# FCC SAR Compliance Test Report

Project Name: LTE Multi-mode USB Rotator

Model : E397u-53

FCC ID : QISE397U-53

Report No. : SYBH (Z-SAR)039052011-2

| | APPROVED | CHECKED | PREPARED |
|---|---|---|---|
| BY | Liu Chunlin | Alvinway | Lu Chaogan |
| DATE | 2011-08-18 | 2011-08-18 | 2011-08-18 |

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# Modified History

| REV. | DESCRIPTION | ISSUED DATE | REMARK |
|---|---|---|---|
| Rev. 1.0 | Initial Test Report Release | 2011-06-16 | Luchaogan |
| Rev. 1.1 | 1) Retest with E-field and dipole by SPEAG calibration;<br>2) Add LTE testing for 1RB in each position. | 2011-07-21 | Luchaogan |
| Rev. 1.2 | 1) Add no proximity sensors are used in the device for explaining test lab KDB 497066;<br>2) Add TCB PBA tracking number: 789536;<br>3) Page 31 of the SAR report; 2nd table, high channel, 1 RB, 0 offset, corrected 20.07to 20.71;<br>4) Unnecessary LTE SAR tests had be removed for QPSK 1 RB and 16 QAM;<br>5) For 16 QAM 50 RB, changed the data from high channel to middle channel being tested. | 2011-07-27 | Luchaogan |
| Rev. 1.3 | 1) Add an illustration identifying these antennas and their functions on page 5;<br>2) Revise the mistake information such as the identification for this USB transmitter, the high channel of CDMA AWS (850) , the SAR probe calibration uncertainty and the value of 10M/QPSK(TOP side) , 1RB/#0;<br>3) Add the measured tissue diectric parameters for the DUT test frequencies;<br>4) Update CDMA 1x EVDO and LTE test configurations on section 6.1 and 6.2<br>5) Update the text descriptions and make the calculated numbers clear. | 2011-08-03 | Luchaogan |
| Rev. 1.4 | 1) Target SAR values corrected in table 6 and normalized to 1 W<br>2) Editorial changes: Conclusion of power verification on pages 30-34.<br>3) dielectric tissue parameters for 1710 / 1730 MHz added in table 5<br>4) Compliance note to KDB450824 added on page 17 | 2011-08-10 | Luchaogan |
| Rev. 1.5 | 1) For LTE and CDMA measurements in AWS band and for 1800 MHz system verification the same TSL and 1750 MHz SAR probe calibration point have been used.<br>2) Updated Tables 7.1.1 and 7.1.2;<br>3) Revised the mistake of 20385. | 2011-08-18 | Luchaogan |
| | | | |
| | | | |

# 1 General Information

## 1.1 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for HUAWEI E397u-53 are as below Table 1.

| Band | | Position | Channel | Measured MAX $SAR_{1g}$ (W/kg) | MAX Conducted Power (dBm) | Turn-up Power (dBm) | Extrapolated Result (W/kg) |
|---|---|---|---|---|---|---|---|
| EVDO AWS | Rev.0 | Righ side 5mm | 450 | 1.050 | 24.31 | 25.0 | 1.23 |
| | Rev.A | | 450 | 1.060 | 24.38 | 25.0 | 1.22 |
| CDMA AWS | 1xRTT | Righ side 5mm | 450 | 0.888 | 24.07 | 25.0 | 1.10 |
| EVDO 1900 | Rev.0 | Front side 5mm | 1175 | 1.020 | 24.41 | 25.0 | 1.17 |
| | Rev.A | | 1175 | 0.955 | 24.36 | 25.0 | 1.11 |
| CDMA 1900 | 1xRTT | Front side 5mm | 1175 | 0.911 | 24.16 | 25.0 | 1.11 |
| LTE 1700 | QPSK | Righ side 5mm | 20175 | 0.960 | 21.43 | 22.5 | 1.23 |
| | 16QAM | | 20175 | **1.190** | 20.80 | 21.5 | 1.40 |

Table 1: Summary of test result

The device is in compliance with Specific Absorption Rate（SAR）for general population/uncontraolled exposure limits of 1.6 W/Kg as averaged over any 1 g tissue according to the FCC rule §2.1093, the ANSI/IEEE C 95.1:1999, the NCRP Report Number 86 for uncontrolled environment, according to the Health Canada's Safety Code 6 and the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2003 and FCC OET Bulletin 65 Supplement.

## 1.2 RF exposure limits

| Human Exposure | Uncontrolled Environment General Population | Controlled Environment Occupational |
|---|---|---|
| **Spatial Peak SAR*** (Brain) | **1.60 mW/g** | 8.00 mW/g |
| **Spatial Average SAR**** (Whole Body) | 0.08 mW/g | 0.40 mW/g |
| **Spatial Peak SAR***** (Hands/Feet/Ankle/Wrist) | 4.00 mW/g | 20.00 mW/g |

Table 2: RF exposure limits

The limit applied in this test report is shown in **bold** letters

**Notes:**

* The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time

** The Spatial Average value of the SAR averaged over the whole body.

*** The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

**Uncontrolled Environments** are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

**Controlled Environments** are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation.

## 1.3 EUT Description

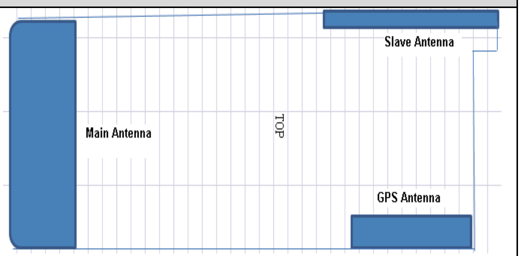
<table>
<tr><td colspan="4">Device Information:</td></tr>
<tr><td>DUT Name:</td><td colspan="3">LTE Multi-mode USB Rotator</td></tr>
<tr><td>Type Identification:</td><td colspan="3">E397u-53</td></tr>
<tr><td>FCC ID :</td><td colspan="3">QISE397U-53</td></tr>
<tr><td>IMEI No:</td><td colspan="3">357149040003968</td></tr>
<tr><td>Device Type :</td><td colspan="3">portable device</td></tr>
<tr><td>Exposure Category:</td><td colspan="3">uncontrolled environment / general population</td></tr>
<tr><td>Hardware Version :</td><td colspan="3">CD1E397UM</td></tr>
<tr><td>Software Version :</td><td colspan="3">11.330.07.00.000</td></tr>
<tr><td>Antenna Type :</td><td colspan="3">Refer to note 2.</td></tr>
<tr><td>Tested with host laptop:</td><td colspan="3">Lenovo ThinkPad T61<br>Lenovo ThinkPad X301</td></tr>
<tr><td colspan="4">Device Operating Configurations:</td></tr>
<tr><td>Supporting Mode(s)</td><td colspan="3">CDMA AWS/PCS,LTE Band IV</td></tr>
<tr><td>Test Modulation</td><td colspan="3">QPSK,16QAM</td></tr>
<tr><td>Device Class</td><td colspan="3">B</td></tr>
<tr><td rowspan="4">Operating Frequency Range(s)</td><td>Band</td><td>Tx (MHz)</td><td>Rx (MHz)</td></tr>
<tr><td>CDMA AWS</td><td>1710-1755</td><td>2110-2155</td></tr>
<tr><td>CDMA PCS</td><td>1850-1910</td><td>1930-1990</td></tr>
<tr><td>LTE Band IV</td><td>1710-1755</td><td>2110-2155</td></tr>
<tr><td rowspan="3">Power Class :</td><td colspan="3">Tested with power control all up bits (CDMA AWS)</td></tr>
<tr><td colspan="3">Tested with power control all up bits (CDMA PCS)</td></tr>
<tr><td colspan="3">3, tested with power control all Max.(LTE Band IV)</td></tr>
<tr><td rowspan="6">Test Channels (low-mid-high) :</td><td colspan="3">25-450-850 (CDMA AWS)</td></tr>
<tr><td colspan="3">25-600-1175 (CDMA PCS)</td></tr>
<tr><td colspan="3">19957-20175-20393(LTE Band IV BW=1.4MHz)</td></tr>
<tr><td colspan="3">19965-20175-20385(LTE Band IV BW=3MHz)</td></tr>
<tr><td colspan="3">19975-20175-20375(LTE Band IV BW=5MHz)</td></tr>
<tr><td colspan="3">20000-20175-20350(LTE Band IV BW=10MHz)</td></tr>
</table>

Table 3: Device information and operating configuration

### 1.3.1 General Description

E397u-53 LTE/CDMA dual mode USB Rotator is subscriber equipment in the LTE/CDMA system. E397u-53 implement such functions as RF signal receiving/transmitting, LTE, CDMA2000 1x and the CDMA2000 1x EV-DO Rev.A/Rev.0 protocol processing, data service etc. Externally it provides USB interface (to connect to the notebook etc.), USIM card interface and Micro SD card interface. E397u-53 has three internal antennas as default.

Note:
1. No proximity sensors are used in the device.
2. The three antennas used in the EUT are listed as below table:

<table>
<tr><td>Antenna Type</td><td>Function</td><td>Antenna Location</td></tr>
<tr><td>Main antenna</td><td>Can transimit and receive signal for all bands (LTE/AWS band,CDMA /PCS band ,CDMA / AWS band).</td><td rowspan="3">
</td></tr>
<tr><td>Slave antenna</td><td>Only receive signal from base staion.</td></tr>
<tr><td>GPS antenna</td><td>Only recieve GPS signal from satellite.</td></tr>
</table>

### 1.4 Test specification(s)

| | |
|---|---|
| IEEE Std C95.1 – 1999 | IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz. |
| IEEE 1528-2003 | Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques |
| OET Bulletin No. 65, Supplement C– 2001 | Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields---Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions |
| Canada's Safety Code 6 | Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz (99-EHD-237) |
| RSS-102 | Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands (Issue 4 of March 2010) |
| KDB941225 D01 | SAR test for 3G devices v02 ,Published on Nov 13 2009 |
| KDB941225 D05 | SAR for LTE Devices v01, Published on Dec 15 2010 |
| KDB447489 D02 | SAR Procedures for Dongle Xmtr v02, Published on Nov 16 2009 |
| Lab PBA | KDB Tracking number: 497066 |
| TCB PBA | KDB Tracking number: 789536 |

### 1.5 Testing laboratory

| | |
|---|---|
| Test Site | Reliability Laboratory of Huawei Technologies Co., Ltd. |
| Test Location | Section K3,Bantian, Longgang District, Shenzhen, P.R.China |
| Telephone | +86-755-28785513 |
| Fax | +86-755-36834474 |
| State of accreditation | The Test laboratory (area of testing) is accredited according to ISO/IEC 17025. CNAS Registration number: L0310 |

### 1.6 Applicant and Manufacturer

| | |
|---|---|
| Company Name | HUAWEI TECHNOLOGIES CO., LTD |
| Address | Huawei Base, Bantian, Longgang District, Shenzhen, P.R.China |

### 1.7 Application details

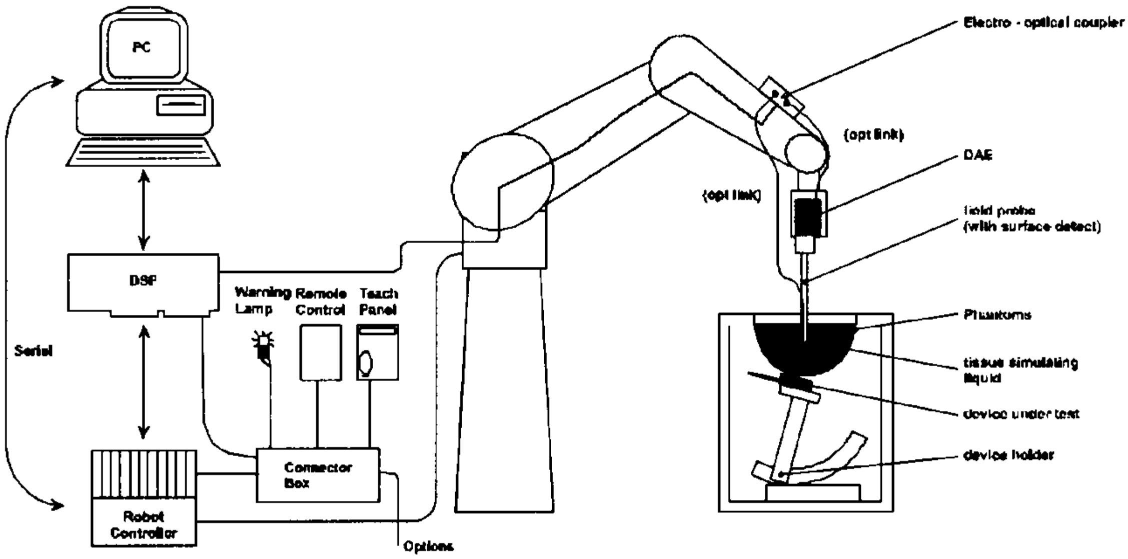
| | |
|---|---|
| Start Date of test | 2011-07-13 |
| End Date of test | 2011-07-21 |

### 1.8 Ambient Condition

| | |
|---|---|
| Ambient temperature | 20°C – 24°C |
| Relative Humidity | 30% – 70% |

# 2 SAR Measurement System

## 2.1 SAR Measurement Set-up




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

- A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronic (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.
- A unit to operate the optical surface detector which is connected to the EOC.
- The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.
- The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows XP.
- DASY5 software and SEMCAD data evaluation software.
- Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
- The generic twin phantom enabling the testing of left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- System validation dipoles allowing to validate the proper functioning of the system.

## 2.2 Test environment

The DASY4 measurement system is placed at the head end of a room with dimensions:
5 x 2.5 x 3 m³, the SAM phantom is placed in a distance of 75 cm from the side walls and 1.1m from the rear wall. Above the test system a 1.5 x 1.5 m² array of pyramid absorbers is installed to reduce reflections from the ceiling.
Picture 1 of the photo documentation shows a complete view of the test environment.
The system allows the measurement of SAR values larger than 0.005 mW/g.

## 2.3 Data Acquisition Electronics description

The data acquisition electronics (DAE) consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converte and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

DAE4

| | | |
|---|---|---|
| Input Impedance | 200MOhm |  |
| The Inputs | symmetrical and floating | |
| Common mode rejection | above 80 dB | |

## 2.4 Probe description

These probes are specially designed and calibrated for use in liquids with high permittivities. They should not be used in air, since the spherical isotropy in air is poor (±2 dB). The dosimetric probes have special calibrations in various liquids at different frequencies.

Isotropic E-Field Probe ES3DV3 for Dosimetric Measurements

| | |
|---|---|
| Construction | Symmetrical design with triangular core<br>Interleaved sensors<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| Calibration | ISO/IEC 17025 calibration service available. |
| Frequency | 10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz) |
| Directivity | ± 0.2 dB in HSL (rotation around probe axis)<br>± 0.3 dB in tissue material (rotation normal to probe axis) |
| Dynamic range | 5 μW/g to > 100 mW/g; Linearity: ± 0.2 dB |
| Dimensions | Overall length: 330 mm (Tip: 20 mm)<br>Tip diameter: 3.9 mm (Body: 12 mm)<br>Distance from probe tip to dipole centers: 2.0 mm |
| Application | General dosimetry up to 4 GHz<br>Dosimetry in strong gradient fields<br>Compliance tests of mobile phones |

Isotropic E-Field Probe EX3DV4 for Dosimetric Measurements

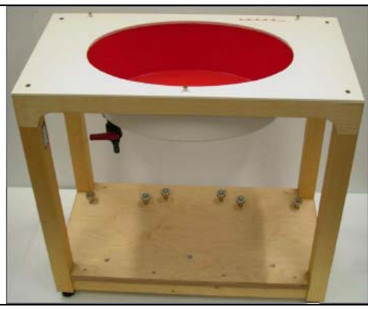
| | |
|---|---|
| Construction | Symmetrical design with triangular core<br>Built-in optical fiber for surface detection system<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., glycolether) |
| Calibration | In air from 10 MHz to 2.5 GHz<br>In head tissue simulating liquid (HSL) at 900 (800-1000) MHz and 1.8 GHz (1700-1910 MHz) (accuracy ± 11%; k=2) Calibration for other liquids and frequencies upon request |
| Frequency | 10 MHz to 3 GHz (dosimetry); Linearity: ± 0.2 dB (30 MHz to 3 GHz) |
| Directivity | ± 0.2 dB in HSL (rotation around probe axis)<br>± 0.4 dB in HSL (rotation normal to probe axis) |
| Dynamic range | 5 μW/g to > 100 mW/g; Linearity: ± 0.2 dB |
| Optical Surface Detection | ± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces (EX3DV4 only) |
| Dimensions | Overall length: 337 mm<br>Tip length: 9 mm<br>Body diameter: 10 mm<br>Tip diameter:2.5 mm<br>Distance from probe tip to dipole centers: 1.0 mm |
| Application | General dosimetry up to 3 GHz<br>Compliance tests of mobile phones<br>Fast automatic scanning in arbitrary phantoms (EX3DV4) |

## 2.5 Phantom description

SAM Twin Phantom

| | | |
|---|---|---|
| Shell Thickness | 2mm +/- 0.2 mm; The ear region: 6mm |  |
| Filling Volume | Approximately 30 liters | |
| Dimensions | Length:1000mm; Width:500mm;<br>Height: adjustable feet | |
| Measurement Areas | Left hand<br>Right hand<br>Flat phantom | |
| The bottom plate contains three pairs of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to cover the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on top of this phantom cover are possible. Three reference marks are provided on the phantom counter. These reference marks are used to teach the absolute phantom position relative to the robot. | | |

ELI4 Phantom

| | | |
|---|---|---|
| Shell Thickness | 2mm +/- 0.2 mm |  |
| Filling Volume | Approximately 30 liters | |
| Dimensions | Length:1000mm; Width:500mm;<br>Height: adjustable feet | |
| Measurement Areas | Flat phantom | |
| The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30MHz to 6GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209-2 and all known tissue simulating liquids. | | |

## 2.6 Device holder description

The DASY5 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. This device holder is used for standard mobile phones or PDA's only. If necessary an additional support of polystyrene material is used.

Larger DUT's (e.g. notebooks) cannot be tested using this device holder. Instead a support of bigger polystyrene cubes and thin polystyrene plates is used to position the DUT in all relevant positions to find and measure spots with maximum SAR values.
Therefore those devices are normally only tested at the flat part of the SAM.

## 2.7 Test Equipment List

This table gives a complete overview of the SAR measurement equipment
Devices used during the test described are marked ☒

| | Manufacturer | Device | Type | Serial number | Date of last calibration )* |
|---|---|---|---|---|---|
| ☒ | SPEAG | Dosimetric E-Field Probe | ES3DV3 | 3254 | 2011-03-11 |
| ☐ | SPEAG | Dosimetric E-Field Probe | EX3DV4 | 3736 | 2010-11-16 |
| ☐ | SPEAG | Dosimetric E-Field Probe | EX3DV4 | 3744 | 2010-11-26 |
| ☒ | SPEAG | 1800 MHz Validation Dipole | D1800V2 | 2d184 | 2011-03-08 |
| ☒ | SPEAG | 1900 MHz Validation Dipole | D1900V2 | 5d018 | 2011-06-16 |
| ☐ | SPEAG | Data acquisition electronics | DAE4 | 851 | 2010-06-30 |
| ☐ | SPEAG | Data acquisition electronics | DAE4 | 852 | 2010-12-24 |
| ☒ | SPEAG | Data acquisition electronics | DAE4 | 1236 | 2010-10-26 |
| ☒ | SPEAG | Software | DASY 5 | N/A | N/A |
| ☒ | SPEAG | Twin Phantom | SAM1 | TP-1475 | N/A |
| ☒ | SPEAG | Twin Phantom | SAM2 | TP-1474 | N/A |
| ☐ | SPEAG | Twin Phantom | SAM3 | TP-1597 | N/A |
| ☐ | SPEAG | Twin Phantom | SAM4 | TP-1620 | N/A |
| ☐ | SPEAG | Flat Phantom | ELI 4.0 | TP-1038 | N/A |
| ☐ | SPEAG | Flat Phantom | ELI 4.0 | TP-1111 | N/A |
| ☒ | ANRITSU | Universal Radio Communication Tester | MT8820C | 6200971028 | 2011-03-31 |
| ☒ | R & S | Universal Radio Communication Tester | CMU 200 | 113989 | 2011-06-02 |
| ☒ | Agilent)* | Network Analyser | E5071B | MY42404956 | 2011-02-22 |
| ☒ | Agilent | Dielectric Probe Kit | 85070E | 2484 | N/A |
| ☒ | Agilent | Signal Generator | N5181A | MY47420989 | 2011-02-22 |
| ☒ | MINI-CIRCUITS | Amplifier | ZHL-42W | QA0746001 | N/A |
| ☒ | Agilent | Power Meter | E4417A | MY45101339 | 2011-02-22 |
| ☒ | Agilent | Power Meter Sensor | E9321A | MY44420359 | 2011-02-22 |

Note: The calibration interval of validation dipoles is 3 years.

1) Per KDB 450824 D02 requirements for dipole calibration, Reliability Laboratory of Huawei SAR lab has adopted three years calibration interval. But each measured dipole is expected to evaluate with the following criteria at least on annual interval.

a) There is no physical damage on the dipole;
b) System validation with specific dipole is within 10% of calibrated value;
c) Return-loss is within 10% of calibrated measurement;
d) Impedance is within 5Ω from the previous measurement.

2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

# 3 SAR Measurement Procedure

## 3.1 Scanning procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

- The „reference“ and „drift“ measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. +/- 5 %.

- The „surface check“ measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within ± 30°.)

- The „area scan “measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strength is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The standard scan uses large grid spacing for faster measurement. Standard grid spacing for head measurements is 15 mm in x- and y- dimension. If a finer resolution is needed, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation.
  Results of this coarse scan are shown in Appendix B.

- A „7x7x7 zoom scan” measures the field in a volume around the 2D peak SAR value acquired in the previous „coarse“ scan. This is a fine 7x7 grid where the robot additionally moves the probe in 7 steps along the z-axis away from the bottom of the Phantom. Grid spacing for the cube measurement is 5 mm in x and y-direction and 5 mm in z-direction. DASY5 is also able to perform repeated zoom scans if more than 1 peak is found during area scan. In this document, the evaluated peak 1g and 10g averaged SAR values are shown in the 2D-graphics in Appendix B. Test results relevant for the specified standard (see chapter 1.4.) are shown in table form in chapter 7.2.

- A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 2mm steps. This measurement shows the continuity of the liquid and can - depending in the field strength – also show the liquid depth. A z-axis scan of the measurement with maximum SAR value is shown in Appendix B.

### 3.2 Spatial Peak SAR Evaluation

The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The basis of the evaluation are the SAR values measured at the points of the fine cube grid consisting of 7 x 7 x 7 points. The algorithm that finds the maximal averaged volume is separated into three different stages.

- The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting 'Graph Evaluated'.

- The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.

- All neighboring volumes are evaluated until no neighboring volume with a higher average value is found.

**Extrapolation**

The extrapolation is based on a least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

**Interpolation**

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computermathematik, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff ].

**Volume Averaging**

At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

**Advanced Extrapolation**

DASY5 uses the advanced extrapolation option which is able to compansate boundary effects on E-field probes.

### 3.3 Data Storage and Evaluation

Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation by SEMCAD

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

| | | |
|---|---|---|
| Probe parameters: | - Sensitivity | $Norm_i$, $a_{i0}$, $a_{i1}$, $a_{i2}$ |
| | - Conversion factor | $ConvF_i$ |
| | - Diode compression point | Dcpi |
| Device parameters: | - Frequency | f |
| | - Crest factor | cf |
| Media parameters: | - Conductivity | $\sigma$ |
| | - Density | $\rho$ |

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot cf/dcp_i$$

with $V_i$ = compensated signal of channel i (i = x, y, z)
$U_i$ = input signal of channel i (i = x, y, z)
cf = crest factor of exciting field (DASY parameter)
$dcp_i$ = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes: $E_i = (V_i / Norm_i \cdot ConvF)^{1/2}$

H-field probes: $H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1}f + a_{i2}f^2)/f$

with $V_i$ = compensated signal of channel i (i = x, y, z)
$Norm_i$ = sensor sensitivity of channel i (i = x, y, z) [mV/(V/m)$^2$] for E-field Probes
ConvF = sensitivity enhancement in solution
$a_{ij}$ = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
$E_i$ = electric field strength of channel i in V/m
$H_i$ = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = (E_x^2 + E_Y^2 + E_z^2)^{1/2}$$

The primary field data are used to calculate the derived field units.

$$SAR = (E_{tot}^2 \cdot \sigma) / (\rho \cdot 1000)$$

with SAR = local specific absorption rate in mW/g
$E_{tot}$ = total field strength in V/m
$\sigma$ = conductivity in [mho/m] or [Siemens/m]
$\rho$ = equivalent tissue density in g/cm$^3$

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = E_{tot}^2 / 3770 \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

with $P_{pwe}$ = equivalent power density of a plane wave in mW/cm$^2$
$E_{tot}$ = total electric field strength in V/m
$H_{tot}$ = total magnetic field strength in A/m

# 4 System Verification Procedure

## 4.1 Tissue Verification

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectic parameter are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within ± 5% of the target values.

The following materials are used for producing the tissue-equivalent materials.

| **Ingredients** (% of weight) | Head Tissue | | | | | |
|---|---|---|---|---|---|---|
| Frequency Band (MHz) | 450 | 835 | 900 | 1800 | 1950 | 2450 |
| Water | 38.56 | 41.45 | 40.92 | 52.64 | 55.242 | 62.7 |
| Salt (NaCl) | 3.95 | 1.45 | 1.48 | 0.36 | 0.306 | 0.5 |
| Sugar | 56.32 | 56.0 | 56.5 | 0.0 | 0.0 | 0.0 |
| HEC | 0.98 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 |
| Bactericide | 0.19 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 |
| Triton X-100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| DGBE | 0.0 | 0.0 | 0.0 | 47.0 | 44.542 | 36.8 |
| **Ingredients** (% of weight) | Body Tissue | | | | | |
| Frequency Band (MHz) | 450 | 835 | 900 | 1800 | 1950 | 2450 |
| Water | 51.16 | 52.4 | 56.0 | 69.91 | 69.91 | 73.2 |
| Salt (NaCl) | 1.49 | 1.40 | 0.76 | 0.13 | 0.13 | 0.04 |
| Sugar | 46.78 | 45.0 | 41.76 | 0.0 | 0.0 | 0.0 |
| HEC | 0.52 | 1.0 | 1.21 | 0.0 | 0.0 | 0.0 |
| Bactericide | 0.05 | 0.1 | 0.27 | 0.0 | 0.0 | 0.0 |
| Triton X-100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| DGBE | 0.0 | 0.0 | 0.0 | 29.96 | 29.96 | 26.7 |

Table 4: Tissue Dielectric Properties

Salt: 99+% Pure Sodium Chloride; Sugar: 98+% Pure Sucrose; Water: De-ionized, 16MΩ+ 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

| Used Target Frequency | Target Tissue | | Measured Tissue | | Liquid Temp. | Test Date |
|---|---|---|---|---|---|---|
| | $\varepsilon_r$ (+/-5%) | σ (S/m) (+/-5%) | $\varepsilon_r$ | σ (S/m) | | |
| 1710MHz Body | 53.5 (50.83~56.18) | 1.46 (1.39~1.53) | 52.05 | 1.463 | 21.6°C | Jul. 15,2011 |
| 1730MHz Body | 53.5 (50.83~56.18) | 1.48 (1.41~1.55) | 52.05 | 1.495 | | |
| 1750MHz Body | 53.4 (50.73~56.07) | 1.49 (1.42~1.56) | 52.06 | 1.503 | | |
| 1800MHz Body | 53.3 (50.64~55.97) | 1.52 (1.44~1.60) | 51.83 | 1.555 | | |
| 1710MHz Body | 53.5 (50.83~56.18) | 1.46 (1.39~1.53) | 52.29 | 1.478 | 21.6°C | Jul. 16,2011 |
| 1730MHz Body | 53.5 (50.83~56.18) | 1.48 (1.41~1.55) | 52.19 | 1.495 | | |
| 1750MHz Body | 53.4 (50.73~56.07) | 1.49 (1.42~1.56) | 52.23 | 1.517 | | |
| 1800MHz Body | 53.3 (50.64~55.97) | 1.52 (1.44~1.60) | 52.06 | 1.573 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1710MHz Body | 53.5 (50.83~56.18) | 1.46 (1.39~1.53) | 52.4 | 1.479 | 21.6°C | Jul. 17,2011 |
| 1730MHz Body | 53.5 (50.83~56.18) | 1.48 (1.41~1.55) | 52.35 | 1.496 | | |
| 1750MHz Body | 53.4 (50.73~56.07) | 1.49 (1.42~1.56) | 52.17 | 1.507 | | |
| 1800MHz Body | 53.3 (50.64~55.97) | 1.52 (1.44~1.60) | 52.16 | 1.545 | | |
| 1710MHz Body | 53.5 (50.83~56.18) | 1.46 (1.39~1.53) | 51.90 | 1.468 | 21.6°C | Jul. 18,2011 |
| 1730MHz Body | 53.5 (50.83~56.18) | 1.48 (1.41~1.55) | 51.81 | 1.492 | | |
| 1750MHz Body | 53.4 (50.73~56.07) | 1.49 (1.42~1.56) | 51.85 | 1.516 | | |
| 1800MHz Body | 53.3 (50.64~55.97) | 1.52 (1.44~1.60) | 51.72 | 1.559 | | |
| 1710MHz Body | 53.5 (50.83~56.18) | 1.46 (1.39~1.53) | 51.48 | 1.508 | 21.6°C | Jul. 20,2011 |
| 1730MHz Body | 53.5 (50.83~56.18) | 1.48 (1.41~1.55) | 51.49 | 1.534 | | |
| 1750MHz Body | 53.4 (50.73~56.07) | 1.49 (1.42~1.56) | 51.45 | 1.536 | | |
| 1800MHz Body | 53.3 (50.64~55.97) | 1.52 (1.44~1.60) | 51.18 | 1.590 | | |
| 1850MHz Body | 53.3 (50.64~55.97) | 1.52 (1.44~1.60) | 53.37 | 1.508 | 21.6°C | Jul. 16,2011 |
| 1880MHz Body | 53.3 (50.64~55.97) | 1.52 (1.44~1.60) | 53.27 | 1.540 | | |
| 1910MHz Body | 53.3 (50.64~55.97) | 1.52 (1.44~1.60) | 53.18 | 1.571 | | |
| 1900MHz Body | 53.3 (50.64~55.97) | 1.52 (1.44~1.60) | 53.21 | 1.559 | | |
| $\varepsilon_r$= Relative permittivity, σ= Conductivity | | | | | | |

Table 5: Measured Tissue Parameter

The dielectric parameters of the tissue-equivalent liquid should be measured under similar ambient conditions and within 2 °C of the conditions expected during the SAR evaluation to satisfy protocol requirements.

**Note: 1) KDB 450824 was ensured to be applied for probe calibration frequencies greater than or equal to 50MHz of the EUT frequencies.**

**2)The above measured tissue parameters were used in the DASY software to perform interpolation via the DASY software to determine actual dielectric parameters at the test frequencies. The SAR test plots may slightly differ from the table above since the DASY rounds to three significant digits.**

**3) For LTE and CDMA measurements in AWS band and for 1800 MHz system verification the same TSL and 1750 MHz SAR probe calibration point have been used.**

## 4.2 System Check

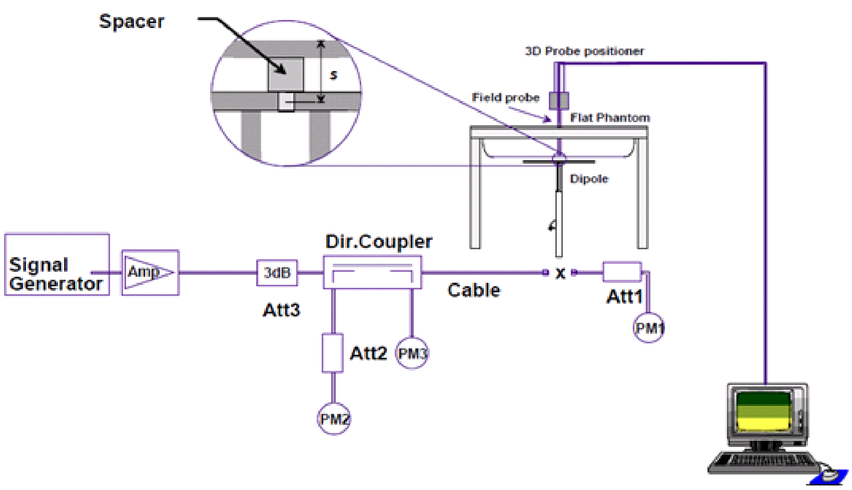
The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system validation is performed with tissue equivalent material according to IEEE P1528 (described above). The following table shows validation results for all frequency bands and tissue liquids used during the tests (Graphic Plot(s) see Appendix A).

| System Check | Target SAR (1W) (+/-10%) | | Measured SAR (Normalized to 1W) | | Liquid Temp. | Test Date |
|---|---|---|---|---|---|---|
| | 1-g (mW/g) | 10-g (mW/g) | 1-g (mW/g) | 10-g (mW/g) | | |
| D1800V2 Body | 38.8 (34.92~42.68) | 20.4 (18.36~22.44) | 38.36 | 20.20 | 21.6°C | Jul. 15,2011 |
| D1800V2 Body | 38.8 (34.92~42.68) | 20.4 (18.36~22.44) | 39.64 | 20.60 | 21.6°C | Jul. 16,2011 |
| D1800V2 Body | 38.8 (34.92~42.68) | 20.4 (18.36~22.44) | 38.88 | 20.04 | 21.6°C | Jul. 17,2011 |
| D1800V2 Body | 38.8 (34.92~42.68) | 20.4 (18.36~22.44) | 39.32 | 20.28 | 21.6°C | Jul. 18,2011 |
| D1800V2 Body | 38.8 (34.92~42.68) | 20.4 (18.36~22.44) | 40.40 | 20.92 | 21.6°C | Jul. 20,2011 |
| D1900V2 Body | 40.5 (36.45~44.55) | 21.1 (18.99~23.21) | 37.48 | 20.12 | 21.6°C | Jul. 16,2011 |

Table 6: System Check Results

## 4.3 Validation Procedure

The validation is performed by using a validation dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a plexiglass spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 250 mW. To adjust this power a power meter is used. The power sensor is connected to the cable before the validation to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the validation to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test (result on plot).
Validation results have to be equal or near the values determined during dipole calibration (target SAR in table above) with the relevant liquids and test system.



# 5 Measurement Uncertainty Evaluation

## 5.1 Measurement uncertainty evaluation for SAR test

The overall combined measurement uncertainty of the measurement system is ± 10.7% (K=1).
The expanded uncertainty (k=2) is assessed to be ± 21.4%
This measurement uncertainty budget is suggested by IEEE P1528 and determined by Schmid & Partner Engineering AG. The breakdown of the individual uncertainties is as follows:

| Error Sources | Uncertainty Value | Probability Distribution | Divisor | $c_i$ 1g | $c_i$ 10g | Standard Uncertainty 1g | Standard Uncertainty 10g | $v_i^2$ or $v_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe calibration | ± 6.0% | Normal | 1 | 1 | 1 | ± 6.0% | ± 6.0% | ∞ |
| Axial isotropy | ± 4.7% | Rectangular | √3 | 0.7 | 0.7 | ± 1.9% | ± 1.9% | ∞ |
| Hemispherical isotropy | ± 9.6% | Rectangular | √3 | 0.7 | 0.7 | ± 3.9% | ± 3.9% | ∞ |
| Spatial resolution | ± 0.0% | Rectangular | √3 | 1 | 1 | ± 0.0% | ± 0.0% | ∞ |
| Boundary effects | ± 1.0% | Rectangular | √3 | 1 | 1 | ± 0.6% | ± 0.6% | ∞ |
| Probe linearity | ± 4.7% | Rectangular | √3 | 1 | 1 | ± 2.7% | ± 2.7% | ∞ |
| System detection limits | ± 1.0% | Rectangular | √3 | 1 | 1 | ± 0.6% | ± 0.6% | ∞ |
| Readout electronics | ± 0.3% | Normal | 1 | 1 | 1 | ± 0.3% | ± 0.3% | ∞ |
| Response time | ± 0.8% | Rectangular | √3 | 1 | 1 | ± 0.5% | ± 0.5% | ∞ |
| Integration time | ± 2.6% | Rectangular | √3 | 1 | 1 | ± 1.5% | ± 1.5% | ∞ |
| RF ambient conditions | ± 3.0% | Rectangular | √3 | 1 | 1 | ± 1.7% | ± 1.7% | ∞ |
| Probe positioner | ± 0.4% | Rectangular | √3 | 1 | 1 | ± 0.2% | ± 0.2% | ∞ |
| Probe positioning | ± 2.9% | Rectangular | √3 | 1 | 1 | ± 1.7% | ± 1.7% | ∞ |
| Max. SAR evaluation | ± 1.0% | Rectangular | √3 | 1 | 1 | ± 0.6% | ± 0.6% | ∞ |
| **Test Sample Related** | | | | | | | | |
| Device positioning | ± 2.9% | Normal | 1 | 1 | 1 | ± 2.9% | ± 2.9% | 145 |
| Device holder uncertainty | ± 3.6% | Normal | 1 | 1 | 1 | ± 3.6% | ± 3.6% | 5 |
| Power drift | ± 5.0% | Rectangular | √3 | 1 | 1 | ± 2.9% | ± 2.9% | ∞ |
| **Phantom and Set-up** | | | | | | | | |
| Phantom uncertainty | ± 4.0% | Rectangular | √3 | 1 | 1 | ± 2.3% | ± 2.3% | ∞ |
| Liquid conductivity (target) | ± 5.0% | Rectangular | √3 | 0.64 | 0.43 | ± 1.8% | ± 1.2% | ∞ |
| Liquid conductivity (meas.) | ± 2.5% | Normal | 1 | 0.64 | 0.43 | ± 1.6% | ± 1.1% | ∞ |
| Liquid permittivity (target) | ± 5.0% | Rectangular | √3 | 0.6 | 0.49 | ± 1.7% | ± 1.4% | ∞ |
| Liquid permittivity (meas.) | ± 2.5% | Normal | 1 | 0.6 | 0.49 | ± 1.5% | ± 1.2% | ∞ |
| **Combined Uncertainty** | | | | | | ± 10.9% | ± 10.7% | 387 |
| **Expanded Std. Uncertainty** | | | | | | **± 21.9%** | **± 21.4%** | |

Table 7:Measurement uncertainties

## 5.2 Measurement uncertainty evaluation for system validation

The overall combined measurement uncertainty of the measurement system is ± 9.2% (K=1).
The expanded uncertainty (k=2) is assessed to be ± 18.4%
This measurement uncertainty budget is suggested by IEEE P1528 and determined by Schmid & Partner Engineering AG. The breakdown of the individual uncertainties is as follows:

| Error Sources | Uncertainty Value | Probability Distribution | Divisor | $c_i$ 1g | $c_i$ 10g | Standard Uncertainty 1g | Standard Uncertainty 10g | $v_i^2$ or $v_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe calibration | ± 6.0% | Normal | 1 | 1 | 1 | ± 6.0% | ± 6.0% | ∞ |
| Axial isotropy | ± 4.7% | Rectangular | √3 | 1 | 1 | ± 2.7% | ± 2.7% | ∞ |
| Hemispherical isotropy | ± 9.6% | Rectangular | √3 | 0.7 | 0.7 | ± 0.0% | ± 0.0% | ∞ |
| Boundary effects | ± 1.0% | Rectangular | √3 | 1 | 1 | ± 0.6% | ± 0.6% | ∞ |
| Probe linearity | ± 4.7% | Rectangular | √3 | 1 | 1 | ± 2.7% | ± 2.7% | ∞ |
| System detection limits | ± 1.0% | Rectangular | √3 | 1 | 1 | ± 0.6% | ± 0.6% | ∞ |
| Readout electronics | ± 0.3% | Normal | 1 | 1 | 1 | ± 0.3% | ± 0.3% | ∞ |
| Response time | ± 0.0% | Rectangular | √3 | 1 | 1 | ± 0.0% | ± 0.0% | ∞ |
| Integration time | ± 0.0% | Rectangular | √3 | 1 | 1 | ± 0.0% | ± 0.0% | ∞ |
| RF ambient conditions | ± 1.0% | Rectangular | √3 | 1 | 1 | ± 0.6% | ± 0.6% | ∞ |
| Probe positioner | ± 0.4% | Rectangular | √3 | 1 | 1 | ± 0.2% | ± 0.2% | ∞ |
| Probe positioning | ± 2.9% | Rectangular | √3 | 1 | 1 | ± 1.7% | ± 1.7% | ∞ |
| Max. SAR evaluation | ± 1.0% | Rectangular | √3 | 1 | 1 | ± 0.6% | ± 0.6% | ∞ |
| **Dipole** | | | | | | | | |
| Deviation of experimental dipole | ± 5.5% | Rectangular | √3 | 1 | 1 | ± 3.2% | ± 3.2% | ∞ |
| Dipole axis to liquid distance | ± 2.0% | Rectangular | 1 | 1 | 1 | ± 1.2% | ± 1.2% | ∞ |
| Power drift | ± 4.7% | Rectangular | √3 | 1 | 1 | ± 2.7% | ± 2.7% | ∞ |
| **Phantom and Set-up** | | | | | | | | |
| Phantom uncertainty | ± 4.0% | Rectangular | √3 | 1 | 1 | ± 2.3% | ± 2.3% | ∞ |
| Liquid conductivity (target) | ± 5.0% | Rectangular | √3 | 0.64 | 0.43 | ± 1.8% | ± 1.2% | ∞ |
| Liquid conductivity (meas.) | ± 2.5% | Normal | 1 | 0.64 | 0.43 | ± 1.6% | ± 1.1% | ∞ |
| Liquid permittivity (target) | ± 5.0% | Rectangular | √3 | 0.6 | 0.49 | ± 1.7% | ± 1.4% | ∞ |
| Liquid permittivity (meas.) | ± 2.5% | Normal | 1 | 0.6 | 0.49 | ± 1.5% | ± 1.2% | ∞ |
| **Combined Uncertainty** | | | | | | **± 9.5%** | **± 9.2%** | |
| **Expanded Std. Uncertainty** | | | | | | **± 18.9%** | **± 18.4%** | |

Table 8: Measurement uncertainties

# 6 SAR Test Configuration

## 6.1 CDMA 1x EVDO Test Configurations

1) Output Power Verification for EVDO
Maximum output power is verified on the High, Middle, Low channel according to procedures in section 3.1.1.3.4 of3GPP2 C.S0033-0TIA-866 for Rev.0 and section 4.3.4 of 3GPP2 C.S0033-A for Rev. A, maximum output power for both Subtype 0/1 and Subtype 2 Physical Layer configurations should be measured.

2) SAR measurement
SAR is measured using FTAP/RTAP and FETA/RETA respectively for Rev.0 and Rev. A devices.
The AT is tested with a Reverse Data Channel rate of 153.6kbps IN Subtype 0/1 Physical Layer configuration; and a Reverse Data Channel payload size of 4096 bits and Termination Target of 16 slot in Subtype 2 Physical Layer configurations. Both FTAP and FETAP are configured with a Forward Traffic Channel data rate corresponding to the 2-slot version of 307.2kbps with the ACK channel transmitting in all slots. AT power control should be in “All Bits Up” conditions for TAP/ETAP.

Body SAR is measured using Subtype 0/1 Physical Layer configurations for Rev.0. SAR for Subtype 2 Physical Layer configurations is not required for Rev. A when the maximum average output of each RF channel is less that measured in Subtype 0/1 Physical Layer configurations. Otherwise, SAR is measured on the maximum output channel for Rev. A using the exposure configuration that results in the highest SAR for that RF channels in Rev.014.

For EVDO devices that also support 1x RTT voice and/or data operations, SAR is not required for 1x RTT when the maximum average output of each channel is less than 1/4 dB higher than that measured in Subtype 0/1 Physical Layer configurations for Rev.0. Otherwise, the ‘Body SAR Measurements’ procedures in the ‘CDMA-2000 1x Handsets’ section should be applied.

## 6.2 LTE Test Configurations

SAR for body exposure configurations is measured according to the “Body SAR Measurements” Procedures of KDB941225 D05 SAR for LTE.

1) The procedures shall be applied independently to the device and exposure configurations required for body, USB dongle orientations and antenna diversity conditions etc. applying the test positions in KDB 447498 for USB dongles.
2) When MPR is implemented permanently within the UE, regardless of network requirements, only those RB configurations allowed (see 3GPP standards) for the channel bandwidth and modulation combinations may be tested with MPR. Configurations with RB allocations below the required RB thresholds must be tested without MPR. A-MPR must always be disabled.

LTE MPR as belows:

| Modulation | Channel bandwidth / Transmission bandwidth configuration [RB] | | | | MPR |
|---|---|---|---|---|---|
| | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | |
| QPSK | ≤ 5 | ≤ 4 | ≤ 8 | ≤ 12 | 0 |
| QPSK | > 5 | > 4 | > 8 | > 12 | 1 |
| 16 QAM | ≤ 5 | ≤ 4 | ≤ 8 | ≤ 12 | 1 |
| 16 QAM | > 5 | > 4 | > 8 | > 12 | 2 |

3) For each LTE frequency band, detail reduce test information is referred to section 7.2.3 and final test summary is as belows:

| Bandwidth | Modulation Type | RB Size and Allocation | Test Channel | SAR Test |
|---|---|---|---|---|
| 10MHz | QPSK | 50% Centered | High Channel | No Test* |
| | | | Middle Channel | Tested* |
| | | | Low Channel | No Test* |
| | | 1RB Lower EDGE | High Channel | No Test |
| | | | Middle Channel | Tested |
| | | | Low Channel | No Test |
| | | 1RB Upper EDGE | High Channel | Tested |
| | | | Middle Channel | No Test |
| | | | Low Channel | No Test |
| | 16QAM | 50% Centered | High Channel | No Test |
| | | | Middle Channel | Tested |
| | | | Low Channel | No Test |
| | | 1RB Lower EDGE | High Channel | No Test |
| | | | Middle Channel | Tested |
| | | | Low Channel | No Test |
| | | 1RB Upper EDGE | High Channel | Tested |
| | | | Middle Channel | No Test |
| | | | Low Channel | No Test |

*Please check SAR test result table of middle channel is <0.8W/kg, other channels are not required.

# 7 SAR Measurement Results

## 7.1 Conducted power measurements

For the measurements a Rohde & Schwarz Radio Communication Tester CMU 200 and an Anritsu Communication Tester MT8820c were used.
The output power was measured using an integrated RF connector and attached RF cable.
SAR drift measured at same position in liquid before and after each SAR test as below 7.2 chapter.

### 7.1.1 Conducted power measurements CDMA1700 MHz

| CDMA2000 AWS (1xRTT) | | Conducted Power (dBm) | | |
|---|---|---|---|---|
| | | 25CH | 450CH | 850CH |
| RC1 | SO55 | 24.11 | 24.02 | 24.06 |
| RC3 | SO55 | 24.02 | 24.17 | 24.09 |
| | TDSO32 (FCH) | 24.15 | 24.16 | 24.08 |
| | TDSO32 (FCH+SCH) | 24.12 | 24.07 | 24.15 |
| CDMA2000 AWS (1xEV-DO) | | Conducted Power (dBm) | | |
| | | 25CH | 450CH | 850CH |
| Rev 0 | RTAP 153.6 | 24.19 | 24.31 | 24.22 |
| Rev A | RETAP 4096 | **24.08** | **24.38** | **24.27** |

Table 9: Test results conducted power measurement CDMA1700 MHz

### 7.1.2 Conducted power measurements CDMA 1900 MHz

| CDMA1900(1xRTT) | | Conducted Power (dBm) | | |
|---|---|---|---|---|
| | | 25CH | 600CH | 1175CH |
| RC1 | SO55 | 24.42 | 24.02 | 24.16 |
| RC3 | SO55 | 24.34 | 24.18 | 24.07 |
| | TDSO32 (FCH) | 24.34 | 24.19 | 24.16 |
| | TDSO32 (FCH+SCH) | 24.35 | 24.13 | 24.15 |
| CDMA1900 (1xEV-DO) | | Conducted Power (dBm) | | |
| | | 25CH | 600CH | 1175CH |
| Rev 0 | RTAP 153.6 | 24.42 | 24.32 | 24.41 |
| Rev A | RETAP 4096 | **24.42** | **24.35** | **24.36** |

Table 10: Test results conducted power measurement CDMA 1900 MHz

Note: RC1+SO55/RC3+SO55 are supported from protocol aspect, but voice calls of the product aren't supported from function aspect.

### 7.1.3 Conducted power measurements LTE FDD IV (1700 MHz) Low Channel

| LTE AWS Band | Uplink Channel Number | BW [MHz] | RB Size | RB Offset | Mod | Conducted Power (dBm) |
|---|---|---|---|---|---|---|
| Low Channel | 19957 | 1.4 | 1 | 0 | QPSK | 20.92 |
| | | | 1 | 5 | QPSK | 21.21 |
| | | | 3 | 2 | QPSK | 21.00 |
| | | | 6 | 0 | QPSK | 19.97 |
| | | | 1 | 0 | 16-QAM | 19.99 |
| | | | 1 | 5 | 16-QAM | 20.09 |
| | | | 3 | 2 | 16-QAM | 20.18 |
| | | | 6 | 0 | 16-QAM | 19.20 |
| | 19965 | 3 | 1 | 0 | QPSK | 21.00 |
| | | | 1 | 14 | QPSK | 21.22 |
| | | | 8 | 4 | QPSK | 20.06 |
| | | | 15 | 0 | QPSK | 20.00 |
| | | | 1 | 0 | 16-QAM | 19.92 |
| | | | 1 | 14 | 16-QAM | 20.12 |
| | | | 8 | 4 | 16-QAM | 19.31 |
| | | | 15 | 0 | 16-QAM | 18.98 |
| | 19975 | 5 | 1 | 0 | QPSK | 20.90 |
| | | | 1 | 24 | QPSK | 21.23 |
| | | | 12 | 6 | QPSK | 20.18 |
| | | | 25 | 0 | QPSK | 20.11 |
| | | | 1 | 0 | 16-QAM | 20.03 |
| | | | 1 | 24 | 16-QAM | 20.22 |
| | | | 12 | 6 | 16-QAM | 19.17 |
| | | | 25 | 0 | 16-QAM | 19.57 |
| | 20000 | 10 | 1 | 0 | QPSK | 21.04 |
| | | | 1 | 49 | QPSK | **21.30** |
| | | | 25 | 12 | QPSK | 20.28 |
| | | | 50 | 0 | QPSK | 20.08 |
| | | | 1 | 0 | 16-QAM | 20.11 |
| | | | 1 | 49 | 16-QAM | 20.30 |
| | | | 25 | 12 | 16-QAM | 19.67 |
| | | | 50 | 0 | 16-QAM | 19.18 |

Table 11: Test results conducted power measurement LTE1700 Low Channel

### 7.1.4 Conducted power measurements LTE FDD IV (1700 MHz) Mid Channel

| LTE AWS Band | Uplink Channel Number | BW [MHz] | RB Size | RB Offset | Mod | Conducted Power (dBm) |
|---|---|---|---|---|---|---|
| Mid Channel | 20175 | 1.4 | 1 | 0 | QPSK | 20.96 |
| | | | 1 | 5 | QPSK | 21.07 |
| | | | 3 | 2 | QPSK | 20.88 |
| | | | 6 | 0 | QPSK | 19.96 |
| | | | 1 | 0 | 16-QAM | 20.26 |
| | | | 1 | 5 | 16-QAM | 20.34 |
| | | | 3 | 2 | 16-QAM | 20.13 |
| | | | 6 | 0 | 16-QAM | 19.14 |
| | | 3 | 1 | 0 | QPSK | 20.87 |
| | | | 1 | 14 | QPSK | 20.80 |
| | | | 8 | 4 | QPSK | 19.77 |
| | | | 15 | 0 | QPSK | 19.78 |
| | | | 1 | 0 | 16-QAM | 20.19 |
| | | | 1 | 14 | 16-QAM | 19.97 |
| | | | 8 | 4 | 16-QAM | 19.04 |
| | | | 15 | 0 | 16-QAM | 18.79 |
| | | 5 | 1 | 0 | QPSK | 21.00 |
| | | | 1 | 24 | QPSK | 20.87 |
| | | | 12 | 6 | QPSK | 19.81 |
| | | | 25 | 0 | QPSK | 19.83 |
| | | | 1 | 0 | 16-QAM | 20.05 |
| | | | 1 | 24 | 16-QAM | 19.86 |
| | | | 12 | 6 | 16-QAM | 18.89 |
| | | | 25 | 0 | 16-QAM | 19.27 |
| | | 10 | 1 | 0 | QPSK | **21.43** |
| | | | 1 | 49 | QPSK | 20.69 |
| | | | 25 | 12 | QPSK | 19.76 |
| | | | 50 | 0 | QPSK | 19.78 |
| | | | 1 | 0 | 16-QAM | 20.80 |
| | | | 1 | 49 | 16-QAM | 20.13 |
| | | | 25 | 12 | 16-QAM | 19.23 |
| | | | 50 | 0 | 16-QAM | 19.00 |

Table 12: Test results conducted power measurement LTE 1700 Mid Channel

### 7.1.5 Conducted power measurements LTE FDD IV (1700 MHz) High Channel

| LTE AWS Band | Uplink Channel Number | BW [MHz] | RB Size | RB Offset | Mod | Conducted Power (dBm) |
|---|---|---|---|---|---|---|
| High Channel | 20393 | 1.4 | 1 | 0 | QPSK | 21.30 |
| | | | 1 | 5 | QPSK | 21.42 |
| | | | 3 | 2 | QPSK | 21.34 |
| | | | 6 | 0 | QPSK | 20.36 |
| | | | 1 | 0 | 16-QAM | 20.58 |
| | | | 1 | 5 | 16-QAM | 20.50 |
| | | | 3 | 2 | 16-QAM | 20.62 |
| | | | 6 | 0 | 16-QAM | 19.60 |
| | 20385 | 3 | 1 | 0 | QPSK | 21.43 |
| | | | 1 | 14 | QPSK | **21.46** |
| | | | 8 | 4 | QPSK | 20.40 |
| | | | 15 | 0 | QPSK | 20.32 |
| | | | 1 | 0 | 16-QAM | 20.78 |
| | | | 1 | 14 | 16-QAM | 20.69 |
| | | | 8 | 4 | 16-QAM | 19.51 |
| | | | 15 | 0 | 16-QAM | 19.40 |
| | 20375 | 5 | 1 | 0 | QPSK | 21.29 |
| | | | 1 | 24 | QPSK | 21.32 |
| | | | 12 | 6 | QPSK | 20.31 |
| | | | 25 | 0 | QPSK | 20.31 |
| | | | 1 | 0 | 16-QAM | 20.78 |
| | | | 1 | 24 | 16-QAM | 20.42 |
| | | | 12 | 6 | 16-QAM | 19.35 |
| | | | 25 | 0 | 16-QAM | 19.61 |
| | 20350 | 10 | 1 | 0 | QPSK | 20.71 |
| | | | 1 | 49 | QPSK | 21.43 |
| | | | 25 | 12 | QPSK | 20.39 |
| | | | 50 | 0 | QPSK | 20.52 |
| | | | 1 | 0 | 16-QAM | 19.87 |
| | | | 1 | 49 | 16-QAM | 20.52 |
| | | | 25 | 12 | 16-QAM | 19.82 |
| | | | 50 | 0 | 16-QAM | 19.56 |

Table 13: Test results conducted power measurement LTE 1700 High Channel

### 7.2 SAR measurement Result

Connection to the EUT is established via air interface with CMU200, and the EUT is set to maximum output power by CMU200. The antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the EUT. The signal transmitted by the simulator to the antenna feeding point shall be lower than the output power level of the EUT by at least 30 dB.

The EUT is tested using an Anritsu MT8820c communications tester as controller unit to set test channels and EUT transmits with maximum output power for LTE.

The measurements were performed in combination with two host laptops (Lenovo ThinkPad X301 and Lenovo ThinkPad T61). Lenovo ThinkPad T61 laptop has horizontal and vertical USB slot, Lenovo ThinkPad X301 Laptop has horizontal USB slot.

#### 7.2.1 SAR measurement Result of CDMA AWS Band

| Test Position | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Limit (W/kg) | Liquid Temp. |
|---|---|---|---|---|---|---|---|
| | | | 1-g | 10-g | | | |
| 1x EV-DO Rev.0 | | | | | | | |
| Front Side 5mm | 450/1732.5 | RTAP 153.6 | 0.790 | 0.476 | -0.002 | 1.60 | 21.5°C |
| Rear Side 5mm | 450/1732.5 | | 0.784 | 0.467 | 0.135 | 1.60 | 21.5°C |
| Left Side 5mm | 450/1732.5 | | 0.613 | 0.342 | 0.063 | 1.60 | 21.5°C |
| Right Side 5mm | 850/1752.5 | | 0.991 | 0.556 | 0.108 | 1.60 | 21.5°C |
| | 450/1732.5 | | 1.050 | 0.579 | 0.174 | 1.60 | 21.5°C |
| | 25/1711.25 | | 0.982 | 0.560 | 0.157 | 1.60 | 21.5°C |
| Top Side 5mm | 450/1732.5 | | 0.058 | 0.036 | 0.042 | 1.60 | 21.5°C |
| 1x EV-DO Rev.A | | | | | | | |
| Right Side 5mm | 450/1732.5 | RETAP 4096 | **1.060** | 0.588 | -0.114 | 1.60 | 21.5°C |
| CDMA 1xRTT | | | | | | | |
| Right Side 5mm | 450/1732.5 | RC3+SO32 | 0.888 | 0.500 | 0.186 | 1.60 | 21.5°C |

Table 14: Test results body SAR CDMA1700 MHz

Note: 1) The maximum SAR value are marks in **bold**.

2) Upper and lower frequencies were measured at the worst position.

3) The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit (< 0.8 W/kg), testing at the high and low channels is optional.

4) Tests in body position were performed with 5 mm air gap between DUT and SAM.

5) The addition body test was performed at worst case.

### 7.2.2 SAR measurement Result of CDMA PCS

| Test Position | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Limit (W/kg) | Liquid Temp. |
|---|---|---|---|---|---|---|---|
| | | | 1-g | 10-g | | | |
| 1x EV-DO Rev.0 | | | | | | | |
| Front Side 5mm | 1175/1908.75 | RTAP 153.6 | **1.020** | 0.611 | 0.105 | 1.60 | 21.5°C |
| | 600/1880 | | 0.999 | 0.596 | -0.019 | 1.60 | 21.5°C |
| | 25/1851.25 | | 0.768 | 0.469 | 0.028 | 1.60 | 21.5°C |
| Rear Side 5mm | 600/1880 | | 0.653 | 0.416 | 0.197 | 1.60 | 21.5°C |
| Left Side 5mm | 600/1880 | | 0.666 | 0.370 | 0.005 | 1.60 | 21.5°C |
| Right Side 5mm | 600/1880 | | 0.712 | 0.398 | 0.147 | 1.60 | 21.5°C |
| Top Side 5mm | 600/1880 | | 0.060 | 0.036 | 0.040 | 1.60 | 21.5°C |
| 1x EV-DO Rev.A | | | | | | | |
| Front Side 5mm | 1175/1908.75 | RETAP 4096 | 0.955 | 0.560 | 0.107 | 1.60 | 21.5°C |
| CDMA 1x RTT | | | | | | | |
| Front Side 5mm | 1175/1908.75 | RC3+SO32 | 0.911 | 0.549 | -0.091 | 1.60 | 21.5°C |

Table 15: Test results body SAR CDMA 1900 MHz

Note: 1) The maximum SAR value are marks in **bold**.

2) Upper and lower frequencies were measured at the worst position.

3) The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit (< 0.8 W/kg), testing at the high and low channels is optional.

4) Tests in body position were performed with 5 mm air gap between DUT and SAM.

5) The addition body test was performed at worst case.

### 7.2.3 SAR measurement Result of LTE AWS Band

**Bandwidth: 10MHz / Modulation: QPSK**

| Test Position | Test channel /Frequency | LTE Configuration | SAR Value (W/kg) | | Power Drift (dB) | Limit (W/kg) | Liquid Temp. |
|---|---|---|---|---|---|---|---|
| | | | 1-g | 10-g | | | |
| 10M/QPSK | | | | | | | |
| Front Side 5mm | 20175/1732.5 | 50%RB/#12 | 0.756 | 0.468 | 0.093 | 1.60 | 21.5°C |
| Rear Side 5mm | 20175/1732.5 | | 0.644 | 0.395 | 0.115 | 1.60 | 21.5°C |
| Left Side 5mm | 20175/1732.5 | | 0.544 | 0.303 | 0.143 | 1.60 | 21.5°C |
| Right Side 5mm | 20350/1750 | | 0.673 | 0.372 | 0.195 | 1.60 | 21.5°C |
| | 20175/1732.5 | | 0.867 | 0.483 | 0.093 | 1.60 | 21.5°C |
| | 20000/1715 | | 0.779 | 0.438 | -0.025 | 1.60 | 21.5°C |
| Top Side 5mm | 20175/1732.5 | | 0.048 | 0.029 | 0.168 | 1.60 | 21.5°C |
| 10M/QPSK | | | | | | | |
| Front Side 5mm | 20175/1732.5 | 1RB/#0 | 0.856 | 0.528 | 0.086 | 1.60 | 21.5°C |
| Rear Side 5mm | 20175/1732.5 | | 0.744 | 0.457 | 0.121 | 1.60 | 21.5°C |
| Left Side 5mm | 20175/1732.5 | | 0.626 | 0.348 | 0.120 | 1.60 | 21.5°C |
| Right Side 5mm | 20175/1732.5 | | 0.960 | 0.538 | 0.006 | 1.60 | 21.5°C |
| Top Side 5mm | 20175/1732.5 | | 0.053 | 0.033 | 0.112 | 1.60 | 21.5°C |
| 10M/QPSK | | | | | | | |
| Front Side 5mm | 20350/1750 | 1RB/#49 | 0.917 | 0.562 | 0.165 | 1.60 | 21.5°C |
| Rear Side 5mm | 20350/1750 | | 0.589 | 0.366 | 0.138 | 1.60 | 21.5°C |
| Left Side 5mm | 20350/1750 | | 0.688 | 0.385 | 0.038 | 1.60 | 21.5°C |
| Right Side 5mm | 20350/1750 | | 0.925 | 0.511 | 0.090 | 1.60 | 21.5°C |
| Top Side 5mm | 20350/1750 | | 0.068 | 0.043 | -0.113 | 1.60 | 21.5°C |

**Bandwidth: 10MHz / Modulation: 16QAM**

| Test Position | Test channel /Frequency | LTE Configuration | SAR Value (W/kg) 1-g | SAR Value (W/kg) 10-g | Power Drift (dB) | Limit (W/kg) | Liquid Temp. |
|---|---|---|---|---|---|---|---|
| 10M/16QAM | | | | | | | |
| Front Side 5mm | 20175/1732.5 | 50%RB/#12 | 0.735 | 0.452 | 0.160 | 1.60 | 21.5°C |
| Rear Side 5mm | 20175/1732.5 | | 0.758 | 0.470 | 0.153 | 1.60 | 21.5°C |
| Left Side 5mm | 20175/1732.5 | | 0.636 | 0.354 | 0.107 | 1.60 | 21.5°C |
| Right Side 5mm | 20175/1732.5 | | 0.943 | 0.527 | 0.126 | 1.60 | 21.5°C |
| Top Side 5mm | 20175/1732.5 | | 0.047 | 0.030 | 0.194 | 1.60 | 21.5°C |
| 10M/16QAM | | | | | | | |
| Front Side 5mm | 20175/1732.5 | 1RB/#0 | 0.882 | 0.545 | 0.111 | 1.60 | 21.5°C |
| Rear Side 5mm | 20175/1732.5 | | 0.856 | 0.531 | 0.057 | 1.60 | 21.5°C |
| Left Side 5mm | 20175/1732.5 | | 0.719 | 0.402 | 0.126 | 1.60 | 21.5°C |
| Right Side 5mm | 20175/1732.5 | | **1.190** | 0.666 | 0.188 | 1.60 | 21.5°C |
| Top Side 5mm | 20175/1732.5 | | 0.053 | 0.033 | 0.036 | 1.60 | 21.5°C |
| 10M/16QAM | | | | | | | |
| Front Side 5mm | 20350/1750 | 1RB/#49 | 0.943 | 0.579 | 0.128 | 1.60 | 21.5°C |
| Rear Side 5mm | 20350/1750 | | 0.612 | 0.382 | 0.086 | 1.60 | 21.5°C |
| Left Side 5mm | 20350/1750 | | 0.691 | 0.387 | 0.173 | 1.60 | 21.5°C |
| Right Side 5mm | 20350/1750 | | 0.951 | 0.527 | 0.180 | 1.60 | 21.5°C |
| Top Side 5mm | 20350/1750 | | 0.069 | 0.044 | -0.023 | 1.60 | 21.5°C |

Table 16: Test results body SAR LTE 1700 MHz

**Note:**

1) The maximum SAR value are marks in **bold**.
2) A-MPR was disabled by Radio Communication Tester;
3) Per KDB447498 D02:
   a) The closest distance from Top side to main antenna is less than 1cm, so Top side SAR is required.
   b) For antennas located more than 2.5 cm from the USB connector, so no SAR test in one or more of these configurations need to be considered in the position of rotator 45º to 90º. (pls see Appendix D)
4) Tests in body position were performed with 5 mm air gap between DUT and SAM.
5) The addition body test was performed at worst case.
6) Per KDB941225 D05，LTE band test reduce is as below the following:

First step:

Refer to Item 3A): Begin by measuring SAR on the high, middle and low (H, M, L) channels[2] using the largest channel bandwidth, in QPSK with 50% RB allocation4 centered within the channel bandwidth. And Foot note 2: When the maximum output power variation across H, M and L channels is ≤ ½ dB, start with the middle channel; otherwise, start with the highest output power channel. When the measured 1-g SAR for the middle or highest output power channel is ≤ 0.8 W/kg, testing of the remaining two channels in that device and exposure configuration is not necessary. Also see footnote 1.

| LTE AWS Band | Uplink Channel Number | BW [MHz] | RB Size | RB Offset | Mod | Max Conducted Power (dBm) | Max Difference |
|---|---|---|---|---|---|---|---|
| Low Channel | 20000 | 10 | 1 | 49 | QPSK | 21.30 | **0.13** |
| Mid Channel | 20175 | 10 | 1 | 0 | QPSK | 21.43 | |
| High Channel | 20350 | 10 | 1 | 49 | QPSK | 21.43 | |

➔ Middle channel, 10MHz BW, 50%/#12, QPSK has been selected.

Second step:
Refer to Item 3B) : Measure SAR in QPSK with 1 RB allocated at the high end of the channel edge using the highest SAR channel measured in A); and then repeat the measurement at the low end of the channel edge.[6]
And Foot note 6: If the maximum average conducted output power for a 1 RB allocation is > ½ dB higher than the 50% RB allocation, instead of using the highest SAR channel measured for QPSK and 50% RB allocation, measure SAR on the highest output power channel for the 1 RB allocation
the maximum average conducted output power should be compared with 1RB/50% RB allocation of the same channel as below the following,

| LTE AWS Band | Uplink Channel Number | BW [MHz] | RB Size | RB Offset | Mod | Max Conducted Power (dBm) | Difference |
|---|---|---|---|---|---|---|---|
| Low Channel | 20000 | 10 | 1 | 49 | QPSK | 21.30 | 1.02 |
| | | 10 | 25 | 12 | QPSK | 20.28 | |
| Mid Channel | 20175 | 10 | 1 | 49 | QPSK | 20.69 | 0.93 |
| | | 10 | 25 | 12 | QPSK | 19.76 | |
| High Channel | 20350 | 10 | 1 | 49 | QPSK | 21.43 | **1.04** |
| | | 10 | 25 | 12 | QPSK | 20.39 | |

➔ High channel, 10 MHz BW, 1RB/#49, QPSK has been selected.

| LTE AWS Band | Uplink Channel Number | BW [MHz] | RB Size | RB Offset | Mod | Max Conducted Power (dBm) | Difference |
|---|---|---|---|---|---|---|---|
| Low Channel | 20000 | 10 | 1 | 0 | QPSK | 21.04 | 0.76 |
| | | 10 | 25 | 12 | QPSK | 20.28 | |
| Mid Channel | 20175 | 10 | 1 | 0 | QPSK | 21.43 | **1.67** |
| | | 10 | 25 | 12 | QPSK | 19.76 | |
| High Channel | 20350 | 10 | 1 | 0 | QPSK | 20.71 | 0.32 |
| | | 10 | 25 | 12 | QPSK | 20.39 | |

➔ Middle channel, 10 MHz BW, 1RB/#0, QPSK has been selected.

For measured SAR in QPSK with 1 RB is < 1.45 W/kg-> Test 1RB configuration on other channels is not required.

Third step:
Refer to Item 4A): For the largest channel bandwidth in each LTE frequency band[7]: Measure SAR in 16QAM with 50% RB allocation using the highest SAR channel measured in 3) A).[8]
And Foot note 7: If the maximum average conducted output power for 16QAM is more than ¼ dB higher than QPSK, apply the procedures for QPSK in 3) to test 16QAM.
And Foot note 8: If the maximum average conducted output power for 16QAM with 50% RB allocation is > ½ dB higher than QPSK with 50% RB allocation, instead of using the highest SAR channel measured in QPSK measure SAR on the highest output power channel for 16QAM with 50% RB allocation.

| LTE AWS Band | Uplink Channel Number | BW [MHz] | RB Size | RB Offset | Mod | Max Conducted Power (dBm) | Difference |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Low Channel | 20000 | 10 | 1 | 49 | QPSK | 21.30 | -1.00 |
| | | 10 | 1 | 49 | 16QAM | 20.30 | |
| Mid Channel | 20175 | 10 | 1 | 0 | QPSK | 21.43 | **-0.63** |
| | | 10 | 1 | 0 | 16QAM | 20.80 | |
| High Channel | 20350 | 10 | 1 | 49 | QPSK | 21.43 | -0.91 |
| | | 10 | 1 | 49 | 16QAM | 20.52 | |

➔ Middle channel, 10 MHz BW , 16QAM has been selected.

| LTE AWS Band | Uplink Channel Number | BW [MHz] | RB Size | RB Offset | Mod | Max Conducted Power (dBm) | Difference |
|---|---|---|---|---|---|---|---|
| Low Channel | 20000 | 10 | 25 | 12 | QPSK | 20.28 | -0.61 |
| | | 10 | 25 | 12 | 16QAM | 19.67 | |
| Mid Channel | 20175 | 10 | 25 | 12 | QPSK | 19.76 | **-0.53** |
| | | 10 | 25 | 12 | 16QAM | 19.23 | |
| High Channel | 20350 | 10 | 25 | 12 | QPSK | 20.39 | -0.57 |
| | | 10 | 25 | 12 | 16QAM | 19.82 | |

➔ Middle channel, 10 MHz BW, 50%RB/#12, 16QAM has been selected..

Refer to Item 4B): Measure SAR in 16QAM with 1 RB allocated at the high end of the channel edge using the SAR channel measured in A); and then repeat the measurement at the low end of the channel edge.[9]

And Foot note 9: If the maximum average conducted output power for a 1 RB allocation is > ½ dB higher than the 50% RB allocation, instead of using the highest SAR channel measured for 16QAM and 50% RB measure SAR on the highest output power channel for the 1 RB allocation.

the maximum average conducted output power should be compared with 1RB/50% RB allocation of the same channel as below the following:

| LTE AWS Band | Uplink Channel Number | BW [MHz] | RB Size | RB Offset | Mod | Max Conducted Power (dBm) | Difference |
|---|---|---|---|---|---|---|---|
| Low Channel | 20000 | 10 | 1 | 0 | 16QAM | 20.11 | 0.44 |
| | | 10 | 25 | 12 | 16QAM | 19.67 | |
| Mid Channel | 20175 | 10 | 1 | 0 | 16QAM | 20.80 | **1.57** |
| | | 10 | 25 | 12 | 16QAM | 19.23 | |
| High Channel | 20350 | 10 | 1 | 0 | 16QAM | 19.87 | 0.05 |
| | | 10 | 25 | 12 | 16QAM | 19.82 | |

➔ Middle channel, 10 MHz BW, 1RB/#0, 16QAM has been selected.

| LTE AWS Band | Uplink Channel Number | BW [MHz] | RB Size | RB Offset | Mod | Max Conducted Power (dBm) | Difference |
|---|---|---|---|---|---|---|---|
| Low Channel | 20000 | 10 | 1 | 49 | 16QAM | 20.30 | 0.63 |
| | | 10 | 25 | 12 | 16QAM | 19.67 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mid Channel | 20175 | 10 | 1 | 49 | 16QAM | 20.13 | **0.90** |
| | | 10 | 25 | 12 | 16QAM | 19.23 | |
| High Channel | 20350 | 10 | 1 | 49 | 16QAM | 20.52 | 0.70 |
| | | 10 | 25 | 12 | 16QAM | 19.82 | |

➔ High channel, 10 MHz BW, 1RB/#49, 16QAM has been selected.

Measured SAR in 16QAM with 1 RB is < 1.45 W/kg-> Test 16QAM on other channels is not required.

Fourth step:

Refer to Item 5B): For the other channel bandwidths used by the device within a LTE frequency band:

a) Max average conducted power of 5MHz/3MHz/1.4MHz BW is is within ½ dB for 10MHzBW:

| Bandwidth(MHz) | 10 MHz | 5 MHz | 3 MHz | 1.4 MHz |
|---|---|---|---|---|
| Max Power (QPSK) | 21.43 | 21.32 | 21.46 | 21.42 |
| Max Power (16QAM) | 20.80 | 20.78 | 20.78 | 20.62 |
| Difference (QPSK) | --- | -0.11 | 0.03 | -0.01 |
| Difference (16QAM) | --- | -0.02 | -0.02 | -0.18 |

b) SAR of QPSK with 50% RB (10MHz) is < 1.45 W/kg.

Therefore: this cannot be tested in the smaller channel bandwidth of QPSK/16QAM.

### 7.3 simultaneous transmission SAR

CDMA / LTE mode can not work at the same time. Only one mode can work at a time.No Simultaneous transmission mode is provided for the device. Therefore, simultaneous transmission SAR is not required.

**Appendix A. System Check Plots**

**(Pls See Appendix A.)**

**Appendix B. SAR Measurement Plots**

**(Pls See Appendix B.)**

**Appendix C. Calibration Certificate**

**(Pls See Appendix C.)**

**Appendix D. Photo documentation**

**(Pls See Appendix D.)**