel_CA} \le \Delta_{IM5} < BW_{Channel_CA}/2 + \Delta f_{ooB} \\ M_A & ; \Delta_{IM5} \ge BW_{Channel_CA}/2 + \Delta f_{ooB} \end{cases}$$

Where

$A = N_{RB_alloc} / N_{RB_agg}$

$\Delta_{IM5} = \max(|F_{C_agg} - (3*F_{agg_alloc_low} - 2*F_{agg_alloc_high})|, |F_{C_agg} - (3*F_{agg_alloc_high} - 2*F_{agg_alloc_low})|)$

CEIL{$M_A$, 0.5} means rounding upwards to closest 0.5dB, i.e. MPR ∈ [3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5]

For intra-band carrier aggregation, the MPR is evaluated per slot and given by the maximum value taken over the transmission(s) on all component carriers within the slot; the maximum MPR over the two slots is then applied for the entire subframe.

For intra-band non-contiguous carrier aggregation with one uplink carrier on the PCC, the requirements in the subclause 6.2.3 apply. For intra-band non-contiguous aggregation with two uplink carriers the MPR is defined tfor those E-UTRA bands where maximum possible $W_{GAP} \le 42.2$ MHz as follows

$$MPR = CEIL\{M_A, 0.5\}$$

Where $M_N$ is defined as follows

$$M_N = \begin{cases} -0.125N + 18.25 & ; 2 \le N \le 50 \\ -0.0333N + 13.67 & ; 50 < N \le 200 \end{cases}$$

Where $N = N_{RB_alloc}$ is the number of allocated resource blocks.

For the UE maximum output power modified by MPR, the power limits specified in subclause 6.2.5A apply.

**LTE Carrier Aggregation Measured Results**

The following power measurements were performed with a single carrier uplink; CA for this particular project is only supported in the downlinks. The CA combinations supported by this device is one (1) Uplink and two (2) Downlinks.

| Type | LTE CA combinations | PCC (UL) | | | | | SCC (DL) | | | LTE Rel 8 Tx. Power [dBm] | LTE Rel 10 Tx. Power [dBm] | Delta (dBm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PCC + SCC | Mode | BW (MHz) | Channel | Freq. (MHz) | RB/Offset | BW (MHz) | Channel | Freq. (MHz) | | | |
| Intra-Band non-contiguous | 41A | QPSK | 20 | 39750 | 2506.0 | 1/99 | 20 | 41490 | 2680.0 | 23.7 | 23.7 | 0.0 |
| Intra-Band Contiguous | 41C | QPSK | 20 | 39750 | 2506.0 | 1/99 | 20 | 39948 | 2525.8 | 23.7 | 23.7 | 0.0 |

**Note:**

Per KDB 941225 D05A LTE Rel. 10 KDB Inquiry Sheet: SAR is excluded for Carrier Aggregation when measured power does not exceed LTE Release 8 by more than a $^1/_4$ dBm



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

### Wi-Fi 2.4GHz Measured Results

| Band | Mode | Data Rate | Ch # | Freq. (MHz) | Max Average Power (dBm) | | | Reduced Average Power (dBm) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Meas Pwr | Tune-up | SAR Test (Yes/No) | Meas Pwr | Tune-up | SAR Test (Yes/No) |
| DSSS 2.4 GHz | 802.11b | 1 Mbps | 1 | 2412 | 15.00 | 15.00 | Yes | 12.50 | 13.00 | Yes |
| | | | 2 | 2417 | 18.80 | 19.00 | | | 13.00 | |
| | | | 6 | 2437 | 18.50 | 19.00 | | 12.30 | 13.00 | |
| | | | 10 | 2457 | 18.90 | 19.00 | | | 13.00 | |
| | | | 11 | 2462 | 15.50 | 16.00 | | 12.20 | 13.00 | |
| OFDM 2.4 GHz | 802.11g | 6 Mbps | 1 | 2412 | Not Required | 17.00 | No | Not Required | 13.00 | No |
| | | | 6 | 2437 | | 17.00 | | | 13.00 | |
| | | | 11 | 2462 | | 17.00 | | | 13.00 | |
| | 802.11n (HT20) | 6.5 Mbps | 1 | 2412 | Not Required | 17.00 | No | Not Required | 13.00 | No |
| | | | 6 | 2437 | | 17.00 | | | 13.00 | |
| | | | 11 | 2462 | | 15.00 | | | 13.00 | |

**Note(s):**

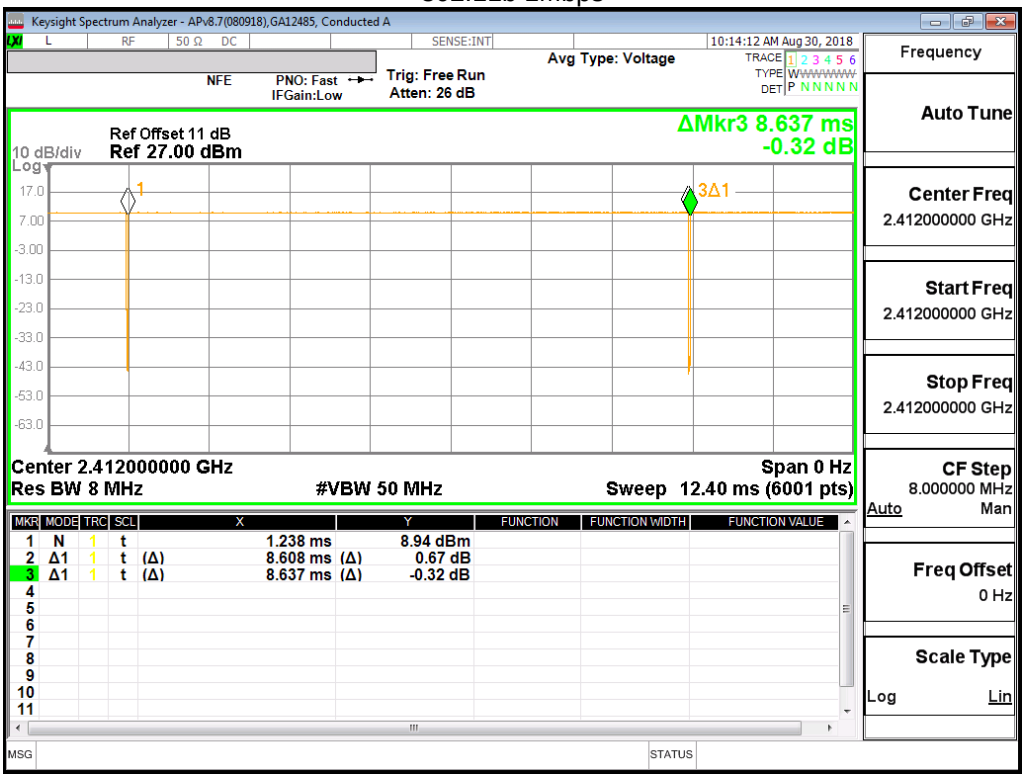
1. SAR testing is not required for OFDM modes when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
2. For "Not Required", SAR Test reduction was applied in accordance with KDB 248227 §2.1, b), 1).

### Duty Factor Measured Results

| Mode | Type | T on (ms) | Period (ms) | Duty Cycle | Crest Factor (1/duty cycle) |
|---|---|---|---|---|---|
| 802.11b | 1 Mbps | 8.608 | 8.637 | 99.66% | 1.00 |

## Duty Cycle plot

802.11b 1Mbps





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

**Wi-Fi 5 GHz Measured Results**

| Band | Mode | Data Rate | Ch # | Freq. (MHz) | MAX Average Power (dBm) | | | Reduced Average Power (dBm) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Meas Pwr | Tune-up | SAR Test (Yes/No) | Meas Pwr | Tune-up | SAR Test (Yes/No) |
| UNII-1 5.2 GHz | 802.11a | 6 Mbps | 36 | 5180 | 16.00 | 16.50 | Yes | Not Required | 11.00 | No |
| | | | 40 | 5200 | 16.00 | 16.50 | | | 11.00 | |
| | | | 44 | 5220 | 16.00 | 16.50 | | | 11.00 | |
| | | | 48 | 5240 | 16.00 | 16.50 | | | 11.00 | |
| | 802.11n (HT20) | 6.5 Mbps | 36 | 5180 | Not Required | 16.50 | No | Not Required | 11.00 | No |
| | | | 40 | 5200 | | 16.50 | | | 11.00 | |
| | | | 44 | 5220 | | 16.50 | | | 11.00 | |
| | | | 48 | 5240 | | 16.50 | | | 11.00 | |
| | 802.11ac (VHT20) | 6.5 Mbps | 36 | 5180 | Not Required | 16.50 | No | Not Required | 11.00 | No |
| | | | 40 | 5200 | | 16.50 | | | 11.00 | |
| | | | 44 | 5220 | | 16.50 | | | 11.00 | |
| | | | 48 | 5240 | | 16.50 | | | 11.00 | |
| | 802.11n (HT40) | 13.5 Mbps | 38 | 5190 | Not Required | 15.00 | No | Not Required | 11.00 | No |
| | | | 46 | 5230 | | 15.00 | | | 11.00 | |
| | 802.11ac (VHT40) | 13.5 Mbps | 38 | 5190 | Not Required | 15.00 | No | Not Required | 11.00 | No |
| | | | 46 | 5230 | | 15.00 | | | 11.00 | |
| | 802.11ac (VHT80) | 29.3 Mbps | 42 | 5210 | Not Required | 11.00 | No | 10.00 | 11.00 | Yes |
| Band | Mode | Data Rate | Ch # | Freq. (MHz) | MAX Average Power (dBm) | | | Reduced Average Power (dBm) | | |
| | | | | | Meas Pwr | Tune-up | SAR Test (Yes/No) | Meas Pwr | Tune-up | SAR Test (Yes/No) |
| UNII-2A 5.3 GHz | 802.11a | 6 Mbps | 52 | 5260 | 15.30 | 16.50 | Yes | Not Required | 11.00 | No |
| | | | 56 | 5280 | 14.80 | 16.50 | | | 11.00 | |
| | | | 60 | 5300 | 15.30 | 16.50 | | | 11.00 | |
| | | | 64 | 5320 | 15.40 | 16.50 | | | 11.00 | |
| | 802.11n (HT20) | 6.5 Mbps | 52 | 5260 | Not Required | 16.50 | No | Not Required | 11.00 | No |
| | | | 56 | 5280 | | 16.50 | | | 11.00 | |
| | | | 60 | 5300 | | 16.50 | | | 11.00 | |
| | | | 64 | 5320 | | 16.50 | | | 11.00 | |
| | 802.11ac (VHT20) | 6.5 Mbps | 52 | 5260 | Not Required | 16.50 | No | Not Required | 11.00 | No |
| | | | 56 | 5280 | | 16.50 | | | 11.00 | |
| | | | 60 | 5300 | | 16.50 | | | 11.00 | |
| | | | 64 | 5320 | | 16.50 | | | 11.00 | |
| | 802.11n (HT40) | 13.5 Mbps | 54 | 5270 | Not Required | 15.00 | No | Not Required | 11.00 | No |
| | | | 62 | 5310 | | 15.00 | | | 11.00 | |
| | 802.11ac (VHT40) | 13.5 Mbps | 54 | 5270 | Not Required | 15.00 | No | Not Required | 11.00 | No |
| | | | 62 | 5310 | | 15.00 | | | 11.00 | |
| | 802.11ac (VHT80) | 29.3 Mbps | 58 | 5290 | Not Required | 14.00 | No | 10.00 | 11.00 | Yes |

**Note(s):**

1. For "Not Required", SAR Test reduction was applied in accordance with KDB 248227 §2.1, b), 1). When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.
2. When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac modes, the channel in the lower order/sequence 802.11 mode (i.e. a, g, n then ac) is selected.
3. When the specified maximum output power is the same for both U-NII band 1 and U-NII band 2A, begin SAR measurement in U-NII band 2A; and if the highest *reported* SAR for U-NII band 2A is
   - ≤ 1.2 W/kg, SAR is not required for U-NII band 1
   - > 1.2 W/kg, both bands should be tested independently for SAR.
4. Wi-Fi Direct is supported in U-NII Band 1. Therefore, Wi-Fi Direct was tested separately for SAR for U-NII Band 1.


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## Wi-Fi 5 GHz Measured Results (continued)

| Band | Mode | Data Rate | Ch # | Freq. (MHz) | MAX Average Power (dBm) | | | Reduced Average Power (dBm) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Meas Pwr | Tune-up | SAR Test (Yes/No) | Meas Pwr | Tune-up | SAR Test (Yes/No) |
| UNII-2C 5.5 GHz | 802.11a | 6 Mbps | 100 | 5500 | 15.50 | 16.50 | Yes | Not Required | 11.00 | No |
| | | | 116 | 5580 | 15.40 | 16.50 | | | 11.00 | |
| | | | 124 | 5620 | 15.60 | 16.50 | | | 11.00 | |
| | | | 144 | 5720 | 15.90 | 16.50 | | | 11.00 | |
| | 802.11n (HT20) | 6.5 Mbps | 100 | 5500 | Not Required | 16.50 | No | Not Required | 11.00 | No |
| | | | 116 | 5580 | | 16.50 | | | 11.00 | |
| | | | 124 | 5620 | | 16.50 | | | 11.00 | |
| | | | 144 | 5720 | | 16.50 | | | 11.00 | |
| | 802.11ac (VHT20) | 6.5 Mbps | 100 | 5500 | Not Required | 16.50 | No | Not Required | 11.00 | No |
| | | | 116 | 5580 | | 16.50 | | | 11.00 | |
| | | | 124 | 5620 | | 16.50 | | | 11.00 | |
| | | | 144 | 5720 | | 16.50 | | | 11.00 | |
| | 802.11n (HT40) | 13.5 Mbps | 102 | 5510 | Not Required | 15.00 | No | Not Required | 11.00 | No |
| | | | 118 | 5590 | | 15.00 | | | 11.00 | |
| | | | 126 | 5630 | | 15.00 | | | 11.00 | |
| | | | 142 | 5710 | | 15.00 | | | 11.00 | |
| | 802.11ac (VHT40) | 13.5 Mbps | 102 | 5510 | Not Required | 15.00 | No | Not Required | 11.00 | No |
| | | | 118 | 5590 | | 15.00 | | | 11.00 | |
| | | | 126 | 5630 | | 15.00 | | | 11.00 | |
| | | | 142 | 5710 | | 15.00 | | | 11.00 | |
| | 802.11ac (VHT80) | 29.3 Mbps | 106 | 5530 | Not Required | 14.00 | No | 10.50 | 11.00 | Yes |
| | | | 122 | 5610 | | 14.00 | | 10.00 | 11.00 | |
| | | | 138 | 5690 | | 14.00 | | 10.00 | 11.00 | |
| Band | Mode | Data Rate | Ch # | Freq. (MHz) | MAX Average Power (dBm) | | | Reduced Average Power (dBm) | | |
| | | | | | Meas Pwr | Tune-up | SAR Test (Yes/No) | Meas Pwr | Tune-up | SAR Test (Yes/No) |
| UNII-3 5.8 GHz | 802.11a | 6 Mbps | 149 | 5745 | 15.50 | 16.50 | Yes | Not Required | 11.00 | No |
| | | | 157 | 5785 | 15.70 | 16.50 | | | 11.00 | |
| | | | 165 | 5825 | 15.50 | 16.50 | | | 11.00 | |
| | 802.11n (HT20) | 6.5 Mbps | 149 | 5745 | Not Required | 16.50 | No | Not Required | 11.00 | No |
| | | | 157 | 5785 | | 16.50 | | | 11.00 | |
| | | | 165 | 5825 | | 16.50 | | | 11.00 | |
| | 802.11ac (VHT20) | 6.5 Mbps | 149 | 5745 | Not Required | 16.50 | No | Not Required | 11.00 | No |
| | | | 157 | 5785 | | 16.50 | | | 11.00 | |
| | | | 165 | 5825 | | 16.50 | | | 11.00 | |
| | 802.11n (HT40) | 13.5 Mbps | 151 | 5755 | Not Required | 15.00 | No | Not Required | 11.00 | No |
| | | | 159 | 5795 | | 15.00 | | | 11.00 | |
| | 802.11ac (VHT40) | 13.5 Mbps | 151 | 5755 | Not Required | 15.00 | No | Not Required | 11.00 | No |
| | | | 159 | 5795 | | 15.00 | | | 11.00 | |
| | 802.11ac (VHT80) | 29.3 Mbps | 155 | 5775 | Not Required | 14.00 | No | 10.20 | 11.00 | Yes |

**Note(s):**

1. For "Not required", SAR Test reduction was applied in accordance with KDB 248227 §2.1, b), 1). When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.
2. When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac modes, the channel in the lower order/sequence 802.11 mode (i.e. a, g, n then ac) is selected.

## Duty Factor Measured Results

| Mode | Type | T on (ms) | Period (ms) | Duty Cycle | Crest Factor (1/duty cycle) |
|---|---|---|---|---|---|
| 802.11a | 6 Mbps | 1.428 | 1.453 | 98.28% | 1.02 |
| 802.11ac | VHT80 | 0.3317 | 0.3558 | 93.23% | 1.07 |


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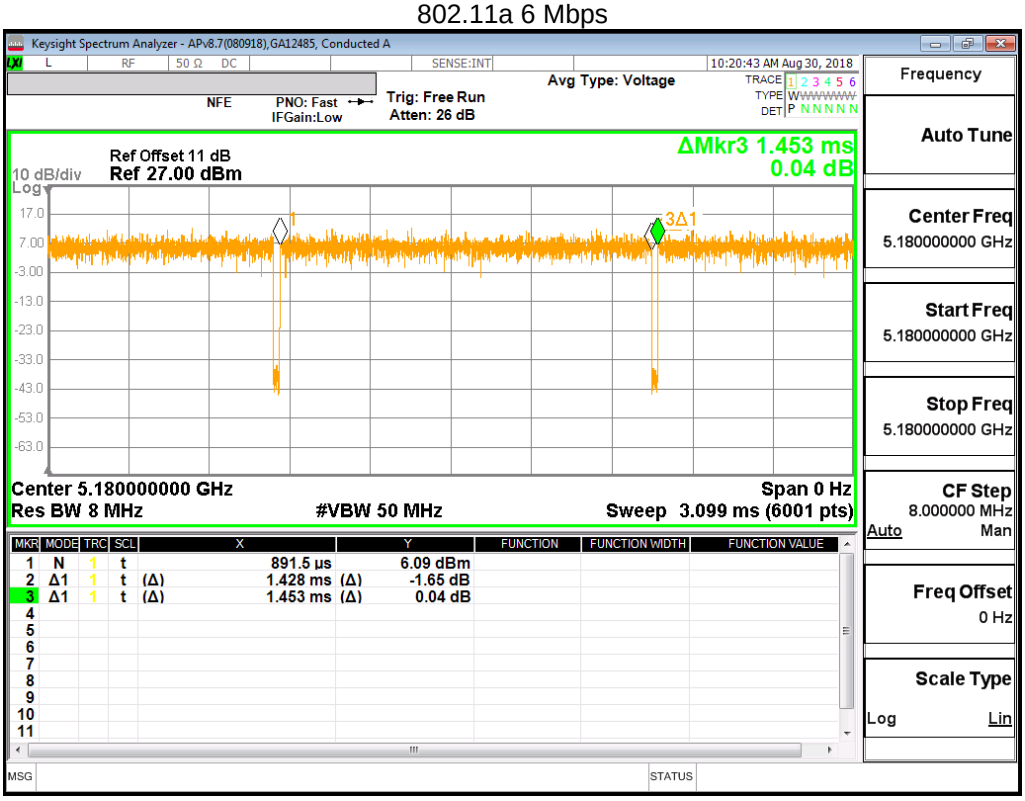
# Duty Cycle plots

802.11a 6 Mbps




802.11ac VHT80

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## 9.7. Bluetooth

### Bluetooth Measured Results

| Band | Mode | Ch # | Freq. (MHz) | Chain 0 Average Power (dBm) | | |
|---|---|---|---|---|---|---|
| | | | | Meas Pwr | Tune-up | SAR Test (Yes/No) |
| 2.4 | GFSK | 0 | 2402 | 8.30 | 10.00 | Yes |
| | | 39 | 2441 | 8.80 | 10.00 | |
| | | 78 | 2480 | 7.80 | 10.00 | |
| | EDR, π/4 DQPSK | 0 | 2402 | 7.00 | 10.00 | No |
| | | 39 | 2441 | 7.50 | 10.00 | |
| | | 78 | 2480 | 6.70 | 10.00 | |
| | EDR, 8-DPSK | 0 | 2402 | 7.00 | 10.00 | No |
| | | 39 | 2441 | 7.50 | 10.00 | |
| | | 78 | 2480 | 6.70 | 10.00 | |
| | LE, GFSK | 0 | 2402 | 4.70 | 5.00 | No |
| | | 19 | 2440 | 4.80 | 5.00 | |
| | | 39 | 2480 | 4.70 | 5.00 | |

**Note(s):**

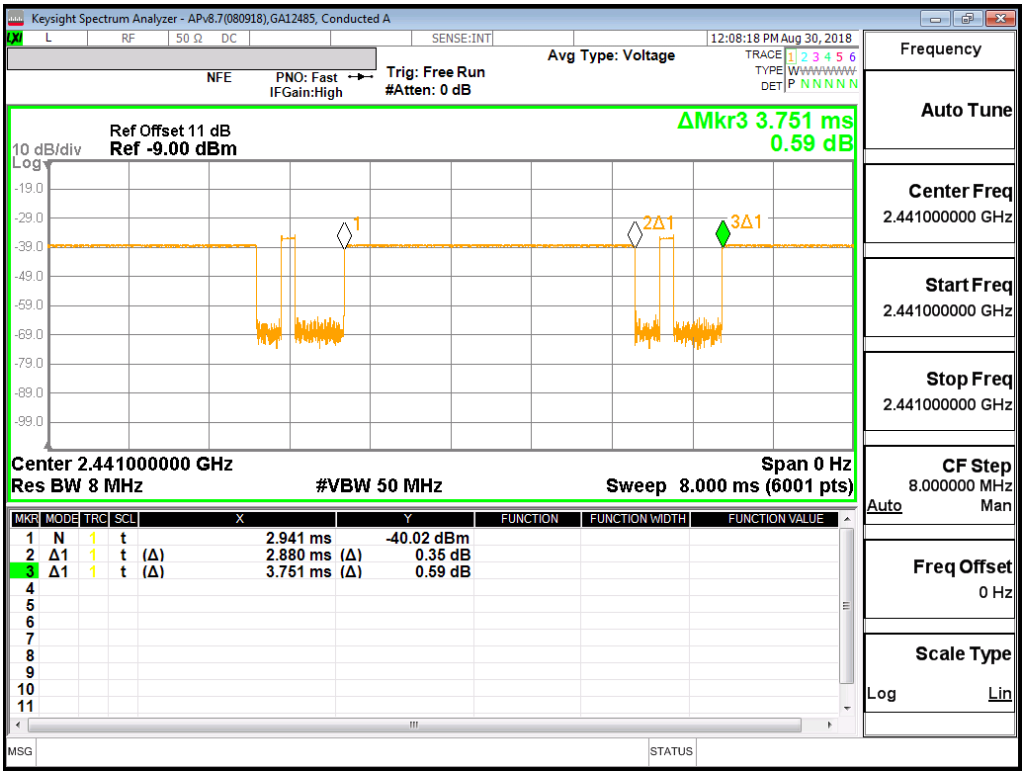
Body-worn and BT Tethering Mode qualify for SAR Test Exclusion. Refer to §10.10.

### Duty Factor Measured Results

| Mode | Type | T on (ms) | Period (ms) | Duty Cycle | Crest Factor (1/duty cycle) |
|---|---|---|---|---|---|
| GFSK | DH5 | 2.88 | 3.751 | 76.78% | 1.30 |

## Duty Cycle plot

GFSK





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# 10. Measured and Reported (Scaled) SAR Results

**SAR Test Reduction criteria are as follows:**

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

**KDB 447498 D01 General RF Exposure Guidance:**

Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

- ≤ 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 648474 D04 Handset SAR (Phablet Only):**

When hotspot mode does not apply, 10-g Extremity SAR is required for all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge in direct contact with a flat phantom, to address interactive hand use exposure conditions.
When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg .
Per TCB workshop April 2016; Page 22, RF Exposure Procedures (Phablet Procedures): phablet 10-g SAR should not be identified as hand or extremity SAR; this should be reported as product specific 10-g SAR in reports and grants.

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

When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

**KDB 941225 D05 SAR for LTE Devices:**

SAR test reduction is applied using the following criteria:

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

**KDB 248227 D01 SAR meas for 802.11:**

SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS procedure is applied to reduce the number of SAR tests; these are


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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). Initial Test Position SAR Test Reduction Procedure is outlined in KDB 248227 D01 §5.1.1. 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*.


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## 10.1. GSM850

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | GPRS 2 Slots | OFF | 0 | Left Touch | 190 | 836.6 | 32.0 | 30.4 | 0.142 | 0.207 | |
| | | | | Left Tilt | 190 | 836.6 | 32.0 | 30.4 | 0.100 | 0.146 | |
| | | | | Right Touch | 190 | 836.6 | 32.0 | 30.4 | 0.199 | **0.290** | 1 |
| | | | | Right Tilt | 190 | 836.6 | 32.0 | 30.4 | 0.100 | 0.146 | |
| Body-worn | GPRS 2 Slots | OFF | 15 | Rear | 190 | 836.6 | 32.0 | 30.4 | 0.267 | **0.389** | 2 |
| | | | | Front | 190 | 836.6 | 32.0 | 30.4 | 0.151 | 0.220 | |
| Hotspot | GPRS 2 Slots | OFF | 10 | Rear | 128 | 826.4 | 32.0 | 30.3 | 0.481 | 0.718 | |
| | | | | | 190 | 836.6 | 32.0 | 30.4 | 0.628 | 0.914 | |
| | | | | | 251 | 846.6 | 32.0 | 30.4 | 0.724 | **1.049** | 3 |
| | | | | Front | 190 | 836.6 | 32.0 | 30.4 | 0.220 | 0.320 | |
| | | | | Edge 3 | 190 | 836.6 | 32.0 | 30.4 | 0.293 | 0.426 | |
| | | | | Edge 4 | 190 | 836.6 | 32.0 | 30.4 | 0.046 | 0.067 | |

## 10.2. GSM1900

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | GPRS 2 Slots | OFF | 0 | Left Touch | 661 | 1880.0 | 28.5 | 27.0 | 0.052 | **0.073** | 4 |
| | | | | Left Tilt | 661 | 1880.0 | 28.5 | 27.0 | 0.015 | 0.021 | |
| | | | | Right Touch | 661 | 1880.0 | 28.5 | 27.0 | 0.028 | 0.039 | |
| | | | | Right Tilt | 661 | 1880.0 | 28.5 | 27.0 | 0.017 | 0.024 | |
| Body-worn | GPRS 2 Slots | OFF | 15 | Rear | 661 | 1880.0 | 28.5 | 27.0 | 0.064 | **0.090** | 5 |
| | | | | Front | 661 | 1880.0 | 28.5 | 27.0 | 0.055 | 0.077 | |
| Hotspot | GPRS 2 Slots | OFF | 10 | Rear | 661 | 1880.0 | 28.5 | 27.0 | 0.145 | **0.203** | 6 |
| | | | | Front | 661 | 1880.0 | 28.5 | 27.0 | 0.129 | 0.181 | |
| | | | | Edge 3 | 661 | 1880.0 | 28.5 | 27.0 | 0.060 | 0.084 | |
| | | | | Edge 4 | 661 | 1880.0 | 28.5 | 27.0 | 0.059 | 0.083 | |

## 10.3. W-CDMA Band II

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | Rel. 99 RMC 12.2 kbps | OFF | 0 | Left Touch | 9400 | 1880.0 | 24.5 | 23.6 | 0.122 | **0.150** | 7 |
| | | | | Left Tilt | 9400 | 1880.0 | 24.5 | 23.6 | 0.034 | 0.042 | |
| | | | | Right Touch | 9400 | 1880.0 | 24.5 | 23.6 | 0.062 | 0.076 | |
| | | | | Right Tilt | 9400 | 1880.0 | 24.5 | 23.6 | 0.038 | 0.047 | |
| Body-worn | Rel. 99 RMC 12.2 kbps | OFF | 15 | Rear | 9400 | 1880.0 | 24.5 | 23.6 | 0.125 | **0.154** | 8 |
| | | | | Front | 9400 | 1880.0 | 24.5 | 23.6 | 0.107 | 0.132 | |
| Hotspot | Rel. 99 RMC 12.2 kbps | OFF | 10 | Rear | 9400 | 1880.0 | 24.5 | 23.6 | 0.286 | **0.353** | 9 |
| | | | | Front | 9400 | 1880.0 | 24.5 | 23.6 | 0.238 | 0.293 | |
| | | | | Edge 3 | 9400 | 1880.0 | 24.5 | 23.6 | 0.139 | 0.171 | |
| | | | | Edge 4 | 9400 | 1880.0 | 24.5 | 23.6 | 0.117 | 0.144 | |


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## 10.4. W-CDMA Band V

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | Rel. 99 RMC 12.2 kbps | OFF | 0 | Left Touch | 4183 | 836.6 | 25.0 | 24.4 | 0.123 | 0.143 | |
| | | | | Left Tilt | 4183 | 836.6 | 25.0 | 24.4 | 0.090 | 0.105 | |
| | | | | Right Touch | 4183 | 836.6 | 25.0 | 24.4 | 0.167 | **0.194** | 10 |
| | | | | Right Tilt | 4183 | 836.6 | 25.0 | 24.4 | 0.091 | 0.106 | |
| Body-worn | Rel. 99 RMC 12.2 kbps | OFF | 15 | Rear | 4183 | 836.6 | 25.0 | 24.4 | 0.215 | **0.250** | 11 |
| | | | | Front | 4183 | 836.6 | 25.0 | 24.4 | 0.129 | 0.150 | |
| Hotspot | Rel. 99 RMC 12.2 kbps | OFF | 10 | Rear | 4183 | 836.6 | 25.0 | 24.4 | 0.507 | **0.589** | 12 |
| | | | | Front | 4183 | 836.6 | 25.0 | 24.4 | 0.181 | 0.210 | |
| | | | | Edge 3 | 4183 | 836.6 | 25.0 | 24.4 | 0.223 | 0.259 | |
| | | | | Edge 4 | 4183 | 836.6 | 25.0 | 24.4 | 0.049 | 0.057 | |

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

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | RB Allocation | RB offset | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | QPSK | OFF | 0 | Left Touch | 20525 | 836.5 | 1 | 0 | 25.0 | 24.3 | 0.134 | 0.157 | |
| | | | | | | | 25 | 0 | 24.0 | 23.2 | 0.099 | 0.118 | |
| | | | | Left Tilt | 20525 | 836.5 | 1 | 0 | 25.0 | 24.3 | 0.083 | 0.098 | |
| | | | | | | | 25 | 0 | 24.0 | 23.2 | 0.061 | 0.073 | |
| | | | | Right Touch | 20525 | 836.5 | 1 | 0 | 25.0 | 24.3 | 0.173 | **0.203** | 13 |
| | | | | | | | 25 | 0 | 24.0 | 23.2 | 0.132 | 0.158 | |
| | | | | Right Tilt | 20525 | 836.5 | 1 | 0 | 25.0 | 24.3 | 0.085 | 0.100 | |
| | | | | | | | 25 | 0 | 24.0 | 23.2 | 0.064 | 0.076 | |
| Body-worn | QPSK | OFF | 15 | Rear | 20525 | 836.5 | 1 | 0 | 25.0 | 24.3 | 0.192 | **0.226** | 14 |
| | | | | | | | 25 | 0 | 24.0 | 23.2 | 0.155 | 0.185 | |
| | | | | Front | 20525 | 836.5 | 1 | 0 | 25.0 | 24.3 | 0.153 | 0.180 | |
| | | | | | | | 25 | 0 | 24.0 | 23.2 | 0.117 | 0.140 | |
| Hotspot | QPSK | OFF | 10 | Rear | 20525 | 836.5 | 1 | 0 | 25.0 | 24.3 | 0.455 | **0.535** | 15 |
| | | | | | | | 25 | 0 | 24.0 | 23.2 | 0.366 | 0.437 | |
| | | | | Front | 20525 | 836.5 | 1 | 0 | 25.0 | 24.3 | 0.178 | 0.209 | |
| | | | | | | | 25 | 0 | 24.0 | 23.2 | 0.139 | 0.166 | |
| | | | | Edge 3 | 20525 | 836.5 | 1 | 0 | 25.0 | 24.3 | 0.208 | 0.244 | |
| | | | | | | | 25 | 0 | 24.0 | 23.2 | 0.165 | 0.197 | |
| | | | | Edge 4 | 20525 | 836.5 | 1 | 0 | 25.0 | 24.3 | 0.061 | 0.072 | |
| | | | | | | | 25 | 0 | 24.0 | 23.2 | 0.036 | 0.043 | |


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## 10.6. LTE Band 41 (20MHz Bandwidth)

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | RB Allocation | RB offset | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | QPSK | OFF | 0 | Left Touch | 40620 | 2593.0 | 1 | 99 | 24.5 | 23.6 | 0.214 | 0.263 | |
| | | | | | | | 50 | 50 | 23.5 | 22.6 | 0.160 | 0.198 | |
| | | | | Left Tilt | 40620 | 2593.0 | 1 | 99 | 24.5 | 23.6 | 0.173 | 0.212 | |
| | | | | | | | 50 | 50 | 23.5 | 22.6 | 0.126 | 0.156 | |
| | | | | Right Touch | 40620 | 2593.0 | 1 | 99 | 24.5 | 23.6 | 0.404 | **0.496** | 16 |
| | | | | | | | 50 | 50 | 23.5 | 22.6 | 0.304 | 0.376 | |
| | | | | Right Tilt | 40620 | 2593.0 | 1 | 99 | 24.5 | 23.6 | 0.133 | 0.163 | |
| | | | | | | | 50 | 50 | 23.5 | 22.6 | 0.097 | 0.120 | |
| Body-worn | QPSK | OFF | 15 | Rear | 40620 | 2593.0 | 1 | 99 | 24.5 | 23.6 | 0.248 | 0.305 | |
| | | | | | | | 50 | 50 | 23.5 | 22.6 | 0.194 | 0.240 | |
| | | | | Front | 40620 | 2593.0 | 1 | 99 | 24.5 | 23.6 | 0.262 | **0.322** | 17 |
| | | | | | | | 50 | 50 | 23.5 | 22.6 | 0.198 | 0.245 | |
| Hotspot | QPSK | OFF | 10 | Rear | 40620 | 2593.0 | 1 | 99 | 24.5 | 23.6 | 0.466 | 0.572 | |
| | | | | | | | 50 | 50 | 23.5 | 22.6 | 0.361 | 0.447 | |
| | | | | Front | 40620 | 2593.0 | 1 | 99 | 24.5 | 23.6 | 0.504 | **0.619** | 18 |
| | | | | | | | 50 | 50 | 23.5 | 22.6 | 0.388 | 0.480 | |
| | | | | Edge 2 | 40620 | 2593.0 | 1 | 99 | 24.5 | 23.6 | 0.409 | 0.502 | |
| | | | | | | | 50 | 50 | 23.5 | 22.6 | 0.315 | 0.390 | |
| | | | | Edge 3 | 40620 | 2593.0 | 1 | 99 | 24.5 | 23.6 | 0.130 | 0.160 | |
| | | | | | | | 50 | 50 | 23.5 | 22.6 | 0.102 | 0.126 | |

## 10.7. Wi-Fi (DTS Band)

When the 802.11b reported SAR of the highest measured maximum output power channel is ≤ 0.8 W/kg, no further SAR testing is required. If SAR is > 0.8 W/kg and ≤ 1.2 W/kg, SAR is required for the next highest measured output power channel. Finally, if SAR is > 1.2 W/kg, SAR is required for the third channel.
SAR testing is not required for OFDM mode(s) when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Area Scan Max. SAR (W/kg) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | 802.11b 1 Mbps | ON | 0 | Left Touch | 1 | 2412.0 | 99.66% | 0.197 | 13.0 | 12.5 | | | |
| | | | | Left Tilt | 1 | 2412.0 | 99.66% | 0.216 | 13.0 | 12.5 | | | |
| | | | | Right Touch | 1 | 2412.0 | 99.66% | 0.322 | 13.0 | 12.5 | | | |
| | | | | Right Tilt | 1 | 2412.0 | 99.66% | **0.435** | 13.0 | 12.5 | 0.251 | **0.283** | 19 |
| Body-worn | 802.11b 1 Mbps | OFF | 15 | Rear | 10 | 2457.0 | 99.66% | **0.348** | 19.0 | 18.9 | 0.239 | **0.245** | 20 |
| | | | | Front | 10 | 2457.0 | 99.66% | 0.276 | 19.0 | 18.9 | | | |
| Hotspot & Wi-Fi Direct | 802.11b 1 Mbps | OFF | 10 | Rear | 10 | 2457.0 | 99.66% | **0.718** | 19.0 | 18.9 | 0.528 | **0.542** | 21 |
| | | | | Front | 10 | 2457.0 | 99.66% | 0.520 | 19.0 | 18.9 | 0.377 | 0.387 | |
| | | | | Edge 1 | 10 | 2457.0 | 99.66% | 0.498 | 19.0 | 18.9 | | | |
| | | | | Edge 4 | 10 | 2457.0 | 99.66% | 0.123 | 19.0 | 18.9 | | | |

**Adjusted SAR for OFDM Modes:**

| Power Back-off | 802.11b Max. Power | | 802.11g Max. Power | | 802.11n HT20 Max. Power | | Highest Reported SAR for 802.11b (W/kg) | Adjusted SAR for 802.11g (W/kg) | Adjusted SAR for 802.11n HT20 (W/kg) |
|---|---|---|---|---|---|---|---|---|---|
| | dBm | mW | dBm | mW | dBm | mW | | | |
| ON | 13.0 | 20 | 13.0 | 20 | 13.0 | 20 | 0.283 | 0.283 | 0.283 |
| OFF | 19.0 | 79 | 17.0 | 50 | 17.0 | 50 | 0.542 | 0.342 | 0.342 |

**Note(s):**

Adjusted SAR for OFDM modes is < 1.2 W/kg, therefore SAR testing is not required for OFDM modes.


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

## UNII-1 &2A

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

- o ≤ 1.2 or 3 W/kg (1g and 10g respectively), SAR is not required for UNII band I
- o > 1.2 or 3 W/kg (1g and 10g respectively), both bands should be tested independently for SAR.

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Area Scan Max. SAR (W/kg) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Wi-Fi Direct | 802.11a 6 Mbps | OFF | 10 | Rear | 44 | 5220.0 | 98.28% | 0.722 | 16.5 | 16.0 | 0.381 | 0.435 | |
| | | | | Front | 44 | 5220.0 | 98.28% | 0.691 | 16.5 | 16.0 | 0.335 | 0.382 | |
| | | | | Edge 1 | 44 | 5220.0 | 98.28% | **1.250** | 16.5 | 16.0 | 0.559 | **0.638** | 22 |
| | | | | Edge 4 | 44 | 5220.0 | 98.28% | 0.102 | 16.5 | 16.0 | | | |

**Note(s):**

Wi-Fi Direct is supported in U-NII Band 1, therefore it was evaluated separately.

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Area Scan Max. SAR (W/kg) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | 802.11ac VHT80 | ON | 0 | Left Touch | 58 | 5290.0 | 93.23% | 0.755 | 11.0 | 10.0 | | | |
| | | | | Left Tilt | 58 | 5290.0 | 93.23% | 0.876 | 11.0 | 10.0 | 0.412 | 0.556 | |
| | | | | Right Touch | 58 | 5290.0 | 93.23% | 0.875 | 11.0 | 10.0 | | | |
| | | | | Right Tilt | 58 | 5290.0 | 93.23% | **0.996** | 11.0 | 10.0 | 0.461 | **0.623** | 23 |
| Body-worn | 802.11a 6 Mbps | OFF | 15 | Rear | 64 | 5320.0 | 98.28% | **0.570** | 16.5 | 15.4 | 0.280 | **0.367** | 24 |
| | | | | Front | 64 | 5320.0 | 98.28% | 0.465 | 16.5 | 15.4 | | | |

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Area Scan Max. SAR (W/kg) | Power (dBm) | | 10-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Product Specific 10g | 802.11a 6 Mbps | OFF | 0 | Rear | 64 | 5320.0 | 98.28% | **10.400** | 16.5 | 15.4 | 0.940 | **1.232** | 25 |
| | | | | Front | 64 | 5320.0 | 98.28% | 6.390 | 16.5 | 15.4 | | | |
| | | | | Edge 1 | 64 | 5320.0 | 98.28% | 8.750 | 16.5 | 15.4 | 0.842 | 1.104 | |
| | | | | Edge 4 | 64 | 5320.0 | 98.28% | 0.498 | 16.5 | 15.4 | | | |

**Note(s):**

1. For Head and Body-worn RF Exposure Conditions, The Highest Reported 1-g SAR for U-NII 2A mode is < 1.2 W/kg, therefore SAR testing is not required for U-NII 1 mode.
2. For Product Specific 10g RF Exposure Condition, The Highest Reported 10-g SAR for U-NII 2A mode is < 3.0 W/kg, therefor SAR testing is not required for U-NII 1 mode.

## U-NII 2C

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Area Scan Max. SAR (W/kg) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | 802.11ac VHT80 | ON | 0 | Left Touch | 106 | 5530.0 | 93.23% | 1.260 | 11.0 | 10.5 | | | |
| | | | | Left Tilt | 106 | 5530.0 | 93.23% | **1.510** | 11.0 | 10.5 | 0.694 | **0.835** | 26 |
| | | | | | 122 | 5610.0 | 93.23% | 1.090 | 11.0 | 10.0 | 0.468 | 0.632 | |
| | | | | Right Touch | 106 | 5530.0 | 93.23% | 1.120 | 11.0 | 10.5 | | | |
| | | | | Right Tilt | 106 | 5530.0 | 93.23% | 1.340 | 11.0 | 10.5 | 0.619 | 0.745 | |
| Body-worn | 802.11a 6 Mbps | OFF | 15 | Rear | 144 | 5720.0 | 98.28% | **0.570** | 16.5 | 15.9 | 0.259 | **0.303** | 27 |
| | | | | Front | 144 | 5720.0 | 98.28% | 0.435 | 16.5 | 15.9 | | | |

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Area Scan Max. SAR (W/kg) | Power (dBm) | | 10-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Product Specific 10g | 802.11a 6 Mbps | OFF | 0 | Rear | 144 | 5720.0 | 98.28% | **9.680** | 16.5 | 15.9 | 0.787 | **0.919** | 28 |
| | | | | Front | 144 | 5720.0 | 98.28% | 2.770 | 16.5 | 15.9 | | | |
| | | | | Edge 1 | 144 | 5720.0 | 98.28% | 5.930 | 16.5 | 15.9 | | | |
| | | | | Edge 4 | 144 | 5720.0 | 98.28% | 0.247 | 16.5 | 15.9 | | | |


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**U-NII 3**

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Area Scan Max. SAR (W/kg) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | 802.11ac VHT80 | ON | 0 | Left Touch | 155 | 5775 | 93.23% | 0.832 | 11.0 | 10.2 | | | |
| | | | | Left Tilt | 155 | 5775 | 93.23% | 0.866 | 11.0 | 10.2 | | | |
| | | | | Right Touch | 155 | 5775 | 93.23% | 0.898 | 11.0 | 10.2 | 0.360 | 0.464 | |
| | | | | Right Tilt | 155 | 5775 | 93.23% | **1.010** | 11.0 | 10.2 | 0.395 | **0.509** | 29 |
| Body-worn | 802.11a 6 Mbps | OFF | 15 | Rear | 157 | 5785 | 98.28% | **0.577** | 16.5 | 15.7 | 0.276 | 0.338 | 30 |
| | | | | Front | 157 | 5785 | 98.28% | 0.444 | 16.5 | 15.7 | | | |
| Hotspot & Wi-Fi Direct | 802.11a 6 Mbps | OFF | 10 | Rear | 157 | 5785 | 98.28% | 1.360 | 16.5 | 15.7 | 0.540 | 0.661 | |
| | | | | Front | 157 | 5785 | 98.28% | 0.605 | 16.5 | 15.7 | 0.354 | 0.433 | |
| | | | | Edge 1 | 157 | 5785 | 98.28% | **1.570** | 16.5 | 15.7 | 0.655 | 0.801 | |
| | | | | | 165 | 5825 | 98.28% | 1.890 | 16.5 | 15.5 | 0.862 | **1.104** | 31 |
| | | | | Edge 4 | 157 | 5785 | 98.28% | 0.116 | 16.5 | 15.7 | | | |

## 10.9. Bluetooth

| RF Exposure Conditions | Mode | Power Back-off | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| Head | GFSK DH5 | OFF | 0 | Left Touch | 39 | 2441 | 76.78% | 10.0 | 8.3 | <0.10 | <0.10 | |
| | | | | Left Tilt | 39 | 2441 | 76.78% | 10.0 | 8.3 | <0.10 | <0.10 | |
| | | | | Right Touch | 39 | 2441 | 76.78% | 10.0 | 8.3 | <0.10 | <0.10 | |
| | | | | Right Tilt | 39 | 2441 | 76.78% | 10.0 | 8.3 | <0.10 | **<0.10** | 32 |

**Note(s):**

Body-worn and BT Tethering Mode qualify for SAR Test Exclusion. Refer to §10.10.



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## 10.10. Standalone SAR Test Exclusion Considerations & Estimated SAR

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.

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.

**Body-worn and BT Tethering:**

| RF Air interface | RF Exposure Conditions | Frequency (GHz) | Max. tune-up tolerance Power | | Min. test separation distance (mm) | SAR test exclusion Result* | Estimated 1-g SAR (W/kg) |
|---|---|---|---|---|---|---|---|
| | | | (dBm) | (mW) | | | |
| Bluetooth | Body-worn | 2.480 | 10.0 | 10 | 15 | 1.0 | 0.140 |
| Bluetooth | Tethering | 2.480 | 10.0 | 10 | 10 | 1.6 | 0.210 |

**Conclusion:**

*: The computed value is ≤ 3; therefore, this qualifies for Standalone SAR test exclusion.


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# 11. SAR Measurement Variability

In accordance with published RF Exposure KDB 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is <0.8 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.8 or 2 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 (~ 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.

| Frequency Band (MHz) | Air Interface | RF Exposure Conditions | Test Position | Repeated SAR (Yes/No) | Highest Measured SAR (W/kg) | First Repeated | |
|---|---|---|---|---|---|---|---|
| | | | | | | Measured SAR (W/kg) | Largest to Smallest SAR Ratio |
| 850 | GSM 850 | Hotspot | Rear | No | 0.724 | N/A | N/A |
| | LTE Band 5 | Hotspot | Rear | No | 0.455 | N/A | N/A |
| | WCDMA Band V | Hotspot | Rear | No | 0.507 | N/A | N/A |
| 1900 | GSM 1900 | Hotspot | Rear | No | 0.145 | N/A | N/A |
| | WCDMA Band II | Hotspot | Rear | No | 0.286 | N/A | N/A |
| 2400 | Wi-Fi 802.11b | Hotspot & Wi-Fi Direct | Rear | No | 0.528 | N/A | N/A |
| | BT | Head | Left Tilt | No | <0.001 | N/A | N/A |
| 2600 | LTE Band 41 | Hotspot | Front | No | 0.504 | N/A | N/A |
| 5200 | Wi-Fi 802.11a | Wi-Fi Direct | Rear | No | 0.559 | N/A | N/A |
| 5300 | Wi-Fi 802.11ac | Head | Right Tilt | No | 0.461 | N/A | N/A |
| 5500 | Wi-Fi 802.11ac | Head | Left Tilt | No | 0.694 | N/A | N/A |
| 5800 | Wi-Fi 802.11ac | Hotspot & Wi-Fi Direct | Edge 1 | Yes | 0.862 | 0.856 | 1.01 |

**Note(s):**

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

## Product Specific 10g SAR:

| Frequency Band (MHz) | Air Interface | RF Exposure Conditions | Test Position | Repeated SAR (Yes/No) | Highest Measured SAR (W/kg) |
|---|---|---|---|---|---|
| 5300 | Wi-Fi 802.11a | Product Specific 10g | Rear | No | 0.940 |
| 5500 | Wi-Fi 802.11a | Product Specific 10g | Edge 1 | No | 0.787 |

**Note(s):**

Repeated Measurement is not required since measured SAR is < 2.0 W/kg.


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# 12. Simultaneous Transmission Conditions

**Simultaneous Transmission Scenarios**

| No. | Capable Transmit Configuration | Head | Body-Worn Accessory | Wireless Router | Notes |
|---|---|---|---|---|---|
| 1 | GSM voice + 2.4 GHz WI-FI | Yes | Yes | N/A | |
| 2 | GSM voice + 5 GHz WI-FI | Yes | Yes | N/A | |
| 3 | GSM voice + 2.4 GHz Bluetooth | Yes^ | Yes | N/A | ^Bluetooth Tethering is considered |
| 4 | UMTS + 2.4 GHz WI-FI | Yes | Yes | Yes | |
| 5 | UMTS + 5 GHz WI-FI | Yes | Yes | Yes | |
| 6 | UMTS + 2.4 GHz Bluetooth | Yes^ | Yes | Yes^ | ^Bluetooth Tethering is considered |
| 7 | LTE + 2.4 GHz WI-FI | Yes | Yes | Yes | |
| 8 | LTE + 5 GHz WI-FI | Yes | Yes | Yes | |
| 9 | LTE + 2.4 GHz Bluetooth | Yes^ | Yes | Yes^ | ^Bluetooth Tethering is considered |
| 10 | GPRS/EDGE + 2.4 GHz WI-FI | N/A | N/A | Yes | |
| 11 | GPRS/EDGE + 5 GHz WI-FI | N/A | N/A | Yes | |
| 12 | GPRS/EDGE + 2.4 GHz Bluetooth | N/A | N/A | Yes^ | |

## 12.1. Simultaneous transmission SAR test exclusion considerations

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

### 12.1.1. Sum of SAR

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

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

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

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

Where:

$SAR_1$ 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 of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$

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

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

When an individual antenna transmits at on two bands simultaneously, the sum of the highest <u>*reported*</u> SAR for the frequency bands should be used to determine $SAR_1$.or $SAR_2$. When SPLSR is necessary, the smallest distance between the peak SAR locations for the antenna pair with respect to the peaks from each antenna should be used.

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


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

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) | | | | ∑ 1-g SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|
| | | WWAN ① | DTS ② | U-NII ③ | BT | WWAN + DTS + | WWAN + U-NII + | WWAN + BT + |
| Head | Left Touch | 0.207 | 0.283 | 0.745 | 0.100 | 0.489 | 0.952 | 0.307 |
| | Left Tilt | 0.146 | 0.283 | 0.835 | 0.100 | 0.428 | 0.981 | 0.246 |
| | Right Touch | 0.290 | 0.283 | 0.464 | 0.100 | 0.572 | 0.754 | 0.390 |
| | Right Tilt | 0.146 | 0.283 | 0.745 | 0.100 | 0.428 | 0.891 | 0.246 |
| Body-worn | Rear | 0.389 | 0.245 | 0.367 | 0.140 | **0.634** | **0.755** | **0.529** |
| | Front | 0.220 | 0.245 | 0.367 | 0.140 | 0.465 | 0.587 | 0.360 |
| Hotspot, Wi-Fi Direct, & BT Tethering | Rear | 1.049 | 0.542 | 0.661 | 0.210 | **1.591** | **1.710** | **1.259** |
| | Front | 0.320 | 0.387 | 0.433 | 0.210 | 0.707 | 0.753 | 0.530 |
| | Edge 1 | | 0.387 | 1.104 | 0.210 | | | 0.210 |
| | Edge 2 | | | | | | | |
| | Edge 3 | 0.426 | | | | | | |
| | Edge 4 | 0.067 | 0.387 | 0.433 | 0.210 | 0.454 | 0.500 | 0.277 |

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

| Test Position | Standalone SAR (W/kg) | | ∑ 1-g SAR (W/kg) | | Calculated distance (mm) | SPLSR (≤ 0.04) | Volume Scan (Yes/ No) |
|---|---|---|---|---|---|---|---|
| | WWAN | U-NII | | | | | |
| Rear | 1.049 | 0.661 | + | 1.710 | 155.2 | 0.01 | No |

| Mode | ① ③ | Peak SAR W/kg | X m | Y m | Z m | d: Calculated distance (mm) | |
|---|---|---|---|---|---|---|---|
| GSM 850 | | 1.06 | 0.0135 | -0.084 | -0.177 | ① + ③ | 155.2 |
| U-NII (5.8GHz) | | 1.33 | 0.005 | 0.071 | -0.175 | | |

The Peak Location Separation Distance is computed by using the
SQRT((X1-X2)^2+(Y1-Y2)^2+(Z1-Z2)^2)

**Conclusion:**

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


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

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) | | | | ∑ 1-g SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|
| | | WWAN ① | DTS ② | U-NII ③ | BT | WWAN + DTS + | WWAN + U-NII + | WWAN + BT + |
| Head | Left Touch | 0.073 | 0.283 | 0.745 | 0.100 | 0.356 | 0.818 | 0.173 |
| | Left Tilt | 0.021 | 0.283 | 0.835 | 0.100 | 0.304 | 0.856 | 0.121 |
| | Right Touch | 0.039 | 0.283 | 0.464 | 0.100 | 0.322 | 0.503 | 0.139 |
| | Right Tilt | 0.024 | 0.283 | 0.745 | 0.100 | 0.306 | 0.769 | 0.124 |
| Body-worn | Rear | 0.090 | 0.245 | 0.367 | 0.140 | 0.335 | 0.457 | 0.230 |
| | Front | 0.077 | 0.245 | 0.367 | 0.140 | 0.323 | 0.444 | 0.217 |
| Hotspot, Wi-Fi Direct, & BT Tethering | Rear | 0.203 | 0.542 | 0.661 | 0.210 | 0.746 | 0.864 | 0.413 |
| | Front | 0.181 | 0.387 | 0.433 | 0.210 | 0.568 | 0.614 | 0.391 |
| | Edge 1 | | 0.387 | 1.104 | 0.210 | | | 0.210 |
| | Edge 2 | | | | | | | |
| | Edge 3 | 0.084 | | | | | | |
| | Edge 4 | 0.083 | 0.387 | 0.433 | 0.210 | 0.470 | 0.516 | 0.293 |

**Conclusion:**

Simultaneous transmission SAR measurement (Volume Scan) is not required because the sum of the 10-g SAR is < 4.0 W/kg.

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

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) | | | | ∑ 1-g SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|
| | | WWAN ① | DTS ② | U-NII ③ | BT | WWAN + DTS + | WWAN + U-NII + | WWAN + BT + |
| Head | Left Touch | 0.150 | 0.283 | 0.745 | 0.100 | 0.433 | 0.895 | 0.250 |
| | Left Tilt | 0.042 | 0.283 | 0.835 | 0.100 | 0.325 | 0.877 | 0.142 |
| | Right Touch | 0.076 | 0.283 | 0.464 | 0.100 | 0.359 | 0.540 | 0.176 |
| | Right Tilt | 0.047 | 0.283 | 0.745 | 0.100 | 0.329 | 0.792 | 0.147 |
| Body-worn | Rear | 0.154 | 0.245 | 0.367 | 0.140 | 0.400 | 0.521 | 0.294 |
| | Front | 0.132 | 0.245 | 0.367 | 0.140 | 0.377 | 0.499 | 0.272 |
| Hotspot, Wi-Fi Direct, & BT Tethering | Rear | 0.353 | 0.542 | 0.661 | 0.210 | 0.895 | 1.014 | 0.563 |
| | Front | 0.293 | 0.387 | 0.433 | 0.210 | 0.680 | 0.726 | 0.503 |
| | Edge 1 | | 0.387 | 1.104 | 0.210 | | | 0.210 |
| | Edge 2 | | | | | | | |
| | Edge 3 | 0.171 | | | | | | |
| | Edge 4 | 0.144 | 0.387 | 0.433 | 0.210 | 0.531 | 0.577 | 0.354 |

**Conclusion:**

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


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

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) | | | | ∑ 1-g SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|
| | | WWAN ① | DTS ② | U-NII ③ | BT | WWAN + DTS + | WWAN + U-NII + | WWAN + BT + |
| Head | Left Touch | 0.143 | 0.283 | 0.745 | 0.100 | 0.425 | 0.888 | 0.243 |
| | Left Tilt | 0.105 | 0.283 | 0.835 | 0.100 | 0.387 | 0.940 | 0.205 |
| | Right Touch | 0.194 | 0.283 | 0.464 | 0.100 | 0.477 | 0.658 | 0.294 |
| | Right Tilt | 0.106 | 0.283 | 0.745 | 0.100 | 0.388 | 0.851 | 0.206 |
| Body-worn | Rear | 0.250 | 0.245 | 0.367 | 0.140 | 0.495 | 0.616 | 0.390 |
| | Front | 0.150 | 0.245 | 0.367 | 0.140 | 0.395 | 0.517 | 0.290 |
| Hotspot, Wi-Fi Direct, & BT Tethering | Rear | 0.589 | 0.542 | 0.661 | 0.210 | 1.131 | **1.250** | 0.799 |
| | Front | 0.210 | 0.387 | 0.433 | 0.210 | 0.597 | 0.643 | 0.420 |
| | Edge 1 | | 0.387 | 1.104 | 0.210 | | | 0.210 |
| | Edge 2 | | | | | | | |
| | Edge 3 | 0.259 | | | | | | |
| | Edge 4 | 0.057 | 0.387 | 0.433 | 0.210 | 0.444 | 0.490 | 0.267 |

**Conclusion:**

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

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

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) | | | | ∑ 1-g SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|
| | | WWAN ① | DTS ② | U-NII ③ | BT | WWAN + DTS + | WWAN + U-NII + | WWAN + BT + |
| Head | Left Touch | 0.157 | 0.283 | 0.745 | 0.100 | 0.440 | 0.902 | 0.257 |
| | Left Tilt | 0.098 | 0.283 | 0.835 | 0.100 | 0.380 | 0.933 | 0.198 |
| | Right Touch | 0.203 | 0.283 | 0.464 | 0.100 | 0.486 | 0.667 | 0.303 |
| | Right Tilt | 0.100 | 0.283 | 0.745 | 0.100 | 0.382 | 0.845 | 0.200 |
| Body-worn | Rear | 0.226 | 0.245 | 0.367 | 0.140 | 0.471 | 0.592 | 0.366 |
| | Front | 0.180 | 0.245 | 0.367 | 0.140 | 0.425 | 0.547 | 0.320 |
| Hotspot, Wi-Fi Direct, & BT Tethering | Rear | 0.535 | 0.542 | 0.661 | 0.210 | 1.077 | 1.196 | 0.745 |
| | Front | 0.209 | 0.387 | 0.433 | 0.210 | 0.596 | 0.642 | 0.419 |
| | Edge 1 | | 0.387 | 1.104 | 0.210 | | | 0.210 |
| | Edge 2 | | | | | | | |
| | Edge 3 | 0.244 | | | | | | |
| | Edge 4 | 0.072 | 0.387 | 0.433 | 0.210 | 0.459 | 0.505 | 0.282 |

**Conclusion:**

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


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## 12.7. Sum of the SAR for LTE Band 41 & Wi-Fi & BT

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) | | | | ∑ 1-g SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|
| | | WWAN ① | DTS ② | U-NII ③ | BT | WWAN + DTS + | WWAN + U-NII + | WWAN + BT + |
| Head | Left Touch | 0.263 | 0.283 | 0.745 | 0.100 | 0.545 | 1.008 | 0.363 |
| | Left Tilt | 0.212 | 0.283 | 0.835 | 0.100 | 0.495 | **1.047** | 0.312 |
| | Right Touch | 0.496 | 0.283 | 0.464 | 0.100 | **0.779** | 0.960 | **0.596** |
| | Right Tilt | 0.163 | 0.283 | 0.745 | 0.100 | 0.446 | 0.908 | 0.263 |
| Body-worn | Rear | 0.305 | 0.245 | 0.367 | 0.140 | 0.550 | 0.671 | 0.445 |
| | Front | 0.322 | 0.245 | 0.367 | 0.140 | 0.567 | 0.688 | 0.462 |
| Hotspot, Wi-Fi Direct, & BT Tethering | Rear | 0.572 | 0.542 | 0.661 | 0.210 | 1.114 | 1.233 | 0.782 |
| | Front | 0.619 | 0.387 | 0.433 | 0.210 | 1.006 | 1.052 | 0.829 |
| | Edge 1 | | 0.387 | 1.104 | 0.210 | | | 0.210 |
| | Edge 2 | 0.502 | | | | | | |
| | Edge 3 | 0.160 | | | | | | |
| | Edge 4 | | 0.387 | 0.433 | 0.210 | | | |

**Conclusion:**

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


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# Appendixes

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

**12440876-S1V1 Appendix A: SAR Setup Photos**

**12440876-S1V1 Appendix B: SAR System Check Plots**

**12440876-S1V1 Appendix C: Highest SAR Test Plots**

**12440876-S1V1 Appendix D: SAR Liquid Tissue Ingredients**

**12440876-S1V1 Appendix E: SAR Probe Calibration Certificates**

**12440876-S1V1 Appendix F: SAR Dipole Calibration Certificates**

**END OF REPORT**


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