# SAR EVALUATION REPORT

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

*For*
**Dolphin CT50 Healthcare**

**FCC ID: HD5-CT50L0N**
**Model Name: CT50L0N**

**Report Number: 15U21901-S1V1**
**Issue Date: 12/14/2015**

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NVLAP LAB CODE 200065-0

**Revision History**

| Rev. | Date | Revisions | Revised By |
|---|---|---|---|
| V1 | 12/14/2015 | Initial Issue | -- |
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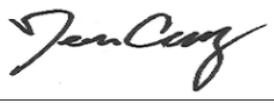
# 1. Attestation of Test Results

| | | | | |
|---|---|---|---|---|
| Applicant Name | Honeywell International Inc, Honeywell Sensing and Productivity Solutions, | | | |
| FCC ID | HD5-CT50L0N | | | |
| Model Name | CT50L0N | | | |
| Applicable Standards | FCC 47 CFR § 2.1093<br>Published RF exposure KDB procedures<br>IEEE Std 1528-2013 | | | |
| **SAR Limits (W/Kg)** | | | | |
| Exposure Category | Peak spatial-average(1g of tissue) | | Extremities (hands, wrists, ankles, etc.) (10g of tissue) | |
| General population / Uncontrolled exposure | 1.6 | | 4 | |
| **The Highest Reported SAR (W/kg)** | | | | |
| **RF Exposure Conditions** | **Equipment Class** | | | |
| | **Licensed** | **DTS** | **U-NII** | **DSS (BT)** |
| Head | N/A | 0.269 | 0.279 | N/A |
| Body-worn | | 0.078 | 0.191 | |
| Extremity | | 0.263 | 0.773 | |
| Simultaneous Tx | | N/A | | |
| Date Tested | 11/16/2015 to 11/19/2015 | | | |
| Test Results | Pass | | | |

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.

| Approved & Released By: | Prepared By: |
|---|---|
|  |  |
| Devin Chang<br>Senior Engineer<br>UL Verification Services Inc. | Henry Wong<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 § 2.1093, IEEE STD 1528-2013, the following FCC Published RF exposure KDB procedures:

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 447498 D03 Supplement C Cross-Reference v01
- 648474 D04 Handset SAR v01r03
- 690783 D01 SAR Listings on Grants v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02

# 3. Facilities and Accreditation

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

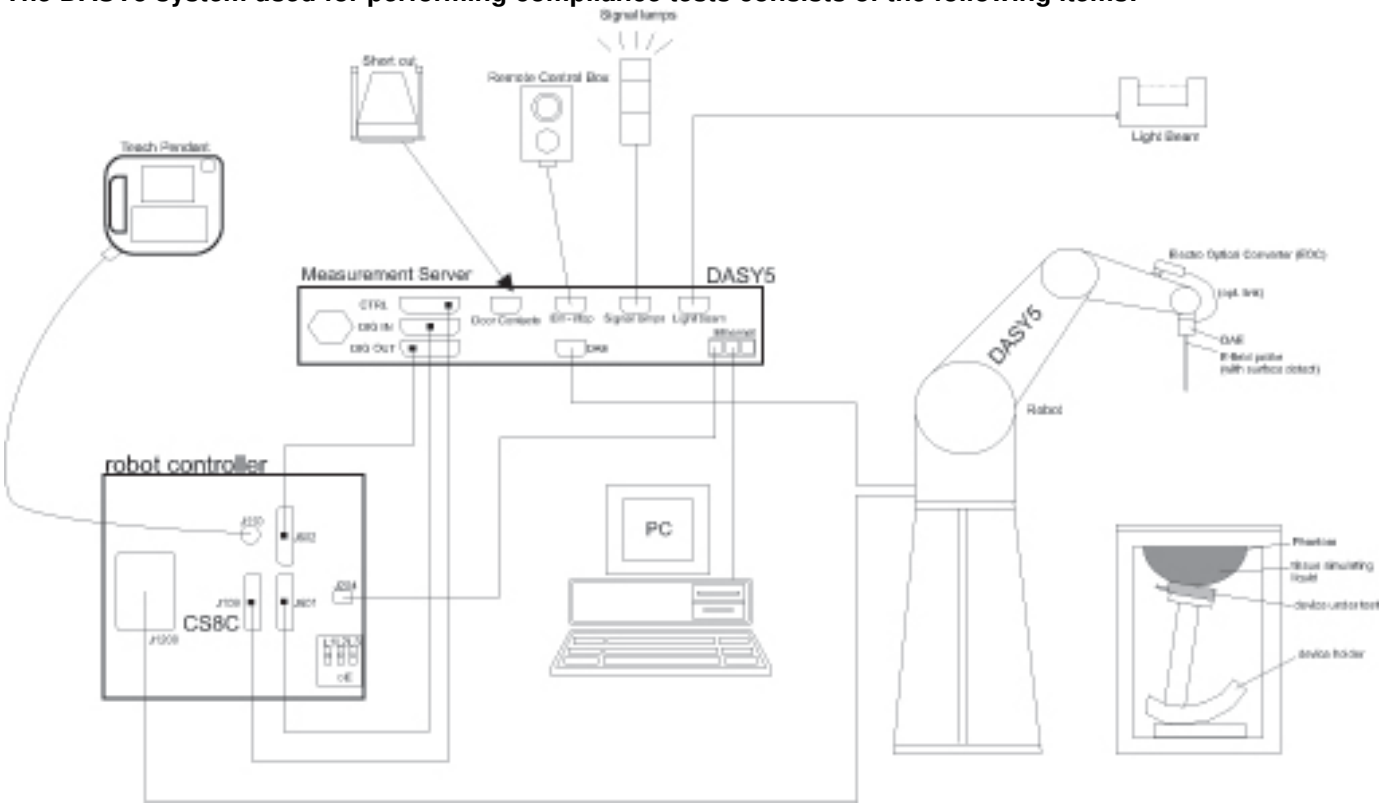
| 47173 Benicia Street | 47266 Benicia Street |
|---|---|
| SAR Lab A | SAR Lab 1 |
| SAR Lab B | SAR Lab 2 |
| SAR Lab C | SAR Lab 3 |
| SAR Lab D | SAR Lab 4 |
| SAR Lab E | SAR Lab 5 |
| SAR Lab F | |
| SAR Lab G | |
| SAR Lab H | |

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

# 4. SAR Measurement System & Test Equipment

## 4.1. SAR Measurement System

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




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

## 4.2. SAR Scan Procedures

**Step 1: Power Reference Measurement**

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

**Step 2: Area Scan**

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

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

| | ≤ 3 GHz | > 3 GHz |
|---|---|---|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | 5 ± 1 mm | 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 | 8753ES | MY40001647 | 7/28/2016 |
| Dielectric Probe kit | SPEAG | DAK-3.5 | 1103 | 2/17/2016 |
| Shorting block | SPEAG | DAK-3.5 Short | SM DAK 200 BA | 2/17/2016 |
| Thermometer | Control Company | Traceable | 140493798 | 8/4/2016 |

**System Check**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| HP Signal Generator | HP | 8665B | 3546A00784 | 6/27/2016 |
| Power Meter | Agilent | N1912A | MY55196007 | 7/2/2016 |
| Power Sensor | Agilent | N1921A | MY53260010 | 7/8/2016 |
| Power Sensor | Agilent | N1921A | MY52260009 | 12/15/2015 |
| Amplifier | MITEQ | AMF-4D-00400600-50-30P | 1622052 | N/A |
| Bi-directional coupler | Werlatone, Inc. | C8060-102 | 2711 | N/A |
| DC Power Supply | Sorensen Ametek | XT15-4 | 1319A02780 | N/A |
| E-Field Probe (SAR Lab 1) | SPEAG | EX3DV4 | 7356 | 4/22/2016 |
| E-Field Probe (SAR Lab 4) | SPEAG | EX3DV4 | 3989 | 3/17/2016 |
| Data Acquisition Electronics (SAR Lab 1) | SPEAG | DAE3 | 500 | 5/22/2016 |
| Data Acquisition Electronics (SAR Lab 4) | SPEAG | DAE4 | 1258 | 5/14/2016 |
| System Validation Dipole | SPEAG | D2450V2 | 899 | 3/13/2016 |
| System Validation Dipole | SPEAG | D5GHzV2 | 1003 | 2/20/2016 |
| Thermometer (SAR Lab 1) | EXTECH | 445703 | CCS-205 | 3/20/2016 |
| Thermometer (SAR Lab 4) | EXTECH | 445703 | CCS-238 | 6/5/2016 |

**Other**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| Power Meter | Agilent | N1912A | MY55196004 | 7/1/2016 |
| Power Sensor | Agilent | N1921A | MY53260001 | 9/24/2016 |

# 5. Measurement Uncertainty

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

# 6. Device Under Test (DUT) Information

## 6.1. DUT Description

| | | | |
|---|---|---|---|
| Device Dimension | Overall (Length x Width): 160 mm x 82 mm<br>Overall Diagonal: 165 mm<br>Display Diagonal: 118 mm | | |
| Battery Options | ☒ Standard – Lithium-ion battery, Rating 3.6Vdc, 14.6Wh | | |
| Wireless Router (Hotspot) | Not Supported | | |
| Wi-Fi Direct | Not Supported | | |
| Test sample information | **S/N** | **IMEI** | **Notes** |
| | 1528840614 | N/A | SAR Radiated Sample |
| | 1528840655 | N/A | SAR Radiated Sample |
| | 1528840612 | N/A | SAR Conducted Sample |

## 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% |
| | Does this device support bands 5.60 ~ 5.65 GHz? ☒ Yes ☐ No | | |
| | Does this device support Band gap channel(s)? ☐ Yes ☒ No | | |
| Bluetooth | 2.4 GHz | Version 4.0 LE | 77.5% (DH5) |

## 6.3. Maximum Output Power from Tune-up Procedure

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

| Upper limit (dB): -2.0 ~ 0.5 | | Max. RF Output Power (dBm) | |
|---|---|---|---|
| RF Air interface | Mode | Target | Max. tune-up tolerance limit |
| WiFi 2.4 GHz | 802.11b | 15.0 | **15.5** |
| | 802.11g | 11.5 | **12.0** |
| | 802.11n HT20 | 9.5 | **10.0** |
| Wi-Fi 5.2/5.3/5.5 GHz | 802.11a | 14.0 | **14.5** |
| | 802.11n HT20 | 14.0 | **14.5** |
| | 802.11n HT40 | 14.0 | **14.5** |
| | 802.11ac VHT20 | 14.0 | **14.5** |
| | 802.11ac VHT40 | 14.0 | **14.5** |
| | 802.11ac VHT80 | 14.0 | **14.5** |
| WiFi 5.8 GHz | 802.11a | 11.5 | **12.0** |
| | 802.11n HT20 | 11.5 | **12.0** |
| | 802.11n HT40 | 11.5 | **12.0** |
| | 802.11ac VHT20 | 11.5 | **12.0** |
| | 802.11ac VHT40 | 11.5 | **12.0** |
| | 802.11ac VHT80 | 11.5 | **12.0** |
| Upper limit (dB): -2.0 ~ 2.0 | | Max. RF Output Power (dBm) | |
| RF Air interface | Mode | Target | Max. tune-up tolerance limit |
| Bluetooth | | 2.0 | **4.0** |
| Bluetooth LE | | 1.0 | **3.0** |

# 7. RF Exposure Conditions (Test Configurations)

Refer to “SAR Photos and Ant locations” Appendix for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

| Wireless technologies | RF Exposure Conditions | DUT-to-User Separation | Test Position | Antenna-to-edge/surface | SAR Required |
|---|---|---|---|---|---|
| WLAN | Head | 0 mm | Left Touch | N/A | Yes |
| | | | Left Tilt (15°) | N/A | Yes |
| | | | Right Touch | N/A | Yes |
| | | | Right Tilt (15°) | N/A | Yes |
| | Body | 15 mm | Rear | N/A | Yes |
| | | | Front | N/A | Yes |
| | Extremity | 0mm | Rear | < 25 mm | Yes |
| | | | Front | < 25 mm | No |
| | | | Edge 1 (Top) | < 25 mm | Yes |
| | | | Edge 2 (Right) | > 25 mm | No |
| | | | Edge 3 (Bottom) | > 25 mm | No |
| | | | Edge 4 (Left) | < 25 mm | Yes |

# 8. Dielectric Property Measurements & System Check

## 8.1. Dielectric Property Measurements

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

**Tissue Dielectric Parameters**

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

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

**IEEE Std 1528-2013**

Refer to Table 3 within the IEEE Std 1528-2013

**Dielectric Property Measurements Results:**

**SAR Lab 1**

| Date | Freq. (MHz) | Liquid Parameters | | | Measured | Target | Delta (%) | Limit ±(%) |
|---|---|---|---|---|---|---|---|---|
| 11/16/2015 | Head 2450 | e' | 38.8000 | Relative Permittivity ($\epsilon_r$): | 38.80 | 39.20 | -1.02 | 5 |
| | | e" | 13.6200 | Conductivity (σ): | 1.86 | 1.80 | 3.08 | 5 |
| | Head 2410 | e' | 38.8900 | Relative Permittivity ($\epsilon_r$): | 38.89 | 39.28 | -0.99 | 5 |
| | | e" | 13.5500 | Conductivity (σ): | 1.82 | 1.76 | 3.14 | 5 |
| | Head 2475 | e' | 38.6800 | Relative Permittivity ($\epsilon_r$): | 38.68 | 39.17 | -1.25 | 5 |
| | | e" | 13.6800 | Conductivity (σ): | 1.88 | 1.83 | 3.04 | 5 |
| 11/16/2015 | Body 2450 | e' | 51.0700 | Relative Permittivity ($\epsilon_r$): | 51.07 | 52.70 | -3.09 | 5 |
| | | e" | 14.4600 | Conductivity (σ): | 1.97 | 1.95 | 1.02 | 5 |
| | Body 2410 | e' | 51.1500 | Relative Permittivity ($\epsilon_r$): | 51.15 | 52.76 | -3.05 | 5 |
| | | e" | 14.3300 | Conductivity (σ): | 1.92 | 1.91 | 0.67 | 5 |
| | Body 2475 | e' | 51.0000 | Relative Permittivity ($\epsilon_r$): | 51.00 | 52.67 | -3.17 | 5 |
| | | e" | 14.4800 | Conductivity (σ): | 1.99 | 1.99 | 0.38 | 5 |

**SAR Lab 4**

| Date | Freq. (MHz) | Liquid Parameters | | | Measured | Target | Delta (%) | Limit ±(%) |
|---|---|---|---|---|---|---|---|---|
| 11/16/2015 | Head 5180 | e' | 34.8700 | Relative Permittivity ($\epsilon_r$): | 34.87 | 36.01 | -3.17 | 5 |
| | | e" | 16.1900 | Conductivity (σ): | 4.66 | 4.63 | 0.70 | 5 |
| | Head 5200 | e' | 34.7100 | Relative Permittivity ($\epsilon_r$): | 34.71 | 35.99 | -3.56 | 5 |
| | | e" | 16.1700 | Conductivity (σ): | 4.68 | 4.65 | 0.52 | 5 |
| | Head 5600 | e' | 34.0800 | Relative Permittivity ($\epsilon_r$): | 34.08 | 35.53 | -4.09 | 5 |
| | | e" | 16.4100 | Conductivity (σ): | 5.11 | 5.06 | 0.98 | 5 |
| | Head 5800 | e' | 33.7800 | Relative Permittivity ($\epsilon_r$): | 33.78 | 35.30 | -4.31 | 5 |
| | | e" | 16.5000 | Conductivity (σ): | 5.32 | 5.27 | 0.97 | 5 |
| | Head 5825 | e' | 33.7300 | Relative Permittivity ($\epsilon_r$): | 33.73 | 35.30 | -4.45 | 5 |
| | | e" | 16.6400 | Conductivity (σ): | 5.39 | 5.27 | 2.27 | 5 |
| 11/16/2015 | Body 5180 | e' | 47.7000 | Relative Permittivity ($\epsilon_r$): | 47.70 | 49.05 | -2.75 | 5 |
| | | e" | 18.7400 | Conductivity (σ): | 5.40 | 5.27 | 2.39 | 5 |
| | Body 5200 | e' | 47.3700 | Relative Permittivity ($\epsilon_r$): | 47.37 | 49.02 | -3.37 | 5 |
| | | e" | 18.8000 | Conductivity (σ): | 5.44 | 5.29 | 2.66 | 5 |
| | Body 5600 | e' | 46.6900 | Relative Permittivity ($\epsilon_r$): | 46.69 | 48.48 | -3.69 | 5 |
| | | e" | 19.1000 | Conductivity (σ): | 5.95 | 5.76 | 3.23 | 5 |
| | Body 5800 | e' | 46.3600 | Relative Permittivity ($\epsilon_r$): | 46.36 | 48.20 | -3.82 | 5 |
| | | e" | 19.2500 | Conductivity (σ): | 6.21 | 6.00 | 3.47 | 5 |
| | Body 5825 | e' | 46.2400 | Relative Permittivity ($\epsilon_r$): | 46.24 | 48.20 | -4.07 | 5 |
| | | e" | 19.4200 | Conductivity (σ): | 6.29 | 6.00 | 4.83 | 5 |

## 8.2. System Check

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are re-measured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

**System Performance Check Measurement Conditions:**

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 ±0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm for measurements > 3 GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
  For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (below 3 GHz) and/or 8x8x7 (above 3 GHz) fine cube was chosen for the cube.
- Distance between probe sensors and phantom surface was set to 3 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was 100 mW.
- The results are normalized to 1 W input power.

**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 1**

| Date Tested | System Dipole | | T.S. Liquid | | Measured Results | | Target (Ref. Value) | Delta ±10 % | Plot No. |
|---|---|---|---|---|---|---|---|---|---|
| | Type | Serial # | | | Zoom Scan to 100 mW | Normalize to 1 W | | | |
| 11/16/2015 | D2450V2 | 899 | Head | 1g | 5.43 | 54.30 | 51.60 | 5.23 | |
| | | | | 10g | 2.43 | 24.30 | 23.90 | 1.67 | |
| 11/16/2015 | D2450V2 | 899 | Body | 1g | 5.18 | 51.80 | 48.80 | **6.15** | 1,2 |
| | | | | 10g | 2.35 | 23.50 | 22.70 | 3.52 | |

**SAR Lab 4**

| Date Tested | System Dipole | | T.S. Liquid | | Measured Results | | Target (Ref. Value) | Delta ±10 % | Plot No. |
|---|---|---|---|---|---|---|---|---|---|
| | Type | Serial # | | | Zoom Scan to 100 mW | Normalize to 1 W | | | |
| 11/16/2015 | 5200 | 1003 | Head | 1g | 7.93 | 79.30 | 76.4 | 3.80 | |
| | | | | 10g | 2.30 | 23.00 | 21.9 | 5.02 | |
| 11/16/2015 | 5600 | 1003 | Head | 1g | 7.63 | 76.30 | 79.6 | -4.15 | |
| | | | | 10g | 2.23 | 22.30 | 22.8 | -2.19 | |
| 11/17/2015 | 5800 | 1003 | Head | 1g | 8.14 | 81.40 | 76.1 | **6.96** | 3,4 |
| | | | | 10g | 2.32 | 23.20 | 21.7 | 6.91 | |
| 11/16/2015 | 5200 | 1003 | Body | 1g | 7.72 | 77.20 | 72.7 | 6.19 | |
| | | | | 10g | 2.17 | 21.70 | 20.4 | 6.37 | |
| 11/16/2015 | 5600 | 1003 | Body | 1g | 7.96 | 79.60 | 77.0 | 3.38 | |
| | | | | 10g | 2.21 | 22.10 | 21.3 | 3.76 | |
| 11/16/2015 | 5800 | 1003 | Body | 1g | 7.90 | 79.00 | 75.0 | 5.33 | |
| | | | | 10g | 2.22 | 22.20 | 20.6 | 7.77 | |

# 9. Conducted Output Power Measurements

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

**Measured Results**

| Band (GHz) | Mode | Data Rate | Ch # | Freq. (MHz) | Avg Pwr (dBm) | Max Output Power (dBm) | SAR Test (Yes/No) | Note(s) |
|---|---|---|---|---|---|---|---|---|
| 2.4 | 802.11b | 1 Mbps | 1 | 2412 | 15.5 | 15.5 | Yes | |
| | | | 6 | 2437 | **15.2** | | | |
| | | | 11 | 2462 | 15.3 | | | |
| | 802.11g | 6 Mbps | 1 | 2412 | Not Required | 12.0 | No | 1 |
| | | | 6 | 2437 | | | | |
| | | | 11 | 2462 | | | | |
| | 802.11n (HT20) | MCS0 | 1 | 2412 | | 10.0 | No | 1 |
| | | | 6 | 2437 | | | | |
| | | | 11 | 2462 | | | | |

**Note(s):**

1. Output Power and SAR is not required for 802.11g/n HT20 channels when the highest *reported* SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

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

**Measured Results**

| Band (GHz) | Mode | Data Rate | Ch # | Freq. (MHz) | Avg Pwr (dBm) | Max Output Power (dBm) | SAR Test (Yes/No) |
|---|---|---|---|---|---|---|---|
| 5.3 (U-NII 2A) | 802.11a | 6 Mbps | 52 | 5260 | Not Required | 14.5 | No |
| | | | 56 | 5280 | | | |
| | | | 60 | 5300 | | | |
| | | | 64 | 5320 | | | |
| | 802.11n (HT20) | MCS0 | 52 | 5260 | Not Required | 14.5 | No |
| | | | 56 | 5280 | | | |
| | | | 60 | 5300 | | | |
| | | | 64 | 5320 | | | |
| | 802.11n (HT40) | MCS0 | 54 | 5270 | Not Required | 14.5 | No |
| | | | 62 | 5310 | | | |
| | 802.11ac (VHT20) | MCS0 | 52 | 5260 | Not Required | 14.5 | No |
| | | | 56 | 5280 | | | |
| | | | 60 | 5300 | | | |
| | | | 64 | 5320 | | | |
| | 802.11ac (VHT40) | MCS0 | 54 | 5270 | Not Required | 14.5 | No |
| | | | 62 | 5310 | | | |
| | 802.11ac (VHT80) | MCS0 | 58 | 5290 | 14.5 | 14.5 | Yes |
| 5.5 (U-NII 2C) | 802.11a | 6 Mbps | 100 | 5500 | Not Required | 14.5 | No |
| | | | 116 | 5580 | | | |
| | | | 124 | 5620 | | | |
| | | | 140 | 5700 | | | |
| | 802.11n (HT20) | MCS0 | 100 | 5500 | Not Required | 14.5 | No |
| | | | 116 | 5580 | | | |
| | | | 124 | 5620 | | | |
| | | | 140 | 5700 | | | |
| | 802.11n (HT40) | MCS0 | 102 | 5510 | Not Required | 14.5 | No |
| | | | 118 | 5590 | | | |
| | | | 134 | 5670 | | | |
| | 802.11ac (VHT20) | MCS0 | 100 | 5500 | Not Required | 14.5 | No |
| | | | 116 | 5580 | | | |
| | | | 124 | 5620 | | | |
| | | | 140 | 5700 | | | |
| | 802.11ac (VHT40) | MCS0 | 102 | 5510 | Not Required | 14.5 | No |
| | | | 118 | 5590 | | | |
| | | | 134 | 5670 | | | |
| | 802.11ac (VHT80) | MCS0 | 106 | 5530 | 14.5 | 14.5 | Yes |
| | | | 122 | 5610 | | | |

| Band (GHz) | Mode | Data Rate | Ch # | Freq. (MHz) | Avg Pwr (dBm) | Max Output Power (dBm) | SAR Test (Yes/No) |
|---|---|---|---|---|---|---|---|
| 5.8 (U-NII 3) | 802.11a | 6 Mbps | 149 | 5745 | Not Required | 12.0 | No |
| | | | 157 | 5785 | | | |
| | | | 165 | 5825 | | | |
| | 802.11n (HT20) | MCS0 | 149 | 5745 | Not Required | 12.0 | No |
| | | | 157 | 5785 | | | |
| | | | 165 | 5825 | | | |
| | 802.11n (HT40) | MCS0 | 151 | 5755 | Not Required | 12.0 | No |
| | | | 159 | 5795 | | | |
| | 802.11ac (VHT20) | MCS0 | 149 | 5745 | Not Required | 12.0 | No |
| | | | 157 | 5785 | | | |
| | | | 165 | 5825 | | | |
| | 802.11ac (VHT40) | MCS0 | 151 | 5755 | Not Required | 12.0 | No |
| | | | 159 | 5795 | | | |
| | 802.11ac (VHT80) | MCS0 | 155 | 5755 | 12.0 | 12.0 | Yes |

**Note(s):**

1. Output Power and SAR measurement is not required for 802.11a, 802.11n HT20/HT40 and 802.11ac VHT20/VHT40 channels when the specified tune-up tolerances for 802.11a, 802.11n HT20/HT40 and 802.11ac VHT20/VHT40 are lower than or equal to 802.11ac VHT80 by more than ½ dB and the measured SAR is ≤ 1.2 W/Kg.
2. When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band.
3. When the specified maximum output power is the same for both UNII band I and UNII band 2A, begin SAR measurement in UNII band 2A; and if the highest *reported* SAR for UNII band 2A is
   - ≤ 1.2 W/kg, SAR is not required for UNII band I
   - > 1.2 W/kg, both bands should be tested independently for SAR.

## 9.3. Bluetooth

Maximum tune-up tolerance limit is 4.00 dBm. This power level qualifies for exclusion of SAR testing.

# 10. Measured and Reported (Scaled) SAR Results

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

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

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

**KDB 648474 D04 Handset SAR (Phablet Only):**
When Hotspot Mode is not supported, 10-g Extremity SAR is required for all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge in direct contact with a flat phantom, to address interactive hand use exposure conditions, for when 1-g SAR was measured at a test separation distance greater than 5 mm.

Additional 1-g SAR testing at 5 mm is not required when hotspot mode 10-g extremity SAR is not required for the surfaces and edges since all 1-g reported SAR < 1.2 W/kg.

**KDB 248227 D01 SAR meas for 802.11 v02r02:**
SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS procedure is applied to reduce the number of SAR tests; these are mutually exclusive. For OFDM, an initial test position is only applicable to next to the ear, UMPC mini-tablet and hotspot mode configurations, which is tested using the initial test configuration to facilitate test reduction. For other exposure conditions with a fixed test position, SAR test reduction is determined using only the initial test configuration.

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the *initial test position(s)* by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The *initial test position(s)* is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). When the *reported* SAR for the *initial test position* is:

- ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR procedures.
- > 0.4 W/kg, SAR is repeated using the same wireless mode test configuration tested in the *initial test position* to measure the subsequent next closet/smallest test separation distance and maximum coupling test position, on the highest maximum output power channel, until the *reported* SAR is ≤ 0.8 W/kg or all required test positions are tested.
  - For subsequent test positions with equivalent test separation distance or when exposure is dominated by coupling conditions, the position for maximum coupling condition should be tested.
  - When it is unclear, all equivalent conditions must be tested.
- For all positions/configurations tested using the *initial test position* and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or all required test channels are considered.
  - The additional power measurements required for this step should be limited to those necessary for identifying subsequent highest output power channels to apply the test reduction.
- When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is ≤ 1.2 W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.
- When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is ≤ 1.2 W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR.

To determine the *initial test position*, Area Scans were performed to determine the position with the *Maximum Value of SAR (measured)*. The position that produced the highest *Maximum Value of SAR* is considered the worst case position; thus used as the *initial test position*.

## 10.1. Wi-Fi (DTS Band)

| Frequency Band | Mode | RF Exposure Conditions | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Area Scan Max. SAR (W/kg) | Power (dBm) | | 1-g SAR (W/kg) | | 10-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | Meas. | Scaled | |
| 2.4GHz | 802.11b 1 Mbps | Head | 0 | Left Touch | 6 | 2437.0 | 0.176 | 15.5 | 15.2 | | | | | |
| | | | | Left Tilt | 6 | 2437.0 | 0.197 | 15.5 | 15.2 | | | | | |
| | | | | Right Touch | 1 | 2412.0 | 0.369 | 15.5 | 15.5 | 0.269 | **0.269** | | | 1 |
| | | | | | 6 | 2437.0 | 0.273 | 15.5 | 15.2 | 0.221 | 0.237 | | | |
| | | | | | 11 | 2462.0 | 0.267 | 15.5 | 15.3 | 0.196 | 0.205 | | | |
| | | | | Right Tilt | 6 | 2437.0 | 0.192 | 15.5 | 15.2 | | | | | |
| | | Body-worn | 15 | Rear | 6 | 2437.0 | 0.086 | 15.5 | 15.2 | 0.073 | **0.078** | | | 2 |
| | | | | Front | 6 | 2437.0 | 0.048 | 15.5 | 15.2 | | | | | |
| | | Extremity | 0 | Rear | 1 | 2412.0 | 0.792 | 15.5 | 15.5 | | | 0.263 | **0.263** | 3 |
| | | | | | 6 | 2437.0 | 0.659 | 15.5 | 15.2 | | | 0.201 | 0.215 | |
| | | | | | 11 | 2462.0 | 0.622 | 15.5 | 15.3 | | | 0.191 | 0.200 | |
| | | | | Edge 1 | 6 | 2437.0 | 0.449 | 15.5 | 15.2 | | | 0.188 | 0.201 | |
| | | | | Edge 4 | 6 | 2437.0 | 0.522 | 15.5 | 15.2 | | | 0.200 | 0.214 | |

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

| Frequency Band | Mode | RF Exposure Conditions | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Area Scan Max. SAR (W/kg) | Power (dBm) | | 1-g SAR (W/kg) | | 10-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | Meas. | Scaled | |
| 5.3 GHz U-NII 2A | 802.11ac VHT80 MCS0 | Head | 0 | Left Touch | 58 | 5290.0 | 0.201 | 14.5 | 14.5 | | | | | |
| | | | | Left Tilt | 58 | 5290.0 | 0.170 | 14.5 | 14.5 | | | | | |
| | | | | Right Touch | 58 | 5290.0 | 0.370 | 14.5 | 14.5 | 0.235 | 0.235 | | | 4 |
| | | | | Right Tilt | 58 | 5290.0 | 0.177 | 14.5 | 14.5 | | | | | |
| | | Body-worn | 15 | Rear | 58 | 5290.0 | 0.342 | 14.5 | 14.5 | 0.191 | **0.191** | | | 5 |
| | | | | Front | 58 | 5290.0 | 0.063 | 14.5 | 14.5 | | | | | |
| | | Extremity | 0 | Rear | 58 | 5290.0 | 8.040 | 14.5 | 14.5 | | | 0.773 | **0.773** | 6 |
| | | | | Edge 1 | 58 | 5290.0 | 0.238 | 14.5 | 14.5 | | | | | |
| | | | | Edge 4 | 58 | 5290.0 | 1.547 | 14.5 | 14.5 | | | | | |
| Frequency Band | Mode | RF Exposure Conditions | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Area Scan Max. SAR (W/kg) | Power (dBm) | | 1-g SAR (W/kg) | | 10-g SAR (W/kg) | | Plot No. |
| | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | Meas. | Scaled | |
| 5.5 GHz U-NII 2C | 802.11ac VHT80 MCS0 | Head | 0 | Left Touch | 106 | 5530.0 | 0.277 | 14.5 | 14.5 | | | | | |
| | | | | Left Tilt | 106 | 5530.0 | 0.219 | 14.5 | 14.5 | | | | | |
| | | | | Right Touch | 106 | 5530.0 | 0.454 | 14.5 | 14.5 | 0.279 | **0.279** | | | 7 |
| | | | | Right Tilt | 106 | 5530.0 | 0.274 | 14.5 | 14.5 | | | | | |
| | | Body-worn | 15 | Rear | 106 | 5530.0 | 0.300 | 14.5 | 14.5 | 0.168 | 0.168 | | | 8 |
| | | | | Front | 106 | 5530.0 | 0.143 | 14.5 | 14.5 | | | | | |
| | | Extremity | 0 | Rear | 106 | 5530.0 | 7.530 | 14.5 | 14.5 | | | 0.655 | 0.655 | 9 |
| | | | | Edge 1 | 106 | 5530.0 | 0.306 | 14.5 | 14.5 | | | | | |
| | | | | Edge 4 | 106 | 5530.0 | 1.670 | 14.5 | 14.5 | | | | | |
| Frequency Band | Mode | RF Exposure Conditions | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Area Scan Max. SAR (W/kg) | Power (dBm) | | 1-g SAR (W/kg) | | 10-g SAR (W/kg) | | Plot No. |
| | | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | Meas. | Scaled | |
| 5.8 GHz U-NII 3 | 802.11ac VHT80 MCS0 | Head | 0 | Left Touch | 155 | 5775.0 | 0.111 | 12.0 | 12.0 | | | | | |
| | | | | Left Tilt | 155 | 5775.0 | 0.081 | 12.0 | 12.0 | | | | | |
| | | | | Right Touch | 155 | 5775.0 | 0.292 | 12.0 | 12.0 | 0.169 | 0.169 | | | 10 |
| | | | | Right Tilt | 155 | 5775.0 | 0.108 | 12.0 | 12.0 | | | | | |
| | | Body-worn | 15 | Rear | 155 | 5775.0 | 0.197 | 12.0 | 12.0 | 0.098 | 0.098 | | | 11 |
| | | | | Front | 155 | 5775.0 | 0.060 | 12.0 | 12.0 | | | | | |
| | | Extremity | 0 | Rear | 155 | 5775.0 | 3.130 | 12.0 | 12.0 | | | 0.357 | 0.357 | 12 |
| | | | | Edge 1 | 155 | 5775.0 | 0.108 | 12.0 | 12.0 | | | | | |
| | | | | Edge 4 | 155 | 5775.0 | 0.855 | 12.0 | 12.0 | | | | | |

## 10.3. Bluetooth

### Standalone SAR Test Exclusion Considerations & Estimated SAR

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

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

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

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

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

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

**Body-worn Accessory Exposure Conditions:**

**Standalone:**

| Max. tune-up tolerance limit | | Min. test separation distance (mm) | Frequency (GHz) | SAR test exclusion Result* | Test Configuration | Estimated 1-g SAR (W/kg) |
|---|---|---|---|---|---|---|
| (dBm) | (mW) | | | | | |
| 4.0 | 3 | 15 | 2.480 | 0.3 | Rear/Front | 0.042 |

**Conclusion:**

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

**Extremity:**

| Max. tune-up tolerance limit | | Min. test separation distance (mm) | Frequency (GHz) | SAR test exclusion Result* | Test Configuration | Estimated 10-g SAR (W/kg) |
|---|---|---|---|---|---|---|
| (dBm) | (mW) | | | | | |
| 4.0 | 3 | 5 | 2.480 | 0.9 | Rear/Front | 0.050 |
| | | | | | | |

**Conclusion:**

*: The computed value is ≤ 7.5; therefore, Bluetooth qualifies for Standalone SAR test exclusion.

# 11. SAR Measurement Variability

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

1) Repeated measurement is not required when the original highest measured SAR is <0.8 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.8 or 2 W/kg (1-g or 10-g respectively), repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or 3 (1-g or 10-g respectively) or when the original or repeated measurement is ≥ 1.45 or 3.6 W/kg (~ 10% from the 1-g or 10-g respective SAR limit).
4) Perform a third repeated measurement only if the original, first, or second repeated measurement is ≥ 1.5 or 3.75 W/kg (1-g or 10-g respectively) and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 or 3 (1-g or 10-g respectively).

**Standard SAR**

| Frequency Band (MHz) | Air Interface | RF Exposure Conditions | Test Position | Repeated SAR (Yes/No) | Highest Measured SAR (W/kg) |
|---|---|---|---|---|---|
| 2400 | Wi-Fi 802.11b/g/n | Head | Right Touch | No | 0.269 |
| 5300 | Wi-Fi 802.11a/n/ac | Head | Right Touch | No | 0.235 |
| 5500 | Wi-Fi 802.11a/n/ac | Head | Right Touch | No | 0.279 |
| 5800 | Wi-Fi 802.11a/n/ac | Head | Right Touch | No | 0.169 |

**Extremity SAR**

| Frequency Band (MHz) | Air Interface | RF Exposure Conditions | Test Position | Repeated SAR (Yes/No) | Highest Measured SAR (W/kg) |
|---|---|---|---|---|---|
| 2400 | Wi-Fi 802.11b/g/n | Extremity | Rear | No | 0.263 |
| 5300 | Wi-Fi 802.11a/n/ac | Extremity | Rear | No | 0.773 |
| 5500 | Wi-Fi 802.11a/n/ac | Extremity | Rear | No | 0.655 |
| 5800 | Wi-Fi 802.11a/n/ac | Extremity | Rear | No | 0.357 |

# 12. Simultaneous Transmission SAR Analysis

Simultaneous Transmission is not supported

# Appendixes

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

**15U21901-S1V1 SAR_App A Photos & Ant. Locations**

**15U21901-S1V1 SAR_App B System Check Plots**

**15U21901-S1V1 SAR_App C Highest Test Plots**

**15U21901-S1V1 SAR_App D Tissue Ingredients**

**15U21901-S1V1 SAR_App E Probe Cal. Certificates**

**15U21901-S1V1 SAR_App F Dipole Cal. Certificates**

**END OF REPORT**