



FCC SAR Compliance Test Report

Project Name: UMTS Smart Phone
Model : HUAWEI Y301-A1, Y301-A1, HUAWEI Y301A1, Y301A1
FCC ID : QISY301-A1
Report No. : SYBH(Z-SAR)035042013-2

| | APPROVED (Lab Manager) | CHECKED | PREPARED |
|------|---------------------------|-----------------|------------------|
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| DATE | 2013-06-19 | 2013-06-19 | 2013-06-19 |

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Reliability Laboratory of Huawei Technologies Co., Ltd.

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※ ※ **Modified History** ※ ※

| REV. | DESCRIPTION | ISSUED DATE | REMARK |
|---------|--|-------------|-----------|
| Rev.1.0 | Initial Test Report Release | 2013-06-06 | GongZhong |
| Rev.1.1 | Correct the ϵ_r value of 2450B to 52.07 of Table 5 on page 20 | 2013-06-19 | GongZhong |
| | | | |
| | | | |
| | | | |

1 General Information

1.1 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for HUAWEI Y301-A1, Y301-A1, HUAWEI Y301A1, Y301A1 are as below Table 1.

| Band | Position* | MAX Reported SAR _{1g} (W/kg) |
|---|-----------------|---------------------------------------|
| GSM850 | Head | 1.040 |
| | Body Worn(15mm) | 0.881 |
| | Hotspot(10mm) | 0.723 |
| GSM1900 | Head | 0.590 |
| | Body Worn(15mm) | 0.566 |
| | Hotspot(10mm) | 1.319 |
| UMTS Band V | Head | 0.793 |
| | Body Worn(15mm) | 0.769 |
| | Hotspot(10mm) | 0.633 |
| UMTS Band IV | Head | 1.308 |
| | Body Worn(15mm) | 0.673 |
| | Hotspot(10mm) | 0.657 |
| UMTS Band II | Head | 1.107 |
| | Body Worn(15mm) | 1.036 |
| | Hotspot(10mm) | 1.050 |
| WiFi | Head | 0.721 |
| | Body Worn(15mm) | 0.359 |
| | Hotspot(10mm) | 0.678 |
| The highest simultaneous SAR is 1.576W/kg per KDB690783 D01 | | |

Table 1: Summary of test result

Note: *For body worn operation, this device has been tested and meets FCC RF exposure guidelines when used with any accessory that contains no metal and that positions the handset a minimum of 15mm from the body. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.

The device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits of 1.6 W/Kg as averaged over any 1g tissue according to the FCC rule §2.1093, the ANSI/IEEE C95.1:1992, the NCRP Report Number 86 for uncontrolled environment, according to 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 Std 1528-2003 & IEEE Std 1528a-2005 and FCC OET Bulletin 65 Supplement C Edition 01-01.

1.2 RF exposure limits

| Human Exposure | Uncontrolled Environment General Population | Controlled Environment Occupational |
|--|--|--|
| Spatial Peak SAR* (Brain/Body/Arms/Legs) | 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

| Device Information: | | | |
|----------------------------------|--|-------------|-------------|
| DUT Name: | UMTS Smart Phone | | |
| Type Identification: | HUAWEI Y301-A1, Y301-A1, HUAWEI Y301A1, Y301A1 | | |
| FCC ID : | QISY301-A1 | | |
| SN No.: | D2H01A9331900203 | | |
| Device Type : | portable device | | |
| Device Phase: | Identical Prototype | | |
| Exposure Category: | uncontrolled environment / general population | | |
| Hardware Version : | HD1Y301A1M | | |
| Software Version : | Y301-A1 V100R001C85B115 | | |
| Antenna Type : | internal antenna | | |
| Others Accessories | Headset | | |
| Device Operating Configurations: | | | |
| Supporting Mode(s) | GSM850/1900, UMTS Band V/IV/II, WiFi (tested),BT | | |
| Test Modulation | GSM(GMSK/8PSK), UMTS(QPSK) | | |
| Device Class | B | | |
| Operating Frequency Range(s) | Band | Tx (MHz) | Rx (MHz) |
| | GSM850 | 824-849 | 869-894 |
| | GSM1900 | 1850-1910 | 1930-1990 |
| | UMTS Band V | 824-849 | 869-894 |
| | UMTS Band IV | 1713 - 1753 | 2113 - 2153 |
| | UMTS Band II | 1850-1910 | 1930-1990 |
| | BT | 2402-2480 | |
| | WiFi | 2412-2462 | |
| GPRS Multislot Class(10) | Max Number of Timeslots in Uplink: | 2 | |
| | Max Number of Timeslots in Downlink: | 4 | |
| | Max Total Timeslot: | 5 | |
| EGPRS Multislot Class(10) | Max Number of Timeslots in Uplink: | 2 | |
| | Max Number of Timeslots in Downlink: | 4 | |
| | Max Total Timeslot: | 5 | |
| HSDPA UE Category | 8 | | |
| HSUPA UE Category: | 6 | | |
| Power Class: | 4, tested with power level 5(GSM850) | | |
| | 1, tested with power level 0(GSM1900) | | |
| | 3, tested with power control "all 1"(UMTS Band V) | | |
| | 3, tested with power control "all 1"(UMTS Band IV) | | |
| | 3, tested with power control "all 1"(UMTS Band II) | | |
| Test Channels (low-mid-high): | 128-190-251 (GSM850) | | |
| | 512-661-810 (GSM1900) | | |
| | 4132-4182-4233 (UMTS Band V) | | |
| | 1312-1413-1513 (UMTS Band IV) | | |
| | 9262-9400-9538 (UMTS Band II) | | |
| | 1-6-11 (WiFi 2450) | | |

Table 3: Device information and operating configuration

1.3.1 General Description

HUAWEI Y301A1, Y301-A1 is subscriber equipment in the WCDMA/GSM system. The HSPA/UMTS frequency band is Band II and Band IV and Band V. The GSM/GPRS/EDGE frequency band includes GSM850 and GSM900 and DCS1800 and PCS1900, but only GSM850 and PCS1900 bands test data included in this report. The Mobile Phone implements such functions as RF signal receiving/transmitting, HSPA/UMTS and GSM/GPRS/EDGE protocol processing, voice, video MMS service, GPS, AGPS and WIFI etc. Externally it provides micro SD card interface, earphone port(to provide voice service) and Micro-SIM Card interface. It also provides Bluetooth module to synchronize data between a PC and the phone, or to use the built-in modem of the phone to access the Internet with a PC, or to exchange data with other Bluetooth devices.

Battery

| Name | Manufacture | Serials number | Description |
|---------------------|-------------------------------|---|---|
| Rechargeable Li-ion | Huawei Technologies Co., Ltd. | 1#: MAIC903XXXX0091 2#: MPCCA13919100157 | Battery Model: HB4W1H Rated capacity: 1750mAh Nominal Voltage:  +3.7V Charging Voltage:  +4.2V |

1.4 Test specification(s)

| | |
|---|--|
| ANSI Std C95.1-1992 | Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.(IEEE Std C95.1-1991) |
| IEEE Std 1528-2003 | Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques |
| IEEE Std 1528a-2005 | IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques Amendment 1: CAD File for Human Head Model (SAM Phantom) |
| OET Bulletin No. 65, Supplement C Edition 01-01– 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 |
| 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 |
| KDB941225 D03 | SAR Test Reduction GSM GPRS EDGE v01 |
| KDB941225 D06 | Hot Spot SAR v01 |
| KDB447498 D01 | General RF Exposure Guidance v05 |
| KDB648474 D04 | SAR Handsets Multi Xmitter and Ant v01 |
| KDB248227 D01 | SAR meas for 802.11 a/b/g v01r02 |
| KDB865664 D01 | SAR measurement 100 MHz to 6 GHz v01 |
| KDB865664 D02 | SAR Reporting v01 |

1.5 Testing laboratory

| | |
|------------------------|---|
| Test Site | The Reliability Laboratory of Huawei Technologies Co., Ltd. |
| Test Location | Zone K3,Huawei Industrial Base, Bantian Industry Area, Longgang District, Shenzhen, Guangdong, China |
| Telephone | +86 755 28780808 |
| Fax | +86 755 89652518 |
| State of accreditation | The Test laboratory (area of testing) is accredited according to ISO/IEC 17025. CNAS Registration number: L0310 A2LA TESTING CERT #2174.01 |

1.6 Applicant and Manufacturer

| | |
|--------------|---|
| Company Name | HUAWEI TECHNOLOGIES CO., LTD |
| Address | Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C |

1.7 Application details

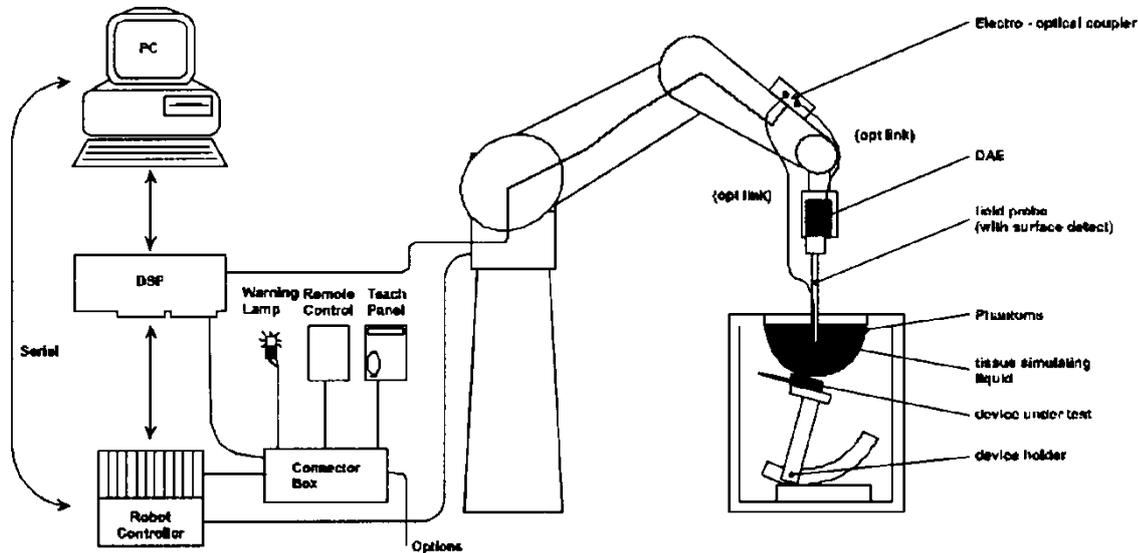
| | |
|--------------------|------------|
| Start Date of test | 2013-05-10 |
| End Date of test | 2013-05-15 |

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 check 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.

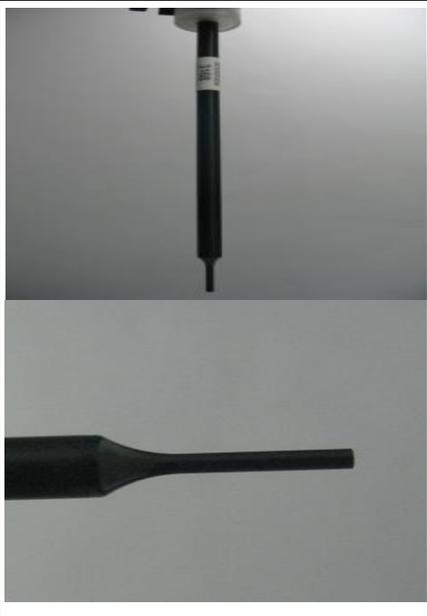
DAE4

| | | |
|-----------------------|--------------------------|--|
| 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 Interleaved sensors Built-in shielding against static charges 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) ± 0.3 dB in tissue material (rotation normal to probe axis) | |
| Dynamic range | 5 μ W/g to > 100 mW/g; Linearity: ± 0.2 dB | |
| Dimensions | Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm | |
| Application | General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones | |

Isotropic E-Field Probe EX3DV4 for Dosimetric Measurements

| | | |
|---------------|---|---|
| Construction | Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |  |
| Calibration | ISO/IEC 17025 calibration service available. | |
| Frequency | 10 MHz to >6 GHz; Linearity: ± 0.2 dB (30 MHz to 6 GHz) | |
| Directivity | ± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis) | |
| Dynamic range | 10 μ W/g to > 100 mW/g; Linearity: ± 0.2 dB (noise: typically < 1 μ W/g) | |
| Dimensions | Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm | |
| Application | High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30% | |

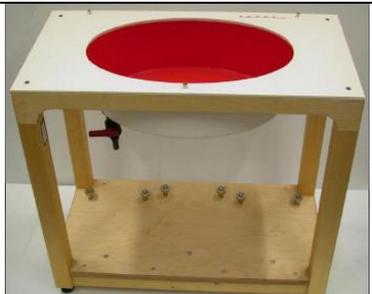
2.5 Phantom description

SAM Twin Phantom

| | | |
|-------------------|--|---|
| Shell Thickness | 2mm +/- 0.2 mm; The ear region: 6mm |  |
| Filling Volume | Approximately 30 liters | |
| Dimensions | Length:1000mm; Width:500mm; Height: adjustable feet | |
| Measurement Areas | Left hand Right hand 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; 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)* | Valid period |
|-------------------------------------|---------------|--------------------------------------|---------|---------------|-----------------------------|--------------|
| <input checked="" type="checkbox"/> | SPEAG | Dosimetric E-Field Probe | EX3DV4 | 3898 | 2013-01-14 | One year |
| <input checked="" type="checkbox"/> | SPEAG | 835 MHz Dipole | D835V2 | 4d126 | 2011-11-07 | Three years |
| <input checked="" type="checkbox"/> | SPEAG | 1800 MHz Dipole | D1800V2 | 2d184 | 2011-03-08 | Three years |
| <input checked="" type="checkbox"/> | SPEAG | 1900 MHz Dipole | D1900V2 | 5d143 | 2011-09-26 | Three years |
| <input type="checkbox"/> | SPEAG | 2000 MHz Dipole | D2000V2 | 1052 | 2011-03-10 | Three years |
| <input type="checkbox"/> | SPEAG | 2300 MHz Dipole | D2300V2 | 1016 | 2011-11-22 | Three years |
| <input checked="" type="checkbox"/> | SPEAG | 2450 MHz Dipole | D2450V2 | 860 | 2011-03-08 | Three years |
| <input type="checkbox"/> | SPEAG | 2600 MHz Dipole | D2600V2 | 1021 | 2011-11-22 | Three years |
| <input checked="" type="checkbox"/> | SPEAG | Data acquisition electronics | DAE4 | 852 | 2012-11-22 | One year |
| <input checked="" type="checkbox"/> | SPEAG | Software | DASY 5 | N/A | N/A | N/A |
| <input checked="" type="checkbox"/> | SPEAG | Twin Phantom | SAM1 | TP-1475 | N/A | N/A |
| <input checked="" type="checkbox"/> | SPEAG | Twin Phantom | SAM2 | TP-1474 | N/A | N/A |
| <input type="checkbox"/> | SPEAG | Twin Phantom | SAM3 | TP-1597 | N/A | N/A |
| <input type="checkbox"/> | SPEAG | Twin Phantom | SAM4 | TP-1620 | N/A | N/A |
| <input type="checkbox"/> | SPEAG | Flat Phantom | ELI 4.0 | TP-1038 | N/A | N/A |
| <input type="checkbox"/> | SPEAG | Flat Phantom | ELI 4.0 | TP-1111 | N/A | N/A |
| <input checked="" type="checkbox"/> | R & S | Universal Radio Communication Tester | CMU 200 | 111397 | 2012-08-13 | One year |
| <input checked="" type="checkbox"/> | Agilent)* | Network Analyser | E5071B | MY42404956 | 2013-02-27 | One year |
| <input checked="" type="checkbox"/> | Agilent | Dielectric Probe Kit | 85070E | 2484 | N/A | N/A |
| <input checked="" type="checkbox"/> | Agilent | Signal Generator | N5181A | MY47420989 | 2013-02-27 | One year |
| <input checked="" type="checkbox"/> | MINI-CIRCUITS | Amplifier | ZHL-42W | QA0746001 | N/A | N/A |
| <input checked="" type="checkbox"/> | Agilent | Power Meter | E4417A | MY45101339 | 2013-02-26 | One year |
| <input checked="" type="checkbox"/> | Agilent | Power Meter Sensor | E9321A | MY44420359 | 2013-02-26 | One year |

Note: All the test equipments are calibrated once a year, except the dipoles, which are calibrated every three years. Moreover, we have self-calibration every year to the dipoles.

1) Per KDB 450824 D02 requirements for dipole calibration, 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 in Appendix C.

- a) There is no physical damage on the dipole;
- b) System check 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 system check. 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 $\pm 0.1\text{mm}$). 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 $\pm 30^\circ$.)
- 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 ($\leq 2\text{GHz}$), 12 mm in x- and y- dimension (2-4 GHz) and 10mm in x- and y- dimension (4-6GHz). 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 “zoom scan” measures the field in a volume around the 2D peak SAR value acquired in the previous “coarse” scan. This is a fine grid with maximum scan spatial resolution: $\Delta x_{\text{zoom}}, \Delta y_{\text{zoom}} \leq 4\text{GHz} - \leq 5\text{ mm}$ and $4-6\text{ GHz} - \leq 4\text{ mm}$; $\Delta z_{\text{zoom}} \leq 3\text{GHz} - \leq 5\text{ mm}$, $3-4\text{ GHz} - \leq 4\text{ mm}$ and $4-6\text{GHz} - \leq 2\text{mm}$ where the robot additionally moves the probe along the z-axis away from the bottom of the Phantom. DASY 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 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 2 mm 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 compensate 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 "DAE4". 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 ₁₀ , a ₁₁ , a ₁₂ |
| | - Conversion factor | ConvF _i |
| | - Diode compression point | Dcpi |
| Device parameters: | - Frequency | f |
| | - Crest factor | cf |
| Media parameters: | - Conductivity | σ |
| | - Density | ρ |

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
 σ = conductivity in [mho/m] or [Siemens/m]
 ρ = equivalent tissue density in g/cm³

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/cm²
 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 if the dielectric parameters are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within $\pm 5\%$ of the target values.

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

| Ingredients (% of weight) | Head Tissue | | | | | |
|---------------------------|-------------|-------|-------|--------|------|--------|
| | 450 | 835 | 1800 | 1900 | 2450 | 2600 |
| Frequency Band (MHz) | 450 | 835 | 1800 | 1900 | 2450 | 2600 |
| Water | 38.56 | 41.45 | 52.64 | 55.242 | 62.7 | 55.242 |
| Salt (NaCl) | 3.95 | 1.45 | 0.36 | 0.306 | 0.5 | 0.306 |
| Sugar | 56.32 | 56.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| HEC | 0.98 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bactericide | 0.19 | 0.1 | 0.0 | 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 | 47.0 | 44.542 | 36.8 | 44.452 |
| Ingredients (% of weight) | Body Tissue | | | | | |
| | 450 | 835 | 1800 | 1900 | 2450 | 2600 |
| Frequency Band (MHz) | 450 | 835 | 1800 | 1900 | 2450 | 2600 |
| Water | 51.16 | 52.4 | 69.91 | 69.91 | 73.2 | 64.493 |
| Salt (NaCl) | 1.49 | 1.40 | 0.13 | 0.13 | 0.04 | 0.024 |
| Sugar | 46.78 | 45.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| HEC | 0.52 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bactericide | 0.05 | 0.1 | 0.0 | 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 | 29.96 | 29.96 | 26.7 | 32.252 |

Table 4: Tissue Dielectric Properties

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

| Tissue Type | Measured Frequency (MHz) | Target Tissue | | Measured Tissue | | Liquid Temp. | Test Date |
|-------------|--------------------------|------------------------|------------------------|-----------------|----------------|--------------|------------|
| | | ϵ_r (+/-5%) | σ (S/m) (+/-5%) | ϵ_r | σ (S/m) | | |
| 835H | 825 | 41.60 (39.52~43.68) | 0.90 (0.86~0.95) | 41.60 | 0.905 | 21.4°C | 2013-05-12 |
| | 835 | 41.50 (39.43~43.58) | 0.90 (0.86~0.95) | 41.53 | 0.911 | | |
| | 850 | 41.50 (39.43~43.58) | 0.92 (0.87~0.96) | 41.31 | 0.921 | | |
| 835B | 825 | 55.20 (52.44~57.96) | 0.97 (0.92~1.02) | 53.21 | 0.923 | 21.4°C | 2013-05-11 |
| | 835 | 55.20 (52.44~57.96) | 0.97 (0.92~1.02) | 53.16 | 0.929 | | |
| | 850 | 55.20 (52.44~57.96) | 0.99 (0.94~1.04) | 53.23 | 0.948 | | |
| 1800H | 1710 | 40.1 (38.10~42.11) | 1.35 (1.28~1.42) | 40.76 | 1.348 | 21.4°C | 2013-05-15 |
| | 1730 | 40.1 (38.10~42.11) | 1.36 (1.29~1.43) | 40.66 | 1.365 | | |
| | 1750 | 40.1 (38.10~42.11) | 1.37 (1.30~1.44) | 40.57 | 1.382 | | |
| | 1800 | 40.0 (38.00~42.00) | 1.40 (1.33~1.47) | 40.31 | 1.424 | | |
| 1800B | 1710 | 53.5 (50.83~56.18) | 1.46 (1.39~1.53) | 53.46 | 1.455 | 21.4°C | 2013-05-11 |
| | 1730 | 53.5 (50.83~56.18) | 1.48 (1.41~1.55) | 53.42 | 1.472 | | |
| | 1750 | 53.4 (50.73~56.07) | 1.49 (1.42~1.56) | 53.35 | 1.489 | | |
| | 1800 | 53.3 (50.64~55.97) | 1.52 (1.44~1.60) | 53.35 | 1.539 | | |
| 1900H | 1850 | 40.00 (38.00~42.00) | 1.40 (1.33~1.47) | 40.72 | 1.367 | 21.4°C | 2013-05-13 |
| | 1880 | 40.00 (38.00~42.00) | 1.40 (1.33~1.47) | 40.51 | 1.396 | | |
| | 1900 | 40.00 (38.00~42.00) | 1.40 (1.33~1.47) | 40.54 | 1.413 | | |
| | 1910 | 40.00 (38.00~42.00) | 1.40 (1.33~1.47) | 40.45 | 1.422 | | |
| 1900B | 1850 | 53.30 (50.64~55.97) | 1.52 (1.44~1.60) | 51.63 | 1.523 | 21.4°C | 2013-05-10 |
| | 1880 | 53.30 (50.64~55.97) | 1.52 (1.44~1.60) | 51.58 | 1.555 | | |
| | 1900 | 53.30 (50.64~55.97) | 1.52 (1.44~1.60) | 51.54 | 1.577 | | |
| | 1910 | 53.30 (50.64~55.97) | 1.52 (1.44~1.60) | 51.53 | 1.588 | | |

| | | | | | | | |
|---|------|------------------------|---------------------|-------|-------|--------|------------|
| 1900B | 1850 | 53.30 (50.64~55.97) | 1.52 (1.44~1.60) | 51.38 | 1.535 | 21.4°C | 2013-05-14 |
| | 1880 | 53.30 (50.64~55.97) | 1.52 (1.44~1.60) | 51.33 | 1.568 | | |
| | 1900 | 53.30 (50.64~55.97) | 1.52 (1.44~1.60) | 51.29 | 1.590 | | |
| | 1910 | 53.30 (50.64~55.97) | 1.52 (1.44~1.60) | 51.28 | 1.592 | | |
| 2450H | 2410 | 39.30 (37.34~41.26) | 1.76 (1.67~1.85) | 39.56 | 1.782 | 21.4°C | 2013-05-11 |
| | 2435 | 39.20 (37.24~41.16) | 1.79 (1.70~1.88) | 39.58 | 1.827 | | |
| | 2450 | 39.20 (37.24~41.16) | 1.80 (1.71~1.89) | 39.47 | 1.823 | | |
| | 2460 | 39.20 (37.24~41.16) | 1.81 (1.72~1.90) | 39.39 | 1.84 | | |
| 2450B | 2410 | 52.80 (50.16~55.44) | 1.91 (1.81~2.00) | 52.37 | 1.957 | 21.4°C | 2013-05-14 |
| | 2435 | 52.70 (50.07~55.34) | 1.94 (1.84~2.04) | 52.21 | 1.993 | | |
| | 2450 | 52.70 (50.07~55.34) | 1.95 (1.85~2.05) | 52.07 | 2.002 | | |
| | 2460 | 52.70 (50.07~55.34) | 1.96 (1.86~2.06) | 52.17 | 2.032 | | |
| ϵ_r = Relative permittivity, σ = Conductivity | | | | | | | |

Table 5: Measured Tissue Parameter

Note: 1) 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.

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

3) 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.

4) For UMTS measurements in band IV, 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 check is performed with tissue equivalent material according to IEEE P1528 (described above). The following table shows system check results for all frequency bands and tissue liquids used during the tests (Graphic Plot(s) see Appendix A).

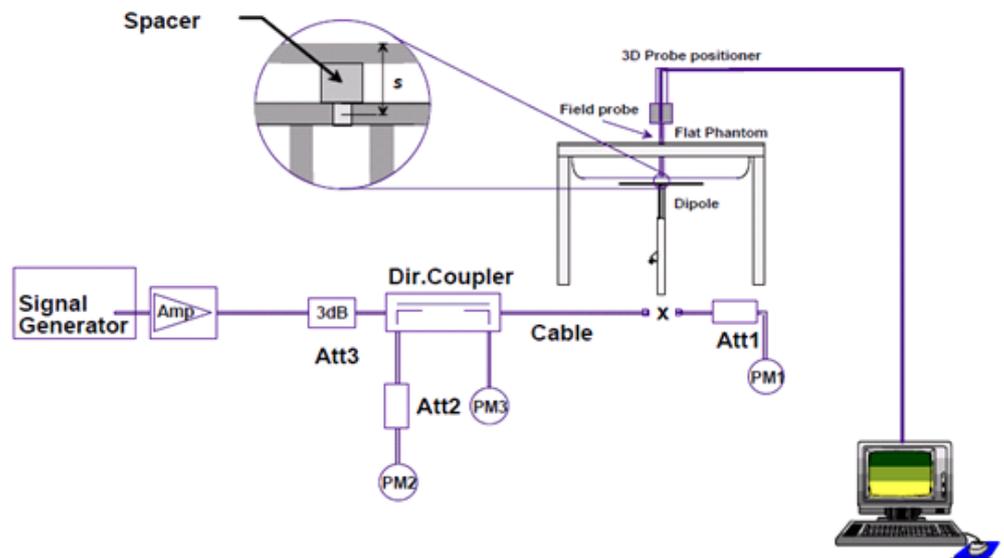
| System Check | Target SAR (1W) (+/-10%) | | Measured SAR (Normalized to 1W) | | Liquid Temp. | Test Date |
|--------------|-----------------------------|------------------------|------------------------------------|----------------|--------------|------------|
| | 1-g (mW/g) | 10-g (mW/g) | 1-g (mW/g) | 10-g (mW/g) | | |
| D835V2 Head | 9.40 (8.46~10.34) | 6.16 (5.54~6.78) | 10.20 | 6.60 | 21.4°C | 2013-05-12 |
| D1800V2 Head | 39.1 (35.19~43.01) | 20.3 (18.27~22.33) | 40.40 | 20.36 | 21.4°C | 2013-05-15 |
| D1900V2 Head | 40.60 (36.54~44.66) | 21.20 (19.08~23.32) | 41.20 | 21.00 | 21.4°C | 2013-05-13 |
| D2450V2 Head | 53.70 (48.33~59.07) | 24.90 (22.41~27.39) | 54.40 | 24.04 | 21.4°C | 2013-05-11 |
| D835V2 Body | 9.54 (8.59~10.49) | 6.29 (5.66~6.92) | 9.60 | 6.32 | 21.4°C | 2013-05-11 |
| D1800V2 Body | 38.8 (34.92~42.68) | 20.4 (18.36~22.44) | 39.56 | 20.32 | 21.4°C | 2013-05-11 |
| D1900V2 Body | 41.40 (37.26~45.54) | 21.80 (19.62~23.98) | 44.40 | 22.64 | 21.4°C | 2013-05-10 |
| D1900V2 Body | 41.40 (37.26~45.54) | 21.80 (19.62~23.98) | 44.40 | 22.40 | 21.4°C | 2013-05-14 |
| D2450V2 Body | 52.80 (47.52~58.08) | 24.50 (22.05~26.95) | 54.40 | 24.12 | 21.4°C | 2013-05-14 |

Table 6: System Check Results

4.3 System check Procedure

The system check is performed by using a system check 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 system check 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 system check 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).

System check 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 $\pm 10.9\%$ ($K=1$).

The expanded uncertainty ($k=2$) is assessed to be $\pm 21.9\%$

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 | $\pm 6.0\%$ | Normal | 1 | 1 | 1 | $\pm 6.0\%$ | $\pm 6.0\%$ | ∞ |
| Axial isotropy | $\pm 4.7\%$ | Rectangular | $\sqrt{3}$ | 0.7 | 0.7 | $\pm 1.9\%$ | $\pm 1.9\%$ | ∞ |
| Hemispherical isotropy | $\pm 9.6\%$ | Rectangular | $\sqrt{3}$ | 0.7 | 0.7 | $\pm 3.9\%$ | $\pm 3.9\%$ | ∞ |
| Spatial resolution | $\pm 0.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.0\%$ | $\pm 0.0\%$ | ∞ |
| Boundary effects | $\pm 1.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.6\%$ | $\pm 0.6\%$ | ∞ |
| Probe linearity | $\pm 4.7\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 2.7\%$ | $\pm 2.7\%$ | ∞ |
| System detection limits | $\pm 1.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.6\%$ | $\pm 0.6\%$ | ∞ |
| Readout electronics | $\pm 0.3\%$ | Normal | 1 | 1 | 1 | $\pm 0.3\%$ | $\pm 0.3\%$ | ∞ |
| Response time | $\pm 0.8\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.5\%$ | $\pm 0.5\%$ | ∞ |
| Integration time | $\pm 2.6\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 1.5\%$ | $\pm 1.5\%$ | ∞ |
| RF ambient conditions | $\pm 3.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 1.7\%$ | $\pm 1.7\%$ | ∞ |
| Probe positioner | $\pm 0.4\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.2\%$ | $\pm 0.2\%$ | ∞ |
| Probe positioning | $\pm 2.9\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 1.7\%$ | $\pm 1.7\%$ | ∞ |
| Max. SAR evaluation | $\pm 1.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.6\%$ | $\pm 0.6\%$ | ∞ |
| Test Sample Related | | | | | | | | |
| Device positioning | $\pm 2.9\%$ | Normal | 1 | 1 | 1 | $\pm 2.9\%$ | $\pm 2.9\%$ | 145 |
| Device holder uncertainty | $\pm 3.6\%$ | Normal | 1 | 1 | 1 | $\pm 3.6\%$ | $\pm 3.6\%$ | 5 |
| Power drift | $\pm 5.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 2.9\%$ | $\pm 2.9\%$ | ∞ |
| Phantom and Set-up | | | | | | | | |
| Phantom uncertainty | $\pm 4.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 2.3\%$ | $\pm 2.3\%$ | ∞ |
| Liquid conductivity (target) | $\pm 5.0\%$ | Rectangular | $\sqrt{3}$ | 0.64 | 0.43 | $\pm 1.8\%$ | $\pm 1.2\%$ | ∞ |
| Liquid conductivity (meas.) | $\pm 2.5\%$ | Normal | 1 | 0.64 | 0.43 | $\pm 1.6\%$ | $\pm 1.1\%$ | ∞ |
| Liquid permittivity (target) | $\pm 5.0\%$ | Rectangular | $\sqrt{3}$ | 0.6 | 0.49 | $\pm 1.7\%$ | $\pm 1.4\%$ | ∞ |
| Liquid permittivity (meas.) | $\pm 2.5\%$ | Normal | 1 | 0.6 | 0.49 | $\pm 1.5\%$ | $\pm 1.2\%$ | ∞ |
| Combined Uncertainty | $u_c = \sqrt{\sum_{i=1}^{21} u_i^2}$ | | | | | $\pm 10.9\%$ | $\pm 10.7\%$ | 387 |
| Expanded Std. Uncertainty | $u_e = 2u_c$ | Normal | K=2 | | | $\pm 21.9\%$ | $\pm 21.4\%$ | |

Table 7: Measurement uncertainties

5.2 Measurement uncertainty evaluation for system check

The overall combined measurement uncertainty of the measurement system is $\pm 9.5\%$ ($K=1$).

The expanded uncertainty ($k=2$) is assessed to be $\pm 18.9\%$

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 | $\pm 6.0\%$ | Normal | 1 | 1 | 1 | $\pm 6.0\%$ | $\pm 6.0\%$ | ∞ |
| Axial isotropy | $\pm 4.7\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 2.7\%$ | $\pm 2.7\%$ | ∞ |
| Hemispherical isotropy | $\pm 9.6\%$ | Rectangular | $\sqrt{3}$ | 0.7 | 0.7 | $\pm 0.0\%$ | $\pm 0.0\%$ | ∞ |
| Boundary effects | $\pm 1.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.6\%$ | $\pm 0.6\%$ | ∞ |
| Probe linearity | $\pm 4.7\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 2.7\%$ | $\pm 2.7\%$ | ∞ |
| System detection limits | $\pm 1.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.6\%$ | $\pm 0.6\%$ | ∞ |
| Readout electronics | $\pm 0.3\%$ | Normal | 1 | 1 | 1 | $\pm 0.3\%$ | $\pm 0.3\%$ | ∞ |
| Response time | $\pm 0.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.0\%$ | $\pm 0.0\%$ | ∞ |
| Integration time | $\pm 0.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.0\%$ | $\pm 0.0\%$ | ∞ |
| RF ambient conditions | $\pm 1.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.6\%$ | $\pm 0.6\%$ | ∞ |
| Probe positioner | $\pm 0.4\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.2\%$ | $\pm 0.2\%$ | ∞ |
| Probe positioning | $\pm 2.9\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 1.7\%$ | $\pm 1.7\%$ | ∞ |
| Max. SAR evaluation | $\pm 1.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 0.6\%$ | $\pm 0.6\%$ | ∞ |
| Dipole | | | | | | | | |
| Deviation of experimental dipole | $\pm 5.5\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 3.2\%$ | $\pm 3.2\%$ | ∞ |
| Dipole axis to liquid distance | $\pm 2.0\%$ | Rectangular | 1 | 1 | 1 | $\pm 1.2\%$ | $\pm 1.2\%$ | ∞ |
| Power drift | $\pm 4.7\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 2.7\%$ | $\pm 2.7\%$ | ∞ |
| Phantom and Set-up | | | | | | | | |
| Phantom uncertainty | $\pm 4.0\%$ | Rectangular | $\sqrt{3}$ | 1 | 1 | $\pm 2.3\%$ | $\pm 2.3\%$ | ∞ |
| Liquid conductivity (target) | $\pm 5.0\%$ | Rectangular | $\sqrt{3}$ | 0.64 | 0.43 | $\pm 1.8\%$ | $\pm 1.2\%$ | ∞ |
| Liquid conductivity (meas.) | $\pm 2.5\%$ | Normal | 1 | 0.64 | 0.43 | $\pm 1.6\%$ | $\pm 1.1\%$ | ∞ |
| Liquid permittivity (target) | $\pm 5.0\%$ | Rectangular | $\sqrt{3}$ | 0.6 | 0.49 | $\pm 1.7\%$ | $\pm 1.4\%$ | ∞ |
| Liquid permittivity (meas.) | $\pm 2.5\%$ | Normal | 1 | 0.6 | 0.49 | $\pm 1.5\%$ | $\pm 1.2\%$ | ∞ |
| Combined Uncertainty | $u_c = \sqrt{\sum_{i=1}^{21} u_i^2}$ | | | | | $\pm 9.5\%$ | $\pm 9.2\%$ | |
| Expanded Std. Uncertainty | $u_e = 2u_c$ | Normal | | K=2 | | $\pm 18.9\%$ | $\pm 18.4\%$ | |

Table 8: Measurement uncertainties

6 SAR Test Configuration

6.1 GSM Test Configuration

SAR tests for GSM850 and GSM1900, a communication link is set up with a base station by air link. Using CMU200 the power lever is set to “5”and “0” in SAR of GSM850 and GSM1900. The tests in the band of GSM850 and GSM1900 are performed in the mode of GPRS/EGPRS function. Since the GPRS class is 10 for this EUT, it has at most 2 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslot is 5. The EGPRS class is 10 for this EUT, it has at most 2 timeslots in uplink, and at most 4 timeslots in downlink, the maximum total timeslot is 5.

When SAR tests for EGPRS mode is necessary, GMSK modulation should be used to minimize SAR measurement error due to higher peak-to-average power (PAR) ratios inherent in 8-PSK.

According to specification 3GPP TS 51.010, the maximum power of the GSM can do the power reduction for the multi-slot.

The allowed power reduction in the multi-slot configuration is as following:

| Number of timeslots in uplink assignment | | Reduction of maximum output power (dB) | | |
|--|------------|--|--------------|--------------|
| Band | Time Slots | GPRS (GMSK) | EGPRS (GMSK) | EGPRS (8PSK) |
| GSM850 | 1 TX slot | 0 | 0 | 0 |
| | 2 TX slots | 1.4 | 1.4 | 1 |
| GSM1900 | 1 TX slot | 0 | 0 | 0 |
| | 2 TX slots | 2.3 | 2.3 | 1 |

Table 9: The allowed power reduction in the multi-slot configuration of GSM

6.2 UMTS Test Configuration

1) RMC

As the SAR body tests for UMTS Band V/IV/II, we established the radio link through call processing. The maximum output power were verified on high, middle and low channels for each test band according to 3GPP TS 34.121 with the following configuration:

- 1) 12.2kbps RMC, 64,144,384 kbps RMC with TPC set to ‘all 1’.
- 2) Test loop Mode 1.

For the output power, the configurations for the DPCCH and DPDCH₁ are as followed (EUT do not support the DPDCH_{2-n})

| | Channel Bit Rate (kbps) | Channel Symbol Rate (ksps) | Spreading Factor | Spreading Code Number | Bits/Slot |
|--------------------|-------------------------|----------------------------|------------------|-----------------------|-----------|
| DPCCH | 15 | 15 | 256 | 0 | 10 |
| DPDCH ₁ | 15 | 15 | 256 | 64 | 10 |
| | 30 | 30 | 128 | 32 | 20 |
| | 60 | 60 | 64 | 16 | 40 |
| | 120 | 120 | 32 | 8 | 80 |
| | 240 | 240 | 16 | 4 | 160 |
| | 480 | 480 | 8 | 2 | 320 |
| DPDCH _n | 960 | 960 | 4 | 1 | 640 |
| | 960 | 960 | 4 | 1, 2, 3 | 640 |

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits configured to all “1s”. SAR for other spreading codes and multiple DPDCHn, when supported by the EUT, are not required when the maximum average outputs of each RF channel, for each spreading code and DPDCHn configuration, are less than ¼ dB higher than those measured in 12.2 kbps RMC.

2) HSDPA

SAR for body exposure configurations is measured according to the “Body SAR Measurements” procedures of 3G device. In addition, body SAR is also measured for HSDPA when the maximum average outputs of each RF channel with HSDPA active is at ¼ dB higher than that measured without HSDPA using 12.2kbps RMC or the maximum SAR 12.2kbps RMC is above 75% of the SAR limit. Body SAR for HSDPA is measured using an FRC with H-Set 1 in Sub-test 1 and a 12.2kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration in 12.2 kbps RMC without HSDPA.

HSDPA should be configured according to UE category of a test device. The number of HS-DSCH/HS-PDSCHs, HAPRQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set. To maintain a consistent test configuration and stable transmission condition, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4ms with a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. The β_c and β_d gain factors for DPCCH and DPDCH were set according to the values in the below table, β_{hs} for HS-DPCCH is set automatically to the correct value when ΔACK , $\Delta NACK$, $\Delta CQI = 8$. The variation of the β_c / β_d ratio causes a power reduction at sub-tests 2 - 4.

| Sub-test ^o | β_c ^o | β_d ^o | β_d (SF) ^o | β_c / β_d ^o | β_{hs} (1) ^o | CM(dB)(2) ^o | MPR (dB) ^o |
|-----------------------|------------------------|------------------------|-----------------------------|----------------------------------|-------------------------------|------------------------|-----------------------|
| 1 ^o | 2/15 ^o | 15/15 ^o | 64 ^o | 2/15 ^o | 4/15 ^o | 0.0 ^o | 0 ^o |
| 2 ^o | 12/15(3) ^o | 15/15(3) ^o | 64 ^o | 12/15(3) ^o | 24/15 ^o | 1.0 ^o | 0 ^o |
| 3 ^o | 15/15 ^o | 8/15 ^o | 64 ^o | 15/8 ^o | 30/15 ^o | 1.5 ^o | 0.5 ^o |
| 4 ^o | 15/15 ^o | 4/15 ^o | 64 ^o | 15/4 ^o | 30/15 ^o | 1.5 ^o | 0.5 ^o |

Note 1: ΔACK , $\Delta NACK$ and $\Delta CQI = 8$ $A_{hs} = \beta_{hs} / \beta_c = 30/15$ $\beta_{hs} = 30/15 * \beta_c$
 Note 2: CM=1 for $\beta_c / \beta_d = 12/15$, $\beta_{hs} / \beta_c = 24/15$. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.
 Note 3: For subtest 2 the β_c / β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$

Table 10: Sub-tests for UMTS Release 5 HSDPA

The measurements were performed with a Fixed Reference Channel (FRC) and H-Set 1 QPSK.

| Parameter | Value |
|----------------------------------|-------------|
| Nominal average inf. bit rate | 534 kbit/s |
| Inter-TTI Distance | 3 TTI's |
| Number of HARQ Processes | 2 Processes |
| Information Bit Payload | 3202 Bits |
| MAC-d PDU size | 336 Bits |
| Number Code Blocks | 1 Block |
| Binary Channel Bits Per TTI | 4800 Bits |
| Total Available SMLs in UE | 19200 SMLs |
| Number of SMLs per HARQ Process | 9600 SMLs |
| Coding Rate | 0.67 |
| Number of Physical Channel Codes | 5 |

Table 11: settings of required H-Set 1 QPSK acc. to 3GPP 34.121

| HS-DSCH Category | Maximum HS-DSCH Codes Received | Minimum Inter-TTI Interval | Maximum HS-DSCH Transport Block Bits/HS-DSCH TTI | Total Soft Channel Bits |
|------------------|--------------------------------|----------------------------|--|-------------------------|
| 1 | 5 | 3 | 7298 | 19200 |
| 2 | 5 | 3 | 7298 | 28800 |
| 3 | 5 | 2 | 7298 | 28800 |
| 4 | 5 | 2 | 7298 | 38400 |
| 5 | 5 | 1 | 7298 | 57600 |
| 6 | 5 | 1 | 7298 | 67200 |
| 7 | 10 | 1 | 14411 | 115200 |
| 8 | 10 | 1 | 14411 | 134400 |
| 9 | 15 | 1 | 25251 | 172800 |
| 10 | 15 | 1 | 27952 | 172800 |
| 11 | 5 | 2 | 3630 | 14400 |
| 12 | 5 | 1 | 3630 | 28800 |
| 13 | 15 | 1 | 34800 | 259200 |
| 14 | 15 | 1 | 42196 | 259200 |
| 15 | 15 | 1 | 23370 | 345600 |
| 16 | 15 | 1 | 27952 | 345600 |

Table 12:HSDPA UE category

3) HSUPA

Body SAR is also measured for HSDPA when the maximum average outputs of each RF channel with HSDPA active is at ¼ dB higher than that measured without HSDPA using 12.2kbps RMC or the maximum SAR 12.2kbps RMC is above 75% of the SAR limit. Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-set 1 and QPSK for FRC and 12.2kbps RMC configured in Test Loop Mode 1 with power control algorithm 2, according to the highest body SAR configuration in 12.2 kbps RMC without HSPA.

Due to inner loop power control requirements in HSDPA, a commercial communication test set should be used for the output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and E-DCH configurations for HSDPA should be configured according to the values indicated below as well as other applicable procedures described in the 'WCDMA Handset' and 'Release 5 HSDPA Data Device' sections of 3G device.

| Sub-test [⊃] | β_c [⊃] | β_d [⊃] | β_d (SF) [⊃] | β_c/β_d [⊃] | β_{hs} ^{(1)⊃} | β_{ec} [⊃] | β_{ed} [⊃] | β_e ^{c⊃} (SF) [⊃] | β_{ed} ^{c⊃} (code) [⊃] | CM ^{(2)⊃} (dB) [⊃] | MP R ^{c⊃} (dB) [⊃] | AG ^{(4)⊃} Inde x [⊃] | E-TFC I ^{c⊃} |
|-----------------------|------------------------|------------------------|-----------------------------|--------------------------------|------------------------------|---------------------------|--|---|--|--------------------------------------|--------------------------------------|--|-----------------------|
| 1 [⊃] | 11/15 ^{(3)⊃} | 15/15 ^{(3)⊃} | 64 [⊃] | 11/15 ^{(3)⊃} | 22/15 [⊃] | 209/225 [⊃] | 1039/225 [⊃] | 4 [⊃] | 1 [⊃] | 1.0 [⊃] | 0.0 [⊃] | 20 [⊃] | 75 [⊃] |
| 2 [⊃] | 6/15 [⊃] | 15/15 [⊃] | 64 [⊃] | 6/15 [⊃] | 12/15 [⊃] | 12/15 [⊃] | 94/75 [⊃] | 4 [⊃] | 1 [⊃] | 3.0 [⊃] | 2.0 [⊃] | 12 [⊃] | 67 [⊃] |
| 3 [⊃] | 15/15 [⊃] | 9/15 [⊃] | 64 [⊃] | 15/9 [⊃] | 30/15 [⊃] | 30/15 [⊃] | $\beta_{ed1}:47/15$ [⊃] $\beta_{ed2}:47/15$ [⊃] | 4 [⊃] | 2 [⊃] | 2.0 [⊃] | 1.0 [⊃] | 15 [⊃] | 92 [⊃] |
| 4 [⊃] | 2/15 [⊃] | 15/15 [⊃] | 64 [⊃] | 2/15 [⊃] | 4/15 [⊃] | 2/15 [⊃] | 56/75 [⊃] | 4 [⊃] | 1 [⊃] | 3.0 [⊃] | 2.0 [⊃] | 17 [⊃] | 71 [⊃] |
| 5 [⊃] | 15/15 ^{(4)⊃} | 15/15 ^{(4)⊃} | 64 [⊃] | 15/15 ^{(4)⊃} | 30/15 [⊃] | 24/15 [⊃] | 134/15 [⊃] | 4 [⊃] | 1 [⊃] | 1.0 [⊃] | 0.0 [⊃] | 21 [⊃] | 81 [⊃] |

Note 1: Δ ACK, Δ NACK and Δ CQI = 8 $A_{hs} = \beta_{hs}/\beta_c = 30/15$ $\beta_{hs} = 30/15 * \beta_c$
 Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference[⊃]
 Note 3 : For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$ [⊃]
 Note 4 : For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 14/15$ and $\beta_d = 15/15$ [⊃]
 Note 5 : Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g[⊃]
 Note 6: β_{ed} can not be set directly; it is set by Absolute Grant Value.[⊃]

Table 13:Subtests for UMTS Release 6 HSUPA

| UE E-DCH Category | Maximum E-DCH Codes Transmitted | Number of HARQ Processes | E-DCH TTI(ms) | Minimum Spreading Factor | Maximum E-DCH Transport Block Bits | Max Rate (Mbps) |
|-------------------|---------------------------------|--------------------------|---------------|--------------------------|------------------------------------|-----------------|
| 1 | 1 | 4 | 10 | 4 | 7110 | 0.7296 |
| 2 | 2 | 8 | 2 | 4 | 2798 | 1.4592 |
| | 2 | 4 | 10 | 4 | 14484 | |
| 3 | 2 | 4 | 10 | 4 | 14484 | 1.4592 |
| 4 | 2 | 8 | 2 | 2 | 5772 | 2.9185 |
| | 2 | 4 | 10 | 2 | 20000 | 2.00 |
| 5 | 2 | 4 | 10 | 2 | 20000 | 2.00 |
| 6 (No DPDCH) | 4 | 8 | 10 | 2SF2&2SF | 11484 | 5.76 |
| | 4 | 4 | 2 | 4 | 20000 | 2.00 |
| 7 (No DPDCH) | 4 | 8 | 2 | 2SF2&2SF | 22996 | ? |
| | 4 | 4 | 10 | 4 | 20000 | ? |

NOTE: When 4 codes are transmitted in parallel, two codes shall be transmitted with SF2 and two with SF4. UE categories 1 to 6 support QPSK only. UE category 7 supports QPSK and 16QAM. (TS25.306-7.3.0).

Table 14:HSUPA UE category

6.3 WiFi Test Configuration

For the 802.11b/g SAR tests, a communication link is set up with the test mode software for WiFi mode test. The Absolute Radio Frequency Channel Number(ARFCN) is allocated to 1, 6 and 11 respectively in the case of 2450 MHz. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode. Each channel should be tested at the lowest data rate.

802.11b/g operating modes are tested independently according to the service requirements in each frequency band. 802.11b/g modes are tested on channel 1, 6, 11; however, if output power reduction is necessary for channels 1 and/or 11 to meet restricted band requirements the highest output channel closest to each of these channels must be tested instead.

SAR is not required for 802.11g/n channels when the maximum average output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels.

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

Notes:
 √ = "default test channels"
 △ = possible 802.11g channels with maximum average output 1/4 dB the "default test channels"
 # = when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

802.11 Test Channels per FCC Requirements

7 SAR Measurement Results

7.1 Conducted power measurements

For the measurements a Rohde & Schwarz Radio Communication Tester CMU 200 was used.

SAR drift measured at the same position in liquid before and after each SAR test as below 7.2 chapter.

Note: CMU200 measures GSM peak and average output power for active timeslots. For SAR the timebased average power is relevant. The difference in between depends on the duty cycle of the TDMA signal :

| No. of timeslots | 1 | 2 | 3 | 4 |
|---|---------|---------|---------|---------|
| Duty Cycle | 1:8.3 | 1:4.1 | 1:2.77 | 1:2.08 |
| timebased avg. power compared to slotted avg. power | -9.19dB | -6.13dB | -4.42dB | -3.18dB |

The signalling modes differ as follows:

| mode | coding scheme | modulation |
|------|---------------|------------|
| GPRS | CS1 to CS4 | GMSK |
| EDGE | MCS1 to MCS4 | GMSK |
| EDGE | MCS5 to MCS9 | 8PSK |

Apart from modulation change (GMSK/8PSK) coding schemes differ in code rate without influence on the RF signal. Therefore one coding scheme per mode was selected for conducted power measurements.

7.1.1 Conducted power measurements GSM850

| GSM850 | | Burst-Averaged output Power (dBm) | | | Division Factors | Frame-Averaged output Power (dBm) | | |
|------------------|------------|-----------------------------------|-------|-------|------------------|-----------------------------------|--------------|--------------|
| | | 128CH | 190CH | 251CH | | 128CH | 190CH | 251CH |
| GSM (CS) | | 32.66 | 32.85 | 33.03 | -9.19 | 23.47 | 23.66 | 23.84 |
| GPRS/EDGE (GMSK) | 1 Tx Slot | 32.66 | 32.85 | 33.01 | -9.19 | 23.47 | 23.66 | 23.82 |
| | 2 Tx Slots | 30.86 | 31.15 | 31.21 | -6.13 | 24.73 | 25.02 | 25.08 |
| EDGE (8PSK) | 1 Tx Slot | 27.51 | 27.48 | 27.46 | -9.19 | 18.32 | 18.29 | 18.27 |
| | 2 Tx Slots | 26.53 | 26.56 | 26.57 | -6.13 | 20.4 | 20.43 | 20.44 |

Table 15: Test results conducted power measurement GSM850(Hotspot disabled)

| GSM850 | | Burst-Averaged output Power (dBm) | | | Division Factors | Frame-Averaged output Power (dBm) | | |
|------------------|------------|-----------------------------------|-------|-------|------------------|-----------------------------------|--------------|--------------|
| | | 128CH | 190CH | 251CH | | 128CH | 190CH | 251CH |
| GSM (CS) | | 30.47 | 30.58 | 30.68 | -9.19 | 21.28 | 21.39 | 21.49 |
| GPRS/EDGE (GMSK) | 1 Tx Slot | 30.46 | 30.59 | 30.68 | -9.19 | 21.27 | 21.40 | 21.49 |
| | 2 Tx Slots | 27.09 | 27.15 | 27.27 | -6.13 | 20.96 | 21.02 | 21.14 |
| EDGE (8PSK) | 1 Tx Slot | 27.20 | 27.17 | 27.24 | -9.19 | 18.01 | 17.98 | 18.05 |
| | 2 Tx Slots | 24.13 | 24.15 | 24.14 | -6.13 | 18.00 | 18.02 | 18.01 |

Table 16: Test results conducted power measurement GSM850(Hotspot activated)

Note: 1. The conducted power of GSM850 is measured with RMS detector.

2. Frame-averaged output power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timeslots.

3. Per KDB 941225 D03v01, the bolded GPRS mode was selected for SAR testing according to the highest frame –averaged output power table.

7.1.2 Conducted power measurements GSM1900

| GSM1900 | | Burst-Averaged output Power (dBm) | | | Division Factors | Frame-Averaged output Power (dBm) | | |
|------------------|------------|-----------------------------------|-------|-------|------------------|-----------------------------------|--------------|--------------|
| | | 512CH | 661CH | 810CH | | 512CH | 661CH | 810CH |
| GSM (CS) | | 30.11 | 30.11 | 29.90 | -9.19 | 20.92 | 20.92 | 20.71 |
| GPRS/EDGE (GMSK) | 1 Tx Slot | 30.10 | 30.11 | 29.90 | -9.19 | 20.91 | 20.92 | 20.71 |
| | 2 Tx Slots | 27.17 | 27.28 | 27.16 | -6.13 | 21.04 | 21.15 | 21.03 |
| EDGE (8PSK) | 1 Tx Slot | 25.45 | 26.50 | 26.48 | -9.19 | 16.26 | 17.31 | 17.29 |
| | 2 Tx Slots | 25.40 | 25.38 | 25.43 | -6.13 | 19.27 | 19.25 | 19.30 |

Table 17: Test results conducted power measurement GSM1900(Hotspot disabled)

| GSM1900 | | Burst-Averaged output Power (dBm) | | | Division Factors | Frame-Averaged output Power (dBm) | | |
|------------------|------------|-----------------------------------|-------|-------|------------------|-----------------------------------|--------------|--------------|
| | | 512CH | 661CH | 810CH | | 512CH | 661CH | 810CH |
| GSM (CS) | | 30.11 | 30.11 | 29.90 | -9.19 | 20.92 | 20.92 | 20.71 |
| GPRS/EDGE (GMSK) | 1 Tx Slot | 30.10 | 30.11 | 29.90 | -9.19 | 20.91 | 20.92 | 20.71 |
| | 2 Tx Slots | 27.17 | 27.28 | 27.16 | -6.13 | 21.04 | 21.15 | 21.03 |
| EDGE (8PSK) | 1 Tx Slot | 25.45 | 26.50 | 26.48 | -9.19 | 16.26 | 17.31 | 17.29 |
| | 2 Tx Slots | 25.40 | 25.38 | 25.43 | -6.13 | 19.27 | 19.25 | 19.30 |

Table 18: Test results conducted power measurement GSM1900(Hotspot activated)

Note: 1. The conducted power of GSM1900 is measured with RMS detector.

2. Frame-averaged output power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timeslots.

3. Per KDB 941225 D03v01, the bolded GPRS mode was selected for SAR testing according to the highest frame –averaged output power table.

7.1.3 Conducted power measurements UMTS Band V

| UMTS Band V | | Conducted Power (dBm) | | |
|-------------|--------------|-----------------------|--------|--------|
| | | 4132CH | 4182CH | 4233CH |
| WCDMA | 12.2kbps RMC | 23.44 | 23.55 | 23.79 |
| | 64kbps RMC | 23.44 | 23.59 | 23.84 |
| | 144kbps RMC | 23.46 | 23.57 | 23.85 |
| | 384kbps RMC | 23.45 | 23.54 | 23.83 |
| HSDPA | Subtest 1 | 23.49 | 23.51 | 23.75 |
| | Subtest 2 | 23.22 | 23.22 | 23.44 |
| | Subtest 3 | 22.64 | 22.60 | 22.87 |
| | Subtest 4 | 22.56 | 22.39 | 22.70 |
| HSUPA | Subtest 1 | 22.82 | 22.94 | 22.99 |
| | Subtest 2 | 21.21 | 21.32 | 21.66 |
| | Subtest 3 | 21.61 | 21.43 | 21.80 |
| | Subtest 4 | 21.73 | 21.83 | 22.10 |
| | Subtest 5 | 23.16 | 22.99 | 23.31 |

Table 19:Test results conducted power measurement UMTS Band V(Hotspot disabled)

| UMTS Band V | | Conducted Power (dBm) | | |
|-------------|--------------|-----------------------|--------|--------|
| | | 4132CH | 4182CH | 4233CH |
| WCDMA | 12.2kbps RMC | 21.67 | 21.65 | 21.87 |
| | 64kbps RMC | 21.67 | 21.68 | 21.96 |
| | 144kbps RMC | 21.67 | 21.68 | 21.94 |
| | 384kbps RMC | 21.66 | 21.67 | 21.94 |
| HSDPA | Subtest 1 | 21.62 | 21.65 | 21.88 |
| | Subtest 2 | 21.27 | 21.24 | 21.54 |
| | Subtest 3 | 20.58 | 20.59 | 20.95 |
| | Subtest 4 | 20.56 | 20.48 | 20.85 |
| HSUPA | Subtest 1 | 20.48 | 21.06 | 21.39 |
| | Subtest 2 | 19.43 | 19.48 | 19.88 |
| | Subtest 3 | 20.21 | 20.18 | 20.44 |
| | Subtest 4 | 19.48 | 19.45 | 20.23 |
| | Subtest 5 | 21.14 | 21.02 | 21.36 |

Table 20:Test results conducted power measurement UMTS Band V(Hotspot activated)

Note: The conducted power of UMTS Band V is measured with RMS detector.

7.1.4 Conducted power measurements UMTS Band IV

| UMTS Band IV | | Conducted Power (dBm) | | |
|--------------|--------------|-----------------------|--------|--------|
| | | 1312CH | 1413CH | 1513CH |
| WCDMA | 12.2kbps RMC | 23.58 | 23.68 | 23.30 |
| | 64kbps RMC | 23.71 | 23.69 | 23.37 |
| | 144kbps RMC | 23.71 | 23.66 | 23.37 |
| | 384kbps RMC | 23.72 | 23.78 | 23.35 |
| HSDPA | Subtest 1 | 23.52 | 23.35 | 23.25 |
| | Subtest 2 | 23.17 | 23.12 | 23.13 |
| | Subtest 3 | 22.65 | 22.70 | 22.42 |
| | Subtest 4 | 22.74 | 22.45 | 22.46 |
| HSUPA | Subtest 1 | 23.13 | 23.04 | 22.65 |
| | Subtest 2 | 21.86 | 21.51 | 21.03 |
| | Subtest 3 | 22.39 | 22.14 | 21.66 |
| | Subtest 4 | 21.78 | 22.01 | 21.51 |
| | Subtest 5 | 22.95 | 23.05 | 22.67 |

Table 21:Test results conducted power measurement UMTS Band IV(Hotspot disabled)

| UMTS Band IV | | Conducted Power (dBm) | | |
|--------------|--------------|-----------------------|--------|--------|
| | | 1312CH | 1413CH | 1513CH |
| WCDMA | 12.2kbps RMC | 20.83 | 20.50 | 20.60 |
| | 64kbps RMC | 20.85 | 20.59 | 20.74 |
| | 144kbps RMC | 20.82 | 20.55 | 20.63 |
| | 384kbps RMC | 20.80 | 20.55 | 23.57 |
| HSDPA | Subtest 1 | 20.77 | 20.49 | 20.58 |
| | Subtest 2 | 20.76 | 20.35 | 20.33 |
| | Subtest 3 | 19.99 | 19.68 | 19.80 |
| | Subtest 4 | 20.36 | 19.74 | 19.72 |
| HSUPA | Subtest 1 | 19.68 | 20.16 | 20.26 |
| | Subtest 2 | 18.81 | 18.56 | 18.54 |
| | Subtest 3 | 19.33 | 19.17 | 19.07 |
| | Subtest 4 | 19.21 | 18.96 | 19.10 |
| | Subtest 5 | 20.34 | 20.11 | 20.27 |

Table 22:Test results conducted power measurement UMTS Band IV(Hotspot activated)

Note: The conducted power of UMTS Band IV is measured with RMS detector.

7.1.5 Conducted power measurements UMTS Band II

| UMTS Band II | | Conducted Power (dBm) | | |
|--------------|--------------|-----------------------|--------|--------|
| | | 9262CH | 9400CH | 9538CH |
| WCDMA | 12.2kbps RMC | 24.11 | 24.28 | 23.95 |
| | 64kbps RMC | 24.12 | 23.70 | 24.06 |
| | 144kbps RMC | 24.14 | 23.76 | 24.03 |
| | 384kbps RMC | 24.15 | 23.80 | 24.04 |
| HSDPA | Subtest 1 | 23.92 | 23.55 | 23.67 |
| | Subtest 2 | 23.80 | 23.37 | 23.55 |
| | Subtest 3 | 23.32 | 22.85 | 23.09 |
| | Subtest 4 | 23.11 | 22.65 | 22.95 |
| HSUPA | Subtest 1 | 23.29 | 23.3 | 22.71 |
| | Subtest 2 | 22.08 | 21.67 | 22.04 |
| | Subtest 3 | 22.56 | 22.26 | 22.07 |
| | Subtest 4 | 22.45 | 22.05 | 22.43 |
| | Subtest 5 | 22.61 | 22.71 | 22.84 |

Table 23: Test results conducted power measurement UMTS Band II (Hotspot disabled)

| UMTS Band II | | Conducted Power (dBm) | | |
|--------------|--------------|-----------------------|--------|--------|
| | | 9262CH | 9400CH | 9538CH |
| WCDMA | 12.2kbps RMC | 21.09 | 20.91 | 20.93 |
| | 64kbps RMC | 21.04 | 20.86 | 20.98 |
| | 144kbps RMC | 21.03 | 20.88 | 20.90 |
| | 384kbps RMC | 21.07 | 20.93 | 20.97 |
| HSDPA | Subtest 1 | 21.03 | 20.90 | 20.93 |
| | Subtest 2 | 20.83 | 20.64 | 20.78 |
| | Subtest 3 | 20.26 | 20.09 | 20.25 |
| | Subtest 4 | 20.23 | 20.03 | 20.18 |
| HSUPA | Subtest 1 | 20.02 | 20.29 | 20.08 |
| | Subtest 2 | 18.96 | 18.95 | 18.89 |
| | Subtest 3 | 19.41 | 19.32 | 19.19 |
| | Subtest 4 | 19.25 | 19.28 | 19.52 |
| | Subtest 5 | 19.93 | 20.26 | 20.29 |

Table 24: Test results conducted power measurement UMTS Band II (Hotspot activated)

Note: The conducted power of UMTS Band II is measured with RMS detector.

7.1.6 Conducted power measurements WiFi&BT

The output power of BT antenna is as following:

| BT 2450 | Average Conducted Power (dBm) | | |
|---------|-------------------------------|------|-------------|
| | 0CH | 39CH | 78CH |
| | 5.85 | 6.36 | 6.84 |

Table 25: Test results conducted power measurement BT.

Note: The conducted power of BT is measured with RMS detector.

The output power of WiFi antenna is as following:

| Wi-Fi 2450MHz | Channel | Average Power (dBm) for Data Rates (Mbps) | | | | | | | |
|-------------------------|---------|---|-------|-------|-------|-------|-------|-------|-------|
| | | 1 | 2 | 5.5 | 11 | / | / | / | / |
| 802.11b | 1 | 20.49 | 20.68 | 20.66 | 20.49 | / | / | / | / |
| | 6 | 20.73 | 20.67 | 20.89 | 20.67 | / | / | / | / |
| | 11 | 20.29 | 20.19 | 20.43 | 20.26 | / | / | / | / |
| 802.11g | Channel | 6 | 9 | 12 | 18 | 24 | 36 | 48 | 54 |
| | 1 | 19.09 | 18.94 | 18.79 | 18.58 | 18.57 | 18.25 | 17.89 | 17.88 |
| | 6 | 19.31 | 18.99 | 18.89 | 18.78 | 18.59 | 18.34 | 17.99 | 17.83 |
| | 11 | 18.77 | 18.62 | 18.6 | 18.39 | 18.24 | 17.96 | 17.84 | 17.57 |
| 802.11n (HT20,800ns) | Channel | 6.5 | 13 | 19.5 | 26 | 39 | 52 | 58.5 | 65 |
| | 1 | 16.66 | 16.56 | 16.29 | 16.02 | 15.87 | 15.55 | 15.39 | 15.29 |
| | 6 | 16.79 | 16.59 | 16.38 | 16.14 | 15.86 | 15.68 | 15.67 | 15.55 |
| | 11 | 16.55 | 16.29 | 16.13 | 15.87 | 15.69 | 15.36 | 15.29 | 15.29 |

Table 26: Test results conducted power measurement WiFi .

Note:

1. The Average conducted power of WiFi is measured with RMS detector.
2. Per KDB248227, For each frequency band, Testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at the lowest data rate.

7.2 SAR measurement Result

- 1) Per KDB447498 D01v05, testing of other required channels within the operating mode of a frequency band is not required when the reported (Scaled) SAR for the middle channel or highest output power channels is $\leq 0.8 \text{ W/kg}$. When the maximum output power variation across the required test channels is $> \frac{1}{2} \text{ dB}$, instead of the middle channel, the highest output power channel must be used.
- 2) Per KDB865664 D01v01, for each frequency band, repeated SAR measurement is required only when the measured SAR is $\geq 0.8 \text{ W/kg}$; if the deviation among the repeated measurement is $\leq 20\%$, and the measured SAR $< 1.45 \text{ W/kg}$, only one repeated measurement is required.
- 3) Per KDB648474 D04v01, SAR is evaluated without a headset connected to the device. When the standalone reported SAR is $\leq 1.2 \text{ W/kg}$, no additional SAR evaluations using a headset are required.
- 4) Per KDB248227, for each frequency band of WiFi, SAR test at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than $\frac{1}{4} \text{ dB}$ higher than those measured at the lowest data rate.
- 5) Per KDB447498 D01v05, Body-worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
- 6) Per KDB941225 and the April 2013 TCB workshop RF exposure slides, when maximum output power is $\leq \frac{1}{4} \text{ dB}$ higher than without HSPA, HSPA+ or DC-HSDPA using 12.2 kbps RMC, and when maximum SAR for 12.2 kbps RMC is $\leq 75\%$ of SAR limit, SAR measurement for HSPA, HSPA+ or DC-HSDPA is not required.
- 7) Per KDB941225 D06v01, the DUT Dimension is bigger than $9 \text{ cm} \times 5 \text{ cm}$, so 10mm is chosen as Hotspot mode. When the antenna-to-edge distance is greater than 2.5cm, such position does not to be tested.
- 8) All measurement SAR result is scaled-up to account for tune-up tolerance is compliant

7.2.1 SAR measurement Result of GSM850

| Test Position of Head | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Left Hand Touched | 190/836.6 | GSM | 0.637 | 0.468 | -0.180 | 32.85 | 33.20 | 0.690 | 21.4°C |
| Left Hand Tilted 15° | 190/836.6 | GSM | 0.470 | 0.358 | -0.040 | 32.85 | 33.20 | 0.509 | 21.4°C |
| Right Hand Touched | 251/848.8 | GSM | 1.000 | 0.739 | 0.000 | 33.03 | 33.20 | 1.040 | 21.4°C |
| Right Hand Touched-repeated* | 251/848.8 | GSM | 0.996 | 0.736 | -0.100 | 33.03 | 33.20 | 1.036 | 21.4°C |
| Right Hand Touched | 190/836.6 | GSM | 0.818 | 0.605 | 0.120 | 32.85 | 33.20 | 0.887 | 21.4°C |
| Right Hand Touched | 128/824.2 | GSM | 0.597 | 0.446 | 0.110 | 32.66 | 33.20 | 0.676 | 21.4°C |
| Right Hand Tilted 15° | 190/836.6 | GSM | 0.486 | 0.373 | 0.080 | 32.85 | 33.20 | 0.527 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Right Hand Touched | 251/848.8 | GSM | 0.948 | 0.709 | 0.100 | 33.03 | 33.20 | 0.986 | 21.4°C |

Table 27: Test results head SAR GSM850

| Test Position of Body-Worn with 15mm | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Towards Phantom | 190/836.6 | GSM | 0.663 | 0.492 | 0.020 | 32.85 | 33.20 | 0.719 | 21.4°C |
| Towards Ground | 251/848.8 | GSM | 0.843 | 0.618 | 0.000 | 33.03 | 33.20 | 0.877 | 21.4°C |
| Towards Ground | 190/836.6 | GSM | 0.749 | 0.548 | -0.010 | 32.85 | 33.20 | 0.812 | 21.4°C |
| Towards Ground | 128/824.2 | GSM | 0.631 | 0.465 | -0.080 | 32.66 | 33.20 | 0.715 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Towards Ground | 251/848.8 | GSM | 0.847 | 0.621 | -0.070 | 33.03 | 33.20 | 0.881 | 21.4°C |
| Towards Ground-repeated* | 251/848.8 | GSM | 0.845 | 0.614 | -0.050 | 33.03 | 33.20 | 0.879 | 21.4°C |

Table 28: Test results Body-Worn SAR GSM850(Hotspot disabled)

| Test Position of Hotspot with 10mm | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Towards Phantom | 190/836.6 | GPRS 1TS | 0.486 | 0.362 | -0.020 | 30.59 | 31.20 | 0.559 | 21.4°C |
| Towards Ground | 190/836.6 | GPRS 1TS | 0.613 | 0.447 | -0.050 | 30.59 | 31.20 | 0.705 | 21.4°C |
| Left edge | 190/836.6 | GPRS 1TS | 0.370 | 0.253 | -0.070 | 30.59 | 31.20 | 0.426 | 21.4°C |
| Right edge | 190/836.6 | GPRS 1TS | 0.368 | 0.253 | 0.000 | 30.59 | 31.20 | 0.423 | 21.4°C |
| Bottom edge | 190/836.6 | GPRS 1TS | 0.088 | 0.038 | 0.140 | 30.59 | 31.20 | 0.102 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Towards Ground | 190/836.6 | GPRS 1TS | 0.628 | 0.459 | -0.100 | 30.59 | 31.20 | 0.723 | 21.4°C |

Table 29: Test results Hotspot SAR GSM850(Hotspot activated)

Note:

- 1) Per KDB941225 D06, for the antenna-to-edge distance is greater than 2.5 cm, so the top side does not need to be tested.
- 2) Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.

7.2.2 SAR measurement Result of GSM1900

| Test Position of Head | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Left Hand Touched | 661/1880 | GSM | 0.351 | 0.212 | -0.130 | 30.11 | 30.80 | 0.411 | 21.4°C |
| Left Hand Tilted 15° | 661/1880 | GSM | 0.239 | 0.133 | 0.160 | 30.11 | 30.80 | 0.280 | 21.4°C |
| Right Hand Touched | 661/1880 | GSM | 0.494 | 0.298 | -0.060 | 30.11 | 30.80 | 0.579 | 21.4°C |
| Right Hand Tilted 15° | 661/1880 | GSM | 0.202 | 0.110 | 0.080 | 30.11 | 30.80 | 0.237 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Right Hand Touched | 661/1880 | GSM | 0.503 | 0.300 | -0.090 | 30.11 | 30.80 | 0.590 | 21.4°C |

Table 30: Test results head SAR GSM1900

| Test Position of Body-Worn with 15mm | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Towards Phantom | 661/1880 | GSM | 0.483 | 0.289 | 0.070 | 30.11 | 30.80 | 0.566 | 21.4°C |
| Towards Ground | 661/1880 | GSM | 0.395 | 0.236 | 0.080 | 30.11 | 30.80 | 0.463 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Towards Phantom | 661/1880 | GSM | 0.456 | 0.272 | 0.120 | 30.11 | 30.80 | 0.535 | 21.4°C |

Table 31: Test results Body-Worn SAR GSM1900(Hotspot disabled)

| Test Position of Hotspot with 10mm | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Towards Phantom | 810/1909.8 | GPRS 2TS | 0.788 | 0.442 | -0.040 | 27.16 | 28.50 | 1.073 | 21.4°C |
| Towards Phantom | 661/1880 | GPRS 2TS | 0.832 | 0.469 | 0.030 | 27.28 | 28.50 | 1.102 | 21.4°C |
| Towards Phantom | 512/1850.2 | GPRS 2TS | 0.739 | 0.424 | 0.080 | 27.17 | 28.50 | 1.004 | 21.4°C |
| Towards Ground | 810/1909.8 | GPRS 2TS | 0.654 | 0.370 | 0.120 | 27.16 | 28.50 | 0.890 | 21.4°C |
| Towards Ground | 661/1880 | GPRS 2TS | 0.678 | 0.393 | -0.140 | 27.28 | 28.50 | 0.898 | 21.4°C |
| Towards Ground | 512/1850.2 | GPRS 2TS | 0.596 | 0.349 | 0.060 | 27.17 | 28.50 | 0.810 | 21.4°C |
| Left edge | 661/1880 | GPRS 2TS | 0.188 | 0.090 | -0.190 | 27.28 | 28.50 | 0.249 | 21.4°C |
| Right edge | 661/1880 | GPRS 2TS | 0.225 | 0.080 | -0.060 | 27.28 | 28.50 | 0.298 | 21.4°C |
| Bottom edge | 810/1909.8 | GPRS 2TS | 0.896 | 0.448 | -0.050 | 27.16 | 28.50 | 1.220 | 21.4°C |
| Bottom edge | 661/1880 | GPRS 2TS | 0.915 | 0.455 | -0.170 | 27.28 | 28.50 | 1.212 | 21.4°C |
| Bottom edge | 512/1850.2 | GPRS 2TS | 0.805 | 0.409 | -0.050 | 27.17 | 28.50 | 1.093 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Bottom edge | 810/1909.8 | GPRS 2TS | 0.949 | 0.481 | 0.090 | 27.16 | 28.50 | 1.292 | 21.4°C |
| Bottom edge-repeated* | 810/1909.8 | GPRS 2TS | 0.969 | 0.496 | 0.060 | 27.16 | 28.50 | 1.319 | 21.4°C |

Table 32: Test results Hotspot SAR GSM1900(Hotspot activated)

Note:

- 1) Per KDB941225 D06, for the antenna-to-edge distance is greater than 2.5 cm, so the top side does not need to be tested.
- 2) * - repeated at the highest SAR measurement according to the FCC KDB 865664
- 3) Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.

7.2.3 SAR measurement Result of UMTS Band V

| Test Position of Head | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Left Hand Touched | 4182/836.4 | RMC | 0.498 | 0.367 | 0.160 | 23.55 | 24.60 | 0.634 | 21.4°C |
| Left Hand Tilted 15° | 4182/836.4 | RMC | 0.416 | 0.316 | -0.110 | 23.55 | 24.60 | 0.530 | 21.4°C |
| Right Hand Touched | 4182/836.4 | RMC | 0.623 | 0.463 | -0.060 | 23.55 | 24.60 | 0.793 | 21.4°C |
| Right Hand Tilted 15° | 4182/836.4 | RMC | 0.439 | 0.336 | 0.050 | 23.55 | 24.60 | 0.559 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Right Hand Touched | 4182/836.4 | RMC | 0.579 | 0.414 | -0.030 | 23.55 | 24.60 | 0.737 | 21.4°C |

Table 33:Test results head SAR UMTS Band V

| Test Position of Body-Worn with 15mm | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Towards Phantom | 4182/836.4 | RMC | 0.503 | 0.373 | -0.010 | 23.55 | 24.60 | 0.641 | 21.4°C |
| Towards Ground | 4182/836.4 | RMC | 0.549 | 0.400 | -0.060 | 23.55 | 24.60 | 0.699 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Towards Ground | 4182/836.4 | RMC | 0.604 | 0.442 | 0.030 | 23.55 | 24.60 | 0.769 | 21.4°C |

Table 34:Test results Body-worn SAR UMTS Band V(Hotspot disabled)

| Test Position of Hotspot with 10mm | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Towards Phantom | 4182/836.4 | RMC | 0.389 | 0.287 | 0.040 | 21.65 | 22.60 | 0.484 | 21.4°C |
| Towards Ground | 4182/836.4 | RMC | 0.509 | 0.367 | 0.010 | 21.65 | 22.60 | 0.633 | 21.4°C |
| Left edge | 4182/836.4 | RMC | 0.307 | 0.209 | -0.110 | 21.65 | 22.60 | 0.382 | 21.4°C |
| Right edge | 4182/836.4 | RMC | 0.350 | 0.240 | -0.010 | 21.65 | 22.60 | 0.436 | 21.4°C |
| Bottom edge | 4182/836.4 | RMC | 0.088 | 0.039 | -0.150 | 21.65 | 22.60 | 0.110 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Towards Ground | 4182/836.4 | RMC | 0.501 | 0.365 | 0.030 | 21.65 | 22.60 | 0.624 | 21.4°C |

Table 35: Test results Hotspot SAR UMTS Band V(Hotspot activated)

Note:

- 1) Per KDB941225 D06, for the antenna-to-edge distance is greater than 2.5 cm, so the top side does not need to be tested.
- 2) Per KDB941225 and the April 2013 TCB workshop RF exposure slides, when maximum output power is $\leq \frac{1}{4}$ dB higher than without HSPA, HSPA+ or DC-HSDPA using 12.2 kbps RMC, and when maximum SAR for 12.2 kbps RMC is $\leq 75\%$ of SAR limit, SAR measurement for HSPA, HSPA+ or DC-HSDPA is not required.

7.2.4 SAR measurement Result of UMTS Band IV

| Test Position of Head | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Left Hand Touched | 1513/1752.6 | RMC | 0.916 | 0.537 | -0.010 | 23.30 | 24.10 | 1.101 | 21.4°C |
| Left Hand Touched | 1413/1732.6 | RMC | 0.816 | 0.480 | -0.170 | 23.68 | 24.10 | 0.899 | 21.4°C |
| Left Hand Touched | 1312/1712.4 | RMC | 0.993 | 0.585 | 0.000 | 23.58 | 24.10 | 1.119 | 21.4°C |
| Left Hand Tilted 15° | 1413/1732.6 | RMC | 0.448 | 0.269 | 0.090 | 23.68 | 24.10 | 0.493 | 21.4°C |
| Right Hand Touched | 1513/1752.6 | RMC | 0.964 | 0.579 | -0.020 | 23.30 | 24.10 | 1.159 | 21.4°C |
| Right Hand Touched | 1413/1732.6 | RMC | 0.939 | 0.566 | -0.010 | 23.68 | 24.10 | 1.034 | 21.4°C |
| Right Hand Touched | 1312/1712.4 | RMC | 1.120 | 0.679 | 0.030 | 23.58 | 24.10 | 1.262 | 21.4°C |
| Right Hand Tilted 15° | 1413/1732.6 | RMC | 0.398 | 0.232 | 0.030 | 23.68 | 24.10 | 0.438 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Right Hand Touched | 1312/1712.4 | RMC | 1.150 | 0.696 | 0.090 | 23.58 | 24.10 | 1.296 | 21.4°C |
| Right Hand Touched-repeated* | 1312/1712.4 | RMC | 1.160 | 0.700 | 0.020 | 23.58 | 24.10 | 1.308 | 21.4°C |

Table 36:Test results head SAR UMTS Band IV

| Test Position of Body-Worn with 15mm | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Towards Phantom | 1413/1732.6 | RMC | 0.599 | 0.372 | -0.030 | 23.68 | 24.10 | 0.660 | 21.4°C |
| Towards Ground | 1413/1732.6 | RMC | 0.553 | 0.341 | 0.090 | 23.68 | 24.10 | 0.609 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Towards Phantom | 1413/1732.6 | RMC | 0.611 | 0.380 | 0.030 | 23.68 | 24.10 | 0.673 | 21.4°C |

Table 37:Test results Body-Worn SAR UMTS Band IV(Hotspot disabled)

| Test Position of Hotspot with 10mm | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Towards Phantom | 1413/1732.6 | RMC | 0.526 | 0.317 | -0.010 | 20.50 | 21.10 | 0.604 | 21.4°C |
| Towards Ground | 1413/1732.6 | RMC | 0.479 | 0.288 | 0.110 | 20.50 | 21.10 | 0.550 | 21.4°C |
| Left edge | 1413/1732.6 | RMC | 0.122 | 0.062 | 0.060 | 20.50 | 21.10 | 0.140 | 21.4°C |
| Right edge | 1413/1732.6 | RMC | 0.086 | 0.046 | 0.050 | 20.50 | 21.10 | 0.099 | 21.4°C |
| Bottom edge | 1413/1732.6 | RMC | 0.572 | 0.297 | -0.060 | 20.50 | 21.10 | 0.657 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Bottom edge | 1413/1732.6 | RMC | 0.545 | 0.283 | -0.050 | 20.50 | 21.10 | 0.626 | 21.4°C |

Table 38: Test results Hotspot SAR UMTS Band IV (Hotspot activated)

Note:

- 1) Per KDB941225 D06, for the antenna-to-edge distance is greater than 2.5 cm, so the top side does not need to be tested.
- 2) * - repeated at the highest SAR measurement according to the FCC KDB 865664.
- 3) Per KDB941225 and the April 2013 TCB workshop RF exposure slides, when maximum output power is $\leq \frac{1}{4}$ dB higher than without HSPA, HSPA+ or DC-HSDPA using 12.2 kbps RMC, and when maximum SAR for 12.2 kbps RMC is $\leq 75\%$ of SAR limit, SAR measurement for HSPA, HSPA+ or DC-HSDPA is not required.

7.2.5 SAR measurement Result of UMTS Band II

| Test Position of Head | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Left Hand Touched | 9400/1880 | RMC | 0.709 | 0.447 | 0.140 | 24.28 | 24.30 | 0.712 | 21.4°C |
| Left Hand Tilted 15° | 9400/1880 | RMC | 0.487 | 0.284 | 0.070 | 24.28 | 24.30 | 0.489 | 21.4°C |
| Right Hand Touched | 9538/1907.6 | RMC | 0.911 | 0.551 | 0.040 | 23.95 | 24.30 | 0.987 | 21.4°C |
| Right Hand Touched | 9400/1880 | RMC | 0.905 | 0.550 | 0.040 | 24.28 | 24.30 | 0.909 | 21.4°C |
| Right Hand Touched | 9262/1852.4 | RMC | 1.060 | 0.652 | 0.130 | 24.11 | 24.30 | 1.107 | 21.4°C |
| Right Hand Tilted 15° | 9400/1880 | RMC | 0.364 | 0.215 | 0.120 | 24.28 | 24.30 | 0.366 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Right Hand Touched | 9262/1852.4 | RMC | 1.060 | 0.653 | 0.120 | 24.11 | 24.30 | 1.107 | 21.4°C |
| Right Hand Touched-repeated* | 9262/1852.4 | RMC | 1.050 | 0.652 | 0.040 | 24.11 | 24.30 | 1.097 | 21.4°C |

Table 39: Test results head SAR UMTS Band II

| Test Position of Body-Worn with 15mm | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Towards Phantom | 9538/1907.6 | RMC | 0.842 | 0.501 | -0.010 | 23.95 | 24.30 | 0.913 | 21.4°C |
| Towards Phantom | 9400/1880 | RMC | 0.841 | 0.503 | -0.040 | 24.28 | 24.30 | 0.845 | 21.4°C |
| Towards Phantom | 9262/1852.4 | RMC | 0.986 | 0.594 | 0.020 | 24.11 | 24.30 | 1.030 | 21.4°C |
| Towards Ground | 9400/1880 | RMC | 0.708 | 0.429 | -0.110 | 24.28 | 24.30 | 0.711 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Towards Phantom | 9262/1852.4 | RMC | 0.987 | 0.596 | 0.040 | 24.11 | 24.30 | 1.031 | 21.4°C |
| Towards Phantom-repeated* | 9262/1852.4 | RMC | 0.992 | 0.599 | 0.030 | 24.11 | 24.30 | 1.036 | 21.4°C |

Table 40: Test results Body-Worn SAR UMTS Band II(Hotspot disabled)

| Test Position of Hotspot with 10mm | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Towards Phantom | 9538/1907.6 | RMC | 0.769 | 0.432 | -0.040 | 20.93 | 21.30 | 0.837 | 21.4°C |
| Towards Phantom | 9400/1880 | RMC | 0.750 | 0.424 | 0.130 | 20.91 | 21.30 | 0.820 | 21.4°C |
| Towards Phantom | 9262/1852.4 | RMC | 0.875 | 0.503 | -0.070 | 21.09 | 21.30 | 0.918 | 21.4°C |
| Towards Ground | 9400/1880 | RMC | 0.619 | 0.361 | -0.110 | 20.91 | 21.30 | 0.677 | 21.4°C |
| Left edge | 9400/1880 | RMC | 0.203 | 0.114 | 0.150 | 20.91 | 21.30 | 0.222 | 21.4°C |
| Right edge | 9400/1880 | RMC | 0.117 | 0.065 | 0.140 | 20.91 | 21.30 | 0.128 | 21.4°C |
| Bottom edge | 9538/1907.6 | RMC | 0.938 | 0.479 | 0.160 | 20.93 | 21.30 | 1.021 | 21.4°C |
| Bottom edge | 9400/1880 | RMC | 0.890 | 0.460 | 0.110 | 20.91 | 21.30 | 0.974 | 21.4°C |
| Bottom edge | 9262/1852.4 | RMC | 1.000 | 0.520 | -0.020 | 21.09 | 21.30 | 1.050 | 21.4°C |
| Bottom edge-repeated* | 9262/1852.4 | RMC | 0.974 | 0.504 | -0.140 | 21.09 | 21.30 | 1.022 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Bottom edge | 9262/1852.4 | RMC | 0.931 | 0.482 | 0.170 | 21.09 | 21.30 | 0.977 | 21.4°C |

Table 41: Test results Hotspot SAR UMTS Band II (Hotspot activated)

Note:

- 1) Per KDB941225 D06, for the antenna-to-edge distance is greater than 2.5 cm, so the top side does not need to be tested.
- 2) * - repeated at the highest SAR measurement according to the FCC KDB 865664.
- 3) Per KDB941225 and the April 2013 TCB workshop RF exposure slides, when maximum output power is $\leq \frac{1}{4}$ dB higher than without HSPA, HSPA+ or DC-HSDPA using 12.2 kbps RMC, and when maximum SAR for 12.2 kbps RMC is $\leq 75\%$ of SAR limit, SAR measurement for HSPA, HSPA+ or DC-HSDPA is not required.

7.2.6 SAR measurement Result of WiFi

| Test Position of Head | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducte d Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|------------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Left Hand Touched | 6/2437 | 802.11 b | 0.401 | 0.192 | 0.010 | 20.68 | 21.50 | 0.484 | 21.4°C |
| Left Hand Tilted 15° | 6/2437 | 802.11 b | 0.497 | 0.235 | 0.040 | 20.68 | 21.50 | 0.600 | 21.4°C |
| Right Hand Touched | 6/2437 | 802.11 b | 0.604 | 0.291 | 0.080 | 20.73 | 21.50 | 0.721 | 21.4°C |
| Right Hand Tilted 15° | 6/2437 | 802.11 b | 0.400 | 0.201 | -0.080 | 20.68 | 21.50 | 0.483 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Right Hand Touched | 6/2437 | 802.11 b | 0.437 | 0.219 | 0.000 | 20.68 | 21.50 | 0.528 | 21.4°C |

Table 42: Test results head SAR WiFi 2450MHz

| Test Position of Body-Worn with 15mm | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducte d Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|------------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Towards Phantom | 6/2437 | 802.11 b | 0.207 | 0.117 | -0.110 | 20.68 | 21.50 | 0.250 | 21.4°C |
| Towards Ground | 6/2437 | 802.11 b | 0.281 | 0.156 | -0.070 | 20.68 | 21.50 | 0.339 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Towards Ground | 6/2437 | 802.11 b | 0.297 | 0.162 | -0.090 | 20.68 | 21.50 | 0.359 | 21.4°C |

Table 43: Test results Body-worn SAR WiFi 2450MHz

| Test Position of Hotspot with 10mm | Test channel /Frequency | Test Mode | SAR Value (W/kg) | | Power Drift (dB) | Conducted Power (dBm) | Tune-up Power (dBm) | Scaled SAR1-g (W/kg) | Liquid Temp. |
|--|-------------------------|-----------|------------------|-------|------------------|-----------------------|---------------------|----------------------|--------------|
| | | | 1-g | 10-g | | | | | |
| Test data with the battery 1# | | | | | | | | | |
| Towards Phantom | 6/2437 | 802.11 b | 0.347 | 0.185 | 0.020 | 20.68 | 21.50 | 0.419 | 21.4°C |
| Towards Ground | 6/2437 | 802.11 b | 0.561 | 0.287 | -0.030 | 20.68 | 21.50 | 0.678 | 21.4°C |
| Left edge | 6/2437 | 802.11 b | 0.561 | 0.262 | 0.130 | 20.68 | 21.50 | 0.678 | 21.4°C |
| Top edge | 6/2437 | 802.11 b | 0.226 | 0.117 | 0.140 | 20.68 | 21.50 | 0.273 | 21.4°C |
| Tested at worst position with the battery 2# | | | | | | | | | |
| Towards Ground | 6/2437 | 802.11 b | 0.551 | 0.280 | -0.180 | 20.68 | 21.50 | 0.666 | 21.4°C |

Table 44: Test results Hotspot SAR WiFi 2450MHz

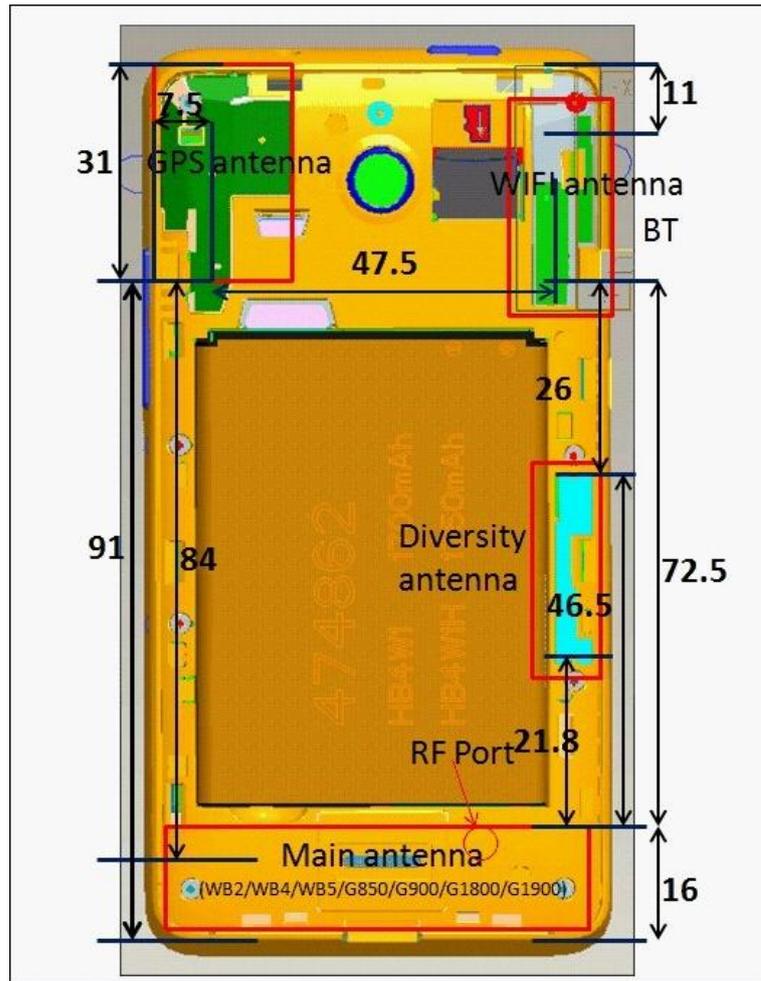
Note:

1) Per KDB941225 D06, for the antenna-to-edge distance is greater than 2.5 cm, so the Bottom&Right sides does not need to be tested.

7.3 Multiple Transmitter Evaluation

The following tables list information which is relevant for the decision if a simultaneous transmit evaluation is necessary according to FCC KDB 447498D01 General RF Exposure Guidance v05.

The location of the antennas inside mobile phone is shown as below picture:



7.3.1 Stand-alone SAR test exclusion

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

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR, where:

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

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

a) Head position

| Mode | P_{max} (dBm)* | P_{max} (mW) | Distance (mm) | f (GHz) | Calculation Result | Exclusion threshold | SAR test exclusion |
|--------------|-------------------------|-----------------------|---------------|---------|--------------------|---------------------|--------------------|
| GSM850 | 33.20 | 2089.30 | 5 | 0.850 | 385.25 | 3.00 | No |
| GSM1900 | 30.80 | 1202.26 | 5 | 1.900 | 331.44 | 3.00 | No |
| UMTS Band V | 24.60 | 288.40 | 5 | 0.850 | 53.18 | 3.00 | No |
| UMTS Band IV | 24.10 | 257.04 | 5 | 1.700 | 67.03 | 3.00 | No |
| UMTS Band II | 24.30 | 269.15 | 5 | 1.900 | 74.20 | 3.00 | No |
| WiFi | 21.50 | 141.25 | 5 | 2.450 | 44.22 | 3.00 | No |
| BT | 8.00 | 6.31 | 5 | 2.450 | 1.98 | 3.00 | Yes |

Table 45: Standalone SAR test exclusion in head position

Note: * - maximum possible output power declared by manufacturer

b) Body-Worn position

| Mode | P_{max} (dBm)* | P_{max} (mW) | Distance (mm) | f (GHz) | Calculation Result | Exclusion threshold | SAR test exclusion |
|--------------|-------------------------|-----------------------|---------------|---------|--------------------|---------------------|--------------------|
| GSM850 | 33.20 | 2089.30 | 15 | 0.850 | 128.42 | 3.00 | No |
| GSM1900 | 30.80 | 1202.26 | 15 | 1.900 | 110.48 | 3.00 | No |
| UMTS Band V | 24.60 | 288.40 | 15 | 0.850 | 17.73 | 3.00 | No |
| UMTS Band IV | 24.10 | 257.04 | 15 | 1.700 | 22.34 | 3.00 | No |
| UMTS Band II | 24.30 | 269.15 | 15 | 1.900 | 24.73 | 3.00 | No |
| WiFi | 21.50 | 141.25 | 15 | 2.450 | 14.74 | 3.00 | No |
| BT | 8.00 | 6.31 | 15 | 2.450 | 0.66 | 3.00 | Yes |

Table 46: Standalone SAR test exclusion in body-worn position

Note: * - maximum possible output power declared by manufacturer

c) Hotspot position

| Mode | P _{max} (dBm)* | P _{max} (mW) | Distance (mm) | f (GHz) | Calculation Result | Exclusion threshold | SAR test exclusion |
|--------------|-------------------------|-----------------------|---------------|---------|--------------------|---------------------|--------------------|
| GSM850 | 33.20 | 2089.30 | 10 | 0.850 | 192.62 | 3.00 | No |
| GSM1900 | 30.80 | 1202.26 | 10 | 1.900 | 165.72 | 3.00 | No |
| UMTS Band V | 24.60 | 288.40 | 10 | 0.850 | 26.59 | 3.00 | No |
| UMTS Band IV | 24.10 | 257.04 | 10 | 1.700 | 33.51 | 3.00 | No |
| UMTS Band II | 24.30 | 269.15 | 10 | 1.900 | 37.10 | 3.00 | No |
| WiFi | 21.50 | 141.25 | 10 | 2.450 | 22.11 | 3.00 | No |
| BT | 8.00 | 6.31 | 10 | 2.450 | 0.99 | 3.00 | Yes |

Table 47: Standalone SAR test exclusion in hotspot position

Note: * - maximum possible output power declared by manufacturer

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

(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [√ f(GHz)/x] W/kg for test separation distances ≤ 50 mm, where x = 7.5 for 1-g SAR.

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion

| Mode | Position | P _{max} (dBm)* | P _{max} (mW) | Distance (mm) | f (GHz) | X | Estimated SAR (W/Kg)* |
|------|-----------|-------------------------|-----------------------|---------------|---------|-----|-----------------------|
| BT | Head | 8.00 | 6.31 | 5.00 | 2.450 | 7.5 | 0.263 |
| BT | Body-worn | 8.00 | 6.31 | 15.00 | 2.450 | 7.5 | 0.088 |
| BT | Hotspot | 8.00 | 6.31 | 10.00 | 2.450 | 7.5 | 0.132 |

Table 48: Estimated SAR calculation for BT

Note: * - maximum possible output power declared by manufacturer

7.3.2 Simultaneous Transmission Possibilities

The Simultaneous Transmission Possibilities are as below:

| Simultaneous Transmission Possibilities | | | | |
|---|--------------------------------------|------|-----------|---------|
| Simultaneous Tx Combination | Configuration | Head | Body-Worn | Hotspot |
| 1 | GSM 850/1900(Voice)+ WiFi 2.4G | Yes | Yes | N/A |
| 2 | GPRS/EDGE 850/1900 (Data)+ WiFi 2.4G | N/A | N/A | Yes |
| 3 | GSM 850/1900(Voice)+BT | Yes | Yes | N/A |
| 4 | GPRS/EDGE 850/1900 (Data)+BT | N/A | N/A | Yes |
| 5 | UMTS Band II/IV/V(Voice)+ WiFi 2.4G | Yes | Yes | N/A |
| 6 | UMTS Band II/IV/V(Data)+ WiFi 2.4G | N/A | N/A | Yes |
| 7 | UMTS Band II/IV/V(Voice)+ BT | Yes | Yes | N/A |
| 8 | UMTS Band II/IV/V(Data)+ BT | N/A | N/A | Yes |

Table 49: Simultaneous Transmission Possibilities

Note: The device does not support simultaneous BT and WiFi, because they share the same antenna.

7.3.3 SAR Summation Scenario

| Test Position | | Scaled SAR _{Max} | | Σ 1-g SAR | SPLSR | Remark |
|---------------|-----------------------|---------------------------|-------|------------------|-------|------------|
| | | GSM850 | WiFi | | | |
| Head | Left Hand Touched | 0.690 | 0.484 | 1.175 | N/A | N/A |
| | Left Hand Tilted 15° | 0.509 | 0.600 | 1.110 | N/A | N/A |
| | Right Hand Touched | 1.040 | 0.721 | See Note | 0.036 | Battery 1# |
| | Right Hand Touched | 0.986 | 0.528 | 1.514 | N/A | Battery 2# |
| | Right Hand Tilted 15° | 0.527 | 0.483 | 1.010 | N/A | N/A |
| Body-Worn | Towards Phantom | 0.719 | 0.250 | 0.969 | N/A | N/A |
| | Towards Ground | 0.881 | 0.359 | 1.240 | N/A | N/A |
| Hotspot | Towards Phantom | 0.559 | 0.419 | 0.978 | N/A | N/A |
| | Towards Ground | 0.723 | 0.678 | 1.400 | N/A | N/A |
| | Left edge | 0.426 | 0.678 | 1.103 | N/A | N/A |
| | Right edge | 0.423 | 0.000 | 0.423 | N/A | N/A |
| | Top edge | 0.000 | 0.273 | 0.273 | N/A | N/A |
| | Bottom edge | 0.102 | 0.000 | 0.102 | N/A | N/A |

Table 50: Simultaneous Tx Combination of GSM850 and WiFi

| Test Position | | Scaled SAR _{Max} | | Σ 1-g SAR | SPLSR | Remark |
|---------------|-----------------------|---------------------------|-------|------------------|-------|--------|
| | | GSM1900 | WiFi | | | |
| Head | Left Hand Touched | 0.411 | 0.484 | 0.895 | N/A | N/A |
| | Left Hand Tilted 15° | 0.280 | 0.600 | 0.880 | N/A | N/A |
| | Right Hand Touched | 0.590 | 0.730 | 1.320 | N/A | N/A |
| | Right Hand Tilted 15° | 0.237 | 0.483 | 0.720 | N/A | N/A |
| Body-Worn | Towards Phantom | 0.566 | 0.250 | 0.816 | N/A | N/A |
| | Towards Ground | 0.463 | 0.359 | 0.822 | N/A | N/A |
| Hotspot | Towards Phantom | 1.102 | 0.419 | 1.521 | N/A | N/A |
| | Towards Ground | 0.898 | 0.678 | 1.576 | N/A | N/A |
| | Left edge | 0.249 | 0.678 | 0.927 | N/A | N/A |
| | Right edge | 0.298 | 0.000 | 0.298 | N/A | N/A |
| | Top edge | 0.000 | 0.273 | 0.273 | N/A | N/A |
| | Bottom edge | 1.319 | 0.000 | 1.319 | N/A | N/A |

Table 51: Simultaneous Tx Combination of GSM1900 and WiFi

| Test Position | | Scaled SAR _{Max} | | Σ 1-g SAR | SPLSR | Remark |
|---------------|-----------------------|---------------------------|-------|------------------|-------|--------|
| | | UMTS Band V | WiFi | | | |
| Head | Left Hand Touched | 0.634 | 0.484 | 1.118 | N/A | N/A |
| | Left Hand Tilted 15° | 0.530 | 0.600 | 1.130 | N/A | N/A |
| | Right Hand Touched | 0.793 | 0.730 | 1.523 | N/A | N/A |
| | Right Hand Tilted 15° | 0.559 | 0.483 | 1.042 | N/A | N/A |
| Body-Worn | Towards Phantom | 0.641 | 0.250 | 0.891 | N/A | N/A |
| | Towards Ground | 0.769 | 0.359 | 1.128 | N/A | N/A |
| Hotspot | Towards Phantom | 0.484 | 0.419 | 0.903 | N/A | N/A |
| | Towards Ground | 0.633 | 0.678 | 1.311 | N/A | N/A |
| | Left edge | 0.382 | 0.678 | 1.060 | N/A | N/A |
| | Right edge | 0.436 | 0.000 | 0.436 | N/A | N/A |
| | Top edge | 0.000 | 0.273 | 0.273 | N/A | N/A |
| | Bottom edge | 0.110 | 0.000 | 0.110 | N/A | N/A |

Table 52: Simultaneous Tx Combination of UMTS Band V and WiFi BG1

| Test Position | | Scaled SAR _{Max} | | Σ 1-g SAR | SPLSR | Remark |
|---------------|-----------------------|---------------------------|-------|------------------|-------|------------|
| | | UMTS Band IV | WiFi | | | |
| Head | Left Hand Touched | 1.119 | 0.484 | See Note | 0.023 | N/A |
| | Left Hand Tilted 15° | 0.493 | 0.600 | 1.093 | N/A | N/A |
| | Right Hand Touched | 1.262 | 0.721 | See Note | 0.034 | Battery 1# |
| | Right Hand Touched | 1.308 | 0.528 | See Note | 0.039 | Battery 2# |
| | Right Hand Tilted 15° | 0.438 | 0.483 | 0.921 | N/A | N/A |
| Body-Worn | Towards Phantom | 0.673 | 0.250 | 0.923 | N/A | N/A |
| | Towards Ground | 0.609 | 0.359 | 0.968 | N/A | N/A |
| Hotspot | Towards Phantom | 0.604 | 0.419 | 1.023 | N/A | N/A |
| | Towards Ground | 0.550 | 0.678 | 1.228 | N/A | N/A |
| | Left edge | 0.140 | 0.678 | 0.818 | N/A | N/A |
| | Right edge | 0.099 | 0.000 | 0.099 | N/A | N/A |
| | Top edge | 0.000 | 0.273 | 0.273 | N/A | N/A |
| | Bottom edge | 0.657 | 0.000 | 0.657 | N/A | N/A |

Table 53: Simultaneous Tx Combination of UMTS Band IV and WiFi

| Test Position | | Scaled SAR _{Max} | | Σ1-g SAR | SPLSR | Remark |
|---------------|-----------------------|---------------------------|-------|--------------|-------|------------|
| | | UMTS Band II | WiFi | | | |
| Head | Left Hand Touched | 0.712 | 0.484 | 1.196 | N/A | N/A |
| | Left Hand Tilted 15° | 0.489 | 0.600 | 1.089 | N/A | N/A |
| | Right Hand Touched | 1.107 | 0.721 | See Note | 0.037 | Battery 1# |
| | Right Hand Touched | 1.107 | 0.528 | See Note | 0.030 | Battery 2# |
| | Right Hand Tilted 15° | 0.366 | 0.483 | 0.849 | N/A | N/A |
| Body-Worn | Towards Phantom | 1.036 | 0.250 | 1.286 | N/A | N/A |
| | Towards Ground | 0.711 | 0.359 | 1.070 | N/A | N/A |
| Hotspot | Towards Phantom | 0.918 | 0.419 | 1.337 | N/A | N/A |
| | Towards Ground | 0.677 | 0.678 | 1.355 | N/A | N/A |
| | Left edge | 0.222 | 0.678 | 0.900 | N/A | N/A |
| | Right edge | 0.128 | 0.000 | 0.128 | N/A | N/A |
| | Top edge | 0.000 | 0.273 | 0.273 | N/A | N/A |
| | Bottom edge | 1.050 | 0.000 | 1.050 | N/A | N/A |

Table 54: Simultaneous Tx Combination of UMTS Band II and WiFi

| Test Position | | Scaled SAR _{Max} | | Σ1-g SAR | SPLSR | Remark |
|---------------|-----------------------|---------------------------|-------|--------------|-------|--------|
| | | GSM850 | BT | | | |
| Head | Left Hand Touched | 0.690 | 0.263 | 0.953 | N/A | N/A |
| | Left Hand Tilted 15° | 0.509 | 0.263 | 0.772 | N/A | N/A |
| | Right Hand Touched | 1.040 | 0.263 | 1.303 | N/A | N/A |
| | Right Hand Tilted 15° | 0.527 | 0.263 | 0.790 | N/A | N/A |
| Body-Worn | Towards Phantom | 0.719 | 0.088 | 0.807 | N/A | N/A |
| | Towards Ground | 0.881 | 0.088 | 0.969 | N/A | N/A |
| Hotspot | Towards Phantom | 0.559 | 0.132 | 0.691 | N/A | N/A |
| | Towards Ground | 0.723 | 0.132 | 0.855 | N/A | N/A |
| | Left edge | 0.426 | 0.132 | 0.558 | N/A | N/A |
| | Right edge | 0.423 | 0.132 | 0.555 | N/A | N/A |
| | Top edge | 0.000 | 0.132 | 0.132 | N/A | N/A |
| | Bottom edge | 0.102 | 0.132 | 0.234 | N/A | N/A |

Table 55: Simultaneous Tx Combination of GSM850 and BT

| Test Position | | Scaled SAR _{Max} | | Σ1-g SAR | SPLSR | Remark |
|---------------|-----------------------|---------------------------|-------|--------------|-------|--------|
| | | GSM1900 | BT | | | |
| Head | Left Hand Touched | 0.411 | 0.263 | 0.674 | N/A | N/A |
| | Left Hand Tilted 15° | 0.280 | 0.263 | 0.543 | N/A | N/A |
| | Right Hand Touched | 0.590 | 0.263 | 0.853 | N/A | N/A |
| | Right Hand Tilted 15° | 0.237 | 0.263 | 0.500 | N/A | N/A |
| Body-Worn | Towards Phantom | 0.566 | 0.088 | 0.654 | N/A | N/A |
| | Towards Ground | 0.463 | 0.088 | 0.551 | N/A | N/A |
| Hotspot | Towards Phantom | 1.102 | 0.132 | 1.234 | N/A | N/A |
| | Towards Ground | 0.898 | 0.132 | 1.030 | N/A | N/A |
| | Left edge | 0.249 | 0.132 | 0.381 | N/A | N/A |
| | Right edge | 0.298 | 0.132 | 0.430 | N/A | N/A |
| | Top edge | 0.000 | 0.132 | 0.132 | N/A | N/A |
| | Bottom edge | 1.319 | 0.132 | 1.451 | N/A | N/A |

Table 56: Simultaneous Tx Combination of GSM1900 and BT

| Test Position | | Scaled SAR _{Max} | | Σ1-g SAR | SPLSR | Remark |
|---------------|-----------------------|---------------------------|-------|--------------|-------|--------|
| | | UMTS Band V | BT | | | |
| Head | Left Hand Touched | 0.634 | 0.263 | 0.897 | N/A | N/A |
| | Left Hand Tilted 15° | 0.530 | 0.263 | 0.793 | N/A | N/A |
| | Right Hand Touched | 0.793 | 0.263 | 1.056 | N/A | N/A |
| | Right Hand Tilted 15° | 0.559 | 0.263 | 0.822 | N/A | N/A |
| Body-Worn | Towards Phantom | 0.641 | 0.088 | 0.729 | N/A | N/A |
| | Towards Ground | 0.769 | 0.088 | 0.857 | N/A | N/A |
| Hotspot | Towards Phantom | 0.484 | 0.132 | 0.616 | N/A | N/A |
| | Towards Ground | 0.633 | 0.132 | 0.765 | N/A | N/A |
| | Left edge | 0.382 | 0.132 | 0.514 | N/A | N/A |
| | Right edge | 0.436 | 0.132 | 0.568 | N/A | N/A |
| | Top edge | 0.000 | 0.132 | 0.132 | N/A | N/A |
| | Bottom edge | 0.110 | 0.132 | 0.242 | N/A | N/A |

Table 57: Simultaneous Tx Combination of UMTS Band V and BT

| Test Position | | Scaled SAR _{Max} | | Σ1-g SAR | SPLSR | Remark |
|---------------|-----------------------|---------------------------|-------|--------------|-------|--------|
| | | UMTS Band IV | BT | | | |
| Head | Left Hand Touched | 1.119 | 0.263 | 1.382 | N/A | N/A |
| | Left Hand Tilted 15° | 0.493 | 0.263 | 0.756 | N/A | N/A |
| | Right Hand Touched | 1.308 | 0.263 | 1.571 | N/A | N/A |
| | Right Hand Tilted 15° | 0.438 | 0.263 | 0.701 | N/A | N/A |
| Body-Worn | Towards Phantom | 0.673 | 0.088 | 0.761 | N/A | N/A |
| | Towards Ground | 0.609 | 0.088 | 0.697 | N/A | N/A |
| Hotspot | Towards Phantom | 0.604 | 0.132 | 0.736 | N/A | N/A |
| | Towards Ground | 0.550 | 0.132 | 0.682 | N/A | N/A |
| | Left edge | 0.140 | 0.132 | 0.272 | N/A | N/A |
| | Right edge | 0.099 | 0.132 | 0.231 | N/A | N/A |
| | Top edge | 0.000 | 0.132 | 0.132 | N/A | N/A |
| | Bottom edge | 0.657 | 0.132 | 0.789 | N/A | N/A |

Table 58: Simultaneous Tx Combination of UMTS Band IV and BT

| Test Position | | Scaled SAR _{Max} | | Σ1-g SAR | SPLSR | Remark |
|---------------|-----------------------|---------------------------|-------|--------------|-------|--------|
| | | UMTS Band II | BT | | | |
| Head | Left Hand Touched | 0.712 | 0.263 | 0.975 | N/A | N/A |
| | Left Hand Tilted 15° | 0.489 | 0.263 | 0.752 | N/A | N/A |
| | Right Hand Touched | 1.107 | 0.263 | 1.370 | N/A | N/A |
| | Right Hand Tilted 15° | 0.366 | 0.263 | 0.629 | N/A | N/A |
| Body-Worn | Towards Phantom | 1.036 | 0.088 | 1.124 | N/A | N/A |
| | Towards Ground | 0.711 | 0.088 | 0.799 | N/A | N/A |
| Hotspot | Towards Phantom | 0.918 | 0.132 | 1.050 | N/A | N/A |
| | Towards Ground | 0.677 | 0.132 | 0.809 | N/A | N/A |
| | Left edge | 0.222 | 0.132 | 0.354 | N/A | N/A |
| | Right edge | 0.128 | 0.132 | 0.260 | N/A | N/A |
| | Top edge | 0.000 | 0.132 | 0.132 | N/A | N/A |
| | Bottom edge | 1.050 | 0.132 | 1.182 | N/A | N/A |

Table 59: Simultaneous Tx Combination of UMTS Band II and BT

Note:

- 1) No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SAR to peak location separation ratio(SPLSR) between the antenna pairs was below 0.04 per FCC KDB447498 D01v05. See Section 7.3.4 for detailed SPLS ratio analysis.
- 2) When SAR to peak location separation ratio is applied to determine simultaneous transmission SAR test exclusion, the highest of the reported stand-alone SAR and estimated SAR is used per KDB690783D01.

7.3.4 SPLSR Evaluation Analysis

According to KDB447498 D01v05, When the sum of SAR is larger than the limit, SAR test exclusion is determined by the SAR to peak location separation ratio(SPLSR).When the SAR to peak location ratio for each pair of antennas is ≤ 0.04 , simultaneous SAR evaluation is not required.

When SAR is measured for both antennas in the pair, the peak location separation distance is computed by the following fomula:

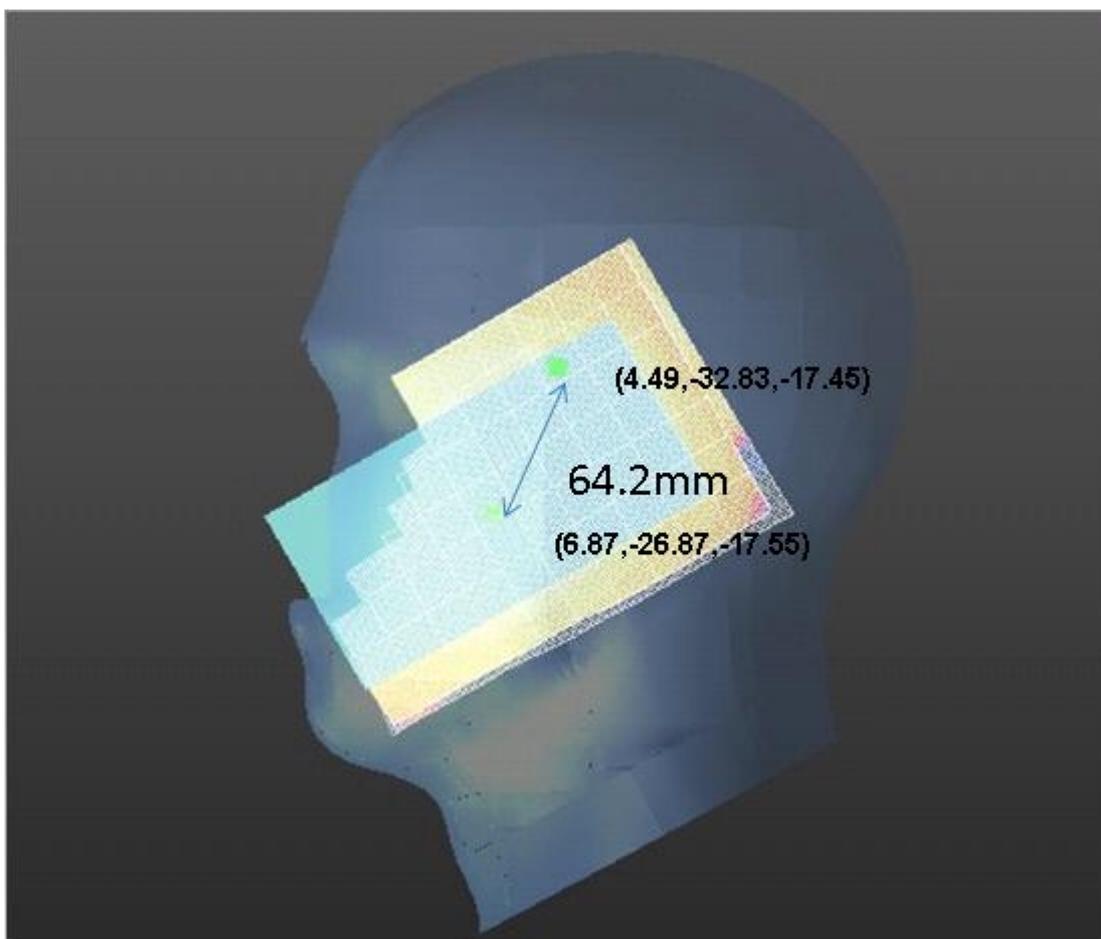
$$\text{Distance}_{\text{Tx1-Tx2}} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$

$$\text{SPLS Ratio} = (\text{SAR}_1 + \text{SAR}_2)^{1.5} / R_i$$

When standalone test exclusion applies, SAR is estimated; the peak location is assumed to be at the feed-point or geometric center of the antenna.

1)The sum of aggregate 1g SAR was above 1.6W/Kg for Right Hand Touched configuration with GSM850 and WiFi.

The Peak SAR location plot is as below:

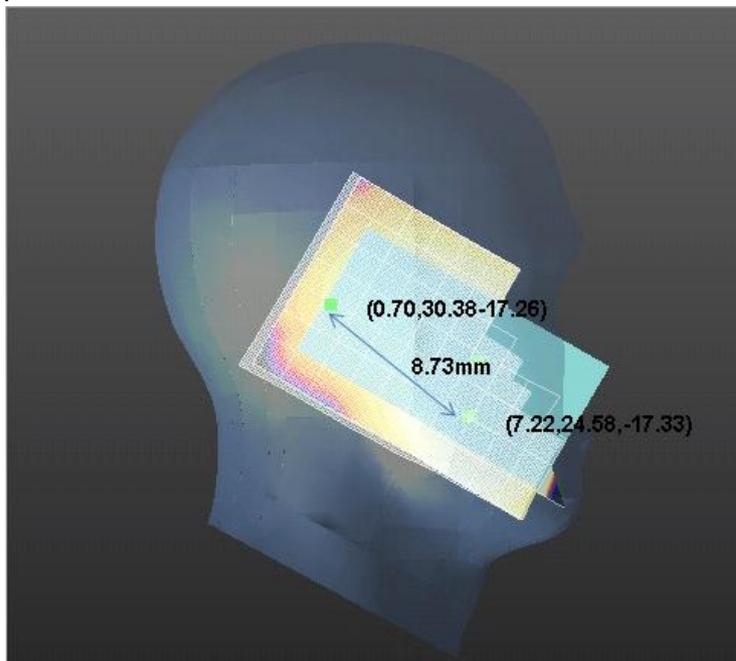


The SAR to peak location ratio calculation is as below:

| Test Position | GSM850 (W/kg) | WiFi (W/kg) | Ri(mm) | SPLSR | Ratio Limit | Simultaneous SAR |
|--------------------|---------------|-------------|--------|-------|-------------|------------------|
| Right Hand Touched | 1.04 | 0.721 | 64.2 | 0.036 | 0.04 | Not required |

2)The sum of aggregate 1g SAR was above 1.6W/Kg for Left Hand Touched configuration with UMTS band IV and WiFi.

The Peak SAR location plot is as below:

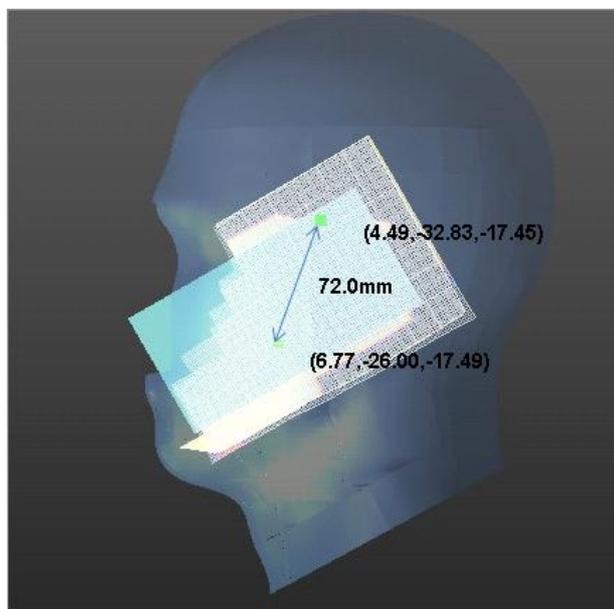


The SAR to peak location ratio calculation is as below:

| Test Position | UMTS Band IV (W/kg) | WiFi (W/kg) | Ri(mm) | SPLSR | Ratio Limit | Simultaneous SAR |
|-------------------|---------------------|-------------|--------|-------|-------------|------------------|
| Left Hand Touched | 1.119 | 0.484 | 87.3 | 0.023 | 0.04 | Not required |

3)The sum of aggregate 1g SAR was above 1.6W/Kg for Right Hand Touched configuration with UMTS band IV and WiFi.

The Peak SAR location plot is as below:

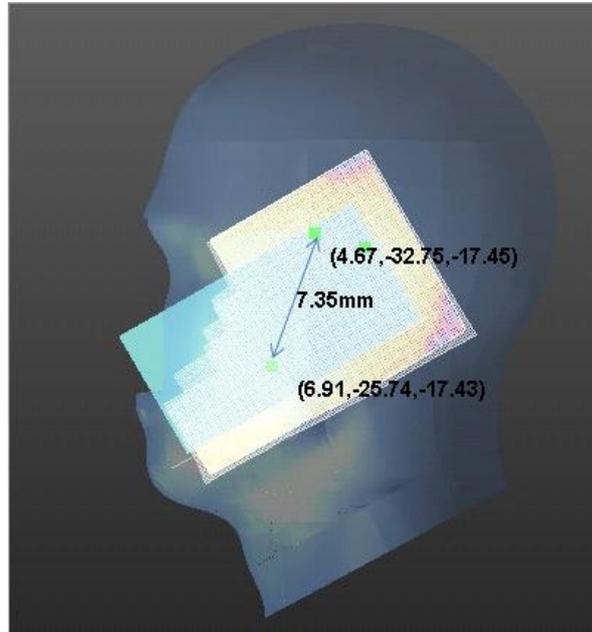


The SAR to peak location ratio calculation is as below:

| Test Position | UMTS Band IV (W/kg) | WiFi (W/kg) | Ri(mm) | SPLSR | Ratio Limit | Simultaneous SAR |
|--------------------|---------------------|-------------|--------|-------|-------------|------------------|
| Right Hand Touched | 1.262 | 0.721 | 72 | 0.039 | 0.04 | Not required |

4)The sum of aggregate 1g SAR was above 1.6W/Kg for Right Hand Touched configuration with UMTS band IV and WiFi.

The Peak SAR location plot is as below:

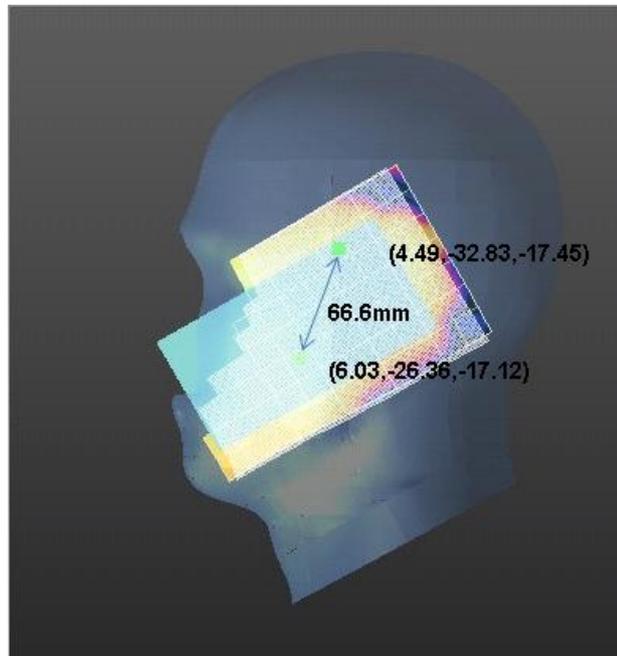


The SAR to peak location ratio calculation is as below:

| Test Position | UMTS Band IV (W/kg) | WiFi (W/kg) | Ri(mm) | SPLSR | Ratio Limit | Simultaneous SAR |
|--------------------|---------------------|-------------|--------|-------|-------------|------------------|
| Right Hand Touched | 1.308 | 0.528 | 73.5 | 0.034 | 0.04 | Not required |

5)The sum of aggregate 1g SAR was above 1.6W/Kg for Right Hand Touched configuration with UMTS band II and WiFi.

The Peak SAR location plot is as below:

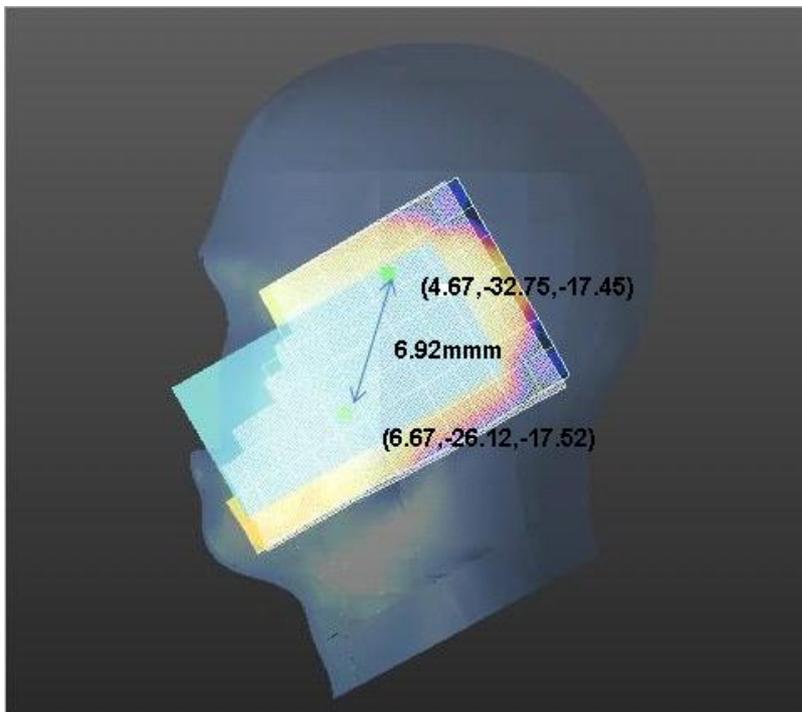


The SAR to peak location ratio calculation is as below:

| Test Position | UMTS Band II (W/kg) | WiFi (W/kg) | Ri(mm) | SPLSR | Ratio Limit | Simultaneous SAR |
|--------------------|---------------------|-------------|--------|-------|-------------|------------------|
| Right Hand Touched | 1.107 | 0.721 | 66.6 | 0.037 | 0.04 | Not required |

6)The sum of aggregate 1g SAR was above 1.6W/Kg for Right Hand Touched configuration with UMTS band II and WiFi.

The Peak SAR location plot is as below:



The SAR to peak location ratio calculation is as below:

| Test Position | UMTS Band II (W/kg) | WiFi (W/kg) | Ri(mm) | SPLSR | Ratio Limit | Simultaneous SAR |
|--------------------|---------------------|-------------|--------|-------|-------------|------------------|
| Right Hand Touched | 1.107 | 0.528 | 69.2 | 0.030 | 0.04 | Not required |

7.3.5 Simultaneous Transmission Conclusion

The above numeral summed SAR results and SPLSR analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore simultaneous transmission SAR with Volume Scans is not required per KDB 447498 D01v05



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.)

End