# SAR EVALUATION REPORT

**IEEE Std 1528-2013**

*For*
**Dolphin CT50**

**FCC ID: HD5-CT50LFN**
**Model Name: CT50LFN**

**Report Number: 12441959-S1V1**
**Issue Date: 10/5/2018**

*Prepared for*
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*Prepared by*
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NVLAP LAB CODE 200065-0

**Revision History**

| Rev. | Date | Revisions | Revised By |
|---|---|---|---|
| V1 | 10/5/2018 | Initial Issue | -- |
| | | | |
| | | | |
| | | | |

## Table of Contents

# 1. Attestation of Test Results

| | | | | |
|---|---|---|---|---|
| Applicant Name | HONEYWELL INTERNATIONAL INC | | | |
| FCC ID | HD5-CT50LFN | | | |
| Model Name | CT50LFN | | | |
| Applicable Standards | Published RF exposure KDB procedures<br>IEEE Std 1528-2013 | | | |
| Exposure Category | SAR Limits (W/Kg) | | | |
| | Peak spatial-average (1g of tissue) | | Extremities (hands, wrists, ankles, etc.) (10g of tissue) | |
| General population / Uncontrolled exposure | 1.6 | | 4 | |
| RF Exposure Conditions | Equipment Class - Highest Reported SAR (W/kg) | | | |
| | PCE | DTS | NII | DSS |
| Head | 0.941 | 0.454 | 0.243 | N/A |
| Body-worn | 0.918 | 0.089 | 0.251 | N/A |
| Product specific 10g SAR | 3.397 | 0.321 | 0.509 | N/A |
| Simultaneous TX | 1.395 | 1.395 | 1.184 | 1.002 |
| Simultaneous TX Product Specific 10g | 3.906 | 3.577 | 3.906 | 3.498 |
| Date Tested | 9/6/2018 to 9/11/2018 | | | |
| Test Results | Pass | | | |

**Note:** WLAN and Bluetooth SAR test results from the original filling FCC ID: HD5-CT50LFN were used in this report for Simultaneous Tx SAR analysis. This report only contains SAR test data for CDMA200 bands BC0 and BC1. WLAN and Bluetooth SAR test results can be found in the original SAR Report: 15U20259-S1A. The WLAN and Bluetooth SAR results from the original filling are reproduced above for reference.

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

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

| Approved & Released By: | Prepared By: |
|---|---|
|  |  |
| Dave Weaver<br>Operations Leader<br>UL Verification Services Inc. | AJ Newcomer<br>Laboratory Engineer<br>UL Verification Services Inc. |

# 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:

- 447498 D01 General RF Exposure Guidance v06
- 447498 D03 Supplement C Cross-Reference v01
- 648474 D04 Handset SAR v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 941225 D06 Hotspot Mode v02r01
- 941225 D07 UMPC Mini Tablet v01r02

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

- TCB workshop October 2015; RF Exposure Procedures (KDB 941225 D05A)
- TCB workshop April 2016; Page 22, RF Exposure Procedures (Phablet Procedures)
- TCB workshop October 2016; RF Exposure Procedures (DUT Holder Perturbations)
- TCB workshop May 2017; Page 9, Broadband Liquid Above 3 GHz

# 3. Facilities and Accreditation

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

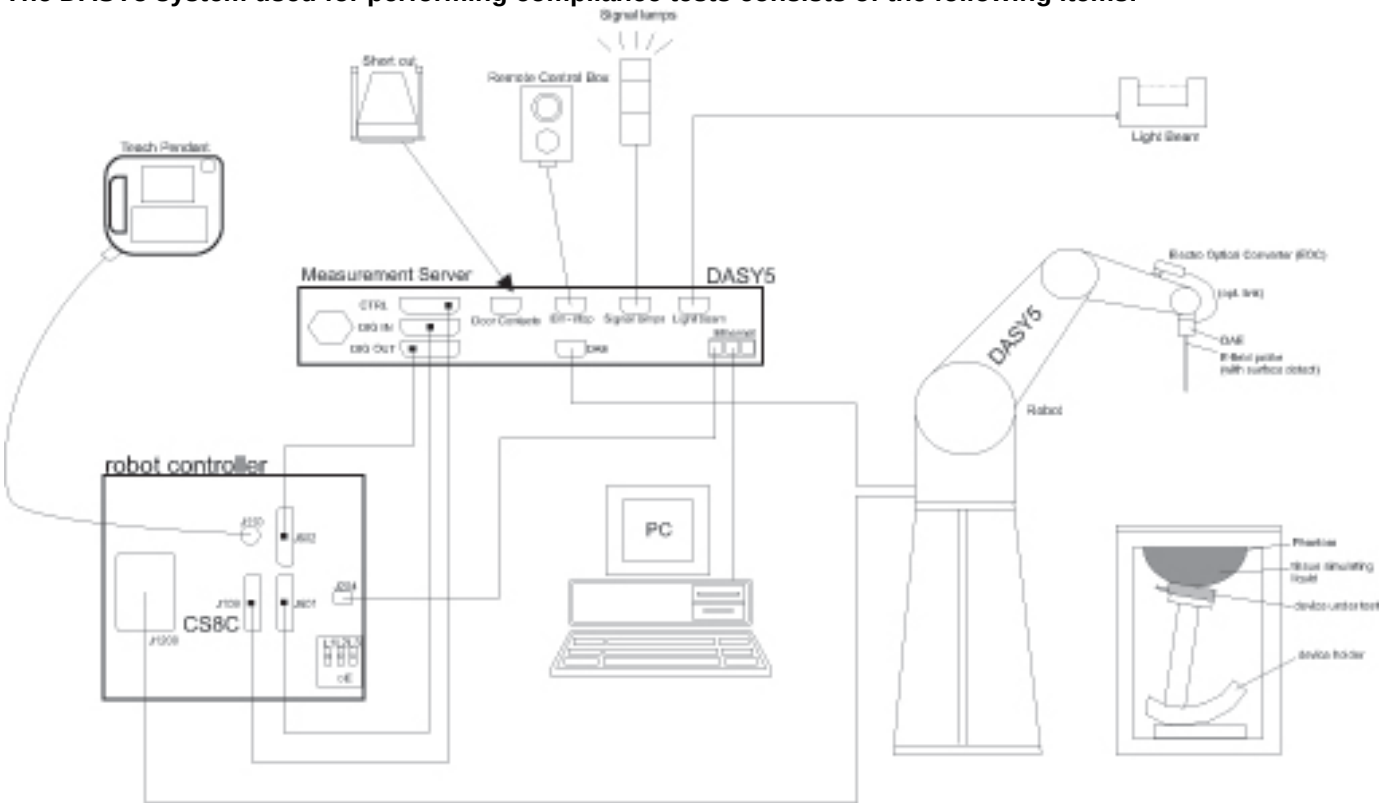
| 47173 Benicia Street | 47266 Benicia Street |
|---|---|
| SAR Lab A | SAR Lab 1 |
| SAR Lab B | SAR Lab 2 |
| SAR Lab C | SAR Lab 3 |
| SAR Lab D | SAR Lab 4 |
| SAR Lab E | SAR Lab 5 |
| SAR Lab F | SAR Lab 6 |
| SAR Lab G | SAR Lab 7 |
| SAR Lab H | SAR Lab 8 |

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

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

**System Check**

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

**Lab Equipment**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| E-Field Probe (SAR Lab 8) | SPEAG | EX3DV4 | 7501 | 5/4/2019 |
| Data Acquisition Electronics (SAR Lab 8) | SPEAG | DAE4 | 1258 | 5/22/2019 |
| System Validation Dipole | SPEAG | D835V2 | 4d117 | 5/16/2019 |
| System Validation Dipole | SPEAG | D1900V2 | 5d163 | 10/5/2018 |
| Thermometer (SAR Lab 8) | Fisher Sceintific | Traceable | 181062300 | 2/26/2019 |

**Other**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| Base Station Simulator | R & S | R & S | 104245-JZ | 6/21/2019 |

**Note(s):**

# 5. Measurement Uncertainty

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

Therefore, the measurement uncertainty is not required.

# 6. Device Under Test (DUT) Information

## 6.1. DUT Description

| | | | |
|---|---|---|---|
| Device Dimension | Refer to Appendix A | | |
| Battery Options | Standard – Lithium-ion battery, Rating 3.6 Vdc, 14.5 Wh | | |
| Accessory | Headset | | |
| Bluetooth Tethering | BT Tethering mode permits the device to share its cellular data connection with other devices.<br>☒ BT Tethering (Bluetooth 2.4 GHz) | | |
| Test sample information | **S/N** | **IMEI** | **Notes** |
| | 1629940712 | 99000621056091 | Conducted |
| | 16299407C7 | 990006210562616 | Radiated |

## 6.2. Wireless Technologies

| Wireless technologies | Frequency bands | Operating Mode | | Duty Cycle used for SAR testing |
|---|---|---|---|---|
| GSM | 850<br>1900 | Voice (GMSK)<br>GPRS (GMSK)<br>EDGE (8PSK) | GSM Class : B<br>Multi-Slot Class:<br>Class 12 - 4 Up, 4 Down | GSM Voice: 12.5%<br>(E)GPRS: 1 Slot: 12.5%<br>2 Slots: 25%<br>3 Slots: 37.5%<br>4 Slots: 50% |
| | Does this device support DTM (Dual Transfer Mode)? ☐ Yes ☒ No | | | |
| CDMA (CDMA2000) | BC0<br>BC1 | 1xRTT (Voice & Data)<br>1xEV-DO Rel. 0<br>1xEV-DO Rev. A<br>1xAdvanced | | 100% |
| | Does this device support SV-DO (1xRTT-1xEVDO)? ☐ Yes ☒ No | | | |
| W-CDMA (UMTS) | Band II<br>Band V | UMTS Rel. 99 (Voice & Data)<br>HSDPA (Rel. 5)<br>HSUPA (Rel. 6)<br>HSPA+ (Rel. 7) | | 100% |
| LTE | FDD Band 2<br>FDD Band 4<br>FDD Band 5<br>FDD Band 17 | QPSK<br>16QAM<br>Rel. 10 Does not support Carrier Aggregation (CA) | | 100% (FDD) |
| | Does this device support SV-LTE (1xRTT-LTE)? ☐ Yes ☒ No | | | |
| Wi-Fi | 2.4 GHz | 802.11b<br>802.11g<br>802.11n (HT20) | | 100% [1] |
| | 5 GHz | 802.11a<br>802.11n (HT20)<br>802.11n (HT40)<br>802.11ac (VHT20)<br>802.11ac (VHT40)<br>802.11ac (VHT80)<br>802.11ac (VHT160) | | 100% [1] |
| | 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 | | (DH5) 77.5%[1] |

**Notes:**

1. Duty cycle for Wi-Fi and Bluetooth is referenced from the original SAR Report 15U20259-S1A
2. This report only contains SAR test results for CDMA 2000 Bands BC0 and BC1. For the SAR test results for all other technologies, refer to the original filling SAR Report: 15U20259-S1A.

## 6.3. General LTE SAR Test and Reporting Considerations

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Frequency range, Channel Bandwidth, Numbers and Frequencies</td><td>
<table>
<tr><td rowspan="3">Band 2</td><td colspan="6">Frequency range: 1850 - 1910 MHz (BW = 60 MHz)</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td>20 MHz</td><td>15 MHz</td><td>10 MHz</td><td>5 MHz</td><td>3 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td>18700 /1860</td><td>18675/ 1857.5</td><td>18650/ 1855</td><td>18625/ 1852.5</td><td>18615/ 1851.5</td><td>18607/ 1850.7</td></tr>
<tr><td>Mid</td><td>18900/ 1880</td><td>18900/ 1880</td><td>18900/ 1880</td><td>18900/ 1880</td><td>18900/ 1880</td><td>18900/ 1880</td></tr>
<tr><td>High</td><td>19100/ 1900</td><td>19125/ 1902.5</td><td>19150/ 1905</td><td>19175/ 1907.5</td><td>19185/ 1908.5</td><td>19193/ 1909.3</td></tr>
<tr><td rowspan="3">Band 4</td><td colspan="6">Frequency range: 1710 - 1755 MHz (BW = 45 MHz)</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td>20 MHz [1]</td><td>15 MHz</td><td>10 MHz</td><td>5 MHz</td><td>3 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td>20050/ 1720</td><td>20025/ 1717.5</td><td>20000/ 1715</td><td>19975/ 1712.5</td><td>19965/ 1711.5</td><td>19957/ 1710.7</td></tr>
<tr><td>Mid</td><td>20175/ 1732.5</td><td>20175/ 1732.5</td><td>20175/ 1732.5</td><td>20175/ 1732.5</td><td>20175/ 1732.5</td><td>20175/ 1732.5</td></tr>
<tr><td>High</td><td>20300/ 1745</td><td>20325/ 1747.5</td><td>20350/ 1750</td><td>20375/ 1752.5</td><td>20385/ 1753.5</td><td>20393/ 1754.3</td></tr>
<tr><td rowspan="3">Band 5</td><td colspan="6">Frequency range: 824 - 849 MHz (BW = 25 MHz)</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td>20 MHz</td><td>15 MHz</td><td>10 MHz [1]</td><td>5 MHz</td><td>3 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td></td><td></td><td>20450/ 829</td><td>20425/ 826.5</td><td>20415/ 825.5</td><td>20407/ 824.7</td></tr>
<tr><td>Mid</td><td></td><td></td><td>20525/ 836.5</td><td>20525/ 836.5</td><td>20525/ 836.5</td><td>20525/ 836.5</td></tr>
<tr><td>High</td><td></td><td></td><td>20600/ 844</td><td>20625/ 846.5</td><td>20635/ 847.5</td><td>20643/ 848.3</td></tr>
<tr><td rowspan="3">Band 17</td><td colspan="6">Frequency range: 704 - 716 MHz (BW = 12 MHz)</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td>20 MHz</td><td>15 MHz</td><td>10 MHz [1]</td><td>5 MHz [1]</td><td>3 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td></td><td></td><td>23780/ 709</td><td>23755/ 706.5</td><td></td><td></td></tr>
<tr><td>Mid</td><td></td><td></td><td>23790/ 710</td><td>23790/ 710</td><td></td><td></td></tr>
<tr><td>High</td><td></td><td></td><td>23800/ 711</td><td>23825/ 713.5</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>LTE transmitter and antenna implementation</td><td>Refer to Appendix A.</td></tr>
<tr><td>Maximum power reduction (MPR)</td><td>
Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3
<table>
<tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth ($N_{RB}$)</th><th rowspan="2">MPR (dB)</th></tr>
<tr><th>1.4 MHz</th><th>3.0 MHz</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th></tr>
<tr><td>QPSK</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 3</td></tr>
<tr><td>256 QAM</td><td colspan="6">≥ 1</td><td>≤ 5</td></tr>
</table>
MPR Built-in by design<br>
The manufacturer MPR values are always within the 3GPP maximum MPR allowance but may not follow the default MPR values.<br>
A-MPR (additional MPR) was disabled during SAR testing
</td></tr>
<tr><td>Power reduction</td><td>No</td></tr>
<tr><td>Spectrum plots for RB configurations</td><td>A properly configured base station simulator was used for the SAR and power measurements; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.</td></tr>
</table>

**Notes:**

1. Maximum bandwidth does not support at least three non-overlapping channels in certain channel bandwidths. When a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing per KDB 941225 D05 SAR for LTE Devices.

# 7. RF Exposure Conditions (Test Configurations)

Refer to Appendix A for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances. This product is a phone supporting next to ear operations with diagonal dimensions greater than 20 cm. As such, it is categorized as a phablet and requires testing in accordance with the phablet procedures described in both KDB 648474 and 616217 in order to, respectively, demonstrate compliance for head SAR and body SAR exposure conditions. The usual body-worn accessory and hotspot mode testing required for phones are however not performed as they are effectively covered by the more conservative test procedures for tablets.

| Wireless technologies | RF Exposure Conditions | DUT-to-User Separation | Test Position | Antenna-to-edge/surface | SAR Required | Note |
|---|---|---|---|---|---|---|
| WWAN | 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 | |
| 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 | |

**Product Specific 10g SAR:**

| Wireless technologies | RF Exposure Conditions | DUT-to-User Separation | Test Position | Antenna-to-edge/surface | SAR Required | Note |
|---|---|---|---|---|---|---|
| WWAN (Main) | Product Specific 10g | 0 mm | Rear | < 25 mm | Yes | 2 |
| | | | Edge 1 | > 25 mm | No | 1 |
| | | | Edge 2 | < 25 mm | Yes | 2 |
| | | | Edge 3 | < 25 mm | Yes | 2 |
| | | | Edge 4 | < 25 mm | Yes | 2 |
| WLAN | Product Specific 10g | 0 mm | Rear | < 25 mm | Yes | 2 |
| | | | Edge 1 | < 25 mm | Yes | 2 |
| | | | Edge 2 | > 25 mm | No | 1 |
| | | | Edge 3 | > 25 mm | No | 1 |
| | | | Edge 4 | < 25 mm | Yes | 2 |

**Notes:**

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

# 8. Dielectric Property Measurements & System Check

## 8.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.
The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.
Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.
The dielectric constant (εr) and conductivity (σ) of typical tissue-equivalent media recipes are expected to be within ± 5% of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEEE Std 1528-2013, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for εr and σ may be relaxed to ± 10%. This is limited to frequencies ≤ 3 GHz.

**Tissue Dielectric Parameters**

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

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

**IEEE Std 1528-2013**

Refer to Table 3 within the IEEE Std 1528-2013

**Dielectric Property Measurements Results:**

| SAR Lab | Date | Band (MHz) | Tissue Type | Frequency (MHz) | Relative Permittivity (εr) | | | Conductivity (σ) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Measured | Target | Delta (%) | Measured | Target | Delta (%) |
| 8 | 9/6/2018 | 1900 | Head | 1900 | 40.07 | 40.00 | 0.18 | 1.42 | 1.40 | 1.57 |
| | | | | 1850 | 40.13 | 40.00 | 0.33 | 1.40 | 1.40 | -0.29 |
| | | | | 1920 | 40.10 | 40.00 | 0.25 | 1.43 | 1.40 | 2.29 |
| 8 | 9/6/2018 | 1900 | Body | 1900 | 52.62 | 53.30 | -1.28 | 1.58 | 1.52 | 3.68 |
| | | | | 1850 | 52.68 | 53.30 | -1.16 | 1.55 | 1.52 | 1.71 |
| | | | | 1920 | 52.66 | 53.30 | -1.20 | 1.59 | 1.52 | 4.41 |
| 8 | 9/10/2018 | 835 | Head | 835 | 41.69 | 41.50 | 0.46 | 0.90 | 0.90 | 0.21 |
| | | | | 805 | 41.78 | 41.68 | 0.24 | 0.89 | 0.90 | -0.69 |
| | | | | 905 | 41.39 | 41.50 | -0.27 | 0.93 | 0.97 | -4.85 |
| 8 | 9/10/2018 | 835 | Body | 835 | 54.31 | 55.20 | -1.61 | 1.01 | 0.97 | 4.12 |
| | | | | 805 | 54.35 | 55.33 | -1.78 | 1.00 | 0.97 | 2.99 |
| | | | | 905 | 53.99 | 55.00 | -1.84 | 1.03 | 1.05 | -2.42 |
| 8 | 9/10/2018 | 1900 | Body | 1900 | 54.50 | 53.30 | 2.25 | 1.58 | 1.52 | 3.68 |
| | | | | 1850 | 54.59 | 53.30 | 2.42 | 1.55 | 1.52 | 1.64 |
| | | | | 1920 | 54.48 | 53.30 | 2.21 | 1.59 | 1.52 | 4.67 |

## 8.2. System Check

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

**System Performance Check Measurement Conditions:**

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

**System Check Results**

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within ±10% of the manufacturer calibrated dipole SAR target. Refer to Appendix B for the SAR System Check Plots.

| SAR Lab | Date | Tissue Type | Dipole Type _Serial # | Dipole Cal. Due Data | Measured Results for 1g SAR | | | | Measured Results for 10g SAR | | | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Zoom Scan to 100 mW | Normalize to 1 W | Target (Ref. Value) | Delta ±10 % | Zoom Scan to 100 mW | Normalize to 1 W | Target (Ref. Value) | Delta ±10 % | |
| 8 | 9/6/2018 | Head | D1900V2 SN:5d163 | 10/5/2018 | 3.850 | 38.50 | 38.77 | -0.70 | 1.990 | 19.90 | 20.10 | -1.00 | |
| 8 | 9/6/2018 | Body | D1900V2 SN:5d163 | 10/5/2018 | 3.920 | 39.20 | 42.99 | **-8.82** | 2.040 | 20.40 | 21.97 | -7.15 | 1,2 |
| 8 | 9/10/2018 | Head | D835V2 SN:4d117 | 5/16/2019 | 0.986 | 9.86 | 9.87 | -0.10 | 0.641 | 6.41 | 6.40 | 0.16 | |
| 8 | 9/10/2018 | Body | D835V2 SN:4d117 | 5/16/2019 | 0.978 | 9.78 | 10.31 | **-5.14** | 0.641 | 6.41 | 6.84 | -6.29 | 3,4 |
| 8 | 9/10/2018 | Body | D1900V2 SN:5d163 | 10/5/2018 | 4.150 | 41.50 | 42.99 | -3.47 | 2.160 | 21.60 | 21.97 | -1.68 | |

# 9. Conducted Output Power Measurements

## 9.1. CDMA

**1x Advanced Setup Procedures used to establish the test signals**

Call box setup procedure

- Protocol Rev > 6 (IS-2000-0)
- System ID: 331; NID: 65535, Reg. Ch. #.:
- Radio Config (RC) > Fwd11, Rvs8
- Service Option (SO) Setup > SO75 (Loopback)
- Traffic Data Rate > Full
- Rvs Power Ctrl > All Up bits (Maximum Tx Pout)
- Reverse Power Control Mode: 00-200 to 400 bps
- Smart blanking was disabled.

SAR for next to the ear head exposure is measured in RC3 with the handset configured to transmit at full rate in SO55. The 3G SAR test reduction procedure is applied to RC1 with RC3 as the primary mode

Body-worn accessory SAR is measured in RC3 with the handset configured in TDSO/SO32 to transmit at full rate on FCH only with all other code channels disabled. The body-worn accessory procedures in KDB Publication 447498 D01 are applied. The 3G SAR test reduction procedure is applied to the multiple code channel configuration (FCH+SCHn), with FCH only as the primary mode.

When VOIP is supported by Ev-Do devices for next to the ear use, head exposure SAR is required.

SAR measurement is not required for the 1xEVDO Rev. A, Rev. B and 1x-Advanced. When primary mode and the adjusted SAR is ≤ 1.2 W/kg and secondary mode is ≤ ¼ dB higher than the primary mode

**CDMA BC0 Measured Results**

| Mode | | Channel | Freq. (MHz) | Maximum Average Power (dBm) | |
|---|---|---|---|---|---|
| | | | | Measured Pwr | Tune-up Limit |
| 1xRTT | RC1, SO55 (Loopback) | 1013 | 824.70 | 23.48 | 24.50 |
| | | 384 | 836.52 | 23.44 | |
| | | 777 | 848.31 | 23.42 | |
| | RC3, SO55 (Loopback) | 1013 | 824.70 | 23.46 | |
| | | 384 | 836.52 | 23.42 | |
| | | 777 | 848.31 | 23.40 | |
| | RC3, SO32 (+F-SCH) | 1013 | 824.70 | 23.45 | |
| | | 384 | 836.52 | 23.43 | |
| | | 777 | 848.31 | 23.41 | |
| 1xAdvanced | Fwd11/Rvs8 SO75 (Loopback) | 1013 | 824.70 | 23.47 | 24.50 |
| | | 384 | 836.52 | 23.43 | |
| | | 777 | 848.31 | 23.39 | |
| 1xEv-Do Rel. 0 | 307.2 kbps (2 slot, QPSK) | 1013 | 824.70 | 23.52 | 24.50 |
| | | 384 | 836.52 | 23.49 | |
| | | 777 | 848.31 | 23.46 | |
| 1xEv-Do Rev. A | 307.2k, QPSK/ ACK channel is transmitted at all the slots | 1013 | 824.70 | 23.48 | 24.50 |
| | | 384 | 836.52 | 23.44 | |
| | | 777 | 848.31 | 23.43 | |

**CDMA BC1 Measured Results**

| Mode | | Channel | Freq. (MHz) | Maximum Average Power (dBm) | |
|---|---|---|---|---|---|
| | | | | Measured Pwr | Tune-up Limit |
| 1xRTT | RC1, SO55 (Loopback) | 25 | 1851.25 | 23.93 | 24.00 |
| | | 600 | 1880.00 | 23.88 | |
| | | 1175 | 1908.75 | 24.00 | |
| | RC3, SO55 (Loopback) | 25 | 1851.25 | 23.90 | |
| | | 600 | 1880.00 | 23.87 | |
| | | 1175 | 1908.75 | 24.00 | |
| | RC3, SO32 (+F-SCH) | 25 | 1851.25 | 23.90 | |
| | | 600 | 1880.00 | 23.87 | |
| | | 1175 | 1908.75 | 24.00 | |
| 1xAdvanced | Fwd11/Rvs8 SO75 (Loopback) | 25 | 1851.25 | 23.90 | 24.00 |
| | | 600 | 1880 | 23.86 | |
| | | 1175 | 1908.75 | 24.00 | |
| 1xEv-Do Rel. 0 | 307.2 kbps (2 slot, QPSK) | 25 | 1851.25 | 24.00 | 24.00 |
| | | 600 | 1880.00 | 24.00 | |
| | | 1175 | 1908.75 | 24.00 | |
| 1xEv-Do Rev. A | 307.2k, QPSK/ ACK channel is transmitted at all the slots | 25 | 1851.25 | 24.00 | 24.00 |
| | | 600 | 1880 | 24.00 | |
| | | 1175 | 1908.75 | 24.00 | |

# 10. Measured and Reported (Scaled) SAR Results

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

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

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

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

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

**KDB 648474 D04 Handset SAR:**

With headset attached, when the reported SAR for body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

**KDB 648474 D04 Handset SAR (Phablet Only):**

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

## 10.1. CDMA BC0

| RF Exposure Conditions | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tune-up Limit | Meas. | Meas. | Scaled | |
| Head | 1xRTT RC3 SO55 | 0 | Left Touch | 384 | 836.52 | 24.50 | 23.42 | 0.606 | 0.777 | |
| | | | Left Tilt | 384 | 836.52 | 24.50 | 23.42 | 0.543 | 0.696 | |
| | | | Right Touch | 1013 | 824.70 | 24.50 | 23.46 | 0.736 | 0.935 | |
| | | | | 384 | 836.52 | 24.50 | 23.42 | 0.732 | 0.939 | |
| | | | | 777 | 848.31 | 24.50 | 23.40 | 0.678 | 0.873 | |
| | | | Right Tilt | 384 | 836.52 | 24.50 | 23.42 | 0.523 | 0.671 | |
| Head | 1xEVDO Rel. 0 | 0 | Left Touch | 384 | 836.52 | 24.50 | 23.49 | 0.618 | 0.780 | |
| | | | Left Tilt | 384 | 836.52 | 24.50 | 23.49 | 0.469 | 0.592 | |
| | | | Right Touch | 1013 | 824.70 | 24.50 | 23.52 | 0.739 | 0.926 | |
| | | | | 384 | 836.52 | 24.50 | 23.49 | 0.746 | **0.941** | 1 |
| | | | | 777 | 848.31 | 24.50 | 23.46 | 0.683 | 0.868 | |
| | | | Right Tilt | 384 | 836.52 | 24.50 | 23.49 | 0.470 | 0.593 | |
| Body-worn | 1xRTT RC3 SO32 | 15 | Rear | 384 | 836.52 | 24.50 | 23.43 | 0.510 | 0.652 | |
| | | | Front | 384 | 836.52 | 24.50 | 23.43 | 0.548 | **0.701** | 2 |

**Product Specific 10g SAR:**

| RF Exposure Conditions | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 10-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tune-up Limit | Meas. | Meas. | Scaled | |
| Product Specific 10g | 1xRTT RC3 SO32 | 0 | Rear | 384 | 836.52 | 24.50 | 23.43 | 1.010 | 1.292 | |
| | | | Front | 384 | 836.52 | 24.50 | 23.43 | 1.410 | **1.804** | 3 |
| | | | Edge 2 | 384 | 836.52 | 24.50 | 23.43 | 0.302 | 0.386 | |
| | | | Edge 3 | 384 | 836.52 | 24.50 | 23.43 | 0.336 | 0.430 | |
| | | | Edge 4 | 384 | 836.52 | 24.50 | 23.43 | 0.504 | 0.645 | |

## 10.2. CDMA BC1

| RF Exposure Conditions | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tune-up Limit | Meas. | Meas. | Scaled | |
| Head | 1xRTT RC3 SO55 | 0 | Left Touch | 600 | 1880.00 | 24.00 | 23.87 | 0.256 | **0.264** | 4 |
| | | | Left Tilt | 600 | 1880.00 | 24.00 | 23.87 | 0.046 | 0.047 | |
| | | | Right Touch | 600 | 1880.00 | 24.00 | 23.87 | 0.138 | 0.142 | |
| | | | Right Tilt | 600 | 1880.00 | 24.00 | 23.87 | 0.076 | 0.079 | |
| Head | 1xEVDO Rel. 0 | 0 | Left Touch | 600 | 1880.00 | 24.00 | 24.00 | 0.256 | 0.256 | |
| | | | Left Tilt | 600 | 1880.00 | 24.00 | 24.00 | 0.054 | 0.054 | |
| | | | Right Touch | 600 | 1880.00 | 24.00 | 24.00 | 0.136 | 0.136 | |
| | | | Right Tilt | 600 | 1880.00 | 24.00 | 24.00 | 0.082 | 0.082 | |
| Body-worn | 1xRTT RC3 SO32 | 15 | Rear | 25 | 1851.30 | 24.00 | 23.90 | 0.897 | **0.918** | 5 |
| | | | | 600 | 1880.00 | 24.00 | 23.87 | 0.787 | 0.811 | |
| | | | | 1175 | 1908.75 | 24.00 | 24.00 | 0.762 | 0.762 | |
| | | | Front | 600 | 1880.00 | 24.00 | 23.87 | 0.362 | 0.373 | |

**Product Specific 10g SAR:**

| RF Exposure Conditions | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 10-g SAR (W/kg) | | Plot No. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tune-up Limit | Meas. | Meas. | Scaled | |
| Product Specific 10g | 1xRTT RC3 SO32 | 0 | Rear | 25 | 1851.30 | 24.00 | 23.90 | 3.320 | **3.397** | 6 |
| | | | | 600 | 1880.00 | 24.00 | 23.87 | 3.030 | 3.122 | |
| | | | | 1175 | 1908.75 | 24.00 | 24.00 | 3.070 | 3.070 | |
| | | | Front | 600 | 1880.00 | 24.00 | 23.87 | 1.330 | 1.370 | |
| | | | Edge 2 | 600 | 1880.00 | 24.00 | 23.87 | 0.117 | 0.121 | |
| | | | Edge 3 | 600 | 1880.00 | 24.00 | 23.87 | 1.640 | 1.690 | |
| | | | Edge 4 | 600 | 1880.00 | 24.00 | 23.87 | 0.283 | 0.292 | |
| Product Specific 10g | 1xEVDO Rel. 0 | 0 | Rear | 25 | 1851.30 | 24.00 | 24.00 | 3.350 | 3.350 | |
| | | | | 600 | 1880.00 | 24.00 | 24.00 | 3.070 | 3.070 | |
| | | | | 1175 | 1908.75 | 24.00 | 24.00 | 3.120 | 3.120 | |

# 11. SAR Measurement Variability

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

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

| Frequency Band (MHz) | Air Interface | RF Exposure Conditions | Test Position | Repeated SAR (Yes/No) | Highest Measured SAR (W/kg) | First Repeated | |
|---|---|---|---|---|---|---|---|
| | | | | | | Measured SAR (W/kg) | Largest to Smallest SAR Ratio |
| 850MHz | CDMA BC0 | Head | Right Touch | No | 0.746 | N/A | N/A |
| 1900MHz | CDMA BC1 | Body | Rear | Yes | 0.897 | 0.889 | 1.01 |

**Note(s):**

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

**Product Specific 10g SAR:**

| Frequency Band (MHz) | Air Interface | RF Exposure Conditions | Test Position | Repeated SAR (Yes/No) | Highest Measured SAR (W/kg) | First Repeated | |
|---|---|---|---|---|---|---|---|
| | | | | | | Measured SAR (W/kg) | Largest to Smallest SAR Ratio |
| 850 MHz | CDMA BC0 | Product Specific 10g | Front | No | 1.410 | N/A | N/A |
| 1900 MHz | CDMA BC1 | Product Specific 10g | Rear | Yes | 3.350 | 3.340 | 1.00 |

**Note(s):**

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

# 12. Simultaneous Transmission Conditions

| RF Exposure Condition | Item | Capable Transmit Configurations | | |
|---|---|---|---|---|
| Head | 1 | GSM(Voice) | + | DTS |
| | 2 | GSM(Voice) | + | U-NII |
| | 3 | GSM(GPRS/EDGE) | + | DTS |
| | 4 | GSM(GPRS/EDGE) | + | U-NII |
| | 5 | CDMA 2000 | + | DTS |
| | 6 | CDMA 2000 | + | U-NII |
| | 7 | W-CDMA | + | DTS |
| | 8 | W-CDMA | + | U-NII |
| | 9 | LTE | + | DTS |
| | 10 | LTE | + | U-NII |
| Body-worn | 11 | GSM(Voice) | + | DTS |
| | 12 | GSM(Voice) | + | U-NII |
| | 13 | GSM(Voice) | + | BT |
| | 14 | GSM(GPRS/EDGE) | + | DTS |
| | 15 | GSM(GPRS/EDGE) | + | U-NII |
| | 16 | GSM(GPRS/EDGE) | + | BT |
| | 17 | W-CDMA | + | DTS |
| | 18 | W-CDMA | + | U-NII |
| | 19 | W-CDMA | + | BT |
| | 20 | W-CDMA | + | DTS |
| | 21 | W-CDMA | + | U-NII |
| | 22 | W-CDMA | + | BT |
| | 23 | LTE | + | DTS |
| | 24 | LTE | + | U-NII |
| | 25 | LTE | + | BT |
| Product Specific 10g | 26 | GSM(Voice) | + | DTS |
| | 27 | GSM(Voice) | + | U-NII |
| | 28 | GSM(Voice) | + | BT |
| | 29 | GSM(GPRS/EDGE) | + | DTS |
| | 30 | GSM(GPRS/EDGE) | + | U-NII |
| | 31 | GSM(GPRS/EDGE) | + | BT |
| | 32 | W-CDMA | + | DTS |
| | 33 | W-CDMA | + | U-NII |
| | 34 | W-CDMA | + | BT |
| | 35 | W-CDMA | + | DTS |
| | 36 | W-CDMA | + | U-NII |
| | 37 | W-CDMA | + | BT |
| | 38 | LTE | + | DTS |
| | 39 | LTE | + | U-NII |
| | 40 | LTE | + | BT |

Notes:

1. Wi-Fi does not support Wi-Fi Hotspot or Wi-Fi Direct.
2. VoIP is supported in GPRS/EDGE, CDMA2000, W-CDMA, and LTE.
3. DTS Radio cannot transmit simultaneously with Bluetooth Radio.
4. U-NII Radio cannot transmit simultaneously with Bluetooth Radio.

## 12.1. Sum of SAR

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

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

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) | | | | ∑ 1-g SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|
| | | WWAN ① | DTS ② | U-NII ③ | BT | WWAN + DTS + | WWAN + U-NII + | WWAN + BT + |
| Head | Left Touch | 0.780 | 0.269 | 0.243 | | 1.049 | 1.023 | |
| | Left Tilt | 0.696 | 0.269 | 0.243 | | 0.965 | 0.939 | |
| | Right Touch | 0.941 | 0.454 | 0.243 | | **1.395** | **1.184** | |
| | Right Tilt | 0.671 | 0.269 | 0.243 | | 0.940 | 0.914 | |
| Body-worn | Rear | 0.918 | 0.089 | 0.251 | 0.084 | 1.007 | 1.169 | **1.002** |
| | Front | 0.701 | 0.089 | 0.251 | 0.084 | 0.790 | 0.952 | 0.785 |

**Conclusion:**

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

**Product Specific 10g SAR:**

| RF Exposure conditions | Test Position | Standalone SAR (W/kg) | | | | ∑ 10-g SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|
| | | WWAN ① | DTS ② | U-NII ③ | BT | WWAN + DTS + | WWAN + U-NII + | WWAN + BT + |
| Extremity | Rear | 3.397 | 0.180 | 0.509 | 0.101 | **3.577** | **3.906** | **3.498** |
| | Edge 1 | | 0.321 | 0.031 | 0.101 | | | |
| | Edge 2 | 0.386 | | | 0.101 | 0.386 | 0.386 | 0.487 |
| | Edge 3 | 1.690 | | | 0.100 | 1.690 | 1.690 | 1.790 |
| | Edge 4 | 0.645 | 0.030 | 0.361 | 0.101 | 0.675 | 1.006 | 0.746 |

**Conclusion:**

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

# Appendixes

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

**12441959-S1V1 Appendix A: SAR Setup Photos**

**12441959-S1V1 Appendix B: SAR System Check Plots**

**12441959-S1V1 Appendix C: Highest SAR Test Plots**

**12441959-S1V1 Appendix D: SAR Liquid Tissue Ingredients**

**12441959-S1V1 Appendix E: SAR Probe Calibration Certificates**

**12441959-S1V1 Appendix F: SAR Dipole Calibration Certificates**

**END OF REPORT**