**FCC OET BULLETIN 65 SUPPLEMENT C 01-01**
**IEEE Std 1528-2003 & IEEE 1528a-2005**

# SAR EVALUATION REPORT

*For*
**iPod Touch**

**Model: A1421**
**FCC ID: BCG-A1421**

**Report Number: 12U14485-8A**
**Issue Date: 9/5/2012**

*Prepared for*
**APPLE INC.**
**1 INFINITE LOOP, MS 26A**
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NVLAP LAB CODE 200065-0

## Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| -- | 8/21/2012 | Initial Issue | -- |
| A | 9/5/2012 | Made the following change:<br>1. Sec. 7: Updated normal operation form “Body-worn Accessory” to “Hand-held use next to or near the body of user”<br>2. Changed “Body-worn Accessory exposure conditions” to “Body Exposure Conditions” | Sunny Shih |


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# 1. Attestation of Test Results

| | | | |
|---|---|---|---|
| Applicant | Apple Inc. | | |
| DUT description | iPod Touch | | |
| Model | A1421 | | |
| Test device is | An identical prototype | | |
| Device category | Portable | | |
| Exposure category | General Population/Uncontrolled Exposure | | |
| Date tested | 7/31/2012 – 8/9/2012 | | |
| FCC Rule Parts | Freq. Range | Highest 1-g SAR | Limit |
| 15.247 | 2412-2462 MHz | 1.10 W/kg (Front w/ 5 mm distance) | 1.6 W/kg |
| | 2402-2480 MHz | 0.204 W/kg (Front w/ 5 mm distance) | |
| 15.407 | 5150-5250 MHz | 1.09 W/kg (Front w/ 5 mm distance) | |
| | 5250-5350 MHz | 1.16 W/kg (Front w/ 5 mm distance) | |
| | 5500-5700 MHz | 1.13 W/kg (Front w/ 5 mm distance) | |
| 15.247 | 5725-5850 MHz | 1.15 W/kg (Front w/ 5 mm distance) | |
| Simultaneous transmission condition | | 1.364 W/kg (refer to Section 14.1.1)<br>(The highest SAR across exposure conditions) | |
| Applicable Standards | | | Test Results |
| FCC OET Bulletin 65 Supplement C 01-01<br>IEEE Std 1528-2003 & IEEE 1528a-2005, | | | Pass |

UL CCS 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 CCS 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS 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 For UL CCS By:

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Engineering Leader
UL CCS

Tested By:

Devin Chang
SAR Engineer
UL CCS

# 2. Test Methodology

The tests documented in this report were performed in accordance with FCC OET Bulletin 65 Supplement C Edition 01-01, IEEE Std 1528-2003 & IEEE 1528a-2005 and the following published KDB procedures:

- 447498 D01 General RF Exposure Guidance v05 **(Draft)**
- 941225 D07 UMPC Mini Tablet Devices v01
- 248227 D01 SAR Meas for 802 11abg v01r02
- 865664 D01 SAR Measurement 100 MHz to 6 GHz v01 **(Draft)**
- 865664 D02 SAR Reporting v01 **(Draft)**

**KDB Inquiry tracking number: 365942**

# 3. Facilities and Accreditation

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

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

# 4. Calibration and Uncertainty

## 4.1. Measuring Instrument Calibration

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

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due date | | |
|---|---|---|---|---|---|---|
| | | | | MM | DD | Year |
| S-Parameter Network Analyzer | Agilent | 8753ES | MY40001647 | 6 | 27 | 2013 |
| Dielectronic Probe kit | HP | 85070C | 2569 | N/A | | |
| ENA Series Network Analyzer | Agilent | E5071B | MY42100131 | 2 | 11 | 2013 |
| Dielectronic Probe kit | HP | 85070E | 594 | N/A | | |
| Synthesized Signal Generator | HP | 8665B | 3438A00633 | 2 | 22 | 2013 |
| Power Meter | HP | 438A | 3513U04320 | 9 | 17 | 2013 |
| Power Sensor A | HP | 8481A | 2237A31744 | 8 | 17 | 2013 |
| Power Sensor B | HP | 8481A | 3318A95392 | 8 | 17 | 2013 |
| Amplifier | MITEQ | 4D00400600-50-30P | 1622052 | N/A | | |
| Directional coupler | Werlatone | C8060-102 | 2149 | N/A | | |
| Synthesized Signal Generator | HP | 8665B | 3744A01084 | 5 | 3 | 2013 |
| Power Meter | HP | 438A | 2822A05684 | 10 | 7 | 2013 |
| Power Sensor A | HP | 8481A | 2702A66876 | 8 | 1 | 2013 |
| Power Sensor B | HP | 8482A | 2349A08568 | 4 | 14 | 2013 |
| Amplifier | MITEQ | 4D00400600-50-30P | 1620606 | N/A | | |
| Directional coupler | Werlatone | C8060-102 | 2141 | N/A | | |
| Thermometer | ERTCO | 639-1S | 8350 | 7 | 30 | 2013 |
| E-Field Probe | SPEAG | EX3DV4 | 3686 | 2 | 16 | 2013 |
| E-Field Probe | SPEAG | EX3DV4 | 3772 | 2 | 16 | 2013 |
| E-Field Probe | SPEAG | EX3DV4 | 3773 | 3 | 14 | 2013 |
| Data Acquisition Electronics | SPEAG | DAE4 | 1239 | 6 | 6 | 2013 |
| Data Acquisition Electronics | SPEAG | DAE4 | 1258 | 3 | 8 | 2013 |
| Data Acquisition Electronics | SPEAG | DAE4 | 1259 | 2 | 13 | 2013 |
| System Validation Dipole | SPEAG | D2450V2 | 748 | 2 | 7 | 2013 |
| System Validation Dipole | SPEAG | D5GHzV2 | 1075 | 2 | 14 | 2013 |
| System Validation Dipole | SPEAG | D5GHzV2 | 1003 | 8 | 23 | 2012 |
| Power Meter | R & S | NRP | 100673 | 5 | 5 | 2013 |
| Power Sensor | R & S | NRP - Z23 | 100168 | 5 | 5 | 2013 |

## 4.2. Measurement Uncertainty

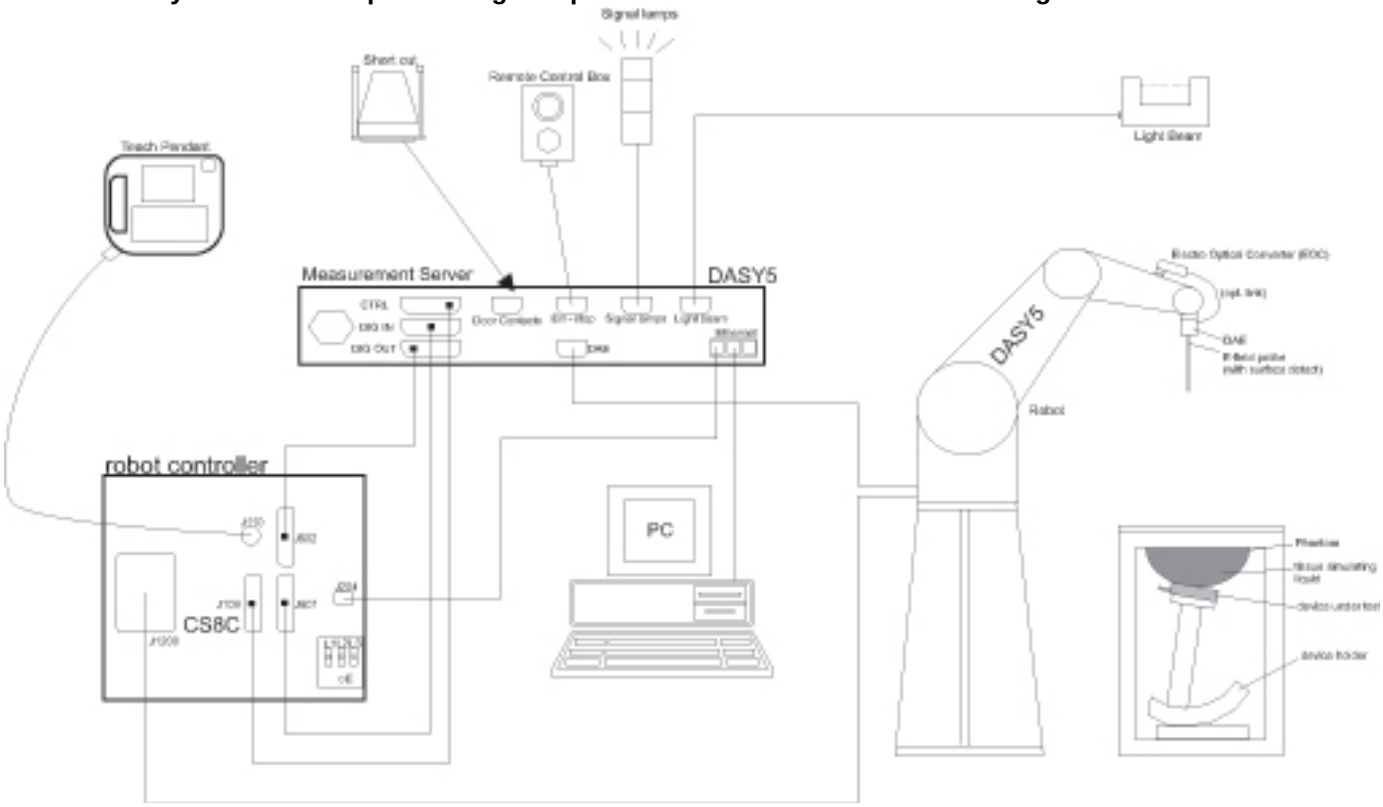
| Component | Error, % | Distribution | Divisor | Sensitivity | U (Xi), % |
|---|---|---|---|---|---|
| **Measurement System** | | | | | |
| Probe Calibration (k=1) | **6.00** | Normal | 1 | 1 | 6.00 |
| Axial Isotropy | 1.15 | Rectangular | 1.732 | 0.7071 | 0.47 |
| Hemispherical Isotropy | 2.30 | Rectangular | 1.732 | 0.7071 | 0.94 |
| Boundary Effect | 0.90 | Rectangular | 1.732 | 1 | 0.52 |
| Probe Linearity | 3.45 | Rectangular | 1.732 | 1 | 1.99 |
| System Detection Limits | 1.00 | Rectangular | 1.732 | 1 | 0.58 |
| Readout Electronics | 0.30 | Normal | 1 | 1 | 0.30 |
| Response Time | 0.80 | Rectangular | 1.732 | 1 | 0.46 |
| Integration Time | 2.60 | Rectangular | 1.732 | 1 | 1.50 |
| RF Ambient Conditions - Noise | 3.00 | Rectangular | 1.732 | 1 | 1.73 |
| RF Ambient Conditions - Reflections | 3.00 | Rectangular | 1.732 | 1 | 1.73 |
| Probe Positioner Mechanical Tolerance | 0.40 | Rectangular | 1.732 | 1 | 0.23 |
| Probe Positioning with respect to Phantom | 2.90 | Rectangular | 1.732 | 1 | 1.67 |
| Extrapolation, Interpolation and Integration | 1.00 | Rectangular | 1.732 | 1 | 0.58 |
| **Test Sample Related** | | | | | |
| Test Sample Positioning | 2.90 | Normal | 1 | 1 | 2.90 |
| Device Holder Uncertainty | 3.60 | Normal | 1 | 1 | 3.60 |
| Output Power Variation - SAR Drift | 5.00 | Rectangular | 1.732 | 1 | 2.89 |
| **Phantom and Tissue Parameters** | | | | | |
| Phantom Uncertainty (shape and thickness) | 4.00 | Rectangular | 1.732 | 1 | 2.31 |
| Liquid Conductivity - deviation from target | 5.00 | Rectangular | 1.732 | 0.64 | 1.85 |
| Liquid Conductivity - measurement | **3.86** | Normal | 1 | 0.64 | 2.47 |
| Liquid Permittivity - deviation from target | 5.00 | Rectangular | 1.732 | 0.6 | 1.73 |
| Liquid Permittivity - measurement uncertainty | **-2.91** | Normal | 1 | 0.6 | -1.75 |
| | | | | Combined Standard Uncertainty Uc(y) = | 10.20 |
| | | | | Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = | 20.40 % |
| | | | | Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = | 1.61 dB |

Measurement uncertainty for 3 to 6 GHz averaged over 1 gram

| Component | Error, % | Distribution | Divisor | Sensitivity | U (Xi), % |
|---|---|---|---|---|---|
| **Measurement System** | | | | | |
| Probe Calibration (k=1) | **6.55** | Normal | 1 | 1 | 6.55 |
| Axial Isotropy | 1.15 | Rectangular | 1.732 | 0.7071 | 0.47 |
| Hemispherical Isotropy | 2.30 | Rectangular | 1.732 | 0.7071 | 0.94 |
| Boundary Effect | 0.90 | Rectangular | 1.732 | 1 | 0.52 |
| Probe Linearity | 3.45 | Rectangular | 1.732 | 1 | 1.99 |
| System Detection Limits | 1.00 | Rectangular | 1.732 | 1 | 0.58 |
| Readout Electronics | 1.00 | Normal | 1 | 1 | 1.00 |
| Response Time | 0.80 | Rectangular | 1.732 | 1 | 0.46 |
| Integration Time | 2.60 | Rectangular | 1.732 | 1 | 1.50 |
| RF Ambient Conditions - Noise | 3.00 | Rectangular | 1.732 | 1 | 1.73 |
| RF Ambient Conditions - Reflections | 3.00 | Rectangular | 1.732 | 1 | 1.73 |
| Probe Positioner Mechanical Tolerance | 0.40 | Rectangular | 1.732 | 1 | 0.23 |
| Probe Positioning with respect to Phantom | 2.90 | Rectangular | 1.732 | 1 | 1.67 |
| Extrapolation, Interpolation and Integration | 3.90 | Rectangular | 1.732 | 1 | 2.25 |
| **Test Sample Related** | | | | | |
| Test Sample Positioning | 1.10 | Normal | 1 | 1 | 1.10 |
| Device Holder Uncertainty | 3.60 | Normal | 1 | 1 | 3.60 |
| Output Power Variation - SAR Drift | 5.00 | Rectangular | 1.732 | 1 | 2.89 |
| **Phantom and Tissue Parameters** | | | | | |
| Phantom Uncertainty (shape and thickness) | 4.00 | Rectangular | 1.732 | 1 | 2.31 |
| Liquid Conductivity - deviation from target | 5.00 | Rectangular | 1.732 | 0.64 | 1.85 |
| Liquid Conductivity - measurement | **4.43** | Normal | 1 | 0.64 | 2.84 |
| Liquid Permittivity - deviation from target | 10.00 | Rectangular | 1.732 | 0.6 | 3.46 |
| Liquid Permittivity - measurement uncertainty | **-4.40** | Normal | 1 | 0.6 | -2.64 |
| | | | | Combined Standard Uncertainty Uc(y), %: | 11.15 |
| | | | | Expanded Uncertainty U, Coverage Factor = 1.96, > 95 % Confidence = | 21.85 % |
| | | | | Expanded Uncertainty U, Coverage Factor = 1.96, > 95 % Confidence = | 1.72 dB |

# 5. Measurement System Description and Setup

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




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

# 6. SAR Measurement Procedure

## 6.1. Normal SAR Measurement Procedure

**Step 1: Power Reference Measurement**

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

**Step 2: Area Scan**

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

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01 (Draft)

| | ≤ 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 either the x or y dimension of the test device in the measurement plane is smaller than the above, the measurement resolution must be ≤ the corresponding x and y dimensions 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 v01 (Draft)

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

**Step 4: Power drift measurement**

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

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

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

## 6.2. Volume Scan Procedures

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

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

**Step 3: Power drift measurement**
The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

# 7. Device Under Test

| | |
|---|---|
| iPod Touch<br>Model: A1421 | |
| Normal operation | Hand-held use next to or near the body of user |
| Simultaneous Transmission | • WiFi 2.4 GHz Radio cannot transmit simultaneously with Bluetooth Radio.<br>• WiFi 5 GHz Radio can transmit simultaneously with Bluetooth Radio.<br>Note: WiFi and BT share same antenna |

## 7.1. Band and Air Interfaces

| | |
|---|---|
| Tx Frequency Bands | • 802.11a/b/g/n: 2412 - 2462 MHz<br>5180 – 5825 MHz<br>• Bluetooth: 2402 - 2480 MHz |

# 8. Summary of Test Configurations

Refer to Section 17 “Antenna Location and Separation Distances” for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

## 8.1. Body Exposure Conditions

The following test configurations are based on the KDB 941225 D07 UMPC Mini Tablet Devices v01

| Test Configurations | Antenna-to-edge/surface | SAR Required | Test separation distance (mm) | Note |
|---|---|---|---|---|
| Rear | < 25 mm | Yes | 5 | |
| Front | < 25 mm | Yes | 5 | |
| Edge 1 | 3.0 mm | Yes | 5 | |
| Edge 2 | 34.4 mm | No | | SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D07 UMPC Mini Tablet Devices v01 |
| Edge 3 | 113.4 mm | No | | SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D07 UMPC Mini Tablet Devices v01 |
| Edge 4 | 1.7 mm | Yes | 5 | |

# 9. RF Output Power Measurement

## 9.1. WiFi (2.4 GHz Band)

Required Test Channels per KDB 248227 D01

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

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

**RF Output Power Results**

| Band (MHz) | Mode | Ch # | Freq. (MHz) | Avg Pwr (dBm) |
|---|---|---|---|---|
| 2.4 | 802.11b | 1 | 2412 | 16.5 |
| | | 6 | 2437 | 16.6 |
| | | 11 | 2462 | 16.5 |
| | 802.11g | 1 | 2412 | 16.5 |
| | | 6 | 2437 | 16.5 |
| | | 11 | 2462 | 16.5 |
| | 802.11n (HT20) | 1 | 2412 | 16.5 |
| | | 6 | 2437 | 16.5 |
| | | 11 | 2462 | 16.0 |

**Note(s):**
1. 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 802.11a/b channels. As per KDB 248227

## 9.2. WiFi (5 GHz Bands)

Required Test Channels per KDB 248227 D01

| Mode | | Band | GHz | Channel | "Default Test Channels" | |
|---|---|---|---|---|---|---|
| | | | | | 802.11a | |
| 802.11a | UNII (15.407) | 5.2 GHz | 5.180 | 36 | √ | |
| | | | 5.200 | 40 | | * |
| | | | 2.220 | 44 | | * |
| | | | 5.240 | 48 | √ | |
| | | 5.3 GHz | 5.260 | 52 | √ | |
| | | | 5.280 | 56 | | * |
| | | | 5.300 | 60 | | * |
| | | | 5.320 | 64 | √ | |
| | | 5.5 GHz | 5.500 | 100 | | |
| | | | 5.520 | 104 | √ | |
| | | | 5.540 | 108 | | * |
| | | | 5.560 | 112 | | * |
| | | | 5.580 | 116 | √ | |
| | | | 5.600 | 120 | | * |
| | | | 5.620 | 124 | √ | |
| | | | 5.640 | 128 | | * |
| | | | 5.660 | 132 | | * |
| | | | 5.680 | 136 | √ | |
| | | | 5.700 | 140 | | * |
| | DTS (15.247) | 5.8 GHz | 5.745 | 149 | √ | |
| | | | 5.765 | 153 | | * |
| | | | 5.785 | 157 | √ | |
| | | | 5.805 | 161 | | * |
| | | | 5.825 | 165 | √ | |

√ = "default test channels"

* = possible 802.11a channels with maximum average output > the "default test channels"

# = when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

**RF Output Power Results**

| Band (MHz) | Mode | Ch # | Freq. (MHz) | Avg Pwr (dBm) |
|---|---|---|---|---|
| 5.2 | 802.11a | 36 | 5180 | 14.0 |
| | | 40 | 5200 | 14.0 |
| | | 44 | 5220 | 14.0 |
| | | 48 | 5240 | 14.0 |
| | 802.11n (HT20) | 36 | 5180 | 14.0 |
| | | 40 | 5200 | 14.0 |
| | | 48 | 5240 | 14.0 |
| | 802.11n (HT40) | 38 | 5190 | 14.0 |
| | | 46 | 5230 | 14.0 |
| 5.3 | 802.11a | 52 | 5260 | 13.5 |
| | | 56 | 5280 | 13.5 |
| | | 60 | 5300 | 13.5 |
| | | 64 | 5320 | 13.5 |
| | 802.11n (HT20) | 52 | 5260 | 13.5 |
| | | 60 | 5300 | 13.5 |
| | | 64 | 5320 | 13.5 |
| | 802.11n (HT40) | 54 | 5270 | 13.5 |
| | | 62 | 5310 | 13.5 |
| 5.5 | 802.11a | 100 | 5500 | 13.0 |
| | | 104 | 5520 | 13.0 |
| | | 108 | 5540 | 13.0 |
| | | 112 | 5560 | 13.0 |
| | | 116 | 5580 | 13.0 |
| | | 120 | 5600 | 13.0 |
| | | 124 | 5620 | 13.0 |
| | | 128 | 5640 | 13.0 |
| | | 132 | 5660 | 13.0 |
| | | 136 | 5680 | 13.0 |
| | | 140 | 5700 | 13.0 |
| | 802.11n (HT20) | 100 | 5500 | 13.0 |
| | | 120 | 5600 | 13.0 |
| | | 140 | 5700 | 13.0 |
| | 802.11n (HT40) | 102 | 5510 | 13.0 |
| | | 118 | 5590 | 13.0 |
| | | 134 | 5670 | 13.0 |
| 5.8 | 802.11a | 149 | 5745 | 13.5 |
| | | 153 | 5765 | 13.5 |
| | | 157 | 5785 | 13.5 |
| | | 161 | 5805 | 13.5 |
| | | 165 | 5825 | 13.5 |
| | 802.11n (HT20) | 149 | 5745 | 13.5 |
| | | 157 | 5785 | 13.5 |
| | | 161 | 5805 | 13.5 |
| | 802.11n (HT40) | 151 | 5755 | 13.5 |
| | | 159 | 5795 | 13.5 |

**Note(s):**

1. SAR is not required for 802.11n HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a/b channels. As per KDB 248227

## 9.3. Bluetooth

**RF Output Power Results**

| Mode | Channel # | Freq. (MHz) | Avg Pwr (dBm) |
|---|---|---|---|
| GFSK | 0 | 2402 | 13.6 |
| | 39 | 2441 | 13.7 |
| | 78 | 2480 | 13.8 |
| QPSK | 0 | 2402 | 11.5 |
| | 39 | 2441 | 11.5 |
| | 78 | 2480 | 11.6 |
| 8-PSK | 0 | 2402 | 11.2 |
| | 39 | 2441 | 11.4 |
| | 78 | 2480 | 11.5 |

# 10. Tissue Dielectric Properties

### IEEE Std 1528-2003 Table 2

| Target Frequency (MHz) | Head | |
|---|---|---|
| | $\varepsilon_r$ | $\sigma$ (S/m) |
| 300 | 45.3 | 0.87 |
| 450 | 43.5 | 0.87 |
| 835 | 41.5 | 0.90 |
| 900 | 41.5 | 0.97 |
| 1450 | 40.5 | 1.20 |
| 1800 – 2000 | 40.0 | 1.40 |
| 2450 | 39.2 | 1.80 |
| 2600 | 39.0 | 1.96 |
| 3000 | 38.5 | 2.40 |

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

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

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

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

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

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

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

## 10.2. Tissue Dielectric Parameter Check Results

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

| Date | Freq. (MHz) | Liquid Parameters | | | Measured | Target | Delta (%) | Limit ±(%) |
|---|---|---|---|---|---|---|---|---|
| 7/31/2012 | Body 5180 | e' | 50.2067 | Relative Permittivity (εr): | 50.21 | 49.05 | 2.37 | 10 |
| | | e" | 18.3124 | Conductivity (σ): | 5.27 | 5.27 | 0.06 | 5 |
| | Body 5200 | e' | 50.2091 | Relative Permittivity (εr): | 50.21 | 49.02 | 2.43 | 10 |
| | | e" | 18.1882 | Conductivity (σ): | 5.26 | 5.29 | -0.68 | 5 |
| | Body 5500 | e' | 49.6647 | Relative Permittivity (εr): | 49.66 | 48.61 | 2.16 | 10 |
| | | e" | 18.5021 | Conductivity (σ): | 5.66 | 5.64 | 0.24 | 5 |
| | Body 5800 | e' | 49.2786 | Relative Permittivity (εr): | 49.28 | 48.20 | 2.24 | 10 |
| | | 21 | 18.8369 | Conductivity (σ): | 6.07 | 6.00 | 1.25 | 5 |
| | Body 5825 | e' | 49.2685 | Relative Permittivity (εr): | 49.27 | 48.20 | 2.22 | 10 |
| | | e" | 18.8667 | Conductivity (σ): | 6.11 | 6.00 | 1.85 | 5 |
| 8/1/2012 | Body 5180 | e' | 51.1435 | Relative Permittivity ($\epsilon_r$): | 51.14 | 49.05 | 4.28 | 10 |
| | | e" | 18.5701 | Conductivity (σ): | 5.35 | 5.27 | 1.47 | 5 |
| | Body 5200 | e' | 51.0886 | Relative Permittivity ($\epsilon_r$): | 51.09 | 49.02 | 4.22 | 10 |
| | | e" | 18.4898 | Conductivity (σ): | 5.35 | 5.29 | 0.97 | 5 |
| | Body 5500 | e' | 50.6141 | Relative Permittivity ($\epsilon_r$): | 50.61 | 48.61 | 4.12 | 10 |
| | | e" | 18.8554 | Conductivity (σ): | 5.77 | 5.64 | 2.16 | 5 |
| | Body 5800 | e' | 50.0753 | Relative Permittivity ($\epsilon_r$): | 50.08 | 48.20 | 3.89 | 10 |
| | | 21 | 18.8692 | Conductivity (σ): | 6.09 | 6.00 | 1.42 | 5 |
| | Body 5825 | e' | 49.9000 | Relative Permittivity ($\epsilon_r$): | 49.90 | 48.20 | 3.53 | 10 |
| | | e" | 18.9209 | Conductivity (σ): | 6.13 | 6.00 | 2.14 | 5 |
| 8/1/2012 | Body 5180 | e' | 47.2955 | Relative Permittivity ($\epsilon_r$): | 47.30 | 49.05 | -3.57 | 10 |
| | | e" | 18.6573 | Conductivity (σ): | 5.37 | 5.27 | 1.94 | 5 |
| | Body 5200 | e' | 47.2586 | Relative Permittivity ($\epsilon_r$): | 47.26 | 49.02 | -3.59 | 10 |
| | | e" | 18.6795 | Conductivity (σ): | 5.40 | 5.29 | 2.01 | 5 |
| | Body 5500 | e' | 46.6834 | Relative Permittivity ($\epsilon_r$): | 46.68 | 48.61 | -3.97 | 10 |
| | | e" | 18.9535 | Conductivity (σ): | 5.80 | 5.64 | 2.69 | 5 |
| | Body 5800 | e' | 46.1406 | Relative Permittivity ($\epsilon_r$): | 46.14 | 48.20 | -4.27 | 10 |
| | | e" | 19.1513 | Conductivity (σ): | 6.18 | 6.00 | 2.94 | 5 |
| | Body 5825 | e' | 46.0790 | Relative Permittivity ($\epsilon_r$): | 46.08 | 48.20 | -4.40 | 10 |
| | | e" | 19.2424 | Conductivity (σ): | 6.23 | 6.00 | 3.87 | 5 |
| 8/1/2012 | Body 2450 | e' | 51.1696 | Relative Permittivity ($\epsilon_r$): | 51.17 | 52.70 | -2.90 | 5 |
| | | e" | 14.8013 | Conductivity (σ): | 2.02 | 1.95 | 3.40 | 5 |
| | Body 2410 | e' | 51.2891 | Relative Permittivity ($\epsilon_r$): | 51.29 | 52.76 | -2.79 | 5 |
| | | e" | 14.7709 | Conductivity (σ): | 1.98 | 1.91 | 3.77 | 5 |
| | Body 2435 | e' | 51.1983 | Relative Permittivity ($\epsilon_r$): | 51.20 | 52.73 | -2.90 | 5 |
| | | e" | 14.8132 | Conductivity (σ): | 2.01 | 1.93 | 3.86 | 5 |
| | Body 2475 | e' | 51.1381 | Relative Permittivity ($\epsilon_r$): | 51.14 | 52.67 | -2.91 | 5 |
| | | e" | 14.9108 | Conductivity (σ): | 2.05 | 1.99 | 3.37 | 5 |
| 8/2/2012 | Body 5180 | e' | 47.4227 | Relative Permittivity ($\epsilon_r$): | 47.42 | 49.05 | -3.31 | 10 |
| | | e" | 18.5990 | Conductivity (σ): | 5.36 | 5.27 | 1.62 | 5 |
| | Body 5200 | e' | 47.4484 | Relative Permittivity ($\epsilon_r$): | 47.45 | 49.02 | -3.21 | 10 |
| | | e" | 18.5067 | Conductivity (σ): | 5.35 | 5.29 | 1.06 | 5 |
| | Body 5500 | e' | 46.9694 | Relative Permittivity ($\epsilon_r$): | 46.97 | 48.61 | -3.38 | 10 |
| | | e" | 18.7858 | Conductivity (σ): | 5.75 | 5.64 | 1.78 | 5 |
| | Body 5800 | e' | 46.5704 | Relative Permittivity ($\epsilon_r$): | 46.57 | 48.20 | -3.38 | 10 |
| | | e" | 18.8566 | Conductivity (σ): | 6.08 | 6.00 | 1.35 | 5 |
| | Body 5825 | e' | 46.3940 | Relative Permittivity ($\epsilon_r$): | 46.39 | 48.20 | -3.75 | 10 |
| | | e" | 19.1079 | Conductivity (σ): | 6.19 | 6.00 | 3.15 | 5 |

**Tissue Dielectric Parameter Check Results (continued)**

| Date | Freq. (MHz) | Liquid Parameters | | | Measured | Target | Delta (%) | Limit ±(%) |
|---|---|---|---|---|---|---|---|---|
| 8/8/2012 | Body 5180 | e' | 48.6849 | Relative Permittivity ($\epsilon_r$): | 48.68 | 49.05 | -0.74 | 10 |
| | | e" | 18.4545 | Conductivity (σ): | 5.32 | 5.27 | 0.83 | 5 |
| | Body 5200 | e' | 48.6780 | Relative Permittivity ($\epsilon_r$): | 48.68 | 49.02 | -0.70 | 10 |
| | | e" | 18.6699 | Conductivity (σ): | 5.40 | 5.29 | 1.95 | 5 |
| | Body 5500 | e' | 48.2502 | Relative Permittivity ($\epsilon_r$): | 48.25 | 48.61 | -0.75 | 10 |
| | | e" | 18.7538 | Conductivity (σ): | 5.74 | 5.64 | 1.61 | 5 |
| | Body 5800 | e' | 47.7486 | Relative Permittivity ($\epsilon_r$): | 47.75 | 48.20 | -0.94 | 10 |
| | | e" | 18.9256 | Conductivity (σ): | 6.10 | 6.00 | 1.72 | 5 |
| | Body 5825 | e' | 47.5942 | Relative Permittivity ($\epsilon_r$): | 47.59 | 48.20 | -1.26 | 10 |
| | | e" | 18.9113 | Conductivity (σ): | 6.13 | 6.00 | 2.09 | 5 |
| 8/8/2012 | Body 2450 | e' | 51.3917 | Relative Permittivity ($\epsilon_r$): | 51.39 | 52.70 | -2.48 | 5 |
| | | e" | 14.1360 | Conductivity (σ): | 1.93 | 1.95 | -1.25 | 5 |
| | Body 2410 | e' | 51.5027 | Relative Permittivity ($\epsilon_r$): | 51.50 | 52.76 | -2.38 | 5 |
| | | e" | 13.9636 | Conductivity (σ): | 1.87 | 1.91 | -1.90 | 5 |
| | Body 2435 | e' | 51.4365 | Relative Permittivity ($\epsilon_r$): | 51.44 | 52.73 | -2.45 | 5 |
| | | e" | 14.0748 | Conductivity (σ): | 1.91 | 1.93 | -1.32 | 5 |
| | Body 2475 | e' | 51.3030 | Relative Permittivity ($\epsilon_r$): | 51.30 | 52.67 | -2.59 | 5 |
| | | e" | 14.2439 | Conductivity (σ): | 1.96 | 1.99 | -1.26 | 5 |
| 8/8/2012 | Body 5180 | e' | 48.8628 | Relative Permittivity ($\epsilon_r$): | 48.86 | 49.05 | -0.37 | 10 |
| | | e" | 18.3911 | Conductivity (σ): | 5.30 | 5.27 | 0.49 | 5 |
| | Body 5200 | e' | 48.8719 | Relative Permittivity ($\epsilon_r$): | 48.87 | 49.02 | -0.30 | 10 |
| | | e" | 18.4319 | Conductivity (σ): | 5.33 | 5.29 | 0.65 | 5 |
| | Body 5500 | e' | 48.3374 | Relative Permittivity ($\epsilon_r$): | 48.34 | 48.61 | -0.57 | 10 |
| | | e" | 18.8451 | Conductivity (σ): | 5.76 | 5.64 | 2.10 | 5 |
| | Body 5800 | e' | 47.7311 | Relative Permittivity ($\epsilon_r$): | 47.73 | 48.20 | -0.97 | 10 |
| | | e" | 18.9198 | Conductivity (σ): | 6.10 | 6.00 | 1.69 | 5 |
| | Body 5825 | e' | 47.5038 | Relative Permittivity ($\epsilon_r$): | 47.50 | 48.20 | -1.44 | 10 |
| | | e" | 18.9680 | Conductivity (σ): | 6.14 | 6.00 | 2.39 | 5 |
| 8/8/2012 | Body 5180 | e' | 48.8382 | Relative Permittivity ($\epsilon_r$): | 48.84 | 49.05 | -0.43 | 10 |
| | | e" | 18.6552 | Conductivity (σ): | 5.37 | 5.27 | 1.93 | 5 |
| | Body 5200 | e' | 48.8041 | Relative Permittivity ($\epsilon_r$): | 48.80 | 49.02 | -0.44 | 10 |
| | | e" | 18.6890 | Conductivity (σ): | 5.40 | 5.29 | 2.06 | 5 |
| | Body 5500 | e' | 48.2451 | Relative Permittivity ($\epsilon_r$): | 48.25 | 48.61 | -0.76 | 10 |
| | | e" | 19.0079 | Conductivity (σ): | 5.81 | 5.64 | 2.99 | 5 |
| | Body 5800 | e' | 47.7518 | Relative Permittivity ($\epsilon_r$): | 47.75 | 48.20 | -0.93 | 10 |
| | | e" | 19.3213 | Conductivity (σ): | 6.23 | 6.00 | 3.85 | 5 |
| | Body 5825 | e' | 47.6913 | Relative Permittivity ($\epsilon_r$): | 47.69 | 48.20 | -1.06 | 10 |
| | | e" | 19.3452 | Conductivity (σ): | 6.27 | 6.00 | 4.43 | 5 |
| 8/9/2012 | Body 5180 | e' | 50.0167 | Relative Permittivity ($\epsilon_r$): | 50.02 | 49.05 | 1.98 | 10 |
| | | e" | 17.7958 | Conductivity (σ): | 5.13 | 5.27 | -2.77 | 5 |
| | Body 5200 | e' | 50.0766 | Relative Permittivity ($\epsilon_r$): | 50.08 | 49.02 | 2.16 | 10 |
| | | e" | 17.6202 | Conductivity (σ): | 5.09 | 5.29 | -3.78 | 5 |
| | Body 5500 | e' | 49.5195 | Relative Permittivity ($\epsilon_r$): | 49.52 | 48.61 | 1.86 | 10 |
| | | e" | 17.9877 | Conductivity (σ): | 5.50 | 5.64 | -2.54 | 5 |
| | Body 5800 | e' | 49.0135 | Relative Permittivity ($\epsilon_r$): | 49.01 | 48.20 | 1.69 | 10 |
| | | e" | 18.2035 | Conductivity (σ): | 5.87 | 6.00 | -2.16 | 5 |
| | Body 5825 | e' | 49.2007 | Relative Permittivity ($\epsilon_r$): | 49.20 | 48.20 | 2.08 | 10 |
| | | e" | 18.3558 | Conductivity (σ): | 5.95 | 6.00 | -0.91 | 5 |
| 8/9/2012 | Body 2450 | e' | 51.3048 | Relative Permittivity ($\epsilon_r$): | 51.30 | 52.70 | -2.65 | 5 |
| | | e" | 13.9043 | Conductivity (σ): | 1.89 | 1.95 | -2.86 | 5 |
| | Body 2410 | e' | 51.3499 | Relative Permittivity ($\epsilon_r$): | 51.35 | 52.76 | -2.67 | 5 |
| | | e" | 13.7775 | Conductivity (σ): | 1.85 | 1.91 | -3.21 | 5 |
| | Body 2435 | e' | 51.3672 | Relative Permittivity ($\epsilon_r$): | 51.37 | 52.73 | -2.58 | 5 |
| | | e" | 13.7952 | Conductivity (σ): | 1.87 | 1.93 | -3.28 | 5 |
| | Body 2475 | e' | 51.1939 | Relative Permittivity ($\epsilon_r$): | 51.19 | 52.67 | -2.80 | 5 |
| | | e" | 13.9143 | Conductivity (σ): | 1.91 | 1.99 | -3.54 | 5 |

# 11. System Performance Check

The system performance check is performed prior to any usage of the system in order to verify SAR system measurement accuracy. The system performance check verifies that the system operates within its specifications of ±10%.

## 11.1. System Performance Check Measurement Conditions

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

## 11.2. Reference SAR Values for System Performance Check

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

| System Dipole | Serial No. | Cal. Date | Freq. (MHz) | Target SAR Values (mW/g) | | |
|---|---|---|---|---|---|---|
| | | | | 1g/10g | Head | Body |
| D2450V2 | 748 | 2/7/12 | 2450 | 1g | 52.7 | 49.9 |
| | | | | 10g | 24.6 | 23.4 |
| D5GHzV2 | 1075 | 2/14/12 | 5200 | 1g | 79.4 | 72.7 |
| | | | | 10g | 22.8 | 20.5 |
| | | | 5500 | 1g | 85.7 | 77.7 |
| | | | | 10g | 24.3 | 21.7 |
| | | | 5800 | 1g | 78.9 | 72.5 |
| | | | | 10g | 22.5 | 20.2 |
| D5GHzV2 | 1003 | 8/23/11 | 5200 | 1g | 76.3 | 74.4 |
| | | | | 10g | 21.7 | 20.8 |
| | | | 5500 | 1g | 80.7 | 79.9 |
| | | | | 10g | 23.0 | 22.3 |
| | | | 5800 | 1g | 76.0 | 76.2 |
| | | | | 10g | 21.6 | 21.2 |

## 11.3. System Performance Check Results

| Date Tested | System Dipole | | T.S. Liquid | SAR Measured (Normalized to 1 W) | | Target (Ref. Value) | Delta (%) | Tolerance (%) |
|---|---|---|---|---|---|---|---|---|
| | Type | Serial No. | | | | | | |
| 7/31/2012 | D5GHzV2 (5.2GHz) | 1075 | Body | 1g | 70.6 | 72.7 | -2.89 | ±10 |
| | | | | 10g | 20.0 | 20.5 | -2.44 | |
| 7/31/2012 | D5GHzV2 (5.5GHz) | 1075 | Body | 1g | 83.1 | 77.7 | 6.95 | ±10 |
| | | | | 10g | 23.4 | 21.7 | 7.83 | |
| 8/1/2012 | D5GHzV2 (5.2GHz) | 1075 | Body | 1g | 71.5 | 72.7 | -1.65 | ±10 |
| | | | | 10g | 20.2 | 20.5 | -1.46 | |
| 8/1/2012 | D5GHzV2 (5.5GHz) | 1075 | Body | 1g | 83.3 | 77.7 | 7.21 | ±10 |
| | | | | 10g | 23.4 | 21.7 | 7.83 | |
| 8/1/2012 | D5GHzV2 (5.8GHz) | 1075 | Body | 1g | 78.1 | 72.5 | 7.72 | ±10 |
| | | | | 10g | 21.9 | 20.2 | 8.42 | |
| 8/1/2012 | D2450V2 | 748 | Body | 1g | 50.8 | 49.9 | 1.80 | ±10 |
| | | | | 10g | 23.4 | 23.4 | 0.00 | |
| 8/2/2012 | D5GHzV2 (5.2GHz) | 1075 | Body | 1g | 72.1 | 72.7 | -0.83 | ±10 |
| | | | | 10g | 20.5 | 20.5 | 0.00 | |
| 8/8/2012 | D5GHzV2 (5.2GHz) | 1075 | Body | 1g | 71.2 | 72.7 | -2.06 | ±10 |
| | | | | 10g | 20.2 | 20.5 | -1.46 | |
| 8/8/2012 | D2450V2 (2450MHz) | 748 | Body | 1g | 46.9 | 49.9 | -6.01 | ±10 |
| | | | | 10g | 22.1 | 23.4 | -5.56 | |
| 8/8/2012 | D5GHzV2 (5.5GHz) | 1003 | Body | 1g | 78.1 | 79.9 | -2.25 | ±10 |
| | | | | 10g | 22.2 | 22.3 | -0.45 | |
| 8/8/2012 | D5GHzV2 (5.6GHz) | 1003 | Body | 1g | 82.5 | 79.9 | 3.25 | ±10 |
| | | | | 10g | 23.4 | 22.3 | 4.93 | |
| 8/8/2012 | D5GHzV2 (5.8GHz) | 1003 | Body | 1g | 77.1 | 76.2 | 1.18 | ±10 |
| | | | | 10g | 21.6 | 21.2 | 1.89 | |
| 8/9/2012 | D5GHzV2 (5.2GHz) | 1075 | Body | 1g | 68.3 | 72.7 | -6.05 | ±10 |
| | | | | 10g | 19.4 | 20.5 | -5.37 | |
| 8/9/2012 | D2450V2 (2450MHz) | 748 | Body | 1g | 47.7 | 49.9 | -4.41 | ±10 |
| | | | | 10g | 22.0 | 23.4 | -5.98 | |

# 12. SAR Test Results

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

### 12.1.1. Body Exposure Conditions

| Test Position | Mode | Dist. (mm) | Ch #. | Freq. (MHz) | Power (dBm) | 1g SAR (W/kg) | Note |
|---|---|---|---|---|---|---|---|
| Rear | 802.11b | 5 | 1 | 2412 | 16.5 | 0.548 | |
| | | | 6 | 2437 | 16.5 | 0.670 | |
| | | | 11 | 2462 | 16.5 | 0.652 | |
| Front | 802.11b | 5 | 1 | 2412 | 16.5 | 0.967 | |
| | | | 6 | 2437 | 16.5 | 1.080 | |
| | | | 11 | 2462 | 16.5 | **1.100** | |
| | | | 11 | 2462 | 16.5 | 1.020 | 2 |
| Edge 1 | 802.11b | 5 | 1 | 2412 | 16.5 | | 1 |
| | | | 6 | 2437 | 16.5 | 0.254 | |
| | | | 11 | 2462 | 16.5 | | 1 |
| Edge 4 | 802.11b | 5 | 1 | 2412 | 16.5 | | 1 |
| | | | 6 | 2437 | 16.5 | 0.177 | |
| | | | 11 | 2462 | 16.5 | | 1 |

**Note(s):**

1. When the 1-g SAR for the mid-band channel or the channel with the highest output power satisfy the following conditions, testing of the other channels in the band is not required. (Per KDB 447498 D01 General RF Exposure Guidance v05)
   ≤ 0.8 W/kg and transmission band ≤ 100 MHz
   ≤ 0.6 W/kg and, 100 MHz < transmission bandwidth ≤ 200 MHz
   ≤ 0.4 W/kg and transmission band > 200 MHz
2. With headset attached.

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

### 12.2.1. Body Exposure Conditions

| Band (GHz) | Test Position | Dist. (mm) | Mode | Ch #. | Freq. (MHz) | Power (dBm) | 1g SAR (W/kg) | Note |
|---|---|---|---|---|---|---|---|---|
| 5.2 | Rear | 5 | 802.11a | 36 | 5180 | 14.0 | 0.431 | |
| | | | | 48 | 5240 | 14.0 | 0.391 | |
| | Front | 5 | 802.11a | 36 | 5180 | 14.0 | **1.090** | |
| | | | | 36 | 5180 | 14.0 | 0.932 | 1 |
| | | | | 48 | 5240 | 14.0 | 0.958 | |
| | Edge 1 | 5 | 802.11a | 36 | 5180 | 14.0 | 0.243 | |
| | | | | 48 | 5240 | 14.0 | 0.166 | |
| | Edge 4 | 5 | 802.11a | 36 | 5180 | 14.0 | 0.070 | |
| | | | | 48 | 5240 | 14.0 | 0.068 | |
| 5.3 | Rear | 5 | 802.11a | 52 | 5260 | 13.5 | 0.434 | |
| | | | | 64 | 5320 | 13.5 | 0.479 | |
| | Front | 5 | 802.11a | 52 | 5260 | 13.5 | 1.100 | |
| | | | | 64 | 5320 | 13.5 | **1.160** | |
| | | | | 64 | 5320 | 13.5 | 0.961 | 1 |
| | Edge 1 | 5 | 802.11a | 52 | 5260 | 13.5 | 0.182 | |
| | | | | 64 | 5320 | 13.5 | 0.194 | |
| | Edge 4 | 5 | 802.11a | 52 | 5260 | 13.5 | 0.055 | |
| | | | | 64 | 5320 | 13.5 | 0.066 | |
| 5.5 | Rear | 5 | 802.11a | 104 | 5520 | 13.0 | 0.479 | |
| | | | | 116 | 5580 | 13.0 | 0.513 | |
| | | | | 124 | 5620 | 13.0 | 0.481 | |
| | | | | 136 | 5680 | 13.0 | 0.500 | |
| | Front | 5 | 802.11a | 104 | 5520 | 13.0 | 0.990 | |
| | | | | 116 | 5580 | 13.0 | 1.080 | |
| | | | | 124 | 5620 | 13.0 | **1.130** | |
| | | | | 124 | 5620 | 13.0 | 1.020 | 1 |
| | | | | 136 | 5680 | 13.0 | 1.090 | |
| | Edge 1 | 5 | 802.11a | 104 | 5520 | 13.0 | 0.226 | |
| | | | | 116 | 5580 | 13.0 | 0.262 | |
| | | | | 124 | 5620 | 13.0 | 0.262 | |
| | | | | 136 | 5680 | 13.0 | 0.290 | |
| | Edge 4 | 5 | 802.11a | 104 | 5520 | 13.0 | 0.067 | |
| | | | | 116 | 5580 | 13.0 | 0.104 | |
| | | | | 124 | 5620 | 13.0 | 0.106 | |
| | | | | 136 | 5680 | 13.0 | 0.114 | |
| 5.8 | Rear | 5 | 802.11a | 149 | 5745 | 13.5 | 0.525 | |
| | | | | 157 | 5785 | 13.5 | 0.470 | |
| | | | | 165 | 5825 | 13.5 | 0.424 | |
| | Front | 5 | 802.11a | 149 | 5745 | 13.5 | **1.150** | |
| | | | | 149 | 5745 | 13.5 | 1.130 | 1 |
| | | | | 157 | 5785 | 13.5 | 1.040 | |
| | | | | 165 | 5825 | 13.5 | 0.987 | |
| | Edge 1 | 5 | 802.11a | 149 | 5745 | 13.5 | 0.212 | |
| | | | | 157 | 5785 | 13.5 | 0.240 | |
| | | | | 165 | 5825 | 13.5 | 0.204 | |
| | Edge 4 | 5 | 802.11a | 149 | 5745 | 13.5 | 0.076 | |
| | | | | 157 | 5785 | 13.5 | 0.060 | |
| | | | | 165 | 5825 | 13.5 | 0.055 | |

**Note(s):**
1. With headset attached.

## 12.3. Bluetooth

### 12.3.1. Body Exposure Conditions

| Test Position | Mode | Dist. (mm) | Ch #. | Freq. (MHz) | Power (dBm) | 1g SAR (W/kg) | Note |
|---|---|---|---|---|---|---|---|
| Rear | GFSK | 5 | 0 | 2402 | 13.6 | | 1 |
| | | | 39 | 2441 | 13.7 | 0.120 | |
| | | | 78 | 2480 | 13.8 | | 1 |
| Front | GFSK | 5 | 0 | 2402 | 13.6 | | 1 |
| | | | 39 | 2441 | 13.7 | 0.204 | |
| | | | 78 | 2480 | 13.8 | | 1 |
| Edge 1 | GFSK | 5 | 0 | 2402 | 13.6 | | 1 |
| | | | 39 | 2441 | 13.7 | 0.051 | |
| | | | 78 | 2480 | 13.8 | | 1 |
| Edge 4 | GFSK | 5 | 0 | 2402 | 13.6 | | 1 |
| | | | 39 | 2441 | 13.7 | 0.031 | |
| | | | 78 | 2480 | 13.8 | | 1 |

**Note(s):**

1. When the 1-g SAR for the mid-band channel or the channel with the highest output power satisfy the following conditions, testing of the other channels in the band is not required. (Per KDB 447498 D01 General RF Exposure Guidance v05)
   ≤ 0.8 W/kg and transmission band ≤ 100 MHz
   ≤ 0.6 W/kg and, 100 MHz < transmission bandwidth ≤ 200 MHz
   ≤ 0.4 W/kg and transmission band > 200 MHz

# 13. Summary of Highest SAR Values

Results for highest SAR values for each frequency band and mode

| Technology/Band | Test configuration | | Mode | Highest 1g SAR (W/kg) |
|---|---|---|---|---|
| WiFi 2.4 GHz | Body | Front | 802.11b 1Mbps | 1.100 |
| WiFi 5.2 GHz | Body | Front | 802.11a 6Mbps | 1.090 |
| WiFi 5.3 GHz | Body | Front | 802.11a 6Mbps | 1.160 |
| WiFi 5.5 GHz | Body | Front | 802.11a 6Mbps | 1.130 |
| WiFi 5.8 GHz | Body | Front | 802.11a 6Mbps | 1.150 |
| Bluetooth | Body | Front | GFSK | 0.204 |

## 13.1. Scaled SAR Values to the Maximum Target Output Power

The highest measured SAR results were scaled, in cases where measured output power is lower than the maximum Target output power level, in each frequency band.

| Technology/ Band | Test Configuration | | Mode | Dist. (mm) | Ch #. | Freq. (MHz) | Power (dBm) | | SAR (W/kg) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Tune-up limit | Measured | Measured | Scaled |
| WiFi 2.4 GHz | Body | Front | 802.11b 1Mbps | 5 | 11 | 2462 | 16.5 | 16.5 | 1.100 | * |
| WiFi 5.2 GHz | Body | Front | 802.11a 6Mbps | 5 | 36 | 5180 | 14.0 | 14.0 | 1.090 | * |
| WiFi 5.3 GHz | Body | Front | 802.11a 6Mbps | 5 | 64 | 5320 | 13.5 | 13.5 | 1.160 | * |
| WiFi 5.5 GHz | Body | Front | 802.11a 6Mbps | 5 | 124 | 5620 | 13.0 | 13.0 | 1.130 | * |
| WiFi 5.8 GHz | Body | Front | 802.11a 6Mbps | 5 | 149 | 5745 | 13.5 | 13.5 | 1.150 | * |
| Bluetooth 2.4 GHz | Body | Front | GFSK | 5 | 39 | 2441 | 13.5 | 13.7 | 0.204 | * |

**Note(s):**

*: SAR Scaling was not applied when the measured output power is equal or greater than the maximum target output power.

## 13.2. SAR Measurement Repeatability

In accordance with published KDB procedure “865664 SAR measurement 100 MHz to 6 GHz DR01”. SAR measurement repeatability is evaluated for the highest measured SAR among all configurations tested in a frequency band according to the following: (per 865664 SAR measurement 100 MHz to 6 GHz DR01)

- < 0.4 W/kg, additional measurement is not required
- ≧ 0.4 W/kg and < 1.2 W/kg, repeat once
- ≧ 1.2 W/kg and < 1.5 W/kg, repeat twice
- ≧ 1.5 W/kg; repeat at least three times

The following additional measurements were repeated after the completion of all other device measurements 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 each measurement.

| Freq. band | Test Configuration | | Mode | Dist. (mm) | Ch #. | Freq. (MHz) | Power (dBm) | Test results (W/kg) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Original | Repeated |
| WiFi 2.4 GHz | Body | Front | 802.11b 1Mbps | 5 | 11 | 2462 | 16.5 | 1.100 | 1.100 |
| WiFi 5.2 GHz | Body | Front | 802.11a 6Mbps | 5 | 36 | 5180 | 14.0 | 1.090 | 1.050 |
| WiFi 5.3 GHz | Body | Front | 802.11a 6Mbps | 5 | 64 | 5320 | 13.5 | 1.160 | 1.090 |
| WiFi 5.5 GHz | Body | Front | 802.11a 6Mbps | 5 | 124 | 5620 | 13.0 | 1.130 | 1.130 |
| WiFi 5.8 GHz | Body | Front | 802.11a 6Mbps | 5 | 149 | 5745 | 13.5 | 1.150 | 1.150 |

## 13.3. SAR Plots (from Summary of Highest SAR Values)

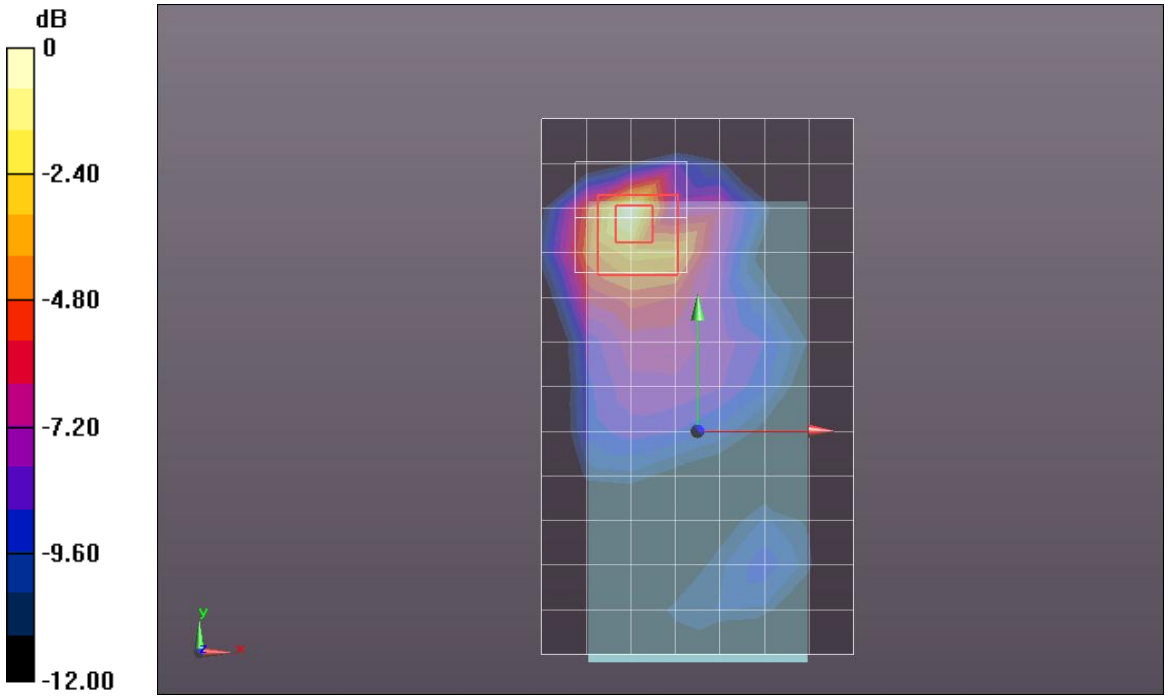
Test Laboratory: UL CCS SAR Lab A Date: 8/2/2012

### WiFi 2.4GHz

Frequency: 2462 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used (interpolated): f = 2462 MHz; $\sigma$ = 2.042 mho/m; $\varepsilon_r$ = 51.151; $\rho$ = 1000 kg/m$^3$
DASY5 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1258; Calibrated: 3/8/2012
- Probe: EX3DV4 - SN3772; ConvF(6.65, 6.65, 6.65); Calibrated: 2/16/2012
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (B); Type: QDOVA001BB; Serial: 1099

**Front/802.11b_ch 11/Area Scan (8x13x1):** Measurement grid: dx=12mm, dy=12mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.519 mW/g

**Front/802.11b_ch 11/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 27.973 V/m; Power Drift = -0.16 dB
Peak SAR (extrapolated) = 2.7540
**SAR(1 g) = 1.1 mW/g; SAR(10 g) = 0.423 mW/g**
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.843 mW/g



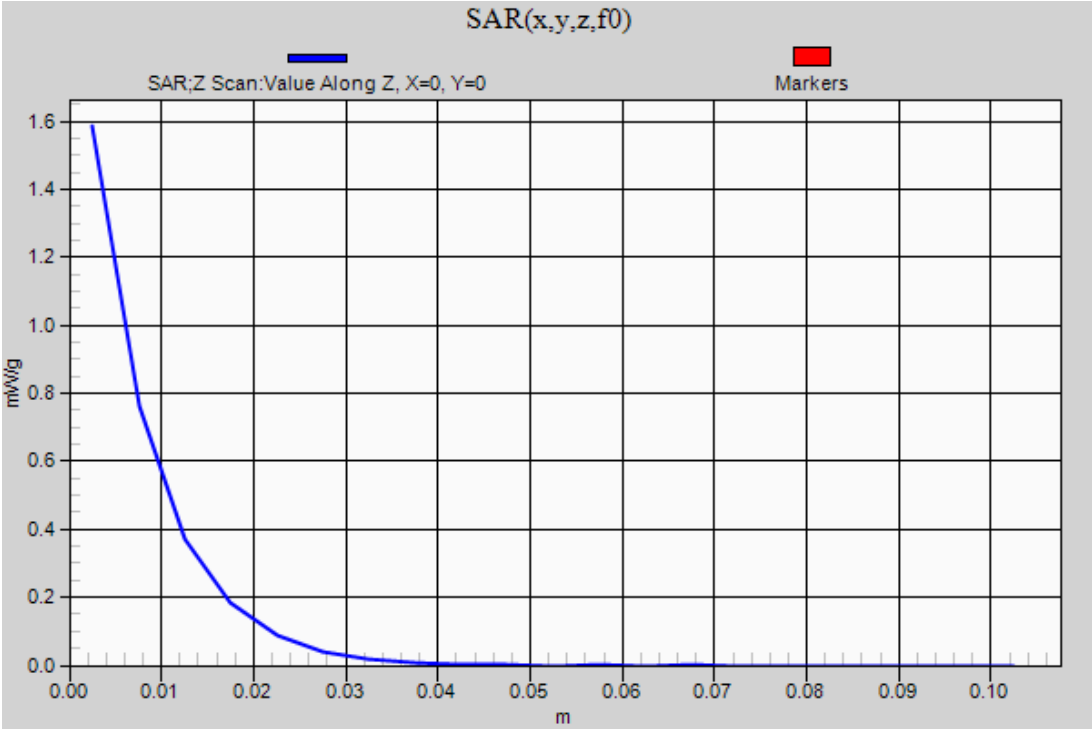

0 dB = 1.519mW/g = 3.63 dB mW/g

Test Laboratory: UL CCS SAR Lab A Date: 8/2/2012

## WiFi 2.4GHz

Frequency: 2462 MHz; Duty Cycle: 1:1

**Front/802.11b_ch 11/Z Scan (1x1x21):** Measurement grid: dx=20mm, dy=20mm, dz=5mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.586 mW/g



Test Laboratory: UL CCS SAR Lab C Date: 8/1/2012

## WiFi 5.2GHz

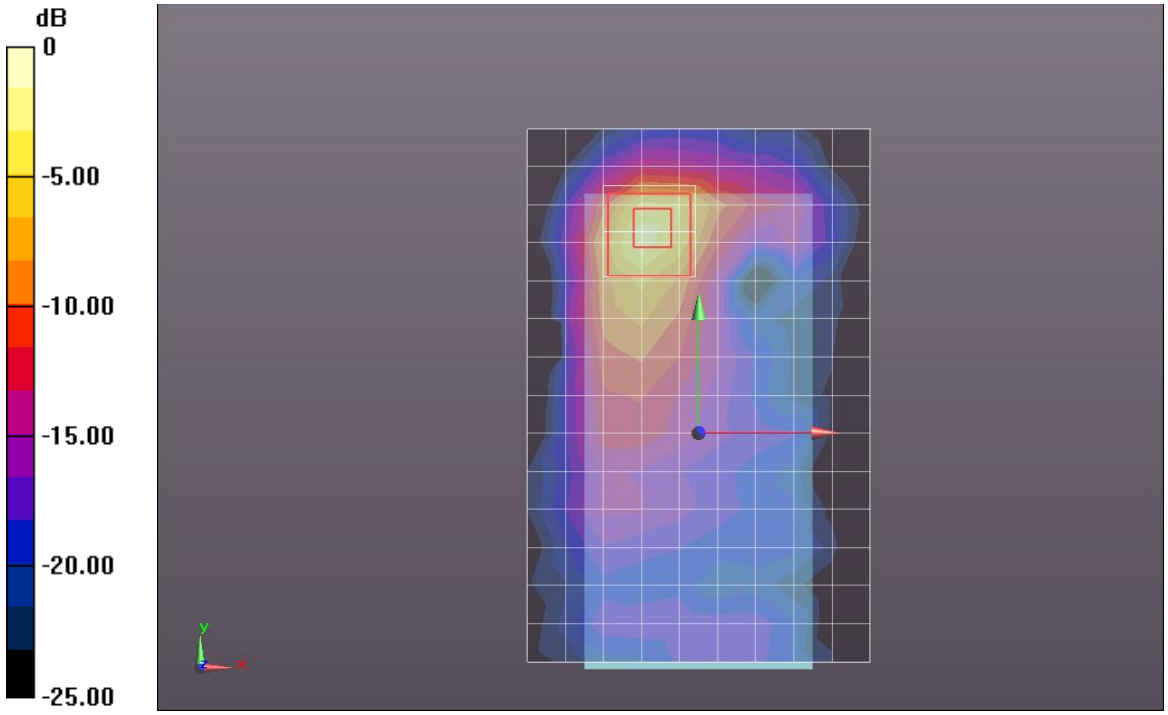
Frequency: 5180 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 25.0°C; Liquid Temperature: 24.0°C
Medium parameters used: f = 5180 MHz; $\sigma$ = 5.277 mho/m; $\varepsilon_r$ = 50.207; $\rho$ = 1000 kg/m$^3$
DASY5 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1239; Calibrated: 6/6/2012
- Probe: EX3DV4 - SN3773; ConvF(4.15, 4.15, 4.15); Calibrated: 3/14/2012
- Sensor-Surface: 2.5mm (Mechanical Surface Detection), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1120

### Front/802.11a_Ch 36/Area Scan (10x15x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 1.417 mW/g

### Front/802.11a_Ch 36/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 17.260 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 4.7340
**SAR(1 g) = 1.09 mW/g; SAR(10 g) = 0.295 mW/g**
Maximum value of SAR (measured) = 2.279 mW/g



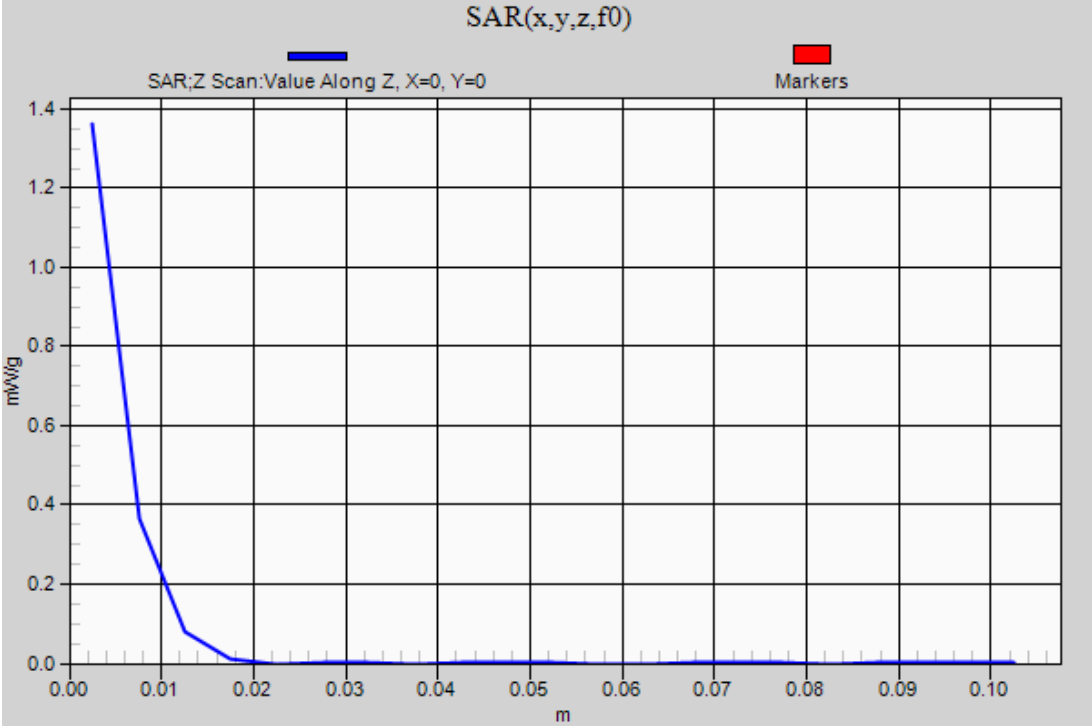

0 dB = 2.280mW/g = 7.16 dB mW/g

Test Laboratory: UL CCS SAR Lab C Date: 8/1/2012

## WiFi 5.2GHz

Frequency: 5180 MHz; Duty Cycle: 1:1

**Front/802.11a_Ch 36/Z Scan (1x1x21):** Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.362 mW/g



Test Laboratory: UL CCS SAR Lab A Date: 8/2/2012

## WiFi 5.3GHz

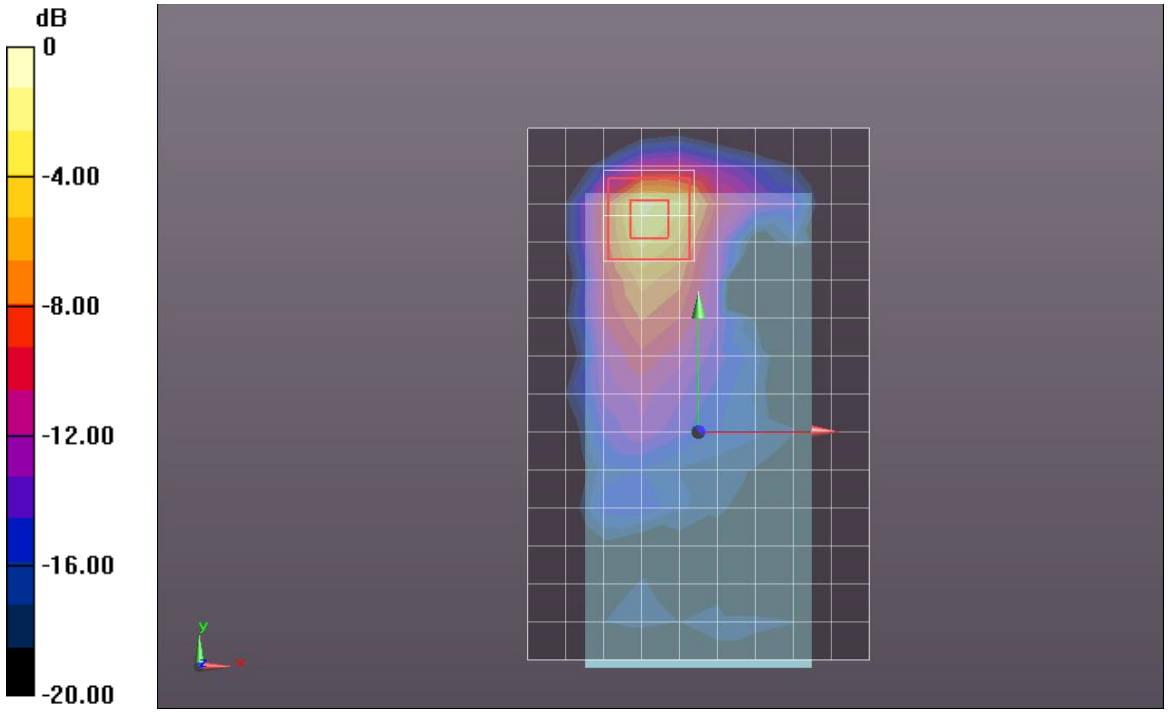
Frequency: 5320 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 25.0°C; Liquid Temperature: 24.0°C
Medium parameters used: f = 5320 MHz; $\sigma$ = 5.518 mho/m; $\varepsilon_r$ = 47.354; $\rho$ = 1000 kg/m$^3$
DASY5 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1258; Calibrated: 3/8/2012
- Probe: EX3DV4 - SN3772; ConvF(3.99, 3.99, 3.99); Calibrated: 2/16/2012
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1120

### Front/802.11a_Ch 64/Area Scan (10x15x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 1.524 mW/g

### Front/802.11a_Ch 64/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 18.072 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 4.8530
**SAR(1 g) = 1.16 mW/g; SAR(10 g) = 0.322 mW/g**
Maximum value of SAR (measured) = 2.495 mW/g



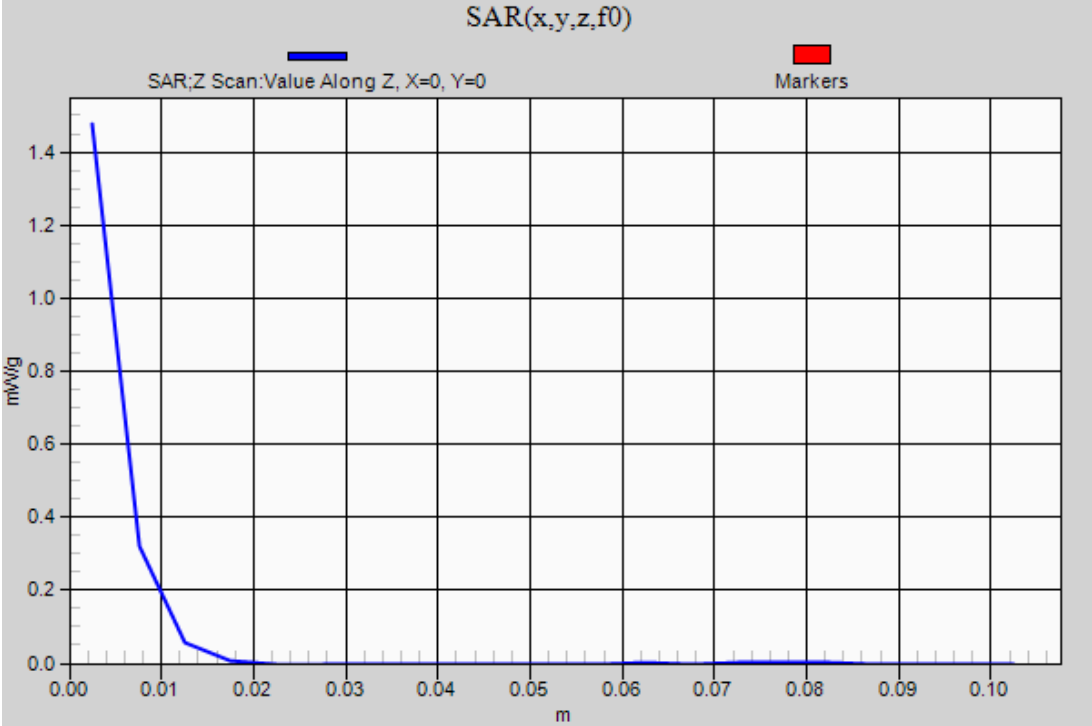

0 dB = 2.500mW/g = 7.96 dB mW/g

Test Laboratory: UL CCS SAR Lab A Date: 8/2/2012

## WiFi 5.3GHz

Frequency: 5320 MHz; Duty Cycle: 1:1

**Front/802.11a_Ch 64/Z Scan (1x1x21):** Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.476 mW/g



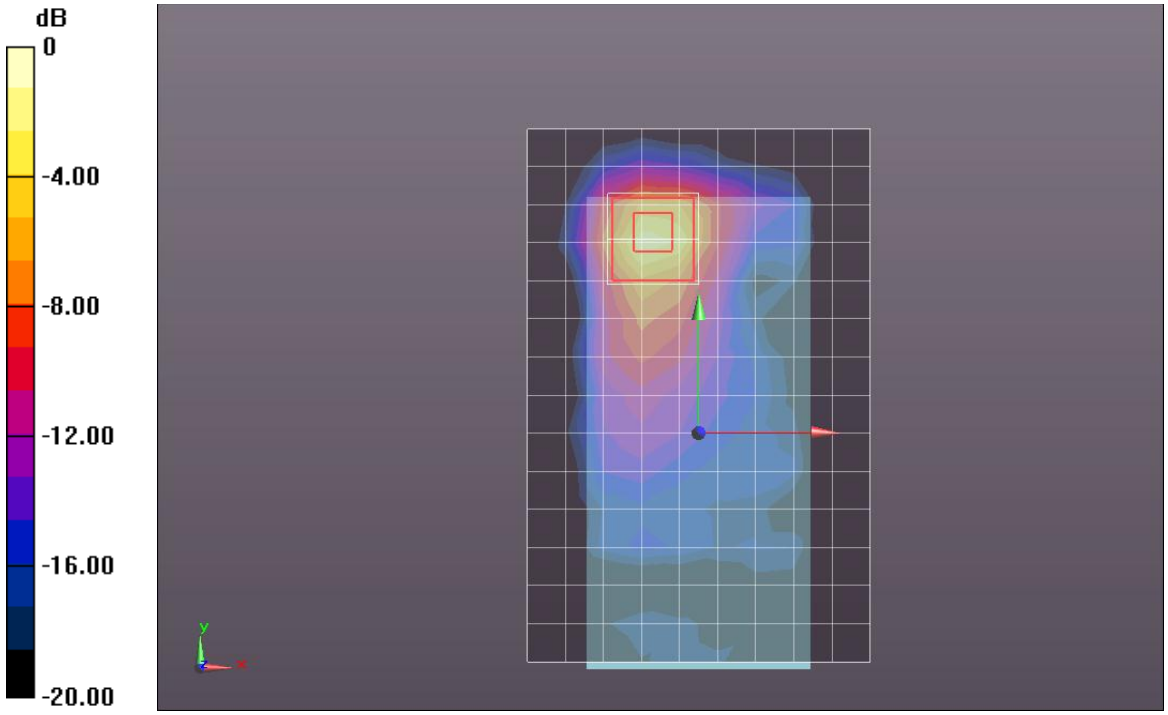
Test Laboratory: UL CCS SAR Lab C Date: 8/2/2012

## WiFi 5.5GHz

Frequency: 5620 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 25.0°C; Liquid Temperature: 24.0°C
Medium parameters used: f = 5620 MHz; $\sigma$ = 5.904 mho/m; $\varepsilon_r$ = 50.36; $\rho$ = 1000 kg/$m^3$
DASY5 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1239; Calibrated: 6/6/2012
- Probe: EX3DV4 - SN3773; ConvF(3.46, 3.46, 3.46); Calibrated: 3/14/2012
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1120

**Front/802.11a_Ch 124/Area Scan (10x15x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.579 mW/g

**Front/802.11a_Ch 124/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 17.655 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 4.9650
**SAR(1 g) = 1.13 mW/g; SAR(10 g) = 0.315 mW/g**
Maximum value of SAR (measured) = 2.286 mW/g



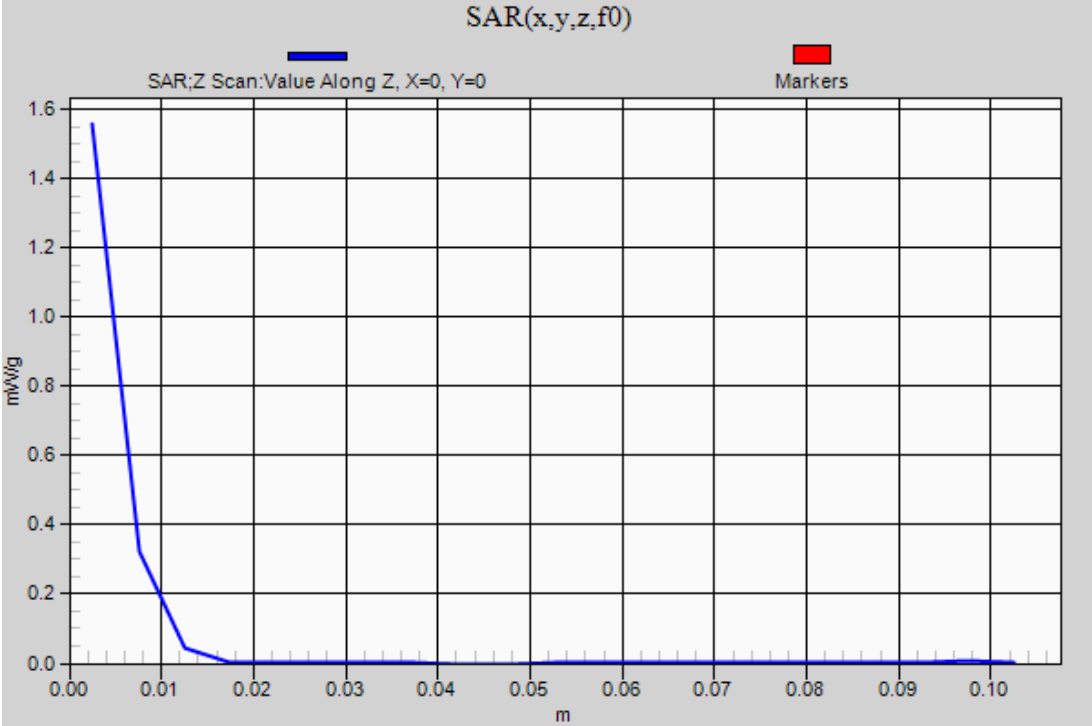

0 dB = 2.290mW/g = 7.20 dB mW/g

Test Laboratory: UL CCS SAR Lab A
Date: 8/2/2012

## WiFi 5.5GHz

Frequency: 5620 MHz; Duty Cycle: 1:1

**Front/802.11a_Ch 124/Z Scan (1x1x21):** Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.558 mW/g



Test Laboratory: UL CCS SAR Lab A Date: 8/1/2012

## WiFi 5.8GHz

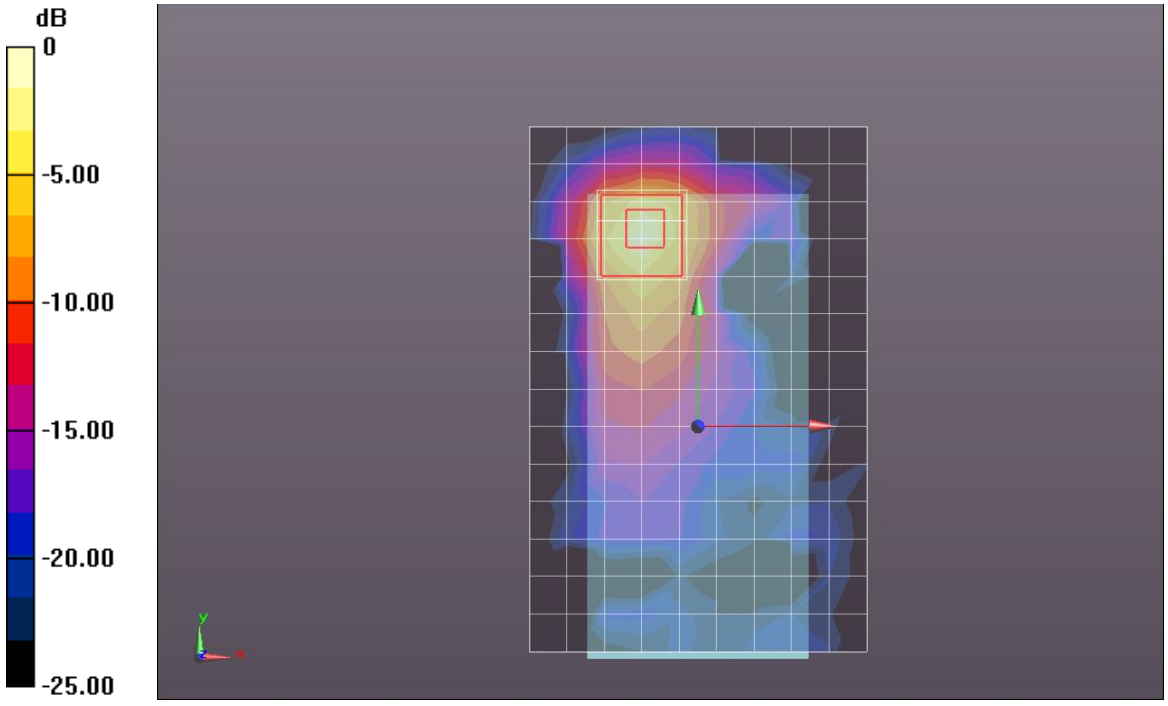
Frequency: 5745 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 25.0°C; Liquid Temperature: 24.0°C
Medium parameters used: f = 5745 MHz; $\sigma$ = 6.122 mho/m; $\varepsilon_r$ = 46.275; $\rho$ = 1000 kg/m$^3$
DASY5 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1258; Calibrated: 3/8/2012
- Probe: EX3DV4 - SN3772; ConvF(3.58, 3.58, 3.58); Calibrated: 2/16/2012
- Sensor-Surface: 2.5mm (Mechanical Surface Detection), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1120

### Front/802.11a_Ch 149/Area Scan (10x15x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 1.828 mW/g

### Front/802.11a_Ch 149/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 18.971 V/m; Power Drift = -0.16 dB
Peak SAR (extrapolated) = 4.8140
**SAR(1 g) = 1.15 mW/g; SAR(10 g) = 0.322 mW/g**
Maximum value of SAR (measured) = 2.275 mW/g



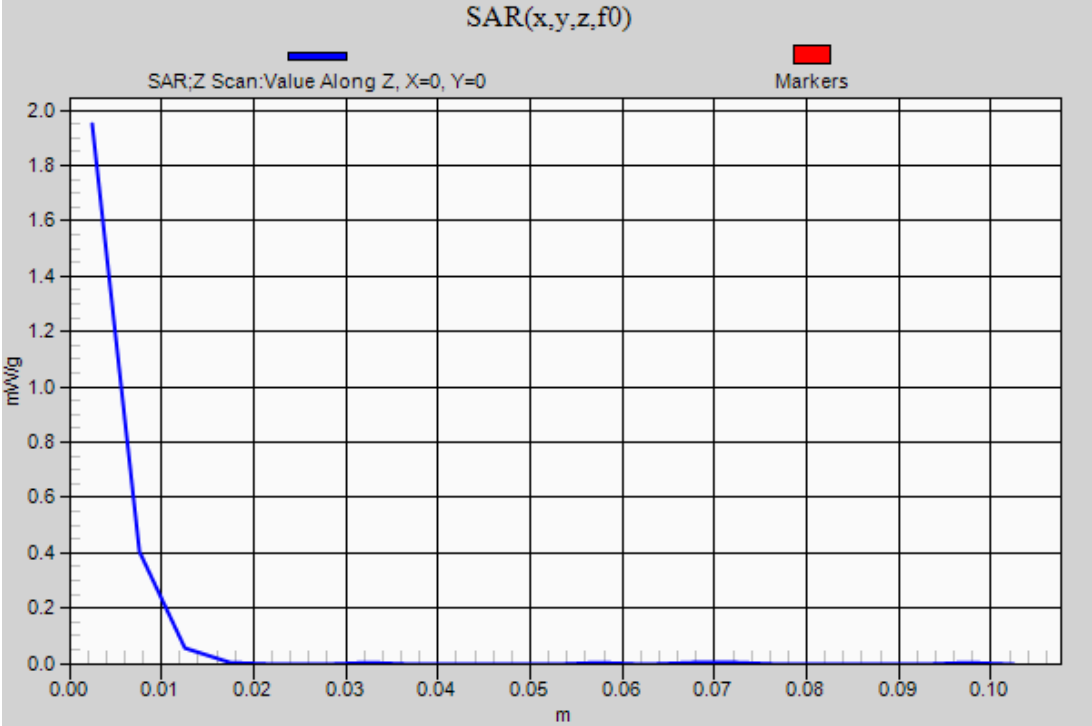

0 dB = 2.280mW/g = 7.16 dB mW/g

Test Laboratory: UL CCS SAR Lab A
Date: 8/1/2012

## WiFi 5.8GHz

Frequency: 5745 MHz; Duty Cycle: 1:1

**Front/802.11a_Ch 149/Z Scan (1x1x21):** Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.949 mW/g



Test Laboratory: UL CCS SAR Lab A Date: 8/9/2012

## Bluetooth

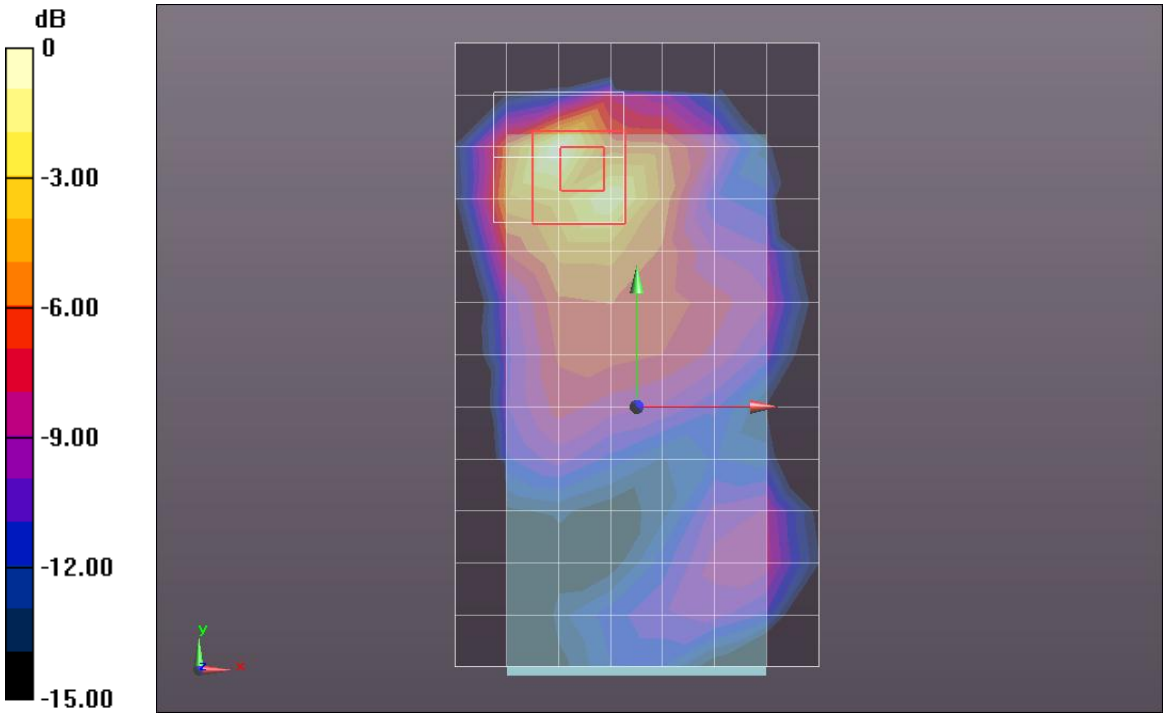
Frequency: 2441 MHz; Duty Cycle: 1:3.43954; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used (interpolated): f = 2441 MHz; $\sigma$ = 1.877 mho/m; $\varepsilon_r$ = 51.294; $\rho$ = 1000 kg/m$^3$
DASY5 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1258; Calibrated: 3/8/2012
- Probe: EX3DV4 - SN3772; ConvF(6.65, 6.65, 6.65); Calibrated: 2/16/2012
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (B); Type: QDOVA001BB; Serial: 1099

### Front/802.15_GFSK_ch 39/Area Scan (8x13x1): Measurement grid: dx=12mm, dy=12mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.223 mW/g

### Front/802.15_GFSK_ch 39/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 10.940 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.5130
**SAR(1 g) = 0.204 mW/g; SAR(10 g) = 0.075 mW/g**
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.327 mW/g



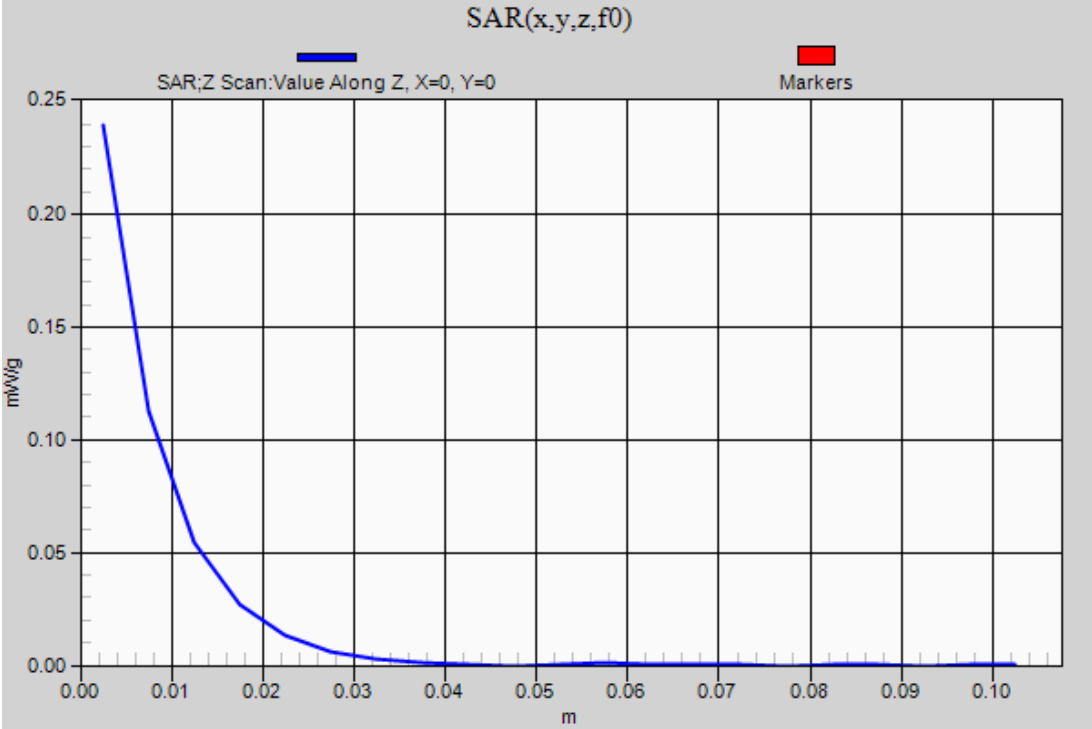

0 dB = 0.223mW/g = -13.03 dB mW/g

Test Laboratory: UL CCS SAR Lab A
Date: 8/9/2012

## Bluetooth

Frequency: 2441 MHz; Duty Cycle: 1:3.43954

**Front/802.15_GFSK_ch 39/Z Scan (1x1x21):** Measurement grid: dx=20mm, dy=20mm, dz=5mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.239 mW/g



# 14. Simultaneous Transmission SAR Analysis

KDB 447498 D01 General RF Exposure Guidance v05 (Draft) introduces a new formula for calculating the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

$$SPLSR = (SAR_1 + SAR_2)1.5 / Ri$$

Where:

$SAR_1$ is the highest measured 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 measured or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

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

A new threshold of 0.04 is also introduced in the draft KDB. Thus, in order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

$$(SAR_1 + SAR_2)1.5 / Ri < 0.04$$

# 14.1. Body Exposure Conditions

## 14.1.1. Sum of the SAR for WiFi 5 GHz Bands & Bluetooth

**Sum of the SAR with Measured Values**

| Test Position | Data | | | | Data | ∑ 1-g SAR (mW/g) |
|---|---|---|---|---|---|---|
| | 5.2 GHz | 5.3 GHz | 5.5 GHz | 5.8 GHz | Bluetooth | |
| Rear | 0.431 | | | | 0.120 | 0.551 |
| | | 0.479 | | | 0.120 | 0.599 |
| | | | 0.513 | | 0.120 | 0.633 |
| | | | | 0.525 | 0.120 | 0.645 |
| Front | 1.09 | | | | 0.204 | 1.294 |
| | | 1.16 | | | 0.204 | **1.364** |
| | | | 1.13 | | 0.204 | 1.334 |
| | | | | 1.15 | 0.204 | 1.354 |
| Edge 1 | 0.243 | | | | 0.051 | 0.294 |
| | | 0.194 | | | 0.051 | 0.245 |
| | | | 0.290 | | 0.051 | 0.341 |
| | | | | 0.240 | 0.051 | 0.291 |
| Edge 2 | 0 | | | | 0 | 0 |
| | | 0 | | | 0 | 0 |
| | | | 0 | | 0 | 0 |
| | | | | 0 | 0 | 0 |
| Edge 3 | 0 | | | | 0 | 0 |
| | | 0 | | | 0 | 0 |
| | | | 0 | | 0 | 0 |
| | | | | 0 | 0 | 0 |
| Edge 4 | 0.070 | | | | 0.031 | 0.101 |
| | | 0.066 | | | 0.031 | 0.097 |
| | | | 0.114 | | 0.031 | 0.145 |
| | | | | 0.076 | 0.031 | 0.107 |

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

**Conclusion:**

Simultaneous transmission SAR measurement (Volume Scan) is not required because the sum of the 1-g SAR is < 1.6 W/kg.

# 15. Appendixes

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

**15.1. System Performance Check Plots**

**15.2. SAR Test Plots for WiFi 2.4 GHz Band**

**15.3. SAR Test Plots for WiFi 5 GHz Bands**

**15.4. SAR Test Plots for Bluetooth**

**15.5. SAR Test Plots for Repeatability**

**15.6. Calibration Certificate for E-Field Probe EX3DV4 - SN 3686**

**15.7. Calibration Certificate for E-Field Probe EX3DV4 - SN 3772**

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

**15.9. Calibration Certificate for D2450V2 - SN 748**

**15.10. Calibration Certificate for D5GHzV2 - SN 1075**

**15.11. Calibration Certificate for D5GHzV2 - SN 1003**