# SAR EVALUATION REPORT

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

*For*
**Tablet**

**FCC ID: PY7TS-0040**

**Report Number: 14U17934-S1A**
**Issue Date: 9/17/2014**

*Prepared for*
**SONY MOBILE COMMUNICATIONS INC.**
**NYA VATTENTORNET MOBILVAGEN 10**
**LUND 22188**
**SWEDEN**

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NVLAP LAB CODE 200065-0

REVISION HISTORY

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| -- | 9/10/2014 | Initial Issue | -- |
| A | 9/17/2014 | Sec. 7.2.:Fixed typo to indicate WLAN instead of WWAN | Yu Chen |
| | | | |
| | | | |

## Table of Contents

# 1. Attestation of Test Results

| | | | | | |
|---|---|---|---|---|---|
| Applicant Name | SONY MOBILE COMMUNICATIONS, INC. | | | | |
| Application Purpose | ☒ Original Grant ☐ Class II Permissive Change | | | | |
| FCC ID | PY7TS-0040 | | | | |
| DUT Description | Tablet | | | | |
| Exposure Category | General Population/Uncontrolled Exposure (1g SAR limit: 1.6 W/kg) | | | | |
| The highest reported SAR | RF Exposure Conditions | Equipment Class | | | |
| | | Licensed | DTS | UNII | Bluetooth |
| | Stand-alone | N/A | 1.349 W/kg | 1.382 W/kg | 0.064 W/kg |
| | Simultaneous Transmission | N/A | N/A | 1.446 W/kg | 1.446 W/kg |
| Applicable Standards | FCC 47 CFR § 2.1093<br>Published RF exposure KDB procedures<br>IEEE Std 1528-2013 | | | | |
| Test Results | Pass | | | | |
| Date tested | 8/25/2014 – 9/9/2014 | | | | |

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: |
|---|---|
|  |  |
| Devin Chang<br>Senior Engineer<br>UL Verification Services Inc. | Yu Chen<br>Laboratory Technician<br>UL Verification Services Inc. |

# 2. Test Specification, Methods and Procedures

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

- 447498 D01 General RF Exposure Guidance v05r02
- 616217 D04 SAR for Laptop and Tablets v01r01
- 248227 D01 SAR Meas for 802 11abg v01r02
- 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- 865664 D02 SAR Reporting v01r01
- 690783 D01 SAR Listings on Grants v01r02

# 3. Facilities and Accreditation

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

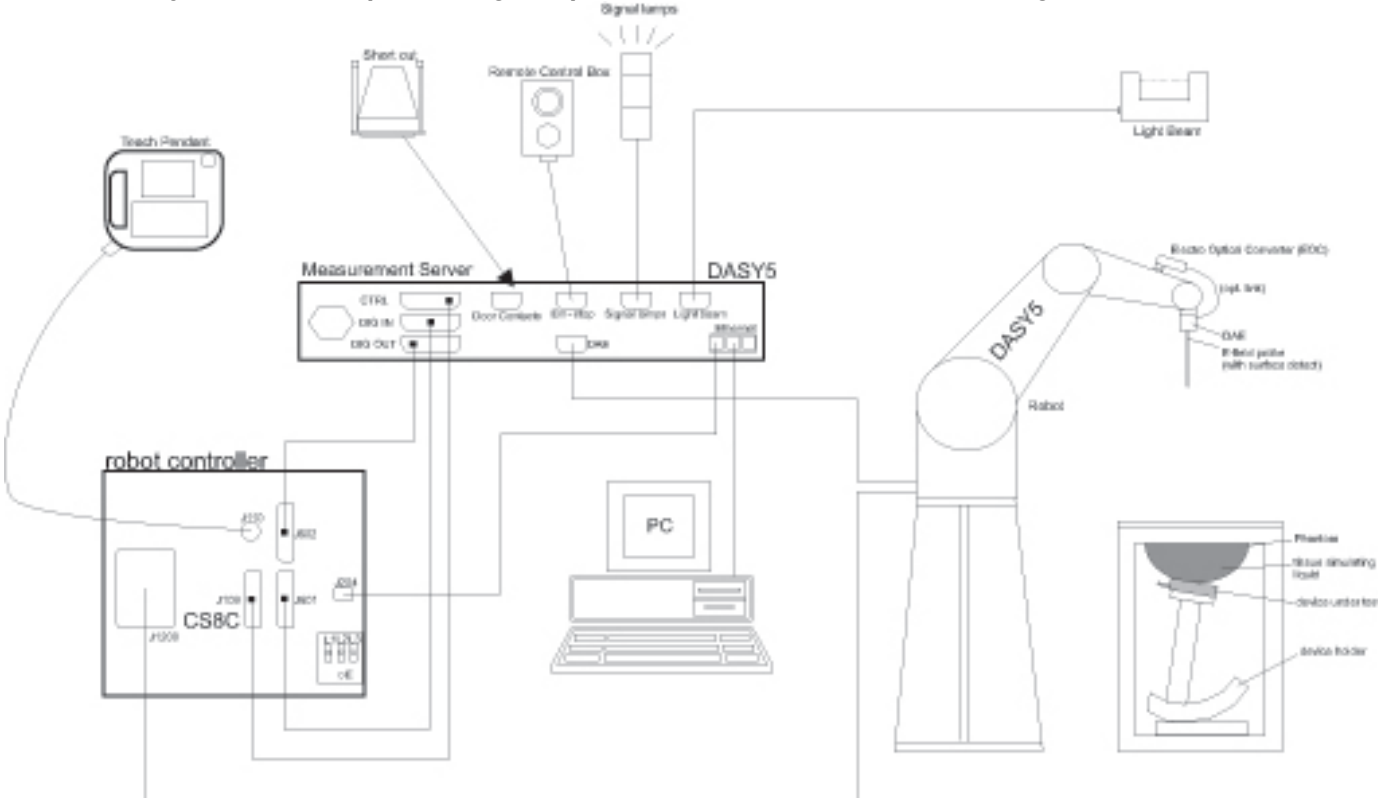
| 47173 Benicia Street | 47266 Benicia Street |
|---|---|
| SAR Lab A | SAR Lab 1 |
| SAR Lab B | SAR Lab 2 |
| SAR Lab C | SAR Lab 3 |
| SAR Lab D | SAR Lab 4 |
| SAR Lab E | SAR Lab 5 |
| SAR Lab F | |
| SAR Lab G | |
| SAR Lab H | |

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

# 4. SAR Measurement System & Test Equipment

## 4.1. SAR Measurement System

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




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

## 4.2. SAR Scan Procedure

**Step 1: Power Reference Measurement**

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

**Step 2: Area Scan**

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

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

| | ≤ 3 GHz | > 3 GHz |
|---|---|---|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | 5 ± 1 mm | ½·δ·ln(2) ± 0.5 mm |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location | 30° ± 1° | 20° ± 1° |
| Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$ | ≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm | 3 – 4 GHz: ≤ 12 mm<br>4 – 6 GHz: ≤ 10 mm |
| | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device. | |

**Step 3: Zoom Scan**

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

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

| | | | ≤ 3 GHz | > 3 GHz |
|---|---|---|---|---|
| Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$ | | | ≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm* | 3 – 4 GHz: ≤ 5 mm*<br>4 – 6 GHz: ≤ 4 mm* |
| Maximum zoom scan spatial resolution, normal to phantom surface | uniform grid: $\Delta z_{Zoom}(n)$ | | ≤ 5 mm | 3 – 4 GHz: ≤ 4 mm<br>4 – 5 GHz: ≤ 3 mm<br>5 – 6 GHz: ≤ 2 mm |
| | graded grid | $\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface | ≤ 4 mm | 3 – 4 GHz: ≤ 3 mm<br>4 – 5 GHz: ≤ 2.5 mm<br>5 – 6 GHz: ≤ 2 mm |
| | | $\Delta z_{Zoom}(n>1)$: between subsequent points | ≤ 1.5·$\Delta z_{Zoom}(n-1)$ | |
| Minimum zoom scan volume | x, y, z | | ≥ 30 mm | 3 – 4 GHz: ≥ 28 mm<br>4 – 5 GHz: ≥ 25 mm<br>5 – 6 GHz: ≥ 22 mm |

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the area scan based *1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

**Step 4: Power drift measurement**

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

**Step 5: Z-Scan (FCC only)**

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

## 4.3. Test Equipment

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

**Dielectric Property Measurements**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| Network Analyzer | Agilent | ENA Series/E5071B | MY42100131 | 2/24/2015 |
| Dielectronic Probe kit | SPEAG | DAK-3.5 | 1087 | 11/13/2014 |
| Dielectronic Probe kit | SPEAG | DAK-3.5 Short | SM DAK 200 BA | N/A |
| Thermometer | Control Company | 4242 | 122529163 | 9/19/2014 |
| Thermometer | EXTECH | 445703 | CCS-200 | 3/24/2015 |

**System Check**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| Synthesized Signal Generator | HP | 8665B | 3744A01155 | 5/12/2015 |
| Power Meter | HP | 438A | 3513U04320 | 10/2/2014 |
| Power Sensor | Agilent | 8481A | 2702A66876 | 9/30/2014 |
| Power Sensor | Agilent | 8481A | 3318A95392 | 9/30/2014 |
| Amplifier | MITEQ | AMF-4D-00400600-50-30P | 1622052 | N/A |
| Bi-directional coupler | Werlatone, Inc. | C8060-102 | 2711 | N/A |
| DC Power Supply | HP | 6296A | 2841A-05955 | N/A |
| E-Field Probe (SAR 3) | SPEAG | EX3DV4 | 3773 | 4/22/2015 |
| E-Field Probe (SAR 4) | SPEAG | EX3DV4 | 3929 | 5/9/2015 |
| Data Acquisition Electronics (SAR 3) | SPEAG | DAE4 | 1380 | 7/23/2015 |
| Data Acquisition Electronics (SAR 4) | SPEAG | DAE4 | 1352 | 9/11/2014 |
| System Validation Dipole | SPEAG | D2450V2 | 706 | 5/20/2015 |
| System Validation Dipole | SPEAG | D5GHzV2 | 1138 | 11/19/2014 |
| Thermometer (SAR Lab 3) | EXTECH | 445703 | CCS-237 | 6/3/2015 |
| Thermometer (SAR Lab 4) | EXTECH | 445703 | CCS-238 | 6/3/2015 |

**Others**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| Power Meter | Agilent | N1912A | MY53040015 | 7/10/2015 |
| Power Sensor | Agilent | N1921A | MY52020011 | 5/6/2015 |
| Power Sensor | Agilent | N1921A | MY52200012 | 9/25/2014 |
| Bluetooth Tester | R & S | CBT | 100987-ww | 4/21/2015 |

# 5. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2003 & 2013 is not required in SAR reports submitted for equipment approval.

# 6. Device Under Test (DUT) Information

## 6.1. DUT Description

| | |
|---|---|
| Device Dimension | Refer to Appendix 14.1 |
| Battery Back Cover | The rechargeable battery is not user accessible. |
| Battery Options | The rechargeable battery is not user accessible. |
| Wi-Fi Direct | Wi-Fi Direct enabled devices transfer data directly between each other<br>☒ Wi-Fi Direct (Wi-Fi 2.4 GHz)<br>☒ Wi-Fi Direct (Wi-Fi 5 GHz) (Group Client only) |

## 6.2. Wireless Technologies

| Wireless technologies | Frequency bands | Operating mode | Duty Cycle used for SAR testing |
|---|---|---|---|
| Wi-Fi | 2.4 GHz | 802.11b<br>802.11g<br>802.11n (HT20) | 100% |
| | 5 GHz | 802.11a<br>802.11n (HT20)<br>802.11n (HT40)<br>802.11ac (VHT20)<br>802.11ac (VHT40)<br>802.11ac (VHT80) | 100% |
| Bluetooth | 2.4 GHz | Version 4.0 LE | 32.25% (DH1), 66.68% (DH3), 77.52% (DH5) |

## 6.3. Nominal and Maximum Output Power

| RF Air interface | Mode | Full Power<br>Max. Tune-up Limit (dBm) |
|---|---|---|
| Wi-Fi 2.4 GHz | 802.11b | **14.0** |
| | 802.11g | **13.5** |
| | 802.11n HT20 | **13.5** |
| Wi-Fi 5 GHz | 802.11a | **12.5** |
| | 802.11n HT20 | **12.5** |
| | 802.11n HT40 | **12.5** |
| | 802.11ac VHT20 | **12.5** |
| | 802.11ac VHT40 | **12.5** |
| | 802.11ac VHT80 | **12.5** |
| Bluetooth | BDR | **10.5** |
| | EDR | **7.9** |
| | BLE | **2.4** |

## 6.4. Simultaneous Transmission Condition

| RF Exposure Condition | Capable Transmit Configurations |
|---|---|
| Body | 1. Wi-Fi 5GHz + BT |

Notes:
1. Wi-Fi 2.4/5 GHz supports MIMO only.
2. Wi-Fi 2.4 GHz Radio cannot transmit simultaneously with Wi-Fi 5 GHz Radio.
3. Wi-Fi 2.4 GHz Radio cannot transmit simultaneously with Bluetooth Radio.
4. Wi-Fi 5 GHz Radio can transmit simultaneously with Bluetooth Radio.

# 7. RF Exposure Conditions (Test Configurations)

The EUT implements the power reduction scheme for SAR compliance, for specific device configuration and orientations, as described below. The complete description of the implementation and functionality is provided in the "Operational Description of Power Reduction" exhibit.

## 7.1. Standalone SAR Test Exclusion Considerations

Since the *Dedicated Host Approach* is applied, the standalone SAR test exclusion procedure in KDB 447498 § 4.3.1 is applied in conjunction with KDB 616217 § 4.3 to determine the minimum test separation distance:

- When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.
- When the separation distance from the antenna to an adjacent edge is > 5 mm, the actual antenna-to-edge separation distance is applied to determine SAR test exclusion.

**SAR Test Exclusion Calculations for WLAN**

**Antennas < 50mm to adjacent edges**

MIMO

| Tx Interface | Frequency (MHz) | Output Power | | Separation Distances (mm) | | | | | | Calculated Threshold Value | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | dBm | mW | Rear | Edge 1 | Edge 2 | Edge 3 | Edge 4 | Front | Rear | Edge 1 | Edge 2 | Edge 3 | Edge 4 | Front |
| **Wi-Fi Main Antenna** | | | | | | | | | | | | | | | |
| Wi-Fi 2.4 GHz | 2462 | 14.00 | 25 | 2.46 | 187.7 | 55.1 | 3 | 36 | | 7.8 -MEASURE- | > 50 mm | > 50 mm | 7.8 -MEASURE- | 1.1 -EXEMPT- | |
| Wi-Fi 5.2 GHz | 5240 | 12.50 | 18 | 2.46 | 187.7 | 55.1 | 3 | 36 | | 8.2 -MEASURE- | > 50 mm | > 50 mm | 8.2 -MEASURE- | 1.1 -EXEMPT- | |
| Wi-Fi 5.3 GHz | 5320 | 12.50 | 18 | 2.46 | 187.7 | 55.1 | 3 | 36 | | 8.3 -MEASURE- | > 50 mm | > 50 mm | 8.3 -MEASURE- | 1.2 -EXEMPT- | |
| Wi-Fi 5.5 GHz | 5700 | 12.50 | 18 | 2.46 | 187.7 | 55.1 | 3 | 36 | | 8.6 -MEASURE- | > 50 mm | > 50 mm | 8.6 -MEASURE- | 1.2 -EXEMPT- | |
| Wi-Fi 5.8 GHz | 5825 | 12.50 | 18 | 2.46 | 187.7 | 55.1 | 3 | 36 | | 8.7 -MEASURE- | > 50 mm | > 50 mm | 8.7 -MEASURE- | 1.2 -EXEMPT- | |
| Bluetooth | 2480 | 10.50 | 11 | 2.46 | 187.7 | 55.1 | 3 | 36 | | 3.5 -MEASURE- | > 50 mm | > 50 mm | 3.5 -MEASURE- | 0.5 -EXEMPT- | |
| **Wi-Fi Sub Antenna** | | | | | | | | | | | | | | | |
| Wi-Fi 2.4 GHz | 2462 | 14.00 | 25 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | 7.8 -MEASURE- | > 50 mm | 4.4 -MEASURE- | 7.8 -MEASURE- | > 50 mm | |
| Wi-Fi 5.2 GHz | 5240 | 12.50 | 18 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | 8.2 -MEASURE- | > 50 mm | 4.6 -MEASURE- | 8.2 -MEASURE- | > 50 mm | |
| Wi-Fi 5.3 GHz | 5320 | 12.50 | 18 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | 8.3 -MEASURE- | > 50 mm | 4.6 -MEASURE- | 8.3 -MEASURE- | > 50 mm | |
| Wi-Fi 5.5 GHz | 5700 | 12.50 | 18 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | 8.6 -MEASURE- | > 50 mm | 4.8 -MEASURE- | 8.6 -MEASURE- | > 50 mm | |
| Wi-Fi 5.8 GHz | 5825 | 12.50 | 18 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | 8.7 -MEASURE- | > 50 mm | 4.8 -MEASURE- | 8.7 -MEASURE- | > 50 mm | |

**Note(s):**

1. According to KDB 447498, if the calculated threshold value is >3 then SAR testing is required.

**Antennas > 50mm to adjacent edges**

MIMO

| Tx Interface | Frequency (MHz) | Output Power | | Separation Distances (mm) | | | | | | Calculated Threshold Value | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | dBm | mW | Rear | Edge 1 | Edge 2 | Edge 3 | Edge 4 | Front | Rear | Edge 1 | Edge 2 | Edge 3 | Edge 4 | Front |
| **Wi-Fi Main Antenna** | | | | | | | | | | | | | | | |
| Wi-Fi 2.4 GHz | 2462 | 14.00 | 25 | 2.46 | 187.7 | 55.1 | 3 | 36 | | < 50 mm | 1472.6 mW -EXEMPT- | 146.6 mW -EXEMPT- | < 50 mm | < 50 mm | |
| Wi-Fi 5.2 GHz | 5240 | 12.50 | 18 | 2.46 | 187.7 | 55.1 | 3 | 36 | | < 50 mm | 1442.5 mW -EXEMPT- | 116.5 mW -EXEMPT- | < 50 mm | < 50 mm | |
| Wi-Fi 5.3 GHz | 5320 | 12.50 | 18 | 2.46 | 187.7 | 55.1 | 3 | 36 | | < 50 mm | 1442 mW -EXEMPT- | 116 mW -EXEMPT- | < 50 mm | < 50 mm | |
| Wi-Fi 5.5 GHz | 5700 | 12.50 | 18 | 2.46 | 187.7 | 55.1 | 3 | 36 | | < 50 mm | 1439.8 mW -EXEMPT- | 113.8 mW -EXEMPT- | < 50 mm | < 50 mm | |
| Wi-Fi 5.8 GHz | 5825 | 12.50 | 18 | 2.46 | 187.7 | 55.1 | 3 | 36 | | < 50 mm | 1439.2 mW -EXEMPT- | 113.2 mW -EXEMPT- | < 50 mm | < 50 mm | |
| Bluetooth | 2480 | 10.50 | 11 | 2.46 | 187.7 | 55.1 | 3 | 36 | | < 50 mm | 1472.3 mW -EXEMPT- | 146.3 mW -EXEMPT- | < 50 mm | < 50 mm | |
| **Wi-Fi Sub Antenna** | | | | | | | | | | | | | | | |
| Wi-Fi 2.4 GHz | 2462 | 14.00 | 25 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | < 50 mm | 1472.6 mW -EXEMPT- | < 50 mm | < 50 mm | 502.4 mW -EXEMPT- | |
| Wi-Fi 5.2 GHz | 5240 | 12.50 | 18 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | < 50 mm | 1442.5 mW -EXEMPT- | < 50 mm | < 50 mm | 472.4 mW -EXEMPT- | |
| Wi-Fi 5.3 GHz | 5320 | 12.50 | 18 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | < 50 mm | 1442 mW -EXEMPT- | < 50 mm | < 50 mm | 471.9 mW -EXEMPT- | |
| Wi-Fi 5.5 GHz | 5700 | 12.50 | 18 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | < 50 mm | 1439.8 mW -EXEMPT- | < 50 mm | < 50 mm | 469.7 mW -EXEMPT- | |
| Wi-Fi 5.8 GHz | 5825 | 12.50 | 18 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | < 50 mm | 1439.2 mW -EXEMPT- | < 50 mm | < 50 mm | 469 mW -EXEMPT- | |

**Note(s):**

1. According to KDB 447498, if the calculated Power threshold is less than the output power then SAR testing is required.

## 7.2. Required Test Configurations

The table below identifies the standalone WLAN test configurations required for this device according to the findings in Section 7.1:

| Test Configurations | Rear | Edge 1 (Top Edge) | Edge 2 (Right Edge ) | Edge 3 (Bottom Edge) | Edge 4 (Left Edge) |
|---|---|---|---|---|---|
| Wi-Fi 2.4 GHz MIMO | Yes | No | Yes | Yes | No |
| Wi-Fi 5 GHz MIMO | Yes | No | Yes | Yes | No |
| Bluetooth | Yes | No | No | Yes | No |

**Note(s):**

1. Yes = Testing is required.
2. No = Testing is not required.

# 8. RF Output Power Measurement

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

Required Test Channels per KDB 248227 D01

**Measured Results**

| Band (GHz) | Mode | Data Rate | Ch # | Freq. (MHz) | Main Ant | Sub Ant | SAR Test (Yes/No) |
|---|---|---|---|---|---|---|---|
| | | | | | Avg Pwr (dBm) | | |
| 2.4 (DTS) | 802.11b | 1 Mbps | 1 | 2412 | 13.8 | 13.8 | Yes |
| | | | 6 | 2437 | 13.8 | 13.6 | |
| | | | 11 | 2462 | 13.6 | 13.8 | |
| | 802.11g | 6 Mbps | 1 | 2412 | 13.7 | 13.7 | No |
| | | | 6 | 2437 | 13.7 | 13.6 | |
| | | | 11 | 2462 | 13.6 | 13.7 | |
| | 802.11n (HT20) | MCS0 | 1 | 2412 | 13.8 | 13.7 | No |
| | | | 6 | 2437 | 13.8 | 13.7 | |
| | | | 11 | 2462 | 13.6 | 13.8 | |

**Note(s):**

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

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

| Mode | Ch # | Freq. (MHz) | Data Rate | Main Ant | Sub Ant | SAR test (Yes/No) |
|---|---|---|---|---|---|---|
| | | | | Avg Pwr (dBm) | | |
| 802.11b | 11 | 2462 | 1 Mbps | 13.8 | 13.8 | Yes |
| | | | 2 Mbps | 13.8 | 13.7 | No |
| | | | 5.5 Mbps | 13.7 | 13.7 | No |
| | | | 11 Mbps | 13.7 | 13.6 | No |

## 8.2. Wi-Fi (5 GHz Bands)

Required Test Channels per KDB 248227 D01

**Measured Results**

| Band (GHz) | Mode | Data Rate | Ch # | Freq. (MHz) | Main Ant Avg Pwr (dBm) | Sub Ant Avg Pwr (dBm) | SAR Test (Yes/No) |
|---|---|---|---|---|---|---|---|
| 5.2 (U-NII-1) | 802.11a | 6 Mbps | 36 | 5180 | 12.3 | 11.8 | Yes |
| | | | 40 | 5200 | 12.4 | 11.8 | |
| | | | 44 | 5220 | 12.3 | 11.8 | |
| | | | 48 | 5240 | 12.5 | 11.8 | |
| | 802.11n (HT20) | MCS0 | 36 | 5180 | 12.3 | 11.9 | No |
| | | | 40 | 5200 | 12.3 | 11.8 | |
| | | | 48 | 5240 | 12.3 | 11.8 | |
| | 802.11n (HT40) | MCS0 | 38 | 5190 | 12.3 | 11.9 | No |
| | | | 46 | 5230 | 12.3 | 11.8 | |
| | 802.11ac (VHT20) | MCS0 | 36 | 5180 | 12.3 | 11.8 | Yes |
| | | | 40 | 5200 | 12.3 | 11.8 | |
| | | | 48 | 5240 | 12.3 | 11.9 | |
| | 802.11ac (VHT40) | MCS0 | 38 | 5190 | 12.4 | 11.9 | No |
| | | | 46 | 5230 | 12.4 | 11.9 | |
| | 802.11ac (VHT80) | MCS0 | 42 | 5210 | 12.3 | 11.8 | No |
| 5.3 (U-NII-2A) | 802.11a | 6 Mbps | 52 | 5260 | 12.5 | 11.6 | Yes |
| | | | 56 | 5280 | 12.3 | 11.7 | |
| | | | 60 | 5300 | 12.3 | 11.7 | |
| | | | 64 | 5320 | 12.3 | 11.9 | |
| | 802.11n (HT20) | MCS0 | 52 | 5260 | 12.3 | 11.9 | No |
| | | | 60 | 5300 | 12.3 | 11.9 | |
| | | | 64 | 5320 | 12.3 | 11.9 | |
| | 802.11n (HT40) | MCS0 | 54 | 5270 | 12.4 | 11.9 | No |
| | | | 62 | 5310 | 12.4 | 11.8 | |
| | 802.11ac (VHT20) | MCS0 | 52 | 5260 | 12.4 | 11.9 | Yes |
| | | | 60 | 5300 | 12.3 | 11.9 | |
| | | | 64 | 5320 | 12.3 | 11.9 | |
| | 802.11ac (VHT40) | MCS0 | 54 | 5270 | 12.4 | 11.9 | No |
| | | | 62 | 5310 | 12.4 | 11.9 | |
| | 802.11ac (VHT80) | MCS0 | 58 | 5290 | 12.4 | 11.9 | No |

**Wi-Fi (5 GHz Bands) Measured Results (continued)**

| Band (GHz) | Mode | Mode | Ch # | Freq. (MHz) | Main Ant | Sub Ant | SAR Test (Yes/No) |
|---|---|---|---|---|---|---|---|
| | | | | | Avg Pwr (dBm) | | |
| 5.5 (U-NII-2C) | 802.11a | 6 Mbps | 100 | 5500 | 12.2 | 12.4 | Yes |
| | | | 104 | 5520 | 12.1 | 12.4 | |
| | | | 108 | 5540 | 12.0 | 12.4 | |
| | | | 112 | 5560 | 12.1 | 12.4 | |
| | | | 116 | 5580 | 12.1 | 12.4 | |
| | | | 120 | 5600 | 11.8 | 12.3 | |
| | | | 124 | 5620 | 11.8 | 12.3 | |
| | | | 128 | 5640 | 11.8 | 12.4 | |
| | | | 132 | 5660 | 12.1 | 12.4 | |
| | | | 136 | 5680 | 11.8 | 12.4 | |
| | | | 140 | 5700 | 11.9 | 12.4 | |
| | 802.11n (HT20) | MCS0 | 100 | 5500 | 12.4 | 12.4 | No |
| | | | 116 | 5580 | 12.2 | 12.4 | |
| | | | 140 | 5700 | 11.9 | 12.4 | |
| | 802.11n (HT40) | MCS0 | 102 | 5510 | 12.2 | 12.4 | No |
| | | | 110 | 5550 | 12.0 | 12.4 | |
| | | | 134 | 5670 | 11.9 | 12.4 | |
| | 802.11ac (VHT20) | MCS0 | 100 | 5500 | 12.2 | 12.4 | Yes |
| | | | 116 | 5580 | 12.1 | 12.4 | |
| | | | 140 | 5700 | 11.9 | 12.4 | |
| | 802.11ac (VHT40) | MCS0 | 102 | 5510 | 12.2 | 12.4 | No |
| | | | 110 | 5550 | 12.0 | 12.4 | |
| | | | 134 | 5670 | 11.9 | 12.4 | |
| | 802.11ac (VHT80) | MCS0 | 106 | 5530 | 12.0 | 12.3 | No |
| | | | 122 | 5610 | 12.2 | 12.4 | |
| 5.8 (U-NII-3) | 802.11a | 6 Mbps | 149 | 5745 | 11.8 | 12.5 | Yes |
| | | | 153 | 5765 | 11.6 | 12.4 | |
| | | | 157 | 5785 | 11.7 | 12.4 | |
| | | | 161 | 5805 | 11.6 | 12.3 | |
| | | | 165 | 5825 | 11.7 | 12.4 | |
| | 802.11n (HT20) | MCS0 | 149 | 5745 | 11.7 | 12.3 | No |
| | | | 157 | 5785 | 11.7 | 12.3 | |
| | | | 161 | 5805 | 11.7 | 12.3 | |
| | 802.11n (HT40) | MCS0 | 151 | 5755 | 11.6 | 12.3 | No |
| | | | 159 | 5795 | 11.5 | 12.3 | |
| | 802.11ac (VHT20) | MCS0 | 149 | 5745 | 11.5 | 12.3 | Yes |
| | | | 157 | 5785 | 11.6 | 12.4 | |
| | | | 165 | 5825 | 11.7 | 12.4 | |
| | 802.11ac (VHT40) | MCS0 | 151 | 5755 | 11.7 | 12.3 | No |
| | | | 159 | 5795 | 11.7 | 12.4 | |
| | 802.11ac (VHT80) | MCS0 | 155 | 5775 | 11.8 | 12.3 | No |

**Note(s):**

Per KDB 248227, SAR is not required for 802.11n HT20/HT40 and 802.11ac VHT40/VHT80 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a channels.

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

| Band | Mode | Ch # | Freq. (MHz) | Data Rate | Main Ant | Sub Ant | SAR test (Yes/No) |
|---|---|---|---|---|---|---|---|
| | | | | | Avg Pwr (dBm) | | |
| 5.2 GHz (U-NII-1) | 802.11a | 48 | 5180 | 6 Mbps | 12.5 | 11.8 | Yes |
| | | | | 9 Mbps | 12.4 | 11.8 | No |
| | | | | 12 Mbps | 12.5 | 11.7 | No |
| | | | | 18 Mbps | 12.4 | 11.8 | No |
| | | | | 24 Mbps | 12.5 | 11.9 | No |
| | | | | 36 Mbps | 12.5 | 11.9 | No |
| | | | | 48 Mbps | 12.5 | 12.0 | No |
| | | | | 54 Mbps | 12.5 | 12.0 | No |
| 5.3 GHz (U-NII-2A) | 802.11a | 64 | 5280 | 6 Mbps | 12.5 | 11.6 | Yes |
| | | | | 9 Mbps | 12.5 | 11.7 | No |
| | | | | 12 Mbps | 12.4 | 11.7 | No |
| | | | | 18 Mbps | 12.4 | 11.7 | No |
| | | | | 24 Mbps | 12.5 | 11.9 | No |
| | | | | 36 Mbps | 12.5 | 11.9 | No |
| | | | | 48 Mbps | 12.5 | 11.9 | No |
| | | | | 54 Mbps | 12.4 | 11.9 | No |
| 5.5 GHz (U-NII-2C) | 802.11a | 104 | 5580 | 6 Mbps | 12.2 | 12.4 | Yes |
| | | | | 9 Mbps | 12.1 | 12.3 | No |
| | | | | 12 Mbps | 12.1 | 12.3 | No |
| | | | | 18 Mbps | 12.1 | 12.3 | No |
| | | | | 24 Mbps | 12.3 | 12.4 | No |
| | | | | 36 Mbps | 12.3 | 12.3 | No |
| | | | | 48 Mbps | 12.3 | 12.3 | No |
| | | | | 54 Mbps | 12.2 | 12.3 | No |
| 5.8 GHz (U-NII-3) | 802.11a | 165 | 5745 | 6 Mbps | 11.8 | 12.5 | Yes |
| | | | | 9 Mbps | 11.7 | 12.4 | No |
| | | | | 12 Mbps | 11.7 | 12.4 | No |
| | | | | 18 Mbps | 11.8 | 12.4 | No |
| | | | | 24 Mbps | 11.8 | 12.5 | No |
| | | | | 36 Mbps | 11.7 | 12.5 | No |
| | | | | 48 Mbps | 11.7 | 12.5 | No |
| | | | | 54 Mbps | 11.6 | 12.5 | No |

## 8.3. Bluetooth

| Band (MHz) | Mode | Ch # | Freq. (MHz) | Freq. (MHz) | Conducted Avg Power | |
|---|---|---|---|---|---|---|
| | | | | | (dBm) | (mW) |
| 2.4 | V3.0 + EDR, GFSK | 0 | 2402 | 2412 | 5.4 | 3.47 |
| | | 39 | 2441 | 2437 | 8.8 | 7.59 |
| | | 78 | 2480 | 2462 | 8.6 | 7.24 |
| | V3.0 + EDR, π/4 DQPSK | 0 | 2402 | 2412 | 3.0 | 2.00 |
| | | 39 | 2441 | 2437 | 6.3 | 4.27 |
| | | 78 | 2480 | 2462 | 5.8 | 3.80 |
| | V3.0 + EDR, 8-DPSK | 0 | 2402 | 2412 | 3.0 | 2.00 |
| | | 39 | 2441 | 2437 | 6.3 | 4.27 |
| | | 78 | 2480 | 2462 | 5.7 | 3.72 |
| | V4.0 LE, GFSK | 0 | 2402 | 2422 | -3.9 | 0.41 |
| | | 19 | 2440 | 2437 | -0.4 | 0.91 |
| | | 39 | 2480 | 2452 | -1.6 | 0.69 |

# 9. 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.

## 9.1. 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

## 9.2. Dielectric Property Measurements Results

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.
The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.
Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.

**SAR Lab 3**

| Date | Freq. (MHz) | Liquid Parameters | | | Measured | Target | Delta (%) | Limit ±(%) |
|---|---|---|---|---|---|---|---|---|
| 9/8/2014 | Body 2450 | e' | 52.1200 | Relative Permittivity ($\epsilon_r$): | 52.12 | 52.70 | -1.10 | 5 |
| | | e'' | 14.9700 | Conductivity (σ): | 2.04 | 1.95 | 4.58 | 5 |
| | Body 2410 | e' | 52.2300 | Relative Permittivity ($\epsilon_r$): | 52.23 | 52.76 | -1.00 | 5 |
| | | e'' | 14.9000 | Conductivity (σ): | 2.00 | 1.91 | 4.68 | 5 |
| | Body 2475 | e' | 52.0600 | Relative Permittivity ($\epsilon_r$): | 52.06 | 52.67 | -1.16 | 5 |
| | | e'' | 15.0300 | Conductivity (σ): | 2.07 | 1.99 | 4.19 | 5 |

**SAR Lab 4**

| Date | Freq. (MHz) | Liquid Parameters | | | Measured | Target | Delta (%) | Limit ±(%) |
|---|---|---|---|---|---|---|---|---|
| 8/25/2014 | Body 5180 | e' | 47.5000 | Relative Permittivity ($\epsilon_r$): | 47.50 | 49.05 | -3.15 | 5 |
| | | e'' | 18.4800 | Conductivity (σ): | 5.32 | 5.27 | 0.97 | 5 |
| | Body 5200 | e' | 47.4700 | Relative Permittivity ($\epsilon_r$): | 47.47 | 49.02 | -3.16 | 5 |
| | | e'' | 18.5100 | Conductivity (σ): | 5.35 | 5.29 | 1.08 | 5 |
| | Body 5600 | e' | 46.8000 | Relative Permittivity ($\epsilon_r$): | 46.80 | 48.48 | -3.46 | 5 |
| | | e'' | 18.8500 | Conductivity (σ): | 5.87 | 5.76 | 1.88 | 5 |
| | Body 5800 | e' | 46.4800 | Relative Permittivity ($\epsilon_r$): | 46.48 | 48.20 | -3.57 | 5 |
| | | e'' | 19.0600 | Conductivity (σ): | 6.15 | 6.00 | 2.45 | 5 |
| | Body 5825 | e' | 46.4400 | Relative Permittivity ($\epsilon_r$): | 46.44 | 48.20 | -3.65 | 5 |
| | | e'' | 19.0900 | Conductivity (σ): | 6.18 | 6.00 | 3.05 | 5 |
| 8/29/2014 | Body 5180 | e' | 47.8700 | Relative Permittivity ($\epsilon_r$): | 47.87 | 49.05 | -2.40 | 5 |
| | | e'' | 18.1600 | Conductivity (σ): | 5.23 | 5.27 | -0.78 | 5 |
| | Body 5200 | e' | 47.8400 | Relative Permittivity ($\epsilon_r$): | 47.84 | 49.02 | -2.41 | 5 |
| | | e'' | 18.1800 | Conductivity (σ): | 5.26 | 5.29 | -0.72 | 5 |
| | Body 5600 | e' | 47.2900 | Relative Permittivity ($\epsilon_r$): | 47.29 | 48.48 | -2.45 | 5 |
| | | e'' | 18.5000 | Conductivity (σ): | 5.76 | 5.76 | -0.01 | 5 |
| | Body 5800 | e' | 46.9800 | Relative Permittivity ($\epsilon_r$): | 46.98 | 48.20 | -2.53 | 5 |
| | | e'' | 18.6200 | Conductivity (σ): | 6.00 | 6.00 | 0.08 | 5 |
| | Body 5825 | e' | 46.9300 | Relative Permittivity ($\epsilon_r$): | 46.93 | 48.20 | -2.63 | 5 |
| | | e'' | 18.6500 | Conductivity (σ): | 6.04 | 6.00 | 0.68 | 5 |
| 9/2/2014 | Body 5180 | e' | 48.8200 | Relative Permittivity ($\epsilon_r$): | 48.82 | 49.05 | -0.46 | 5 |
| | | e'' | 18.1000 | Conductivity (σ): | 5.21 | 5.27 | -1.10 | 5 |
| | Body 5200 | e' | 48.7900 | Relative Permittivity ($\epsilon_r$): | 48.79 | 49.02 | -0.47 | 5 |
| | | e'' | 18.1600 | Conductivity (σ): | 5.25 | 5.29 | -0.83 | 5 |
| | Body 5600 | e' | 48.2100 | Relative Permittivity ($\epsilon_r$): | 48.21 | 48.48 | -0.55 | 5 |
| | | e'' | 18.4500 | Conductivity (σ): | 5.74 | 5.76 | -0.28 | 5 |
| | Body 5800 | e' | 47.8200 | Relative Permittivity ($\epsilon_r$): | 47.82 | 48.20 | -0.79 | 5 |
| | | e'' | 18.7100 | Conductivity (σ): | 6.03 | 6.00 | 0.57 | 5 |
| | Body 5825 | e' | 47.8200 | Relative Permittivity ($\epsilon_r$): | 47.82 | 48.20 | -0.79 | 5 |
| | | e'' | 18.7600 | Conductivity (σ): | 6.08 | 6.00 | 1.27 | 5 |

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

## 10.1. Reference Target SAR Values

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

| System Dipole | Serial No. | Cal. Date | Freq. (MHz) | Target SAR Values (W/kg) | | |
|---|---|---|---|---|---|---|
| | | | | 1g/10g | Head | Body |
| D2450V2 | 706 | 5/20/2014 | 2450 | 1g | 53.0 | 50.2 |
| | | | | 10g | 24.5 | 23.4 |
| D5GHzV2 | 1138 | 11/19/2013 | 5200 | 1g | 78.5 | 72.9 |
| | | | | 10g | 22.5 | 20.4 |
| | | | 5600 | 1g | 82.7 | 78.3 |
| | | | | 10g | 23.5 | 21.7 |
| | | | 5800 | 1g | 78.3 | 72.8 |
| | | | | 10g | 22.4 | 20.1 |

## 10.2. System Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within 10% of the manufacturer calibrated dipole SAR target.

**SAR Lab 3**

| Date Tested | System Dipole | | T.S. Liquid | | Measured Results | | | Target (Ref. Value) | Delta ±10 % | Est./Zoom Ratio | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type | Serial # | | | Area Scan | Zoom Scan | Normalize to 1 W | | | | |
| 9/8/2014 | D2450V2 | 706 | Body | 1g | 5.61 | 5.39 | 53.9 | 50.2 | 7.37 | 3.92 | 1,2 |
| | | | | 10g | 2.44 | 2.49 | 24.9 | 23.4 | 6.41 | | |

**SAR Lab 4**

| Date Tested | System Dipole | | T.S. Liquid | | Measured Results | | | Target (Ref. Value) | Delta ±10 % | Est./Zoom Ratio | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type | Serial # | | | Area Scan | Zoom Scan | Normalize to 1 W | | | | |
| 8/25/2014 | D5GHzV2 (5.2 GHz) | 1138 | Body | 1g | 6.95 | 7.44 | 74.4 | 72.9 | 2.06 | -7.05 | |
| | | | | 10g | 1.92 | 2.15 | 21.5 | 20.4 | 5.39 | | |
| 8/25/2014 | D5GHzV2 (5.6 GHz) | 1138 | Body | 1g | 7.59 | 8.09 | 80.9 | 78.3 | 3.32 | -6.59 | |
| | | | | 10g | 2.04 | 2.30 | 23.0 | 21.7 | 5.99 | | |
| 8/25/2014 | D5GHzV2 (5.8 GHz) | 1138 | Body | 1g | 7.10 | 7.60 | 76.0 | 72.8 | 4.40 | -7.04 | 3,4 |
| | | | | 10g | 1.93 | 2.17 | 21.7 | 20.1 | 7.96 | | |
| 8/29/2014 | D5GHzV2 (5.6 GHz) | 1138 | Body | 1g | 7.49 | 7.98 | 79.8 | 78.3 | 1.92 | -6.54 | |
| | | | | 10g | 2.02 | 2.26 | 22.6 | 21.7 | 4.15 | | |
| 9/2/2014 | D5GHzV2 (5.6 GHz) | 1138 | Body | 1g | 7.36 | 7.90 | 79.0 | 78.3 | 0.89 | -7.34 | |
| | | | | 10g | 1.99 | 2.24 | 22.4 | 21.7 | 3.23 | | |

# 11. Measured and Reported (Scaled) SAR Results

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

**KDB 447498 D01 General RF Exposure Guidance:**
Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

- ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

**KDB 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 248227 D01 SAR Measurements Procedures for 802.11 a/b/g Transmitters v01r02 (pg.6):**
Each channel should be tested at the lowest data rate in each a-b/g mode or 4.9 GHz channel BW configuration.
When the extrapolated maximum peak SAR for the maximum output channel is ≤ 1.6 W/kg and the 1-g averaged SAR is ≤ 0.8 W/kg, testing of other channels in the “default test channels” or “required test channels” configuration is optional.

**April 2013 TCB Workshop Updates:**
Apply usual 802.11 test exclusion considerations, but include 802.11ac SAR for highest 802.11a configuration in each frequency band and each exposure condition.

## 11.1. Wi-Fi DTS Band

| Mode | | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Main Antenna | | | | Sub Antenna | | | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Power (dBm) | | 1-g SAR (W/kg) | | Power (dBm) | | 1-g SAR (W/kg) | | |
| | | | | | | Tune-up limit | Meas. | Meas. | Scaled | Tune-up limit | Meas. | Meas. | Scaled | |
| MIMO (Main + Sub) | 802.11b | 0 | Rear | 1 | 2412 | 14.0 | 13.8 | 0.806 | 0.844 | 14.0 | 13.8 | 1.140 | 1.194 | |
| | | | | 6 | 2437 | 14.0 | 13.8 | 1.030 | 1.079 | 14.0 | 13.6 | 1.230 | **1.349** | 1 |
| | | | | 11 | 2462 | 14.0 | 13.6 | 0.922 | 1.011 | 14.0 | 13.8 | 1.160 | 1.215 | |
| | | | Edge 2 | 6 | 2437 | 14.0 | 13.8 | | | 14.0 | 13.6 | 0.094 | 0.103 | |
| | | | Edge 3 | 6 | 2437 | 14.0 | 13.8 | | | 14.0 | 13.6 | 0.594 | 0.651 | |

## 11.2. Wi-Fi UNII Band

| Mode | | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Main Antenna | | | | Sub Antenna | | | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Power (dBm) | | 1-g SAR (W/kg) | | Power (dBm) | | 1-g SAR (W/kg) | | |
| | | | | | | Tune-up limit | Meas. | Meas. | Scaled | Tune-up limit | Meas. | Meas. | Scaled | |
| MIMO (Main + Sub) | 802.11a | 0 | Rear | 40 | 5200 | 12.5 | 12.4 | 1.220 | 1.248 | 12.5 | 11.8 | 0.984 | 1.156 | |
| | | | | 48 | 5240 | 12.5 | 12.5 | 0.954 | 0.954 | 12.5 | 11.8 | 0.744 | 0.874 | |
| | | | | 52 | 5260 | 12.5 | 12.5 | 0.982 | 0.982 | 12.5 | 11.6 | 1.020 | 1.255 | |
| | | | | 64 | 5320 | 12.5 | 12.3 | 1.210 | 1.267 | 12.5 | 11.9 | 0.796 | 0.914 | |
| | | | | 100 | 5500 | 12.5 | 12.2 | 1.210 | 1.297 | 12.5 | 12.4 | 0.977 | 1.000 | |
| | | | | 116 | 5580 | 12.5 | 12.1 | 1.260 | **1.382** | 12.5 | 12.4 | 1.190 | 1.218 | 2 |
| | | | | 132 | 5660 | 12.5 | 12.1 | 1.150 | 1.261 | 12.5 | 12.4 | 0.920 | 0.941 | |
| | | | | 149 | 5745 | 12.5 | 11.8 | 0.689 | 0.810 | 12.5 | 12.5 | 0.694 | 0.694 | |
| | | | | 157 | 5785 | 12.5 | 11.7 | 0.894 | 1.075 | 12.5 | 12.4 | 0.794 | 0.812 | 3 |
| | | | | 165 | 5825 | 12.5 | 11.7 | 0.648 | 0.779 | 12.5 | 12.4 | 0.790 | 0.808 | |
| | | | Edge 2 | 48 | 5240 | 12.5 | 12.5 | | | 12.5 | 11.8 | 0.199 | 0.234 | |
| | | | | 52 | 5260 | 12.5 | 12.5 | | | 12.5 | 11.6 | 0.182 | 0.224 | |
| | | | | 100 | 5500 | 12.5 | 12.2 | | | 12.5 | 12.4 | 0.119 | 0.122 | |
| | | | | 149 | 5745 | 12.5 | 11.8 | | | 12.5 | 12.5 | 0.161 | 0.161 | |
| | | | Edge 3 | 40 | 5200 | 12.5 | 12.4 | | | 12.5 | 11.8 | 1.110 | 1.304 | 4 |
| | | | | 48 | 5240 | 12.5 | 12.5 | | | 12.5 | 11.8 | 1.060 | 1.245 | |
| | | | | 52 | 5260 | 12.5 | 12.5 | | | 12.5 | 11.6 | 1.100 | 1.353 | 5 |
| | | | | 64 | 5320 | 12.5 | 12.3 | | | 12.5 | 11.9 | 1.130 | 1.297 | |
| | | | | 100 | 5500 | 12.5 | 12.2 | 0.931 | 0.998 | 12.5 | 12.4 | 0.325 | 0.333 | |
| | | | | 116 | 5580 | 12.5 | 12.1 | 1.160 | 1.272 | 12.5 | 12.4 | 0.423 | 0.433 | |
| | | | | 132 | 5660 | 12.5 | 12.1 | 1.080 | 1.184 | 12.5 | 12.4 | 0.403 | 0.412 | |
| | | | | 149 | 5745 | 12.5 | 11.8 | | | 12.5 | 12.5 | 0.754 | 0.754 | |

**Additional Test for 802.11ac VHT20 Mode**

| Mode | | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Main Antenna | | | | Sub Antenna | | | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Power (dBm) | | 1-g SAR (W/kg) | | Power (dBm) | | 1-g SAR (W/kg) | | |
| | | | | | | Tune-up limit | Meas. | Meas. | Scaled | Tune-up limit | Meas. | Meas. | Scaled | |
| MIMO (Main + Sub) | 802.11ac VHT20 | 0 | Edge 3 | 40 | 5200 | 12.5 | 12.3 | | | 12.5 | 11.8 | 0.723 | 0.849 | |
| | | | Edge 3 | 52 | 5260 | 12.5 | 12.5 | | | 12.5 | 11.6 | 0.720 | 0.886 | |
| | | | Rear | 116 | 5580 | 12.5 | 12.1 | 0.824 | 0.903 | 12.5 | 12.4 | 0.827 | 0.846 | |
| | | | Rear | 157 | 5785 | 12.5 | 11.7 | 0.506 | 0.608 | 12.5 | 12.4 | 0.600 | 0.614 | |

## 11.1. Bluetooth

| Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| 802.16 GFSK | 0 | Rear | 39 | 2441 | 10.5 | 8.8 | **0.064** | 0.095 | 6 |
| | | Edge 3 | 39 | 2441 | 10.5 | 8.8 | 0.018 | 0.027 | |

# 12. SAR Measurement Variability

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz v01r03. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

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

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

| Frequency Band (MHz) | Air Interface | Stand-alone (W/kg) | Repeated SAR (Yes/No) |
|---|---|---|---|
| 2400 | Wi-Fi 802.11b/g/n | 1.230 | Yes |
| | Bluetooth | 0.064 | No |
| 5200 | Wi-Fi 802.11a/n | 1.220 | Yes |
| 5300 | Wi-Fi 802.11a/n | 1.210 | Yes |
| 5500 | Wi-Fi 802.11a/n | 1.260 | Yes |
| 5800 | Wi-Fi 802.11a/n | 0.894 | Yes |

## 12.2. Repeated Measurement Results

| Frequency band (MHz) | Air Interface | Test Position | Mode | Pwr Back-off | Dist. (mm) | Ch #. | Freq. (MHz) | Meas. SAR (W/kg) | | Largest to Smallest SAR Ratio |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Original | Repeated | |
| 2400 | Wi-Fi 802.11b/g/n | Rear | 802.11b 1Mbps | N/A | 0 | 6 | 2437.0 | 1.230 | 1.220 | 1.01 |
| 5200 | Wi-Fi 802.11a/n | Rear | 802.11a 6Mbps | N/A | 0 | 40 | 5200.0 | 1.220 | 1.080 | 1.13 |
| 5300 | Wi-Fi 802.11a/n | Rear | 802.11a 6Mbps | N/A | 0 | 64 | 5320.0 | 1.210 | 1.080 | 1.12 |
| 5500 | Wi-Fi 802.11a/n | Rear | 802.11a 6Mbps | N/A | 0 | 116 | 5580.0 | 1.260 | 1.080 | 1.17 |
| 5800 | Wi-Fi 802.11a/n | Rear | 802.11a 6Mbps | N/A | 0 | 157 | 5785.0 | 0.894 | 0.894 | 1.00 |

**Note(s):**

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

# 13. Simultaneous Transmission SAR Analysis

## 13.1. Estimated SAR for Simultaneous Transmission SAR Analysis

### Considerations for SAR estimation

1. When standalone SAR test exclusion applies, standalone SAR must also be estimated to determine simultaneous transmission SAR test exclusion.
2. Dedicated Host Approach criteria for SAR test exclusion is likewise applied to SAR estimation, with certain distinctions between test exclusion and SAR estimation:
   - When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied for SAR estimation; this is the same between test exclusion and SAR estimation calculations.
   - When the separation distance from the antenna to an adjacent edge is > 5 mm but ≤ 50 mm, the actual antenna-to-edge separation distance is applied for SAR estimation.
   - When the minimum test separation distance is > 50 mm, the estimated SAR value is 0.4 W/kg
3. Test positions Edge 3 and Edge 4 are inherently compliant as they consist of only estimated SAR values for all applicable transmitters and consequently will always have sum of SAR values < 1.2 W/kg. Simultaneous transmission SAR analysis was therefore not performed for these test positions.

### 13.1.1. Estimated SAR for WLAN

MIMO

| Tx Interface | Frequency (MHz) | Output Power | | Separation Distances (mm) | | | | | | Estimated 1-g SAR Value (W/kg) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | dBm | mW | Rear | Edge 1 | Edge 2 | Edge 3 | Edge 4 | Front | Rear | Edge 1 | Edge 2 | Edge 3 | Edge 4 | Front |
| **Wi-Fi Main Antenna** | | | | | | | | | | | | | | | |
| Wi-Fi 2.4 GHz | 2462 | 14.00 | 25 | 2.46 | 187.7 | 55.1 | 3 | 36 | | -MEASURE- | 0.400 | 0.400 | -MEASURE- | 0.145 | |
| Wi-Fi 5.2 GHz | 5240 | 12.50 | 18 | 2.46 | 187.7 | 55.1 | 3 | 36 | | -MEASURE- | 0.400 | 0.400 | -MEASURE- | 0.153 | |
| Wi-Fi 5.3 GHz | 5320 | 12.50 | 18 | 2.46 | 187.7 | 55.1 | 3 | 36 | | -MEASURE- | 0.400 | 0.400 | -MEASURE- | 0.154 | |
| Wi-Fi 5.5 GHz | 5700 | 12.50 | 18 | 2.46 | 187.7 | 55.1 | 3 | 36 | | -MEASURE- | 0.400 | 0.400 | -MEASURE- | 0.159 | |
| Wi-Fi 5.8 GHz | 5825 | 12.50 | 18 | 2.46 | 187.7 | 55.1 | 3 | 36 | | -MEASURE- | 0.400 | 0.400 | -MEASURE- | 0.161 | |
| Bluetooth | 2480 | 10.50 | 11 | 2.46 | 187.7 | 55.1 | 3 | 36 | | -MEASURE- | 0.400 | 0.400 | -MEASURE- | 0.064 | |
| **Wi-Fi Sub Antenna** | | | | | | | | | | | | | | | |
| Wi-Fi 2.4 GHz | 2462 | 14.00 | 25 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | -MEASURE- | 0.400 | -MEASURE- | -MEASURE- | 0.400 | |
| Wi-Fi 5.2 GHz | 5240 | 12.50 | 18 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | -MEASURE- | 0.400 | -MEASURE- | -MEASURE- | 0.400 | |
| Wi-Fi 5.3 GHz | 5320 | 12.50 | 18 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | -MEASURE- | 0.400 | -MEASURE- | -MEASURE- | 0.400 | |
| Wi-Fi 5.5 GHz | 5700 | 12.50 | 18 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | -MEASURE- | 0.400 | -MEASURE- | -MEASURE- | 0.400 | |
| Wi-Fi 5.8 GHz | 5825 | 12.50 | 18 | 2.32 | 187.7 | 8.85 | 4.6 | 90.685 | | -MEASURE- | 0.400 | -MEASURE- | -MEASURE- | 0.400 | |

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

| Test Position | | Simultaneous Transmission Scenario | | ∑ 1-g SAR (mW/g) | SPLSR (Yes/ No) |
|---|---|---|---|---|---|
| | | ① Wi-Fi(UNII) | ② Bluetooth | | |
| Rear | ① + ② | 1.382 | 0.064 | **1.446** | No |
| Edge 1 | ① + ② | 0.400 | 0.400 | 0.800 | No |
| Edge 2 | ① + ② | 0.234 | 0.400 | 0.634 | No |
| Edge 3 | ① + ② | 1.353 | 0.018 | 1.371 | No |
| Edge 4 | ① + ② | 0.400 | 0.064 | 0.464 | No |

**Conclusion:**

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

# 14. Appendixes

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

**14.1. Photos and Antenna Locations**

**14.2. System Performance Check Plots**

**14.3. Highest SAR Test Plots**

**14.4. Calibration Certificate for E-Field Probe EX3DV4 - SN 3773**

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

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

**14.7. Calibration Certificate for D5GHzV2 - SN 1138**

**END OF REPORT**