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# TEST REPORT

**Test Report No.: 1-9303/15-01-02-A**

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-00

## Testing Laboratory


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**Accredited Test Laboratory:**
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-00

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## Manufacturer

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## Test Standard/s

| | |
|---|---|
| IEEE 1528-2003 | Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR)in the Human Head from Wireless Communications Devices: Measurement Techniques |
| RSS-102 Issue 4 | Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) |

For further applied test standards please refer to section 3 of this test report.

## Test Item

| | |
|---|---|
| Kind of test item: | GSM -Smartphone |
| Device type: | portable device |
| **Model name:** | **RM-1077 BOM2** |
| S/N serial number: | N/A |
| FCC-ID: | PYARM-1077 |
| IMEI-Number: | 04402740222165 / 04402740222082 |
| Hardware status: | 2030 |
| Software status: | 02162.00000.15045.58000 |
| Frequency: | see technical details |
| Antenna: | integrated antenna |
| Battery option: | BV-T5C |
| Accessories: | Headset WH-108 |
| Test sample status: | identical prototype |
| Exposure category: | general population / uncontrolled environment |

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# 2 General information

## 2.1 Notes and disclaimer

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## 2.2 Application details

| | |
|---|---|
| Date of receipt of order: | 2015-02-04 |
| Date of receipt of test item: | 2015-02-04 |
| Start of test: | 2015-02-06 |
| End of test: | 2015-02-11 |
| Person(s) present during the test: | |

## 2.3 Statement of compliance

The SAR values found for the RM-1077 BOM2 GSM -Smartphone are below the maximum recommended levels of 1.6 W/Kg as averaged over any 1 g tissue according to the FCC rule §2.1093, the ANSI/IEEE C 95.1:1992, the NCRP Report Number 86 for uncontrolled environment, according to the Health Canada's Safety Code 6 and the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure.
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 15 mm from the body. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.
According to KDB pub 941225 D06 this device has been tested with 10 mm distance to the phantom for operation in WLAN hot spot mode.

## 2.4 Technical details

| Band tested for this test report | Technology | Lowest transmit frequency/MHz | Highest transmit frequency/MHz | Lowest receive Frequency/MHz | Highest receive Frequency/MHz | Kind of modulation | Power Class | Tested power control level | GPRS/EGPRS mobile station class | GPRS/EGPRS multislot class | (E)GPRS voice mode or DTM | Test channel low | Test channel middle | Test channel high | Maximum output power/dBm )* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ☐ | GSM | 880.2 | 914.8 | 925.2 | 959.8 | GMSK 8-PSK | 4 E2 | 5 | B | 33 | no | 975 | 37 | 124 | -- |
| ☐ | GSM DCS | 1710.2 | 1784.8 | 1805.2 | 1879.8 | GMSK 8-PSK | 1 E2 | 0 | B | 33 | no | 512 | 698 | 885 | -- |
| ☒ | GSM cellular | 824.2 | 848.8 | 869.2 | 893.8 | GMSK 8-PSK | 4 E2 | 5 | B | 33 | no | 128 | 190 | 251 | 32.5 |
| ☒ | GSM PCS | 1850.2 | 1909.8 | 1930.2 | 1989.8 | GMSK 8-PSK | 1 E2 | 0 | B | 33 | no | 512 | 661 | 810 | 29.9 |
| ☐ | UMTS FDD I | 1922.4 | 1977.6 | 2112.4 | 2167.6 | QPSK | 3 | max | -- | -- | -- | 9612 | 9750 | 9888 | -- |
| ☒ | UMTS FDD II | 1852.4 | 1907.6 | 1932.4 | 1987.6 | QPSK | 3 | max | -- | -- | -- | 9262 | 9400 | 9538 | 23.1 |
| ☒ | UMTS FDD V | 826.4 | 846.6 | 871.4 | 891.6 | QPSK | 3 | max | -- | -- | -- | 4132 | 4182 | 4233 | 23.3 |
| ☐ | UMTS FDD VIII | 882.4 | 912.6 | 927.4 | 957.6 | QPSK | 3 | max | -- | -- | -- | 2712 | 2788 | 2863 | -- |
| ☐ | WLAN | 2412 | 2472 | 2412 | 2472 | CCK OFDM | -- | max | -- | -- | -- | 1 | 7 | 13 | -- |
| ☒ | WLAN US | 2412 | 2462 | 2412 | 2462 | CCK OFDM | -- | max | -- | -- | -- | 1 | 6 | 11 | 18.5 |
| ☐ | BT | 2402 | 2480 | 2402 | 2480 | GFSK | 3 | max | -- | -- | -- | 0 | 39 | 78 | 9.74 |

)*: measured slotted peak power for GSM, averaged max. RMS power for UMTS, WLAN and BT.

| supported UMTS features | category | remarks |
|---|---|---|
| Release 8 DC-HSDPA | 24 | 42.2 Mbit/s |
| Release 7 HSDPA | 14 | 21.1 Mbit/s |
| Release 6 HSUPA | 6 | no MIMO, 5.76 Mbit/s |

## 2.5 Transmitter and Antenna Operating Configurations

| Simultaneous transmission conditions | | |
|---|---|---|
| GSM / GPRS / EDGE / DTM | + | BT/BLE[1] |
| GSM / GPRS / EDGE / DTM | + | WLAN 2.4GHz |
| UMTS / HSPA | + | BT/BLE |
| UMTS / HSPA | + | WLAN 2.4GHz |

Table 1: Simultaneous transmission conditions

Note: BT and WLAN can be active at the same time, but only with interleaving of packages switched on board level. That means that they don't transmit at the same time.

BLE[1] - Bluetooth low energy

# 3 Test standards/ procedures references

| Test Standard | Version | Test Standard Description |
|---|---|---|
| IEEE 1528-2003 | 2003-04 | Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques |
| IEEE 1528-2013 | 2014-06 | Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques |
| RSS-102 Issue 4 | 2010-03 | Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) |
| Canada's Safety Code No. 6 | 99-EHD-237 | Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz |
| IEEE Std. C95-3 | 2002 | IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave |
| IEEE Std. C95-1 | 1992 | IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. |
| IEC 62209-2 | 2010 | Human exposure to radio frequency fields from hand-held and bodymounted wireless communication devices. Human models, instrumentation, and procedures. Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz) |

FCC KDBs:

| | | |
|---|---|---|
| KDB 865664D01v01 | February 7, 2014 | FCC OET SAR measurement requirements 100 MHz to 6 GHz |
| KDB 865664D02v01 | May 28, 2013 | RF Exposure Compliance Reporting and Documentation Considerations |
| KDB 447498D01v05 | February 7, 2014 | Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies |
| KDB 648474D04v01 | December 4, 2013 | SAR Evaluation Considerations for Wireless Handsets |
| KDB 941225D01v02 | October, 2007 | SAR Measurements Procedures for 3G Devices |
| KDB 941225D02v01 | December 14, 2009 | 3GPP R6 HSPA and R7 HSPA+ SAR Guidance |
| KDB 941225D02v02 | May 28, 2013 | SAR Guidance for HSPA, HSPA+, DC-HSDPA and 1x-Advanced |
| KDB 941225D04v01 | January 27, 2010 | Evaluating SAR for GSM/(E)GPRS Dual Transfer Mode |
| KDB 941225D03v01 | December, 2008 | SAR Test Reduction Procedure for GSM/GPRS/EDGE |
| KDB 941225D06v01 | May 28, 2013 | SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities |
| KDB 248227D01v01 | May 29, 2007 | SAR Measurement Procedures for 802.11 a/b/g Transmitters |
| KDB 450824D01v01 | January, 2007 | SAR Probe Calibration and System Verification considerations for measurements from 150 MHz to 3 GHz |
| KDB 450824D02v01 | April 4, 2012 | Dipole Requirements for SAR System Validation and Verification |

## 3.1 RF exposure limits

| Human Exposure | Uncontrolled Environment General Population | Controlled Environment Occupational |
|---|---|---|
| Spatial Peak SAR* (Brain and Trunk) | **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).

# 4 Summary of Measurement Results

| | |
|---|---|
| ☒ | **No deviations from the technical specifications ascertained** |
| ☐ | Deviations from the technical specifications ascertained |

**Maximum SAR value reported for 1g (W/kg)**

| | | PCE | DTS | UNII |
|---|---|---|---|---|
| **head** | | **1.222** | **0.814** | **---** |
| **body worn 15 mm distance** | | **1.004** | **0.161** | **---** |
| **hotspot operation 10 mm distance** | | **1.254** | **0.398** | --- |
| **collocated situations** | **$SPLSR_i \leq 0.04$** | **0.04** | | |

## 4.1 Maximum measured and reported SAR values for head configuration

| **HEAD** | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ results(W/kg) | |
|---|---|---|---|---|
| | Measured | Extrapolated | Measured | Extrapolated |
| GSM 850 | 1.140 | 1.222 | 0.881 | 0.944 |
| GSM 1900 | 0.908 | 0.973 | 0.579 | 0.620 |
| UMTS FDD II | 0.873 | 0.980 | 0.549 | 0.616 |
| UMTS FDD V | 0.695 | 0.798 | 0.527 | 0.605 |
| WLAN 2450 | 0.632 | 0.814 | 0.312 | 0.402 |

| reported **Combined SAR WWAN** and **WLAN 2.4GHz** evaluation | | |
|---|---|---|
| Frequency band | Position | **Combined SAR** <1.6W/kg |
| GSM 850 | left cheek | **1.290** |
| GSM 1900 | left cheek | 0.950 |
| UMTS FDD II | left cheek | 0.974 |
| WCDMA FDD V | left cheek | 0.912 |

## 4.2 Maximum measured and reported SAR values for body worn configuration

| **body worn** | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ results(W/kg) | |
|---|---|---|---|---|
| | Measured | Extrapolated | Measured | Extrapolated |
| GSM 850 | 0.937 | 1.004 | 0.713 | 0.764 |
| GSM 1900 | 0.559 | 0.599 | 0.361 | 0.387 |
| UMTS FDD II | 0.557 | 0.625 | 0.364 | 0.408 |
| UMTS FDD V | 0.635 | 0.729 | 0.485 | 0.557 |
| WLAN 2450 | 0.128 | 0.161 | 0.066 | 0.083 |

| reported **Combined SAR WWAN** and **WLAN 2.4GHz** evaluation | | |
|---|---|---|
| Frequency band | Position | **Combined SAR** <1.6W/kg |
| GSM 850 | rear 15mm | **1.040** |
| GSM 1900 | front 15mm | 0.682 |
| UMTS FDD II | front 15mm | 0.713 |
| WCDMA FDD V | rear 15mm | 0.780 |

## 4.3 Maximum measured and reported SAR values for hotspot configuration

| hotspot | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ results(W/kg) | |
|---|---|---|---|---|
| | Measured | Extrapolated | Measured | Extrapolated |
| GSM 850 | 1.170 | 1.254 | 0.904 | 0.969 |
| GSM 1900 | 0.788 | 0.844 | 0.518 | 0.555 |
| UMTS FDD II | 0.776 | 0.871 | 0.506 | 0.568 |
| UMTS FDD V | 0.870 | 0.954 | 0.669 | 0.734 |
| WLAN 2450 | 0.316 | 0.398 | 0.150 | 0.189 |

| reported **Combined SAR WWAN** and **WLAN 2.4GHz** evaluation | | |
|---|---|---|
| Frequency band | Position | **Combined SAR** <1.6W/kg |
| GSM 850 | rear 10mm | **1.330** |
| GSM 1900 | rear 10mm | 0.920 |
| UMTS FDD II | front 10mm | 1.030 |
| WCDMA FDD V | rear 10mm | 1.030 |

## 4.4 SAR measurement variability and measurement uncertainty analysis

This analysis is required for worst case results larger than 0.8 W/kg.

| frequency band | highest original measurement result at worst case position (W/kg) | repeated measurement result at worst case position (W/kg) | ratio <1.2 |
|---|---|---|---|
| GSM 835 | 1.160 | 1.170 | 1.01 |
| GSM 1900 | 0.902 | 0.908 | 1.01 |
| UMTS FDD II | 0.873 | 0.872 | 1.00 |

# 5 Test Environment

Ambient temperature: 20 – 24 °C
Tissue Simulating liquid: 20 – 24 °C

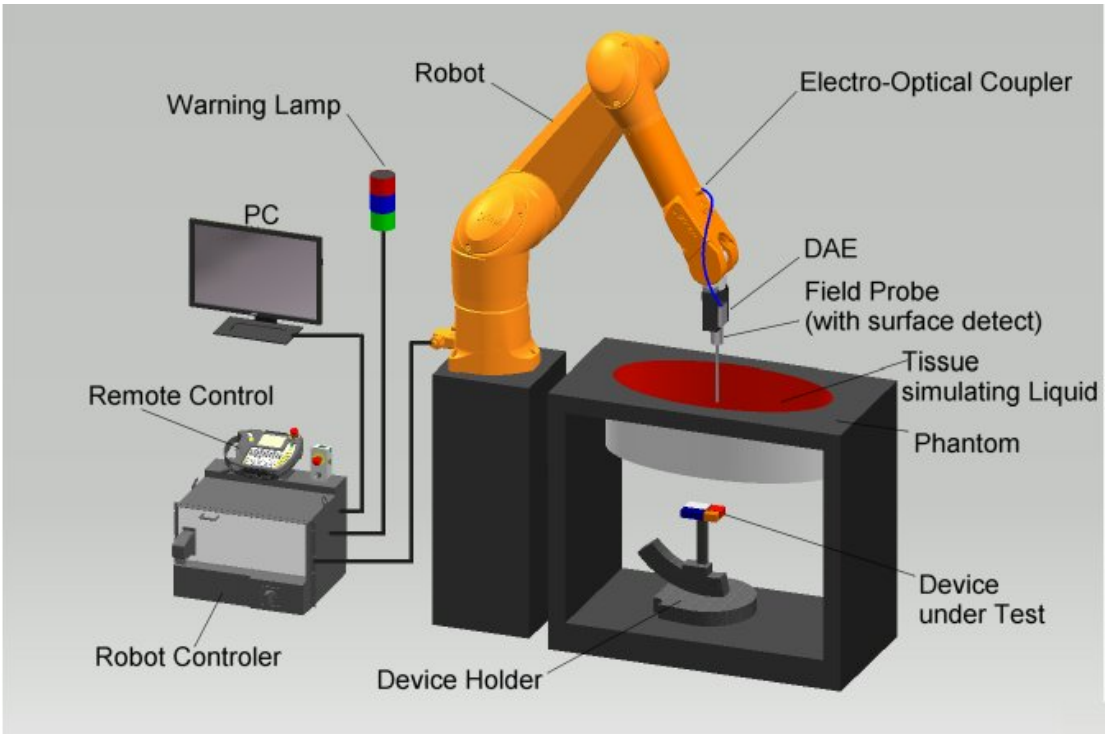
Relative humidity content: 40 – 50 %
Air pressure: not relevant for this kind of testing
Power supply: 230 V / 50 Hz

Exact temperature values for each test are shown in the table(s) under 7.1 and/or on the measurement plots.

# 6 Test Set-up

## 6.1 Measurement system

### 6.1.1 System Description




- The DASY system for performing compliance tests consists of the following items:
- A standard high precision 6-axis robot (Stäubli RX/TX 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.
- 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.
- 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 DASY measurement server.
- The DASY 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 7.
- DASY 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 triple flat and eli phantom for the testing of handheld and body-mounted wireless devices.
- The device holder for handheld mobile phones and mounting device adaptor for laptops
- Tissue simulating liquid mixed according to the given recipes.
- System check dipoles allowing to validate the proper functioning of the system.

### 6.1.2 Test environment

The DASY measurement system is placed in a laboratory room within an environment which avoids influence on SAR measurements by ambient electromagnetic fields and any reflection from the environment. The pictures at the beginning of the photo documentation show a complete view of the test environment. The system allows the measurement of SAR values larger than 0.005 mW/g.

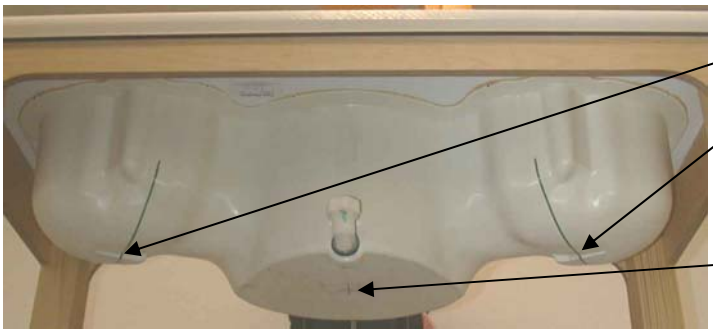
### 6.1.3 Probe description

| Isotropic E-Field Probe ES3DV3 for Dosimetric Measurements | |
|---|---|
| Technical data according to manufacturer information | |
| Construction | Symmetrical design with triangular core<br>Interleaved sensors<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., butyl diglycol) |
| Calibration | Calibration certificate in Appendix D |
| Frequency | 10 MHz to 3 GHz (dosimetry); Linearity: ± 0.2 dB (30 MHz to 3 GHz) |
| Directivity | ± 0.2 dB in HSL (rotation around probe axis)<br>± 0.3 dB in HSL (rotation normal to probe axis) |
| Dynamic range | 5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB |
| Dimensions | Overall length: 330 mm<br>Tip length: 20 mm<br>Body diameter: 12 mm<br>Tip diameter: 3.9 mm<br>Distance from probe tip to dipole centers: 2.0 mm |
| Application | General dosimetry up to 3 GHz<br>Compliance tests of mobile phones<br>Fast automatic scanning in arbitrary phantoms (ES3DV3) |

| Isotropic E-Field Probe EX3DV4 for Dosimetric Measurements | |
|---|---|
| Technical data according to manufacturer information | |
| Construction | Symmetrical design with triangular core<br>Interleaved sensors<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| Calibration | ISO/IEC 17025 calibration service available. |
| Frequency | 10 MHz to >6 GHz (dosimetry); Linearity: ± 0.2 dB (30 MHz to 6 GHz) |
| Directivity | ± 0.3 dB in HSL (rotation around probe axis)<br>± 0.5 dB in tissue material (rotation normal to probe axis) |
| Dynamic range | 10 µW/g to > 100 mW/g; Linearity: ± 0.2 dB (noise: typically<1 µW/g) |
| Dimensions | Overall length: 337 mm (Tip: 20mm)<br>Tip length: 2.5 mm (Body: 12mm)<br>Typical distance from probe tip to dipole centers: 1mm |
| 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%. |

### 6.1.4 Phantom description

The used SAM Phantom meets the requirements specified in FCC KDB865664 D01 for Specific Absorption Rate (SAR) measurements.
The phantom consists of a fibreglass shell integrated in a wooden table. It allows left-hand and right-hand head as well as body-worn measurements with a maximum liquid depth of 18 cm in head position and 22 cm in planar position (body measurements). The thickness of the Phantom shell is 2 mm +/- 0.1 mm.



Triple Modular Phantom consists of three identical modules which can be installed and removed separately without emptying the liquid. It includes three reference points for phantom installation. Covers prevent evaporation of the liquid. Phantom material is resistant to DGBE based tissue simulating liquids.

### 6.1.5 Device holder description

The DASY 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.

### 6.1.6 Scanning procedure

- The DASY 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 highest integrated SAR value is the main concern in compliance test applications. These values can mostly be found at the inner surface of the phantom and cannot be measured directly due to the sensor offset in the probe. To extrapolate the surface values, the measurement distances to the surface must be known accurately. A distance error of 0.5mm could produce SAR errors of 6% at 1800 MHz. Using predefined locations for measurements is not accurate enough. Any shift of the phantom (e.g., slight deformations after filling it with liquid) would produce high uncertainties. For an automatic and accurate detection of the phantom surface, the DASY5 system uses the mechanical surface detection. The detection is always at touch, but the probe will move backward from the surface the indicated distance before starting the measurement.

- 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 scan uses different grid spacings for different frequency measurements. Standard grid spacing for head measurements in frequency ranges ≤ 2GHz is 15 mm in x- and y-dimension. For higher frequencies a finer resolution is needed, thus for the grid spacing is reduced according the following table:

| **Area scan grid spacing for different frequency ranges** | |
|---|---|
| Frequency range | Grid spacing |
| ≤ 2 GHz | ≤ 15 mm |
| 2 – 4 GHz | ≤ 12 mm |
| 4 – 6 GHz | ≤ 10 mm |

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 annex B.

- A „zoom scan” measures the field in a volume around the 2D peak SAR value acquired in the previous „coarse“ scan. It uses a fine meshed grid where the robot moves the probe in steps along all the 3 axis (x,y and z-axis) starting at the bottom of the Phantom. The grid spacing for the cube measurement is varied according to the measured frequency range, the dimensions are given in the following table:

| **Zoom scan grid spacing and volume for different frequency ranges** | | | |
|---|---|---|---|
| Frequency range | Grid spacing for x, y axis | Grid spacing for z axis | Minimum zoom scan volume |
| ≤ 2 GHz | ≤ 8 mm | ≤ 5 mm | ≥ 30 mm |
| 2 – 3 GHz | ≤ 5 mm | ≤ 5 mm | ≥ 28 mm |
| 3 – 4 GHz | ≤ 5 mm | ≤ 4 mm | ≥ 28 mm |
| 4 – 5 GHz | ≤ 4 mm | ≤ 3 mm | ≥ 25 mm |
| 5 – 6 GHz | ≤ 4 mm | ≤ 2 mm | ≥ 22 mm |

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 annex B. Test results relevant for the specified standard (see section 3) are shown in table form in section 7.

### 6.1.7 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 all points in the three directions x, y and z. 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 1 to 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 neighbouring volumes are evaluated until no neighbouring 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

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

### 6.1.8 Data Storage and Evaluation

Data Storage

The DASY software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4", ".DA5x". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

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

Data Evaluation by SEMCAD

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

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

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY 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 [mV/(V/m)$^2$] for E-field Probes | (i = x, y, z) |
| | ConvF | = sensitivity enhancement in solution | |
| | $a_{ij}$ | = sensor sensitivity factors for H-field probes | |
| | f | = carrier frequency [GHz] | |
| | $E_i$ | = electric field strength of channel i in V/m | |
| | $H_i$ | = magnetic field strength of channel i in A/m | |

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

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

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

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

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

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

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

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

### 6.1.9 Tissue simulating liquids: dielectric properties

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

(Liquids used for tests described in section 7. are marked with ☒) :

| **Ingredients** (% of weight) | **Frequency (MHz)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| frequency band | ☐ 450 | ☐ 750 | ☒ 835 | ☐ 900 | ☐ 1450 | ☐ 1750 | ☒ 1900 | ☐ 2450 | ☐ 5000 |
| Water | 38.56 | 41.1 | 41.45 | 40.92 | 54.37 | 55.35 | 55.19 | 54.7 | 64 - 78 |
| Salt (NaCl) | 3.95 | 1.4 | 1.45 | 1.48 | 0.63 | 0.38 | 0.19 | 0.0 | 2 - 3 |
| Sugar | 56.32 | 57.0 | 56.0 | 56.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| HEC | 0.98 | 0.2 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bactericide | 0.19 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 |
| Tween 20 | 0.0 | 0.0 | 0.0 | 0.0 | 44.90 | 44.17 | 44.52 | 45.2 | 0.0 |
| Emulsifiers | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9 - 15 |
| Mineral Oil | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 11 - 18 |

Table 3: Head tissue dielectric properties

| **Ingredients** (% of weight) | **Frequency (MHz)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| frequency band | ☐ 450 | ☐ 750 | ☒ 835 | ☐ 900 | ☐ 1450 | ☐ 1750 | ☒ 1900 | ☐ 2450 | ☐ 5000 |
| Water | 51.16 | 51.7 | 52.4 | 56.0 | 71.40 | 71.45 | 71.56 | 71.65 | 64 - 78 |
| Salt (NaCl) | 1.49 | 0.9 | 1.40 | 0.76 | 0.55 | 0.5 | 0.39 | 0.3 | 2 - 3 |
| Sugar | 46.78 | 47.2 | 45.0 | 41.76 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| HEC | 0.52 | 0.0 | 1.0 | 1.21 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bactericide | 0.05 | 0.1 | 0.1 | 0.27 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 |
| Tween 20 | 0.0 | 0.0 | 0.0 | 0.0 | 27.95 | 27.95 | 27.95 | 27.95 | 0.0 |
| Emulsifiers | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9 - 15 |
| Mineral Oil | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 11 - 18 |

Table 4: Body tissue dielectric properties

Salt: 99+% Pure Sodium Chloride
Sugar: 98+% Pure Sucrose
Tween 20: Polyoxyethylene (20) sorbitan monolaurate
Water: De-ionized, 16MΩ+ resistivity
HEC: Hydroxyethyl Cellulose

## 6.1.10 Tissue simulating liquids: parameters

| Liquid HSL | Freq. (MHz) | Target head tissue | | Measurement **head** tissue | | | | | Measurement date |
|---|---|---|---|---|---|---|---|---|---|
| | | Permittivity | Conductivity (S/m) | Permittivity | Dev. % | Conductivity | | Dev. % | |
| | | | | | | ε" | (S/m) | | |
| 850/900 | 824 | 41.56 | 0.90 | 41.8 | 0.7% | 20.15 | 0.92 | 2.7% | 2015-02-06 |
| | 825 | 41.55 | 0.90 | 41.8 | 0.6% | 20.16 | 0.93 | 2.9% | |
| | 835 | 41.50 | 0.90 | 41.6 | 0.3% | 20.10 | 0.93 | 3.7% | |
| | 837 | 41.50 | 0.90 | 41.6 | 0.3% | 20.11 | 0.94 | 3.8% | |
| | 847 | 41.50 | 0.91 | 41.5 | 0.0% | 20.08 | 0.95 | 3.6% | |
| | 849 | 41.50 | 0.92 | 41.5 | -0.1% | 20.06 | 0.95 | 3.5% | |
| 1900 | 1850 | 40.00 | 1.40 | 39.1 | -2.3% | 12.95 | 1.33 | -4.8% | 2015-02-09 |
| | 1852 | 40.00 | 1.40 | 39.1 | -2.3% | 12.93 | 1.33 | -4.9% | |
| | 1880 | 40.00 | 1.40 | 39.0 | -2.6% | 12.97 | 1.36 | -3.1% | |
| | 1900 | 40.00 | 1.40 | 38.9 | -2.7% | 12.99 | 1.37 | -1.9% | |
| | 1908 | 40.00 | 1.40 | 38.9 | -2.7% | 13.01 | 1.38 | -1.4% | |
| | 1910 | 40.00 | 1.40 | 38.9 | -2.8% | 13.03 | 1.38 | -1.1% | |

Table 5: Parameter of the head tissue simulating liquid

| Liquid MSL | Freq. (MHz) | Target head tissue | | Measurement **body** tissue | | | | | Measurement date |
|---|---|---|---|---|---|---|---|---|---|
| | | Permittivity | Conductivity (S/m) | Permittivity | Dev. % | Conductivity | | Dev. % | |
| | | | | | | ε" | (S/m) | | |
| 850/900 | 824 | 55.24 | 0.97 | 54.4 | -1.6% | 21.86 | 1.00 | 3.4% | 2015-02-11 |
| | 825 | 55.24 | 0.97 | 54.4 | -1.6% | 21.85 | 1.00 | 3.5% | |
| | 835 | 55.20 | 0.97 | 54.2 | -1.8% | 21.80 | 1.01 | 4.4% | |
| | 837 | 55.19 | 0.97 | 54.2 | -1.8% | 21.77 | 1.01 | 4.2% | |
| | 847 | 55.16 | 0.98 | 54.1 | -1.9% | 21.71 | 1.02 | 3.9% | |
| | 849 | 55.16 | 0.99 | 54.1 | -2.0% | 21.70 | 1.02 | 3.8% | |
| 1900 | 1850 | 53.30 | 1.52 | 52.8 | -1.0% | 14.25 | 1.47 | -3.5% | 2015-02-10 |
| | 1852 | 53.30 | 1.52 | 52.7 | -1.1% | 14.25 | 1.47 | -3.4% | |
| | 1880 | 53.30 | 1.52 | 52.7 | -1.2% | 14.30 | 1.50 | -1.6% | |
| | 1900 | 53.30 | 1.52 | 52.7 | -1.2% | 14.29 | 1.51 | -0.6% | |
| | 1905 | 53.30 | 1.52 | 52.7 | -1.2% | 14.29 | 1.51 | -0.4% | |
| | 1908 | 53.30 | 1.52 | 52.7 | -1.1% | 14.31 | 1.52 | -0.1% | |
| | 1910 | 53.30 | 1.52 | 52.7 | -1.1% | 14.33 | 1.52 | 0.2% | |

Table 6: Parameter of the body tissue simulating liquid
Note: The dielectric properties have been measured using the contact probe method at 22°C.

## 6.1.11 Measurement uncertainty evaluation for SAR test

| DASY5 Uncertainty Budget<br>According to IEEE 1528/2003 and IEC 62209-1 for the 30 MHz - 3 GHz range | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Source of uncertainty | ncertainty Valu<br>± % | Probability Distribution | Divisor | $c_i$<br>(1g) | $c_i$<br>(10g) | Standard Uncertainty<br>± %, (1g) | Standard Uncertainty<br>± %, (10g) | $v_i^2$ or $v_{eff}$ |
| **Measurement System** | | | | | | | | |
| Probe calibration | ± 6.0 % | Normal | 1 | 1 | 1 | ± 6.0 % | ± 6.0 % | ∞ |
| Axial isotropy | ± 4.7 % | Rectangular | √ 3 | 0.7 | 0.7 | ± 1.9 % | ± 1.9 % | ∞ |
| Hemispherical isotropy | ± 9.6 % | Rectangular | √ 3 | 0.7 | 0.7 | ± 3.9 % | ± 3.9 % | ∞ |
| Boundary effects | ± 1.0 % | Rectangular | √ 3 | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| Probe linearity | ± 4.7 % | Rectangular | √ 3 | 1 | 1 | ± 2.7 % | ± 2.7 % | ∞ |
| System detection limits | ± 1.0 % | Rectangular | √ 3 | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| Readout electronics | ± 0.3 % | Normal | 1 | 1 | 1 | ± 0.3 % | ± 0.3 % | ∞ |
| Response time | ± 0.8 % | Rectangular | √ 3 | 1 | 1 | ± 0.5 % | ± 0.5 % | ∞ |
| Integration time | ± 2.6 % | Rectangular | √ 3 | 1 | 1 | ± 1.5 % | ± 1.5 % | ∞ |
| RF ambient noise | ± 3.0 % | Rectangular | √ 3 | 1 | 1 | ± 1.7 % | ± 1.7 % | ∞ |
| RF ambient reflections | ± 3.0 % | Rectangular | √ 3 | 1 | 1 | ± 1.7 % | ± 1.7 % | ∞ |
| Probe positioner | ± 0.4 % | Rectangular | √ 3 | 1 | 1 | ± 0.2 % | ± 0.2 % | ∞ |
| Probe positioning | ± 2.9 % | Rectangular | √ 3 | 1 | 1 | ± 1.7 % | ± 1.7 % | ∞ |
| Max.SAR evaluation | ± 1.0 % | Rectangular | √ 3 | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| **Test Sample Related** | | | | | | | | |
| Device positioning | ± 2.9 % | Normal | 1 | 1 | 1 | ± 2.9 % | ± 2.9 % | 145 |
| Device holder uncertainty | ± 3.6 % | Normal | 1 | 1 | 1 | ± 3.6 % | ± 3.6 % | 5 |
| Power drift | ± 5.0 % | Rectangular | √ 3 | 1 | 1 | ± 2.9 % | ± 2.9 % | ∞ |
| **Phantom and Set-up** | | | | | | | | |
| Phantom uncertainty | ± 4.0 % | Rectangular | √ 3 | 1 | 1 | ± 2.3 % | ± 2.3 % | ∞ |
| Liquid conductivity (target) | ± 5.0 % | Rectangular | √ 3 | 0.64 | 0.43 | ± 1.8 % | ± 1.2 % | ∞ |
| Liquid conductivity (meas.) | ± 5.0 % | Rectangular | √ 3 | 0.64 | 0.43 | ± 1.8 % | ± 1.2 % | ∞ |
| Liquid permittivity (target) | ± 5.0 % | Rectangular | √ 3 | 0.6 | 0.49 | ± 1.7 % | ± 1.4 % | ∞ |
| Liquid permittivity (meas.) | ± 5.0 % | Rectangular | √ 3 | 0.6 | 0.49 | ± 1.7 % | ± 1.4 % | ∞ |
| **Combined Std.** | | | | | | ± 11.1 % | ± 10.8 % | 387 |
| **Expanded Std.** | | | | | | ± **22.1** % | ± **21.6** % | |

Table 7: Measurement uncertainties
Worst-Case uncertainty budget for DASY5 assessed according to IEEE 1528/2003.
The budget is valid for 2G and 3G communication signals and frequency range 300MHz - 3 GHz.
For these conditions it represents a worst-case analysis. For specifc tests and configurations, the uncertainty could be considerable smaller.

| Relative DASY5 Uncertainty Budget for SAR Tests<br>According to IEEE 1528/2013 and IEC62209/2011 for the 0.3 - 3GHz range | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Error Description | ncertainty Valu<br>± % | Probability Distribution | Divisor | $c_i$<br>(1g) | $c_i$<br>(10g) | Standard Uncertainty<br>± %, (1g) | Standard Uncertainty<br>± %, (10g) | $v_i^2$ or $v_{eff}$ |
| **Measurement System** | | | | | | | | |
| Probe calibration | ± 6.0 % | Normal | 1 | 1 | 1 | ± 6.0 % | ± 6.0 % | ∞ |
| Axial isotropy | ± 4.7 % | Rectangular | √ 3 | 0.7 | 0.7 | ± 1.9 % | ± 1.9 % | ∞ |
| Hemispherical isotropy | ± 9.6 % | Rectangular | √ 3 | 0.7 | 0.7 | ± 3.9 % | ± 3.9 % | ∞ |
| Boundary effects | ± 1.0 % | Rectangular | √ 3 | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| Probe linearity | ± 4.7 % | Rectangular | √ 3 | 1 | 1 | ± 2.7 % | ± 2.7 % | ∞ |
| System detection limits | ± 1.0 % | Rectangular | √ 3 | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| Modulation Response | ± 2.4 % | Rectangular | √ 3 | 1 | 1 | ± 1.4 % | ± 1.4 % | ∞ |
| Readout electronics | ± 0.3 % | Normal | 1 | 1 | 1 | ± 0.3 % | ± 0.3 % | ∞ |
| Response time | ± 0.8 % | Rectangular | √ 3 | 1 | 1 | ± 0.5 % | ± 0.5 % | ∞ |
| Integration time | ± 2.6 % | Rectangular | √ 3 | 1 | 1 | ± 1.5 % | ± 1.5 % | ∞ |
| RF ambient noise | ± 3.0 % | Rectangular | √ 3 | 1 | 1 | ± 1.7 % | ± 1.7 % | ∞ |
| RF ambient reflections | ± 3.0 % | Rectangular | √ 3 | 1 | 1 | ± 1.7 % | ± 1.7 % | ∞ |
| Probe positioner | ± 0.4 % | Rectangular | √ 3 | 1 | 1 | ± 0.2 % | ± 0.2 % | ∞ |
| Probe positioning | ± 2.9 % | Rectangular | √ 3 | 1 | 1 | ± 1.7 % | ± 1.7 % | ∞ |
| Max. SAR evaluation | ± 2.0 % | Rectangular | √ 3 | 1 | 1 | ± 1.2 % | ± 1.2 % | ∞ |
| **Test Sample Related** | | | | | | | | |
| Device positioning | ± 2.9 % | Normal | 1 | 1 | 1 | ± 2.9 % | ± 2.9 % | 145 |
| Device holder uncertainty | ± 3.6 % | Normal | 1 | 1 | 1 | ± 3.6 % | ± 3.6 % | 5 |
| Power drift | ± 5.0 % | Rectangular | √ 3 | 1 | 1 | ± 2.9 % | ± 2.9 % | ∞ |
| **Phantom and Set-up** | | | | | | | | |
| Phantom uncertainty | ± 6.1 % | Rectangular | √ 3 | 1 | 1 | ± 3.5 % | ± 3.5 % | ∞ |
| SAR correction | ± 1.9 % | Rectangular | √ 3 | 1 | 0.84 | ± 1.1 % | ± 0.9 % | ∞ |
| Liquid conductivity (meas.) | ± 5.0 % | Rectangular | √ 3 | 0.78 | 0.71 | ± 2.3 % | ± 2.0 % | ∞ |
| Liquid permittivity (meas.) | ± 5.0 % | Rectangular | √ 3 | 0.26 | 0.26 | ± 0.8 % | ± 0.8 % | ∞ |
| Temp. Unc. - Conductivity | ± 3.4 % | Rectangular | √ 3 | 0.78 | 0.71 | ± 1.5 % | ± 1.4 % | ∞ |
| Temp. Unc. - Permittivity | ± 0.4 % | Rectangular | √ 3 | 0.23 | 0.26 | ± 0.1 % | ± 0.1 % | ∞ |
| **Combined Uncertainty** | | | | | | ± 11.3 % | ± 11.3 % | 330 |
| **Expanded Std. Uncertainty** | | | | | | ± **22.7** % | ± **22.5** % | |

Table 8: Measurement uncertainties
Worst-Case uncertainty budget for DASY5 assessed according to IEEE 1528/2013 and IEC 62209-1/2011 standards. The budget is valid for the frequency range 300MHz -3 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerable smaller.

| DASY5 Uncertainty Budget<br>According to IEC 62209-2/2010 for the 30 MHz - 6 GHz range | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Source of uncertainty | ncertainty Valu<br>± % | Probability Distribution | Divisor | $c_i$<br>(1g) | $c_i$<br>(10g) | Standard Uncertainty<br>± %, (1g) | Standard Uncertainty<br>± %, (10g) | $v_i^2$ or $v_{eff}$ |
| **Measurement System** | | | | | | | | |
| Probe calibration | ± 6.6 % | Normal | 1 | 1 | 1 | ± 6.6 % | ± 6.6 % | ∞ |
| Axial isotropy | ± 4.7 % | Rectangular | √ 3 | 0.7 | 0.7 | ± 1.9 % | ± 1.9 % | ∞ |
| Hemispherical isotropy | ± 9.6 % | Rectangular | √ 3 | 0.7 | 0.7 | ± 3.9 % | ± 3.9 % | ∞ |
| Boundary effects | ± 2.0 % | Rectangular | √ 3 | 1 | 1 | ± 1.2 % | ± 1.2 % | ∞ |
| Probe linearity | ± 4.7 % | Rectangular | √ 3 | 1 | 1 | ± 2.7 % | ± 2.7 % | ∞ |
| System detection limits | ± 1.0 % | Rectangular | √ 3 | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| Modulation Response | ± 2.4 % | Rectangular | √ 3 | 1 | 1 | ± 1.4 % | ± 1.4 % | ∞ |
| Readout electronics | ± 0.3 % | Normal | 1 | 1 | 1 | ± 0.3 % | ± 0.3 % | ∞ |
| Response time | ± 0.8 % | Rectangular | √ 3 | 1 | 1 | ± 0.5 % | ± 0.5 % | ∞ |
| Integration time | ± 2.6 % | Rectangular | √ 3 | 1 | 1 | ± 1.5 % | ± 1.5 % | ∞ |
| RF ambient noise | ± 3.0 % | Rectangular | √ 3 | 1 | 1 | ± 1.7 % | ± 1.7 % | ∞ |
| RF ambient reflections | ± 3.0 % | Rectangular | √ 3 | 1 | 1 | ± 1.7 % | ± 1.7 % | ∞ |
| Probe positioner | ± 0.8 % | Rectangular | √ 3 | 1 | 1 | ± 0.5 % | ± 0.5 % | ∞ |
| Probe positioning | ± 6.7 % | Rectangular | √ 3 | 1 | 1 | ± 3.9 % | ± 3.9 % | ∞ |
| Post-processing | ± 4.0 % | Rectangular | √ 3 | 1 | 1 | ± 2.3 % | ± 2.3 % | ∞ |
| **Test Sample Related** | | | | | | | | |
| Device positioning | ± 2.9 % | Normal | 1 | 1 | 1 | ± 2.9 % | ± 2.9 % | 145 |
| Device holder uncertainty | ± 3.6 % | Normal | 1 | 1 | 1 | ± 3.6 % | ± 3.6 % | 5 |
| Power drift | ± 5.0 % | Rectangular | √ 3 | 1 | 1 | ± 2.9 % | ± 2.9 % | ∞ |
| **Phantom and Set-up** | | | | | | | | |
| Phantom uncertainty | ± 7.9 % | Rectangular | √ 3 | 1 | 1 | ± 4.6 % | ± 4.6 % | ∞ |
| SAR correction | ± 1.9 % | Rectangular | √ 3 | 1 | 0.84 | ± 1.1 % | ± 0.9 % | ∞ |
| Liquid conductivity (meas.) | ± 5.0 % | Rectangular | √ 3 | 0.78 | 0.71 | ± 2.3 % | ± 2.0 % | ∞ |
| Liquid permittivity (meas.) | ± 5.0 % | Rectangular | √ 3 | 0.26 | 0.26 | ± 0.8 % | ± 0.8 % | ∞ |
| Temp. Unc. - Conductivity | ± 3.4 % | Rectangular | √ 3 | 0.78 | 0.71 | ± 1.5 % | ± 1.4 % | ∞ |
| Temp. Unc. - Permittivity | ± 0.4 % | Rectangular | √ 3 | 0.23 | 0.26 | ± 0.1 % | ± 0.1 % | ∞ |
| **Combined Uncertainty** | | | | | | ± 12.7 % | ± 12.6 % | 330 |
| **Expanded Std. Uncertainty** | | | | | | ± **25.4** % | ± **25.3** % | |

Table 9: Measurement uncertainties.
Worst-Case uncertainty budget for DASY5 assessed according to according to IEC 62209-2/2010 standard. The budget is valid for the frequency range 30MHz - 6 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerable smaller.

### 6.1.12 Measurement uncertainty evaluation for System Check

| Uncertainty of a System Performance Check with DASY5 System for the 0.3 - 3 GHz range | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Source of uncertainty | Uncertainty Value | Probability Distribution | Divisor | $c_i$ (1g) | $c_i$ (10g) | Standard Uncertainty ± %, (1g) | Standard Uncertainty ± %, (10g) | $v_i^2$ or $v_{eff}$ |
| **Measurement System** | | | | | | | | |
| Probe calibration | ± 6.0 % | Normal | 1 | 1 | 1 | ± 6.0 % | ± 6.0 % | ∞ |
| Axial isotropy | ± 4.7 % | Rectangular | √ 3 | 0.7 | 0.7 | ± 1.9 % | ± 1.9 % | ∞ |
| Hemispherical isotropy | ± 0.0 % | Rectangular | √ 3 | 0.7 | 0.7 | ± 0.0 % | ± 0.0 % | ∞ |
| Boundary effects | ± 1.0 % | Rectangular | √ 3 | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| Probe linearity | ± 4.7 % | Rectangular | √ 3 | 1 | 1 | ± 2.7 % | ± 2.7 % | ∞ |
| System detection limits | ± 1.0 % | Rectangular | √ 3 | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| Readout electronics | ± 0.3 % | Normal | 1 | 1 | 1 | ± 0.3 % | ± 0.3 % | ∞ |
| Response time | ± 0.0 % | Rectangular | √ 3 | 1 | 1 | ± 0.0 % | ± 0.0 % | ∞ |
| Integration time | ± 0.0 % | Rectangular | √ 3 | 1 | 1 | ± 0.0 % | ± 0.0 % | ∞ |
| RF ambient conditions | ± 3.0 % | Rectangular | √ 3 | 1 | 1 | ± 1.7 % | ± 1.7 % | ∞ |
| Probe positioner | ± 0.4 % | Rectangular | √ 3 | 1 | 1 | ± 0.2 % | ± 0.2 % | ∞ |
| Probe positioning | ± 2.9 % | Rectangular | √ 3 | 1 | 1 | ± 1.7 % | ± 1.7 % | ∞ |
| Max. SAR evaluation | ± 1.0 % | Rectangular | √ 3 | 1 | 1 | ± 0.6 % | ± 0.6 % | ∞ |
| **Test Sample Related** | | | | | | | | |
| Dev. of experimental dipole | ± 0.0 % | Rectangular | √ 3 | 1 | 1 | ± 0.0 % | ± 0.0 % | ∞ |
| Source to liquid distance | ± 2.0 % | Rectangular | √ 3 | 1 | 1 | ± 1.2 % | ± 1.2 % | ∞ |
| Power drift | ± 3.4 % | Rectangular | √ 3 | 1 | 1 | ± 2.0 % | ± 2.0 % | ∞ |
| **Phantom and Set-up** | | | | | | | | |
| Phantom uncertainty | ± 4.0 % | Rectangular | √ 3 | 1 | 1 | ± 2.3 % | ± 2.3 % | ∞ |
| SAR correction | ± 1.9 % | Rectangular | √ 3 | 1 | 0.84 | ± 1.1 % | ± 0.9 % | ∞ |
| Liquid conductivity (meas.) | ± 5.0 % | Normal | 1 | 0.78 | 0.71 | ± 3.9 % | ± 3.6 % | ∞ |
| Liquid permittivity (meas.) | ± 5.0 % | Normal | 1 | 0.26 | 0.26 | ± 1.3 % | ± 1.3 % | ∞ |
| Temp. unc. - Conductivity | ± 1.7 % | Rectangular | √ 3 | 0.78 | 0.71 | ± 0.8 % | ± 0.7 % | ∞ |
| Temp. unc. - Permittivity | ± 0.3 % | Rectangular | √ 3 | 0.23 | 0.26 | ± 0.0 % | ± 0.0 % | ∞ |
| **Combined Uncertainty** | | | | | | ± 9.1 % | ± 8.9 % | 330 |
| **Expanded Std. Uncertainty** | | | | | | ± **18.2** % | ± **17.9** % | |

Table 10: Measurement uncertainties of the System Check with DASY5 (0.3-3GHz)

Note: Worst case probe calibration uncertainty has been applied for all probes used during the measurements.

### 6.1.13 System check

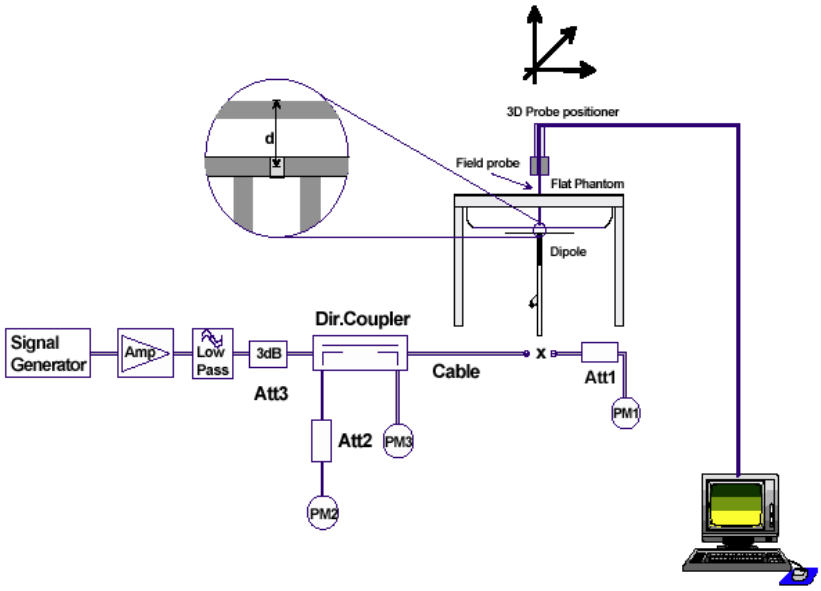
The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system check is performed with tissue equivalent material according to IEEE 1528. The following table shows system check results for all frequency bands and tissue liquids used during the tests (plot(s) see annex A).

| System performence check (1000 mW) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| System validation Kit | Probe / SN | Frequency | Target $SAR_{1g}$ /mW/g (+/- 10%) | Target $SAR_{10g}$ /mW/g (+/- 10%) | Measured $SAR_{1g}$ / mW/g | $SAR_{1g}$ dev. | Measured $SAR_{10g}$ / mW/g | $SAR_{10g}$ dev. | Measured date |
| D835V2 S/N: 4d153 | ES3DV3 3320 | 835 MHz head | 9.58 | 6.21 | 9.87 | 3.0% | 6.53 | 5.2% | 2015-02-06 |
| D835V2 S/N: 4d153 | EX3DV4 3944 | 835 MHz body | 9.40 | 6.12 | 9.75 | 3.7% | 6.46 | 5.6% | 2015-02-11 |
| D1900V2 S/N: 5d009 | ES3DV3 3320 | 1900 MHz head | 40.10 | 21.00 | 40.80 | 1.7% | 21.30 | 1.4% | 2015-02-09 |
| D1900V2 S/N: 5d009 | EX3DV4 3944 | 1900 MHz body | 40.90 | 21.70 | 40.90 | 0.0% | 21.60 | -0.5% | 2015-02-10 |

Table 11: Results system check

## 6.1.14 System check procedure

The system check is performed by using a validation dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a plexiglass spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 1000 mW for frequencies below 2 GHz or 100 mW for frequencies above 2 GHz. 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 validation to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test (result on plot).
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.



### 6.1.15 System validation

The system validation is performed in a similar way as a system check. It needs to be performed once a SAR measurement system has been established and allows an evaluation of the system accuracy with all components used together with the specified system. It has to be repeated at least once a year or when new system components are used (DAE, probe, phantom, dipole, liquid type).
In addition to the procedure used during system check a system validation also includes checks of probe isotropy, probe modulation factor and RF signal.

The following table lists the system validations relevant for this test report:

| Frequency (MHz) | Test System | DASY SW | Dipole Type /SN | Probe Type / SN | Calibrated signal type(s) | DAE unit Type / SN | head validation | body validation |
|---|---|---|---|---|---|---|---|---|
| 835 | Saarbrücken / SAR-2 | V52.8.7 | D835V2 / 4d153 | ES3DV3 / 3320 | CW | DAE3/ 477 | 2014-07-02 | 2014-07-02 |
| 1900 | Saarbrücken / SAR-2 | V52.8.7 | D1900V2 / 5d009 | ES3DV3 / 3320 | CW | DAE3/ 477 | 2014-07-14 | 2014-07-10 |
| 835 | Saarbrücken / SAR-2 | V52.8.7 | D835V2 / 4d153 | EX3DV4 / 3944 | CW | DAE3/ 477 | | 2015-02-11 |
| 1900 | Saarbrücken / SAR-2 | V52.8.7 | D1900V2 / 5d009 | EX3DV4 / 3944 | CW | DAE3/ 477 | | 2015-02-10 |

# 7 Detailed Test Results

## 7.1 Conducted power measurements

For the measurements the Rohde & Schwarz Radio Communication Tester CMU 200 was used.
The output power was measured using an integrated RF connector and attached RF cable.
The conducted output power was also checked before and after each SAR measurement. The resulting power values were within a 0.2 dB tolerance of the values shown below.

Note: CMU200 measures GSM peak and average output power for active timeslots.
For SAR the time based 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 | 1: 4 | 1 : 2.66 | 1 : 2 |
| time based avg. power compared to slotted avg. power | - 9 dB | - 6 dB | - 4.25 dB | - 3 dB |

The signalling modes differ as follows :

| ***mode*** | ***coding scheme*** | ***modulation*** |
|---|---|---|
| GPRS | CS1 to CS4 | GMSK |
| EGPRS (EDGE) | MCS1 to MCS4 | GMSK |
| EGPRS (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 GSM 850 MHz

| Conducted output power GSM 850 MHz (dBm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SN: 4402740222165 | | | Slotted avg. power | | | Time based avg. power | | |
| Slot configuration | Tuning target (dBm) | Upper limit (dBm) | CH 128 824.2 MHz | CH 190 836.6 MHz | CH 251 848.8 MHz | CH 128 824.2 MHz | CH 190 836.6 MHz | CH 251 848.8 MHz |
| GSM 1-slot | **32.5** | **32.9** | 32.5 | 32.1 | 32.4 | 23.5 | 23.1 | 23.4 |
| GPRS 2-slot | **31.5** | **31.9** | 31.7 | 31.3 | 31.6 | **25.7** | 25.3 | 25.6 |
| GPRS 3-slot | **29.5** | **29.9** | 29.6 | 29.2 | 29.5 | 25.3 | 24.9 | 25.2 |
| GPRS 4-slot | **28.0** | **28.4** | 28.1 | 27.9 | 28.1 | 25.1 | 24.9 | 25.1 |
| EGRPS 1-slot | **26.4** | **26.8** | 26.3 | 25.9 | 26.1 | 17.3 | 16.9 | 17.1 |
| EGPRS 2-slot | **26.0** | **26.4** | 25.9 | 25.6 | 25.7 | 19.9 | 19.6 | 19.7 |
| EGPRS 3-slot | **25.5** | **25.9** | 25.4 | 25.1 | 25.3 | 21.1 | 20.8 | 21.0 |
| EGPRS 4-slot | **25.0** | **25.4** | 25.2 | 24.9 | 25.1 | 22.2 | 21.9 | 22.1 |

Table 12: Test results conducted power measurement GSM 850 MHz

### 7.1.2 Conducted power measurements GSM 1900 MHz

| Conducted output power GSM 1900 MHz (dBm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SN: 4402740222082 | | | Slotted avg. power | | | Time based avg. power | | |
| Slot configuration | Tuning target (dBm) | Upper limit (dBm) | CH 512 1850.2 MHz | CH 661 1880.0 MHz | CH 810 1909.8 MHz | CH 512 1850.2 MHz | CH 661 1880.0 MHz | CH 810 1909.8 MHz |
| GSM 1-slot | **29.5** | **29.9** | 29.9 | 29.9 | 29.8 | 20.9 | 20.9 | 20.8 |
| GPRS 2-slot | **29.5** | **29.9** | 29.6 | 29.7 | 29.6 | 23.6 | **23.7** | 23.6 |
| GPRS 3-slot | **27.5** | **27.9** | 27.6 | 27.7 | 27.7 | 23.3 | 23.4 | 23.4 |
| GPRS 4-slot | **26.1** | **26.5** | 26.4 | 26.4 | 26.4 | 23.4 | 23.4 | 23.4 |
| EGRPS 1-slot | **26.0** | **26.4** | 25.7 | 25.7 | 25.7 | 16.7 | 16.7 | 16.7 |
| EGPRS 2-slot | **26.0** | **26.4** | 25.7 | 25.6 | 25.5 | 19.7 | 19.6 | 19.5 |
| EGPRS 3-slot | **25.5** | **25.9** | 25.5 | 25.4 | 25.4 | 21.2 | 21.1 | 21.1 |
| EGPRS 4-slot | **25.0** | **25.4** | 25.0 | 25.0 | 24.9 | 22.0 | 22.0 | 21.9 |

Table 13: Test results conducted power measurement GSM 1900 MHz

### 7.1.3 Justification of SAR measurements in GSM mode

SAR measurements were performed in the configuration with highest calculated time based averaged output power.

### 7.1.4 Conducted power measurements UMTS FDD V (850 MHz)

| SN: 4402740222165 | Max. RMS output power 850 MHz (FDD V) / dBm | | | | |
|---|---|---|---|---|---|
| Mode | Tuning target | Upper limit | CH 4132 826.4 MHz | CH 4175 835.0 MHz | CH 4233 846.6 MHz |
| WCDMA | **23.5** | **23.9** | 23.3 | 23.3 | 23.3 |
| HSUPA Sub-mode 1 | **22** | **22.4** | 22.2 | 21.7 | 21.8 |
| HSUPA Sub-mode 2 | **21.5** | **21.9** | 21.2 | 21.3 | 21.2 |
| HSUPA Sub-mode 3 | **21.2** | **21.6** | 21.2 | 20.9 | 20.8 |
| HSUPA Sub-mode 4 | **21.9** | **22.3** | 21.9 | 21.9 | 21.8 |
| HSUPA Sub-mode 5 | **22.5** | **22.9** | 22.3 | 22.3 | 22.4 |
| DC-HSDPA Sub-mode 1 | **22.5** | **22.9** | 22.2 | 22.2 | 22.2 |
| DC-HSDPA Sub-mode 2 | **22.5** | **22.9** | 22.3 | 22.2 | 22.2 |
| DC-HSDPA Sub-mode 3 | **22** | **22.4** | 22.7 | 21.8 | 22.8 |
| DC-HSDPA Sub-mode 4 | **22** | **22.4** | 21.8 | 21.7 | 21.8 |

Table 14: Test results conducted power measurement UMTS FDD V 850MHz

### 7.1.5 Conducted power measurements UMTS FDD II (1900 MHz)

| SN: 4402740222082 | Max. RMS output power UMTS FDD II 1900 MHz / dBm | | | | |
|---|---|---|---|---|---|
| Mode | Tuning target | Upper limit | CH 9262 1852.4 MHz | CH 9400 1880.0 MHz | CH 9538 1907.6 MHz |
| WCDMA | **23** | **23.4** | 23.1 | 22.9 | 22.9 |
| HSUPA Sub-mode 1 | **21.8** | **22.2** | 21.9 | 21.9 | 21.6 |
| HSUPA Sub-mode 2 | **20.5** | **20.9** | 21.1 | 20.9 | 20.8 |
| HSUPA Sub-mode 3 | **20.7** | **21.1** | 20.7 | 20.9 | 20.6 |
| HSUPA Sub-mode 4 | **21.3** | **21.7** | 21.5 | 21.3 | 21.5 |
| HSUPA Sub-mode 5 | **22** | **22.4** | 22.1 | 22.0 | 22.0 |
| DC-HSDPA Sub-mode 1 | **22** | **22.4** | 22.3 | 22.2 | 22.2 |
| DC-HSDPA Sub-mode 2 | **22** | **22.4** | 22.3 | 22.2 | 22.2 |
| DC-HSDPA Sub-mode 3 | **21.5** | **21.9** | 21.8 | 21.7 | 21.7 |
| DC-HSDPA Sub-mode 4 | **21.5** | **21.9** | 21.8 | 21.7 | 21.7 |

Table 15: Test results conducted power measurement UMTS FDD II 1900MHz

Remark: None of the HSDPA/HSUPA settings leads to conducted power values exceeding the conducted power in RMC mode by more than 0.25 dB.
Therefore no additional SAR measurements were performed in HSDPA/HSUPA mode.

### 7.1.6 Test-set-up information for WCDMA / HSPDA / HSUPA

a) WCDMA RMC

In RMC (reference measurement channel) mode the conducted power at 4 different bit rates was measured. They correspond with the used spreading factors as follows:

| ***Bit rate*** | ***12.2 kbit/s*** | ***64 kbit/s*** | ***144 kbit/s*** | ***384 kbit/s*** |
|---|---|---|---|---|
| Spreading factor (SF) | 64 | 16 | 8 | 4 |

In RMC mode only DPCCH and DPDCH are active. As bit rate changes do not influence the relative power of any code channel the measured RMS output power remains on the same level which is set to maximum by TPC (Transmit power control) pattern type 'All 1'.

b) HSDPA

HSDPA adds the HS-DPCCH in uplink as a control channel for high speed data transfer in downlink.
In HSDPA mode 4 sub-tests are defined by 3GPP 34.121 according to the following table:

| **Sub-test** | $\beta_c$ | $\beta_d$ | $\beta_d$ **(SF)** | $\beta_c/\beta_d$ | $\beta_{hs}$ **(1)** | **CM(dB)(2)** |
|---|---|---|---|---|---|---|
| 1 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 0.0 |
| 2 | 12/15(3) | 15/15(3) | 64 | 12/15(3) | 24/15 | 1.0 |
| 3 | 15/15 | 8/15 | 64 | 15/8 | 30/15 | 1.5 |
| 4 | 15/15 | 4/15 | 64 | 15/4 | 30/15 | 1.5 |

Note 1: $\Delta_{ACK}$, $\Delta_{NACK}$, $\Delta_{CQI}$ = 8 $\Longleftrightarrow$ $A_{hs} = \beta_{hs}/\beta_c$ = 30/15 $\Longleftrightarrow$ $\beta_{hs}$ = 30/15 * $\beta_c$
Note 2 : CM = 1 for $\beta_c/\beta_d$ = 12/15, $\beta_{hs}/\beta_c$ = 24/15
Note 3 : For subtest 2 the $\beta_c/\beta_d$ 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 16: Sub-tests for UMTS Release 5 HSDPA

The $\beta_c$ and $\beta_d$ gain factors for DPCCH and DPDCH were set according to the values in the above table, $\beta_{hs}$ for HS-DPCCH is set automatically to the correct value when $\Delta_{ACK}$, $\Delta_{NACK}$, $\Delta_{CQI}$ = 8. The variation of the $\beta_c/\beta_d$ ratio causes a power reduction at sub-tests 2 - 4.
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 17: settings of required H-Set 1 QPSK acc. to 3GPP 34.121

b) DC-HSDPA (3GPP Release 8)

Dual Cell – HSDPA has been signalized using the following settings for connection setup:

| Parameter<br>During Connection Setup | Value |
|---|---|
| P-CPICH_Ec/Ior | -10 dB |
| P-CCPCH | -12 |
| SCH_Ec/Ior | -12 |
| PICH_Ec/Ior | -15 |
| HS-PDSCH | off |
| HS-SCCH_1 | off |
| DPCH_Ec/Ior | -5 |
| OCNS_Ec/Ior | -3.1 |

Table 18: Downlink Physical Channels according to 3GPP 34.121 Table E.5.0

The fixed reference channel has been set to H-set 12 according to 3GPP TS 34.121 Table C.8.1.12:

| Parameter | Unit | Value |
|---|---|---|
| Nominal Average Inf. Bit Rate | kbit/s | 60 |
| Inter-TTI Distance | TTI's | 1 |
| Information Bit Payload ($N_{INF}$) | Bits | 120 |
| Number Code Blocks | Blocks | 1 |
| Binary Channel Bits Per TTI | Bits | 960 |
| Total Available SML's in UE | SML's | 19200 |
| Number of SML's per HARQ Process | SML's | 3200 |
| Coding Rate | | 0.15 |
| Number of Physical Channel Codecs | Codecs | 1 |
| Modulation | | QPSK |
| Note 1: The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table.<br>Note 2: Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used. | | |

Table 19: H-Set 12 QPSK configuration

The same Sub-test settings as for Release 5 HSDPA were used for the tests.

c) HSUPA

In HSUPA mode additional code channels (E-DPCCH, E-DPDCHn) are added for data transfer in uplink at higher bit rates.

5 sub-tests are defined by 3GPP 34.121 according to the following table :

| Sub-test | $\beta_c$ | $\beta_d$ | $\beta_d$ (SF) | $\beta_c/\beta_d$ | $\beta_{hs}$(1) | $\beta_{ec}$ | $\beta_{ed}$ | $\beta_{ec}$ (SF) | $\beta_{ed}$ (code) | CM(2) (dB) | MPR (dB) | AG(4) Index | E-TFCI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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<br>$\beta_{ed2}$: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: $\Delta_{ACK}$, $\Delta_{NACK}$, $\Delta_{CQI}$ = 8 $\Longleftrightarrow$ $A_{hs} = \beta_{hs}/\beta_c = 30/15 \Longleftrightarrow \beta_{hs} = 30/15 * \beta_c$
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 $\beta_c/\beta_d$ 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 $\beta_c/\beta_d$ 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 : $\beta_{ed}$ can not be set directly; it is set by Absolute Grant Value

Table 20: Subtests for UMTS Release 6 HSUPA

To achieve the settings above some additional procedures were defined by 3GPP 34.121. Those have been included in an application note for the CMU200 and were exactly followed :

- Test mode connection (BS signal tab) :
RMC 12.2 kbit/s + HSPA 34.108 with loop mode 1
- HS-DSCH settings (BS signal tab):
- FRC with H-set 1 QPSK
- ACK-NACK repetition factor = 3
- CQI feedback cycle = 4ms
- CQI repetition factor = 2
- HSUPA-specific signalling settings (UE signal tab) :
- E-TFCI table index = 0
- E-DCH minimum set E-TFCI = 9
- Puncturing limit non-max = 0.84
- max. number of channelisation codes = 2x SF4
- Initial Serving Grant Value = Off
- HSDPA and HSUPA Gain factors (UE signal tab)

| *Sub-test* | $\beta_c$ | $\beta_d$ | $\Delta_{ACK}$, $\Delta_{NACK}$, $\Delta_{CQI}$ | $\Delta$E–DPCCH )* |
|---|---|---|---|---|
| 1 | 10 | 15 | 8 | 6 |
| 2 | 6 | 15 | 8 | 8 |
| 3 | 15 | 9 | 8 | 8 |
| 4 | 2 | 15 | 8 | 5 |
| 5 | 14 | 15 | 8 | 7 |

)* : $\beta_{ec}$ and $\beta_{ed}$ ratios (relative to $\beta_c$ and $\beta_d$) are set by $\Delta$E–DPCCH

- HSUPA Reference E-TFCIs (UE signal tab > HSUPA gain factors) :

| ***Sub-test*** | **1, 2, 4, 5** | | | | |
|---|---|---|---|---|---|
| Number of E-TFCIs | 5 | | | | |
| Reference E-TFCI | 11 | 67 | 71 | 75 | 81 |
| Reference E-TFCI power offset | 4 | 18 | 23 | 26 | 27 |

| ***Sub-test*** | **3** | |
|---|---|---|
| Number of E-TFCIs | 2 | |
| Reference E-TFCI | 11 | 92 |
| Reference E-TFCI power offset | 4 | 18 |

- HSUPA-specific generator parameters (BS Signal tab > HSUPA > E-AGCH > AG Pattern)

| ***Sub-test*** | ***Absolute Grant Value (AG Index)*** |
|---|---|
| 1 | 20 |
| 2 | 12 |
| 3 | 15 |
| 4 | 17 |
| 5 | 21 |

- Power Level settings (BS Signal tab > Node B-settings):
- Level reference: Output Channel Power (Ior)
- Output Channel Power (Ior): -86 dBm

- Downlink Physical Channel Settings (BS signal tab)
- P-CPICH: -10 dB
- S-CPICH: Off
- P-SCH : -15 dB
- S-SCH : -15 dB
- P-CCPCH: -12 dB
- S-CCPCH: -12 dB
- PICH : -15 dB
- AICH : -12 dB
- DPDCH : -10 dB
- HS-SCCH : -8 dB
- HS-PDSCH : -3 dB
- E-AGCH : -20 dB
- E-RGCH/E-HICH - 20 dB
- E-RGCH Active: Off

The settings above were stored once for each sub-test and recalled before the measurement.

HSUPA test procedure:

To reach maximum output power in HSUPA mode the following procedures were followed:

3 different TPC patterns were defined:
Set 1: Closed loop with target power 10 dBm
Set 2: Single Pattern+Alternating with binary pattern '11111' for 1 dB steps 'up'
Set 3: Single Pattern+Alternating with binary pattern '00000' for 1 dB steps 'down'

After recalling a certain HSUPA sub-test the HSUPA E-AGCH graph with E-TFCI event counter is displayed. After starting with the closed loop command the power is increased in 1 dB steps by activating pattern set 2 until the UE decreases the transmitted E-TFCI.
At this point set 3 is activated once to reduce the output power to the value at which the original E-TFCI, which is required for the sub-test, appears again.

For conducted power measurements the same steps are repeated in the power menu to read out the corresponding maximum RMS output power with the target E-TFCI.
For SAR measurements it is useful to switch to Code Domain Power vs. Time display.
Here the CMU200 shows relative power values (max. and min.) of each code channel which should roughly correspond to the numerators of the gain factors e.g.:

| **Sub-test** | $\beta_c$ | $\beta_d$ | $\beta_{hs}$ | $\beta_{ec}$ | $\beta_{ed}$ |
|---|---|---|---|---|---|
| 5 | 15 | 15 | 30 | 24 | 134 |

By this way a surveillance of signalling conditions is possible to make sure that HSUPA code channels are active during the complete SAR measurement.

### 7.1.7 Conducted power measurements WLAN 2450 MHz

#### 7.1.7.1 Earpiece 'ON'

| 802.11b | | maximum average conducted output power [dBm] | | | |
|---|---|---|---|---|---|
| Band | Ch | 1Mbps | 2Mbps | 5.5Mbps | 11Mbps |
| 2450MHz | 1 | 15.4 | 15.5 | 15.9 | 15.6 |
| | 6 | 15.4 | 15.6 | 15.6 | 15.6 |
| | 11 | **15.7** | 15.6 | 15.7 | 15.5 |

Table 21: Test results conducted power measurement 802.11b

| 802.11g | | maximum average conducted output power [dBm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Band | Ch | 6Mbps | 9Mbps | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps |
| 2450MHz | 1 | 11.6 | 11.3 | 11.6 | 11.3 | 11.5 | 11.3 | 11.6 | 11.5 |
| | 6 | 15.5 | 15.5 | 15.3 | 15.3 | 15.4 | 15.3 | 15.1 | 13.2 |
| | 11 | 12.2 | 12.3 | 12.2 | 12.4 | 12.4 | 12.3 | 12.3 | 12.1 |

Table 22: Test results conducted power measurement 802.11g

| 802.11n HT-20 | | maximum average conducted output power [dBm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Band | Ch | MCS-0 6.5Mbps | MCS-1 13Mbps | MCS-2 19.5Mbps | MCS-3 26Mbps | MCS-4 39Mbps | MCS-5 52Mbps | MCS-6 58.5Mbps | MCS-7 65Mbps |
| 2450MHz | 1 | 11.6 | 11.6 | 11.4 | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 |
| | 6 | 15.5 | 15.5 | 15.5 | 15.6 | 15.5 | 14.5 | 12.1 | 11.2 |
| | 11 | 12.2 | 12.5 | 12.2 | 12.4 | 12.3 | 12.3 | 12.3 | 11.2 |

Table 23: Test results conducted power measurement 802.11n HT-20

### 7.1.7.2 Earpiece 'OFF'

| 802.11b | | maximum average conducted output power [dBm] | | | |
|---|---|---|---|---|---|
| Band | Ch | 1Mbps | 2Mbps | 5.5Mbps | 11Mbps |
| 2450MHz | 1 | 17.1 | 17.0 | 17.2 | 17.2 |
| | 6 | 18.0 | 18.2 | 18.5 | 18.3 |
| | 11 | **18.3** | 18.3 | 18.5 | 18.4 |

Table 24: Test results conducted power measurement 802.11b

| 802.11g | | maximum average conducted output power [dBm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Band | Ch | 6Mbps | 9Mbps | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps |
| 2450MHz | 1 | 11.6 | 11.3 | 11.6 | 11.3 | 11.5 | 11.3 | 11.6 | 11.5 |
| | 6 | 16.2 | 16.2 | 16.3 | 16.3 | 16.3 | 16.3 | 15.1 | 13.2 |
| | 11 | 12.2 | 12.3 | 12.2 | 12.4 | 12.4 | 12.3 | 12.3 | 12.1 |

Table 25: Test results conducted power measurement 802.11g

| 802.11n HT-20 | | maximum average conducted output power [dBm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Band | Ch | MCS-0 6.5Mbps | MCS-1 13Mbps | MCS-2 19.5Mbps | MCS-3 26Mbps | MCS-4 39Mbps | MCS-5 52Mbps | MCS-6 58.5Mbps | MCS-7 65Mbps |
| 2450MHz | 1 | 11.6 | 11.6 | 11.4 | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 |
| | 6 | 16.3 | 16.4 | 16.4 | 16.4 | 15.5 | 14.5 | 12.1 | 11.2 |
| | 11 | 12.2 | 12.5 | 12.2 | 12.4 | 12.3 | 12.3 | 12.3 | 11.2 |

Table 26: Test results conducted power measurement 802.11n HT-20

### 7.1.8 Standalone SAR Test Exclusion

| Standalone SAR test exclusion considerations for **Head** position | | | | | |
|---|---|---|---|---|---|
| Communication system | freq. (MHz) | $P_{avg}$* (dBm) | $P_{avg}$* (mW) | **threshold$_{1-g}$ comparison value** | SAR test exclusion |
| GSM 850 | 835 | 25.7 | 371.5 | 67.9 | no |
| GSM 1900 | 1900 | 23.7 | 234.4 | 64.6 | no |
| UMTS FDD II | 1900 | 23.4 | 218.8 | 60.3 | no |
| UMTS FDD V | 835 | 23.9 | 245.5 | 44.9 | no |
| WLAN 2450 | 2450 | 16.5 | 44.7 | 14.0 | no |
| Bluetooth 2450 | 2450 | 9.7 | 9.3 | 2.9 | yes |

Table 27: Standalone SAR test exclusion considerations in **head position**

| Standalone SAR test exclusion considerations for **Hot spot mode** position | | | | | | |
|---|---|---|---|---|---|---|
| Communication system | freq. (MHz) | distance (mm) | $P_{avg}$* (dBm) | $P_{avg}$* (mW) | **threshold$_{1-g}$ comparison value** | SAR test exclusion |
| GSM 850 | 835 | 10 | 25.7 | 371.5 | 34.0 | no |
| GSM 1900 | 1900 | 10 | 23.7 | 234.4 | 32.3 | no |
| UMTS FDD II | 1900 | 10 | 23.4 | 218.8 | 30.2 | no |
| UMTS FDD V | 835 | 10 | 23.9 | 245.5 | 22.4 | no |
| WLAN 2450 | 2450 | 10 | 19.0 | 79.4 | 12.4 | no |
| Bluetooth 2450 | 2450 | 10 | 9.7 | 9.3 | 1.5 | yes |

Table 28: Standalone SAR test exclusion considerations in **hotspot mode position**

$P_{avg}$* - maximum possible output power declared by manufacturer

The **1-g SAR test exclusion thresholds** for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:
[(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] · [√f(GHz)] ≤ **3.0** for 1-g SAR, where:

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

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

| Standalone SAR test exclusion considerations for **Body worn** position | | | | | | |
|---|---|---|---|---|---|---|
| Communication system | freq. (MHz) | distance (mm) | $P_{avg}$* (dBm) | $P_{avg}$* (mW) | **threshold$_{1-g}$ comparison value** | SAR test exclusion |
| GSM 850 | 835 | 15 | 25.7 | 371.5 | 22.6 | no |
| GSM 1900 | 1900 | 15 | 23.7 | 234.4 | 21.5 | no |
| UMTS FDD II | 1900 | 15 | 23.4 | 218.8 | 20.1 | no |
| UMTS FDD V | 835 | 15 | 23.9 | 245.5 | 15.0 | no |
| WLAN 2450 | 2450 | 15 | 19.0 | 79.4 | 8.3 | no |
| Bluetooth 2450 | 2450 | 15 | 9.7 | 9.3 | 1.0 | yes |

Table 29: Standalone SAR test exclusion considerations in **body position**

$P_{avg}$* - maximum possible output power declared by manufacturer

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

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

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion

### 7.1.9 Hotspot mode SAR measurement positions

| Hotspot mode SAR measurement positions | | | | | | |
|---|---|---|---|---|---|---|
| mode | front | rear | left edge | right edge | top edge | bottom edge |
| GSM 850 | yes | yes | yes | yes | no | yes |
| GSM 1900 | yes | yes | yes | yes | no | yes |
| WCDMA FDD II | yes | yes | yes | yes | no | yes |
| WCDMA FDD V | yes | yes | yes | yes | no | yes |
| WLAN 2450 | yes | yes | yes | yes | yes | no |

The edges with less than 2.5 cm distance to the TX antennas need to be tested for hotspot SAR.

Antenna dimensions and separation distances see in Annex Photo documentation

## 7.2 SAR test results

### 7.2.1 General description of test procedures

- The **GSM** and **UMTS SAR measurements** were performed at **worst case positons** from test report 1-7605/14-01-02-A at **low, middle and high** channels (**class II permissive change** according to FCC KDB 178919 D01)

- The DUT is tested using CMU 200 communication tester as controller unit to set test channels and maximum output power to the DUT, as well as for measuring the conducted peak power.
- Test positions as described in the tables above are in accordance with the specified test standard.
- Tests with GSM were performed in the configuration with highest calculated time based averaged output power (see conducted power results).
- UMTS was tested in RMC mode with 12.2 kbit/s and TPC bits set to 'all 1'.
- WLAN was tested in 802.11b mode with 1 MBit/s. According to KDB 248227 the SAR testing for 802.11g/n is not required since the maximum power of 802.11g/n is less ¼ dB higher than maximum power of 802.11b.
- Required WLAN test channels were selected according to KDB 248227
- 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 15 mm from the body. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.
- According to FCC KDB pub 941225 D06 this device has been tested with 10 mm distance to the phantom for operation in WLAN hot spot mode.
- Per FCC KDB pub 941225 D06 the edges with antennas within 2.5 cm are required to be evaluated for SAR to cover WLAN hot spot function.
- For SAR measurements test samples with fixed **power back off** have been used in **WLAN 2450** mode for all configurations that require power back off during normal operation **in voice call**.
- According to IEEE 1528 the SAR test shall be performed at middle channel. Testing of top and bottom channel is optional.
- According to KDB 447498 D01 testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
  - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
  - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
  - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
- IEEE 1528-2013 require the middle channel to be tested first. This generally applies to wireless devices that are designed to operate in technologies with tight tolerances for maximum output power variations across channels in the band. When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.

### 7.2.2 Results overview

| measured / extrapolated SAR numbers - Head - GSM 850 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | time slots | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) |
| | | | | declared** | measured | meas. | extrapol. | meas. | extrap. | | |
| 128 | 824.2 | 2 | left cheek | 31.4 | 31.0 | 0.747 | 0.819 | 0.584 | 0.640 | 0.02 | 21.3 |
| 190 | 836.6 | 2 | left cheek | 31.4 | 30.8 | 0.846 | 0.971 | 0.663 | 0.761 | 0.11 | 21.3 |
| 251 | 848.8 | 2 | left cheek | 31.4 | 30.8 | **0.917** | **1.053** | 0.712 | 0.817 | 0.00 | 21.3 |
| 190 | 836.6 | 2 | left tilted 15° | 31.4 | 30.8 | 0.448 | 0.514 | 0.354 | 0.406 | 0.01 | 21.3 |
| 128 | 824.2 | 2 | right cheek | 31.4 | 31.0 | 0.687 | 0.753 | 0.538 | 0.590 | 0.07 | 21.3 |
| 190 | 836.6 | 2 | right cheek | 31.4 | 30.8 | 0.778 | 0.893 | 0.610 | 0.700 | -0.04 | 21.3 |
| 251 | 848.8 | 2 | right cheek | 31.4 | 30.8 | 0.877 | 1.007 | 0.677 | 0.777 | 0.14 | 21.3 |
| 190 | 836.6 | 2 | right tilted 15° | 31.4 | 30.8 | 0.433 | 0.497 | 0.339 | 0.389 | 0.10 | 21.3 |
| 251 | 848.8 | 2 | left cheek* | 31.4 | 30.8 | 0.912 | 1.047 | 0.713 | 0.819 | 0.08 | 21.3 |
| EGPRS 3TS (8PSK) | | | | | | | | | | | |
| 251 | 848.8 | 3 | left cheek | 26.6 | 26.2 | 0.431 | 0.473 | 0.335 | 0.367 | -0.12 | 21.3 |
| **measured / extrapolated SAR numbers - Head - GSM 850 MHz** | | | | | | | | | | | |
| Ch. | Freq. (MHz) | time slots | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) |
| | | | | declared** | measured | measured | extrapolated | meas. | extrap. | | |
| 128 | 824.2 | 2 | left cheek | 31.9 | 31.7 | 0.864 | 0.905 | 0.671 | 0.703 | 0.04 | 22.2 |
| 190 | 836.6 | 2 | left cheek | 31.9 | 31.3 | 1.040 | 1.194 | 0.799 | 0.917 | -0.04 | 22.2 |
| 251 | 848.8 | 2 | left cheek | 31.9 | 31.6 | **1.140** | **1.222** | 0.881 | 0.944 | 0.04 | 22.2 |

Table 30: Test results head SAR GSM 850MHz GMSK **2TS** in uplink (see max. SAR plot in Annex B.1: GSM 850MHz page 62)

| measured / extrapolated SAR numbers - hotspot mode - GSM 850 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | time slots | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 128 | 824.2 | 2 | front | 31.4 | 31.0 | 0.786 | 0.862 | 0.613 | 0.672 | -0.010 | 22.6 | 10 |
| 190 | 836.6 | 2 | front | 31.4 | 30.8 | 0.870 | 0.999 | 0.678 | 0.778 | 0.030 | 22.6 | 10 |
| 251 | 848.8 | 2 | front | 31.4 | 30.8 | 0.902 | 1.036 | 0.699 | 0.803 | 0.040 | 22.6 | 10 |
| 128 | 824.2 | 2 | rear | 31.4 | 31.0 | 0.889 | 0.975 | 0.689 | 0.755 | -0.030 | 22.6 | 10 |
| 190 | 836.6 | 2 | rear | 31.4 | 30.8 | 0.960 | 1.102 | 0.740 | 0.850 | 0.070 | 22.6 | 10 |
| 251 | 848.8 | 2 | rear | 31.4 | 30.8 | **1.010** | **1.160** | **0.774** | 0.889 | -0.030 | 22.6 | 10 |
| 190 | 836.6 | 2 | left edge | 31.4 | 30.8 | 0.491 | 0.564 | 0.344 | 0.395 | -0.020 | 22.6 | 10 |
| 190 | 836.6 | 2 | right edge | 31.4 | 30.8 | 0.489 | 0.561 | 0.339 | 0.389 | 0.100 | 22.6 | 10 |
| 190 | 836.6 | 2 | bottom edge | 31.4 | 30.8 | 0.086 | 0.099 | 0.053 | 0.061 | -0.060 | 22.6 | 10 |
| 251 | 848.8 | 2 | rear* | 31.4 | 30.8 | 0.996 | 1.144 | 0.767 | 0.881 | -0.030 | 22.6 | 10 |
| **measured / extrapolated SAR numbers - hotspot mode - GSM 850 MHz** | | | | | | | | | | | | |
| Ch. | Freq. (MHz) | time slots | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | measured | extrapol. | meas. | extrap. | | | |
| 128 | 824.2 | 2 | rear | 31.9 | 31.7 | 0.914 | 0.957 | 0.706 | 0.739 | -0.02 | 22.7 | 10 |
| 190 | 836.6 | 2 | rear | 31.9 | 31.3 | 1.030 | 1.183 | 0.797 | 0.915 | 0.01 | 22.7 | 10 |
| 251 | 848.8 | 2 | rear | 31.9 | 31.6 | 1.160 | 1.243 | 0.893 | 0.957 | 0.01 | 22.7 | 10 |
| 251 | 848.8 | 2 | rear* | 31.9 | 31.6 | **1.170** | **1.254** | **0.904** | **0.969** | 0.01 | 22.7 | 10 |

Table 31: Test results hotspot mode SAR GSM 850 MHz (see max. SAR plot in Annex B.1: GSM 850MHz

Top edge position for hotspot mode is not required since the distance from the main antenna to the edge is greater than 2.5 cm.

| measured / extrapolated SAR numbers - Body worn - GSM 850 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | time slots | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 128 | 824.2 | 2 | front | 31.4 | 31.0 | 0.676 | 0.741 | 0.521 | 0.571 | -0.010 | 22.6 | 15 |
| 190 | 836.6 | 2 | front | 31.4 | 30.8 | 0.719 | 0.826 | 0.555 | 0.637 | -0.030 | 22.6 | 15 |
| 251 | 848.8 | 2 | front | 31.4 | 30.8 | 0.777 | 0.892 | 0.595 | 0.683 | -0.050 | 22.6 | 15 |
| 128 | 824.2 | 2 | rear | 31.4 | 31.0 | 0.725 | 0.795 | 0.555 | 0.609 | 0.030 | 22.6 | 15 |
| 190 | 836.6 | 2 | rear | 31.4 | 30.8 | 0.789 | 0.906 | 0.602 | 0.691 | -0.060 | 22.6 | 15 |
| 251 | 848.8 | 2 | rear | 31.4 | 30.8 | **0.835** | **0.959** | 0.636 | 0.730 | 0.040 | 22.6 | 15 |
| **measured / extrapolated SAR numbers - Body worn - GSM 850 MHz** | | | | | | | | | | | | |
| Ch. | Freq. (MHz) | time slots | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | measured | extrapol. | meas. | extrap. | | | |
| 128 | 824.2 | 2 | rear | 31.9 | 31.7 | 0.775 | 0.812 | 0.592 | 0.620 | -0.02 | 22.7 | 15 |
| 190 | 836.6 | 2 | rear | 31.9 | 31.3 | 0.863 | 0.991 | 0.658 | 0.755 | -0.03 | 22.7 | 15 |
| 251 | 848.8 | 2 | rear | 31.9 | 31.6 | **0.937** | **1.004** | 0.713 | 0.764 | -0.01 | 22.7 | 15 |

Table 32: Test results body worn SAR GSM 850 MHz (see max. SAR plot in Annex B.1: GSM 850MHz)

* - repeated at the highest SAR measurement according to the FCC KDB 865664
** - maximum possible output power declared by manufacturer

| measured / extrapolated SAR numbers - Head - GSM 1900 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | time slots | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | |
| 512 | 1850.2 | 2 | left cheek | 29.4 | 29.0 | 0.812 | 0.890 | 0.522 | 0.572 | -0.080 | 21.7 |
| 661 | 1880.0 | 2 | left cheek | 29.4 | 29.2 | 0.869 | 0.910 | 0.550 | 0.576 | -0.030 | 21.7 |
| 810 | 1909.8 | 2 | left cheek | 29.4 | 29.2 | 0.840 | 0.880 | 0.529 | 0.554 | 0.000 | 21.7 |
| 661 | 1880.0 | 2 | left tilted 15° | 29.4 | 29.2 | 0.401 | 0.420 | 0.257 | 0.269 | 0.020 | 21.7 |
| 661 | 1880.0 | 2 | right cheek | 29.4 | 29.2 | 0.566 | 0.593 | 0.377 | 0.395 | -0.050 | 21.7 |
| 661 | 1880.0 | 2 | right tilted 15° | 29.4 | 29.2 | 0.476 | 0.498 | 0.296 | 0.310 | 0.000 | 21.7 |
| 661 | 1880.0 | 2 | left cheek* | 29.4 | 29.2 | **0.887** | **0.929** | 0.563 | 0.590 | -0.070 | 21.7 |
| EGPRS 4TS (8PSK) | | | | | | | | | | | |
| 661 | 1880.0 | 4 | left cheek | 25.4 | 24.8 | 0.663 | 0.761 | 0.420 | 0.482 | 0.000 | 21.7 |
| **measured / extrapolated SAR numbers - Head - GSM 1900 MHz** | | | | | | | | | | | |
| Ch. | Freq. (MHz) | time slots | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ (W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | |
| 512 | 1850.2 | 2 | left cheek | 29.9 | 29.6 | 0.902 | 0.967 | 0.576 | 0.617 | -0.01 | 22.6 |
| 661 | 1880.0 | 2 | left cheek | 29.9 | 29.7 | 0.901 | 0.943 | 0.569 | 0.596 | 0.07 | 22.6 |
| 810 | 1909.8 | 2 | left cheek | 29.9 | 29.6 | 0.869 | 0.931 | 0.544 | 0.583 | -0.01 | 22.6 |
| 512 | 1850.2 | 2 | left cheek* | 29.9 | 29.6 | **0.908** | **0.973** | 0.579 | 0.620 | 0.03 | 22.6 |

Table 33: Test results head SAR GSM 1900MHz GMSK **2TS** in uplink (see max. SAR plot Annex B.2: GSM 1900MHz page 65)

| measured/extrapolated SAR numbers - hotspot mode - GSM 1900MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | time slots | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 661 | 1880.0 | 2 | front | 29.4 | 29.2 | 0.698 | 0.731 | 0.462 | 0.484 | -0.030 | 22.2 | 10 |
| 512 | 1850.2 | 2 | rear | 29.4 | 29.0 | 0.715 | 0.784 | 0.472 | 0.518 | -0.070 | 22.2 | 10 |
| 661 | 1880.0 | 2 | rear | 29.4 | 29.2 | 0.779 | 0.816 | 0.417 | 0.437 | -0.050 | 22.2 | 10 |
| 810 | 1909.8 | 2 | rear | 29.4 | 29.2 | **0.799** | **0.837** | 0.423 | 0.443 | -0.050 | 22.2 | 10 |
| 661 | 1880.0 | 2 | left edge | 29.4 | 29.2 | 0.584 | 0.612 | 0.357 | 0.374 | -0.030 | 22.2 | 10 |
| 661 | 1880.0 | 2 | right edge | 29.4 | 29.2 | 0.220 | 0.230 | 0.135 | 0.141 | 0.030 | 22.2 | 10 |
| 661 | 1880.0 | 2 | bottom edge | 29.4 | 29.2 | 0.280 | 0.293 | 0.152 | 0.159 | -0.050 | 22.2 | 10 |
| **measured / extrapolated SAR numbers - hotspot mode - GSM 1900 MHz** | | | | | | | | | | | | |
| Ch. | Freq. (MHz) | time slots | Position | cond. $P_{max}$ (dBm) | | SAR1g (W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 512 | 1850.2 | 2 | rear | 29.9 | 29.6 | **0.788** | **0.844** | 0.518 | 0.555 | 0.03 | 22.8 | 10 |
| 661 | 1880.0 | 2 | rear | 29.9 | 29.7 | 0.712 | 0.746 | 0.464 | 0.486 | -0.01 | 22.8 | 10 |
| 810 | 1909.8 | 2 | rear | 29.9 | 29.6 | 0.726 | 0.778 | 0.465 | 0.498 | 0.01 | 22.8 | 10 |

Table 34: Test results hotspot mode SAR GSM 1900 MHz (see max. SAR plot Annex B.2: GSM 1900MHz)
Top edge position for hotspot mode is not required since the distance from the main antenna to the edge is greater than 2.5 cm.

* - repeated at the highest SAR measurement according to the FCC KDB 865664
** - maximum possible output power declared by manufacturer

| measured / extrapolated SAR numbers - Body worn - GSM 1900 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | time slots | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 512 | 1850.2 | 2 | front | 29.4 | 29.2 | 0.444 | 0.465 | 0.294 | 0.308 | -0.080 | 22.2 | 15 |
| 661 | 1880.0 | 2 | front | 29.4 | 29.2 | 0.460 | 0.482 | 0.304 | 0.318 | 0.060 | 22.2 | 15 |
| 810 | 1909.8 | 2 | front | 29.4 | 29.2 | **0.492** | **0.515** | 0.321 | 0.336 | -0.010 | 22.2 | 15 |
| 661 | 1880.0 | 2 | rear | 29.4 | 29.2 | 0.440 | 0.461 | 0.290 | 0.304 | 0.050 | 22.2 | 15 |
| **measured / extrapolated SAR numbers - Body worn - GSM 1900 MHz** | | | | | | | | | | | | |
| Ch. | Freq. (MHz) | time slots | Position | cond. $P_{max}$ (dBm) | | SAR1g (W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 512 | 1850.2 | 2 | front | 29.9 | 29.6 | 0.496 | 0.531 | 0.326 | 0.349 | 0.04 | 22.8 | 15 |
| 661 | 1880.0 | 2 | front | 29.9 | 29.7 | 0.540 | 0.565 | 0.353 | 0.370 | 0.02 | 22.8 | 15 |
| 810 | 1909.8 | 2 | front | 29.9 | 29.6 | **0.559** | **0.599** | 0.361 | 0.387 | -0.01 | 22.8 | 15 |

Table 35: Test results body worn SAR GSM 1900 MHz (see max. SAR plot Annex B.2: GSM 1900MHz)

| measured / extrapolated SAR numbers - Head - UMTS FDD II 1880 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | |
| 9262 | 1852.4 | RMC | left cheek | 23.4 | 23.1 | 0.735 | 0.788 | 0.473 | 0.507 | -0.040 | 21.7 |
| 9400 | 1880.0 | RMC | left cheek | 23.4 | 22.9 | 0.793 | 0.890 | 0.507 | 0.569 | -0.040 | 21.7 |
| 9538 | 1907.6 | RMC | left cheek | 23.4 | 22.9 | **0.853** | **0.957** | 0.539 | 0.605 | -0.030 | 21.7 |
| 9400 | 1880.0 | RMC | left tilted 15° | 23.4 | 22.9 | 0.316 | 0.355 | 0.203 | 0.228 | -0.030 | 21.7 |
| 9400 | 1880.0 | RMC | right cheek | 23.4 | 22.9 | 0.515 | 0.578 | 0.342 | 0.384 | 0.020 | 21.7 |
| 9400 | 1880.0 | RMC | right tilted 15° | 23.4 | 22.9 | 0.379 | 0.425 | 0.236 | 0.265 | 0.070 | 21.7 |
| 9538 | 1907.6 | RMC | left cheek* | 23.4 | 22.9 | 0.790 | 0.886 | 0.501 | 0.562 | 0.000 | 21.7 |
| **measured / extrapolated SAR numbers - Head - UMTS FDD II 1880 MHz** | | | | | | | | | | | |
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | |
| 9262 | 1852.4 | RMC | left cheek | 23.4 | 23.1 | 0.851 | 0.912 | 0.542 | 0.581 | 0.04 | 22.6 |
| 9400 | 1880.0 | RMC | left cheek | 23.4 | 22.9 | 0.870 | 0.976 | 0.549 | 0.616 | 0.08 | 22.6 |
| 9538 | 1907.6 | RMC | left cheek | 23.4 | 22.9 | **0.873** | **0.980** | 0.545 | 0.612 | 0.01 | 22.6 |
| 9538 | 1907.6 | RMC | left cheek* | 23.4 | 22.9 | 0.872 | 0.978 | 0.544 | 0.610 | 0.03 | 22.6 |

Table 36: Test results head SAR UMTS FDD II 1880 MHz (see max. SAR plot Annex B.3: UMTS FDD II page 68)

* - repeated at the highest SAR measurement according to the FCC KDB 865664
** - maximum possible output power declared by manufacturer

| measured / extrapolated SAR numbers - hotspot mode - UMTS FDD II 1880 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 9262 | 1852.4 | RMC | front | 23.4 | 23.1 | 0.614 | 0.658 | 0.408 | 0.437 | 0.010 | 22.2 | 10 |
| 9400 | 1880.0 | RMC | front | 23.4 | 22.9 | 0.658 | 0.738 | 0.435 | 0.488 | -0.030 | 22.2 | 10 |
| 9538 | 1907.6 | RMC | front | 23.4 | 22.9 | **0.699** | **0.784** | 0.458 | 0.514 | -0.030 | 22.2 | 10 |
| 9400 | 1880.0 | RMC | rear | 23.4 | 22.9 | 0.620 | 0.696 | 0.337 | 0.378 | 0.000 | 22.2 | 10 |
| 9400 | 1880.0 | RMC | left edge | 23.4 | 22.9 | 0.602 | 0.675 | 0.366 | 0.411 | -0.020 | 22.2 | 10 |
| 9400 | 1880.0 | RMC | right edge | 23.4 | 22.9 | 0.260 | 0.292 | 0.158 | 0.177 | 0.000 | 22.2 | 10 |
| 9400 | 1880.0 | RMC | bottom edge | 23.4 | 22.9 | 0.276 | 0.310 | 0.153 | 0.172 | 0.020 | 22.2 | 10 |

| measured / extrapolated SAR numbers - hotspot mode - UMTS FDD II 1880 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 9262 | 1852.4 | RMC | front | 23.4 | 23.1 | 0.712 | 0.763 | 0.470 | 0.504 | 0.06 | 22.8 | 10 |
| 9400 | 1880.0 | RMC | front | 23.4 | 22.9 | 0.754 | 0.846 | 0.496 | 0.557 | 0.08 | 22.8 | 10 |
| 9538 | 1907.6 | RMC | front | 23.4 | 22.9 | **0.776** | **0.871** | 0.506 | 0.568 | -0.02 | 22.8 | 10 |

Test results hotspot mode SAR UMTS FDD II 1880 MHz (see max. SAR plot Annex B.3: UMTS FDD II)

| measured / extrapolated SAR numbers - Body worn - UMTS FDD II 1880 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 9262 | 1852.4 | RMC | front | 23.4 | 23.1 | 0.407 | 0.436 | 0.270 | 0.289 | -0.010 | 22.2 | 15 |
| 9400 | 1880.0 | RMC | front | 23.4 | 22.9 | 0.449 | 0.504 | 0.294 | 0.330 | -0.170 | 22.2 | 15 |
| 9538 | 1907.6 | RMC | front | 23.4 | 22.9 | **0.458** | **0.514** | 0.298 | 0.334 | -0.020 | 22.2 | 15 |
| 9400 | 1880.0 | RMC | rear | 23.4 | 22.9 | 0.364 | 0.408 | 0.240 | 0.269 | 0.000 | 22.2 | 15 |
| **measured / extrapolated SAR numbers - Body worn - UMTS FDD II 1880 MHz** | | | | | | | | | | | | |
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 9262 | 1852.4 | RMC | front | 23.4 | 23.1 | 0.497 | 0.533 | 0.328 | 0.351 | -0.02 | 22.8 | 15 |
| 9400 | 1880.0 | RMC | front | 23.4 | 22.9 | 0.531 | 0.596 | 0.347 | 0.389 | -0.08 | 22.8 | 15 |
| 9538 | 1907.6 | RMC | front | 23.4 | 22.9 | **0.557** | **0.625** | 0.364 | 0.408 | 0.00 | 22.8 | 15 |

Table 37: Test results body worn SAR UMTS FDD II 1880MHz (see max. SAR plot Annex B.3: UMTS FDD II)

| measured / extrapolated SAR numbers - Head - UMTS FDD V 850 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | |
| 4132 | 826.4 | RMC | left cheek | 23.9 | 23.4 | 0.633 | 0.710 | 0.494 | 0.554 | 0.030 | 21.3 |
| 4182 | 836.4 | RMC | left cheek | 23.9 | 23.4 | 0.648 | 0.727 | 0.505 | 0.567 | 0.020 | 21.3 |
| 4233 | 846.6 | RMC | left cheek | 23.9 | 23.5 | **0.692** | **0.759** | 0.533 | 0.584 | 0.000 | 21.3 |
| 4182 | 836.4 | RMC | left tilted 15° | 23.9 | 23.4 | 0.130 | 0.146 | 0.103 | 0.116 | 0.120 | 21.3 |
| 4182 | 836.4 | RMC | right cheek | 23.9 | 23.4 | 0.639 | 0.717 | 0.499 | 0.560 | 0.020 | 21.3 |
| 4182 | 836.4 | RMC | right tilted 15° | 23.9 | 23.4 | 0.371 | 0.416 | 0.292 | 0.328 | 0.010 | 21.3 |
| **measured / extrapolated SAR numbers - Head - UMTS FDD V 850 MHz** | | | | | | | | | | | |
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | |
| 4132 | 826.4 | RMC | left cheek | 23.9 | 23.3 | 0.599 | 0.688 | 0.457 | 0.525 | 0.12 | 22.2 |
| 4182 | 836.4 | RMC | left cheek | 23.9 | 23.3 | 0.650 | 0.746 | 0.492 | 0.565 | 0.03 | 22.2 |
| 4233 | 846.6 | RMC | left cheek | 23.9 | 23.3 | **0.695** | **0.798** | **0.527** | **0.605** | 0.04 | 22.2 |

Table 38: Test results head SAR UMTS FDD V 850 MHz (see max. SAR plot Annex B.4: UMTS FDD V page 71)

| measured / extrapolated SAR numbers - hotspot mode - UMTS FDD V 850 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 4182 | 836.4 | RMC | front | 23.9 | 23.4 | 0.702 | 0.788 | 0.549 | 0.616 | 0.040 | 22.2 | 10 |
| 4132 | 826.4 | RMC | rear | 23.9 | 23.4 | 0.790 | 0.886 | 0.609 | 0.683 | 0.090 | 22.2 | 10 |
| 4182 | 836.4 | RMC | rear | 23.9 | 23.4 | 0.799 | 0.896 | 0.615 | 0.690 | 0.000 | 22.2 | 10 |
| 4233 | 846.6 | RMC | rear | 23.9 | 23.5 | 0.819 | 0.898 | 0.629 | 0.690 | 0.080 | 22.2 | 10 |
| 4182 | 836.4 | RMC | left edge | 23.9 | 23.4 | 0.525 | 0.589 | 0.366 | 0.411 | -0.040 | 22.2 | 10 |
| 4182 | 836.4 | RMC | right edge | 23.9 | 23.4 | 0.519 | 0.582 | 0.363 | 0.407 | 0.000 | 22.2 | 10 |
| 4182 | 836.4 | RMC | bottom edge | 23.9 | 23.4 | 0.071 | 0.080 | 0.044 | 0.049 | 0.020 | 22.2 | 10 |
| 4233 | 846.6 | RMC | rear* | 23.9 | 23.5 | **0.870** | **0.954** | 0.669 | 0.734 | -0.040 | 22.2 | 10 |
| **measured / extrapolated SAR numbers - hotspot mode - UMTS FDD V 850 MHz** | | | | | | | | | | | | |
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 4132 | 826.4 | RMC | rear | 23.9 | 23.3 | 0.776 | 0.891 | 0.597 | 0.685 | -0.03 | 22.7 | 10 |
| 4182 | 836.4 | RMC | rear | 23.9 | 23.3 | 0.770 | 0.884 | 0.591 | 0.679 | -0.01 | 22.7 | 10 |
| 4233 | 846.6 | RMC | rear | 23.9 | 23.3 | **0.786** | **0.902** | **0.601** | 0.690 | 0.03 | 22.7 | 10 |

Table 39: Test results hotspot mode SAR UMTS FDD V 850 MHz (see max. SAR plot Annex B.4: UMTS FDD V)
** - maximum possible output power declared by manufacturer

| measured / extrapolated SAR numbers - Body worn - UMTS FDD V 850 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 4182 | 836.4 | RMC | front | 23.9 | 23.4 | 0.611 | 0.686 | 0.470 | 0.527 | 0.000 | 22.2 | 15 |
| 4132 | 826.4 | RMC | rear | 23.9 | 23.4 | 0.633 | 0.710 | 0.483 | 0.542 | -0.010 | 22.2 | 15 |
| 4182 | 836.4 | RMC | rear | 23.9 | 23.4 | 0.639 | **0.717** | 0.487 | 0.546 | 0.010 | 22.2 | 15 |
| 4233 | 846.6 | RMC | rear | 23.9 | 23.5 | **0.648** | 0.711 | 0.494 | 0.542 | -0.010 | 22.2 | 15 |
| **measured / extrapolated SAR numbers - Body worn - UMTS FDD V 850 MHz** | | | | | | | | | | | | |
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 4132 | 826.4 | RMC | rear | 23.9 | 23.3 | **0.635** | **0.729** | **0.485** | **0.557** | -0.02 | 22.7 | 15 |
| 4182 | 836.4 | RMC | rear | 23.9 | 23.3 | 0.617 | 0.708 | 0.470 | 0.540 | -0.10 | 22.7 | 15 |
| 4233 | 846.6 | RMC | rear | 23.9 | 23.3 | 0.619 | 0.711 | 0.473 | 0.543 | 0.10 | 22.7 | 15 |

Table 40: Test results body worn SAR UMTS FDD V 850 MHz (see max. SAR plot Annex B.4: UMTS FDD V)

| measured / extrapolated SAR numbers - Head - WLAN 2450 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | |
| 1 | 2412 | 1Mbit/s | left cheek | 16.5 | 15.4 | 0.626 | 0.806 | 0.307 | 0.395 | 0.030 | 20.9 |
| 6 | 2437 | 1Mbit/s | left cheek | 16.5 | 15.4 | **0.632** | **0.814** | 0.312 | 0.402 | 0.110 | 20.9 |
| 11 | 2462 | 1Mbit/s | left cheek | 16.5 | 15.7 | 0.573 | 0.689 | 0.282 | 0.339 | 0.030 | 20.9 |
| 11 | 2462 | 1Mbit/s | left tilted 15° | 16.5 | 15.7 | 0.415 | 0.499 | 0.192 | 0.231 | 0.080 | 20.9 |
| 11 | 2462 | 1Mbit/s | right cheek | 16.5 | 15.7 | 0.283 | 0.340 | 0.155 | 0.186 | 0.010 | 20.9 |
| 11 | 2462 | 1Mbit/s | right tilted 15° | 16.5 | 15.7 | 0.215 | 0.258 | 0.110 | 0.132 | -0.020 | 20.9 |

Table 41: Test results head SAR WLAN 2450 MHz (see **test report 1-7605/14-01-02-A**)

| measured / extrapolated SAR numbers - hotspot mode - WLAN 2450 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 11 | 2462 | 1Mbit/s | front | 19.0 | 18.3 | 0.214 | 0.251 | 0.114 | 0.134 | 0.110 | 21.7 | 10 |
| 1 | 2412 | 1Mbit/s | rear | 18.0 | 17.1 | 0.247 | 0.304 | 0.117 | 0.144 | -0.020 | 21.7 | 10 |
| 6 | 2437 | 1Mbit/s | rear | 19.0 | 18.0 | **0.316** | **0.398** | 0.150 | 0.189 | 0.070 | 21.7 | 10 |
| 11 | 2462 | 1Mbit/s | rear | 19.0 | 18.3 | 0.294 | 0.345 | 0.137 | 0.161 | -0.010 | 21.7 | 10 |
| 11 | 2462 | 1Mbit/s | left edge | 19.0 | 18.3 | 0.040 | 0.047 | 0.014 | 0.017 | -0.080 | 21.7 | 10 |
| 11 | 2462 | 1Mbit/s | right edge | 19.0 | 18.3 | 0.119 | 0.140 | 0.066 | 0.078 | 0.110 | 21.7 | 10 |
| 11 | 2462 | 1Mbit/s | top edge | 19.0 | 18.3 | 0.091 | 0.107 | 0.049 | 0.057 | -0.060 | 21.7 | 10 |

Table 42: Test results hotspot mode SAR WLAN 2450 MHz (see **test report 1-7605/14-01-02-A**)
Bottom side edge positions for hotspot mode are not required since the distance from the WLAN antenna to the edge is greater than 2.5cm.

| measured / extrapolated SAR numbers - Body worn - WLAN 2450 MHz from test report 1-7605/14-01-02-A | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | Freq. (MHz) | test cond. | Position | cond. $P_{max}$ (dBm) | | $SAR_{1g}$ results(W/kg) | | $SAR_{10g}$ (W/kg) | | power drift (dB) | liquid (°C) | dist. (mm) |
| | | | | declared** | measured | meas. | extrap. | meas. | extrap. | | | |
| 11 | 2462 | 1Mbit/s | front | 19.0 | 18.3 | 0.104 | 0.122 | 0.058 | 0.068 | -0.010 | 21.7 | 15 |
| 1 | 2412 | 1Mbit/s | rear | 18.0 | 17.1 | 0.094 | 0.116 | 0.051 | 0.063 | 0.120 | 21.7 | 15 |
| 6 | 2437 | 1Mbit/s | rear | 19.0 | 18.0 | **0.128** | **0.161** | 0.066 | 0.083 | -0.030 | 21.7 | 15 |
| 11 | 2462 | 1Mbit/s | rear | 19.0 | 18.3 | 0.123 | 0.145 | 0.064 | 0.075 | -0.020 | 21.7 | 15 |

Table 43: Test results body worn SAR WLAN 2450 MHz (see **test report 1-7605/14-01-02-A**)
** - maximum possible output power declared by manufacturer

| Estimated stand alone SAR. | | | | | |
|---|---|---|---|---|---|
| Communication system | freq. (GHz) | distance (mm) | $P_{avg}$ (dBm) | $P_{avg}$ (mW) | estimated$_{1-g}$ (W/kg) |
| Bluetooth 2450 | 2.45 | 5 | 9.7 | 9.4 | 0.393 |
| Bluetooth 2450 | 2.45 | 15 | 9.7 | 9.4 | 0.131 |

Table 44: Estimated stand alone SARmax for Bluetooth 2450MHz head and body

### 7.2.3 Multiple Transmitter Information

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.

| reported SAR **WWAN** and **WLAN 2.4GHz**, **ΣSAR** evaluation, **SPLSRi** | | | | | | |
|---|---|---|---|---|---|---|
| Frequency band | Position | SARmax /W/kg | | **ΣSAR** | distance | **ratio** |
| | | WWAN | WLAN | <1.6W/kg | **Ri**, mm | ≤ 0.04 |
| GSM 850 | left cheek | 1.222 | 0.814 | **2.036** | 70.9 | 0.04 |
| | rear 10mm | 1.254 | 0.398 | **1.652** | 52.9 | 0.04 |
| | rear 15mm | 1.004 | 0.161 | 1.165 | | |
| GSM 1900 | left cheek | 0.973 | 0.814 | **1.787** | 82.2 | 0.03 |
| | rear 10mm | 0.844 | 0.398 | 1.242 | | |
| | front 15mm | 0.599 | 0.122 | 0.721 | | |
| UMTS FDD II | left cheek | 0.980 | 0.814 | **1.794** | 82.2 | 0.03 |
| | front 10mm | 0.871 | 0.251 | 1.122 | | |
| | front 15mm | 0.625 | 0.122 | 0.747 | | |
| WCDMA FDD V | left cheek | 0.798 | 0.814 | **1.612** | 73.8 | 0.03 |
| | rear 10mm | 0.902 | 0.398 | 1.300 | | |
| | rear 15mm | 0.729 | 0.161 | 0.890 | | |

Table 45: $SAR_{max}$ WWAN and **WLAN 2.4GHz**, ΣSAR evaluation, **$SPLSR_i$**

| reported SAR **WWAN** and **WLAN 2.4GHz**, Combined**SAR** evaluation | | | | |
|---|---|---|---|---|
| Frequency band | Position | SARmax /W/kg | | **Combined SAR** |
| | | WWAN | WLAN | <1.6W/kg |
| GSM 850 | left cheek | 1.222 | 0.814 | 1.290 |
| | rear 10mm | 1.254 | 0.398 | 1.330 |
| | rear 15mm | 1.004 | 0.161 | 1.040 |
| GSM 1900 | left cheek | 0.973 | 0.814 | 0.950 |
| | rear 10mm | 0.844 | 0.398 | 0.920 |
| | front 15mm | 0.599 | 0.122 | 0.682 |
| UMTS FDD II | left cheek | 0.980 | 0.814 | 0.974 |
| | front 10mm | 0.871 | 0.251 | 1.030 |
| | front 15mm | 0.625 | 0.122 | 0.713 |
| WCDMA FDD V | left cheek | 0.798 | 0.814 | 0.912 |
| | rear 10mm | 0.902 | 0.398 | 0.971 |
| | rear 15mm | 0.729 | 0.161 | 0.780 |

Table 46: $SAR_{max}$ WWAN and **WLAN 2.4GHz**, Combined SAR evaluation (worst case see in Annex B.5: Combined Multi Band Fast SAR page 74 )

| reported SAR **WWAN** and **Bluetooth 2.4GHz**, **ΣSAR** evaluation, **SPLSRi** | | | | | | |
|---|---|---|---|---|---|---|
| Frequency band | Position | SARmax /W/kg | | **ΣSAR** | distance | **ratio** |
| | | WWAN | Bluetooth | <1.6W/kg | **Ri**, mm | ≤ 0.04 |
| GSM 850 | left cheek | 1.222 | 0.393 | **1.615** | 115.5 | 0.018 |
| | rear 15mm | 1.004 | 0.131 | 1.135 | | |
| GSM 1900 | left cheek | 0.973 | 0.393 | 1.366 | | |
| | front 15mm | 0.599 | 0.131 | 0.730 | | |
| UMTS FDD II | left cheek | 0.980 | 0.393 | 1.373 | | |
| | front 15mm | 0.625 | 0.131 | 0.756 | | |
| WCDMA FDD V | left cheek | 0.798 | 0.393 | 1.191 | | |
| | rear 15mm | 0.729 | 0.131 | 0.860 | | |

Table 47: $SAR_{max}$ WWAN and **Bluetooth 2450MHz**, ΣSAR evaluation

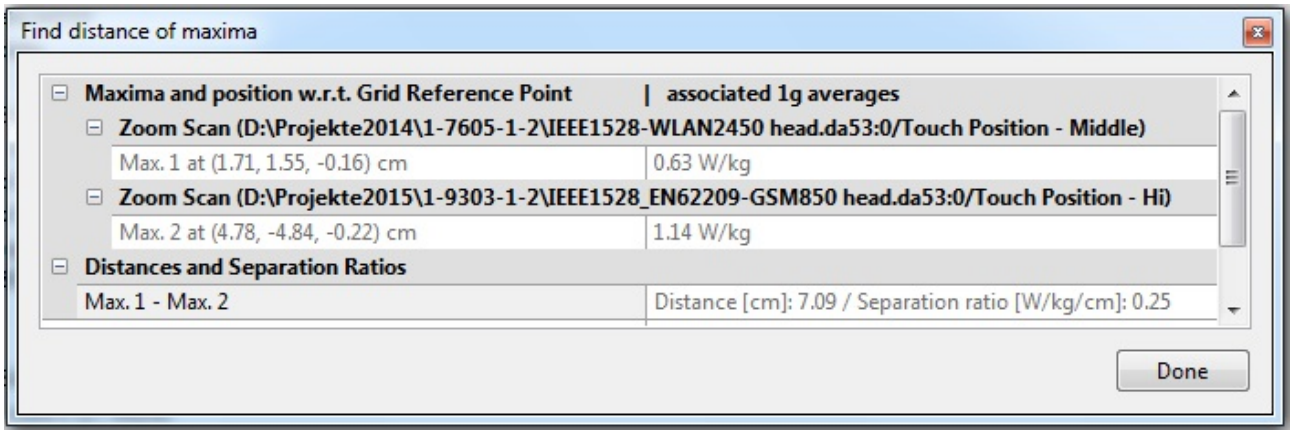
Minimum antenna separation distance between MAIN antenna and Bluetooth antenna – **115.5 mm**

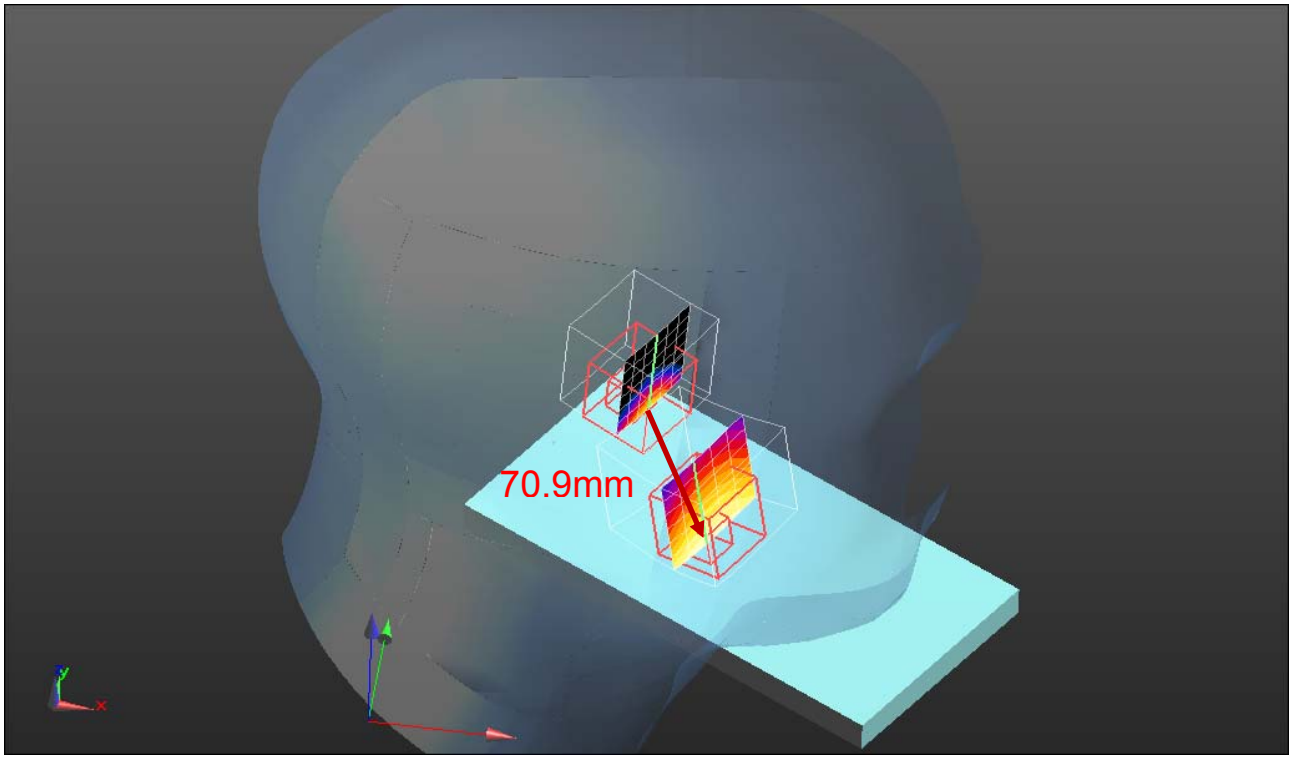
## Conclusion:

ΣSAR > 1.6 W/kg, but SAR-to-(peak-locations spacing) **ratio** (**SPLSR**$_i$) is less than **0.04** therefore simultaneous transmissions SAR measurement with the enlarged zoom scan measurement and volume scan post-processing procedures is **not** required.

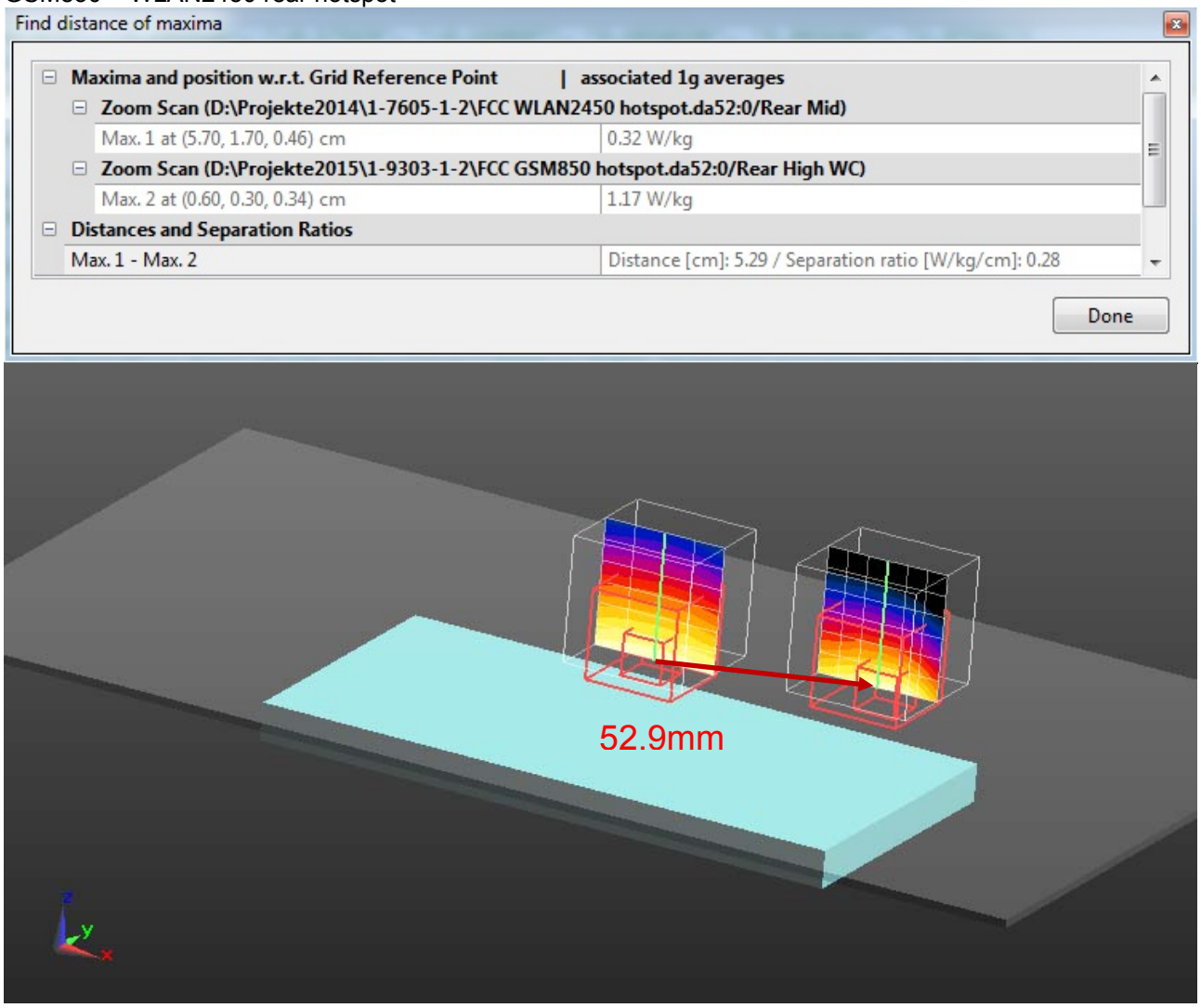
### 7.2.4 SAR peak location separation

GSM850 + WLAN2450 left cheek

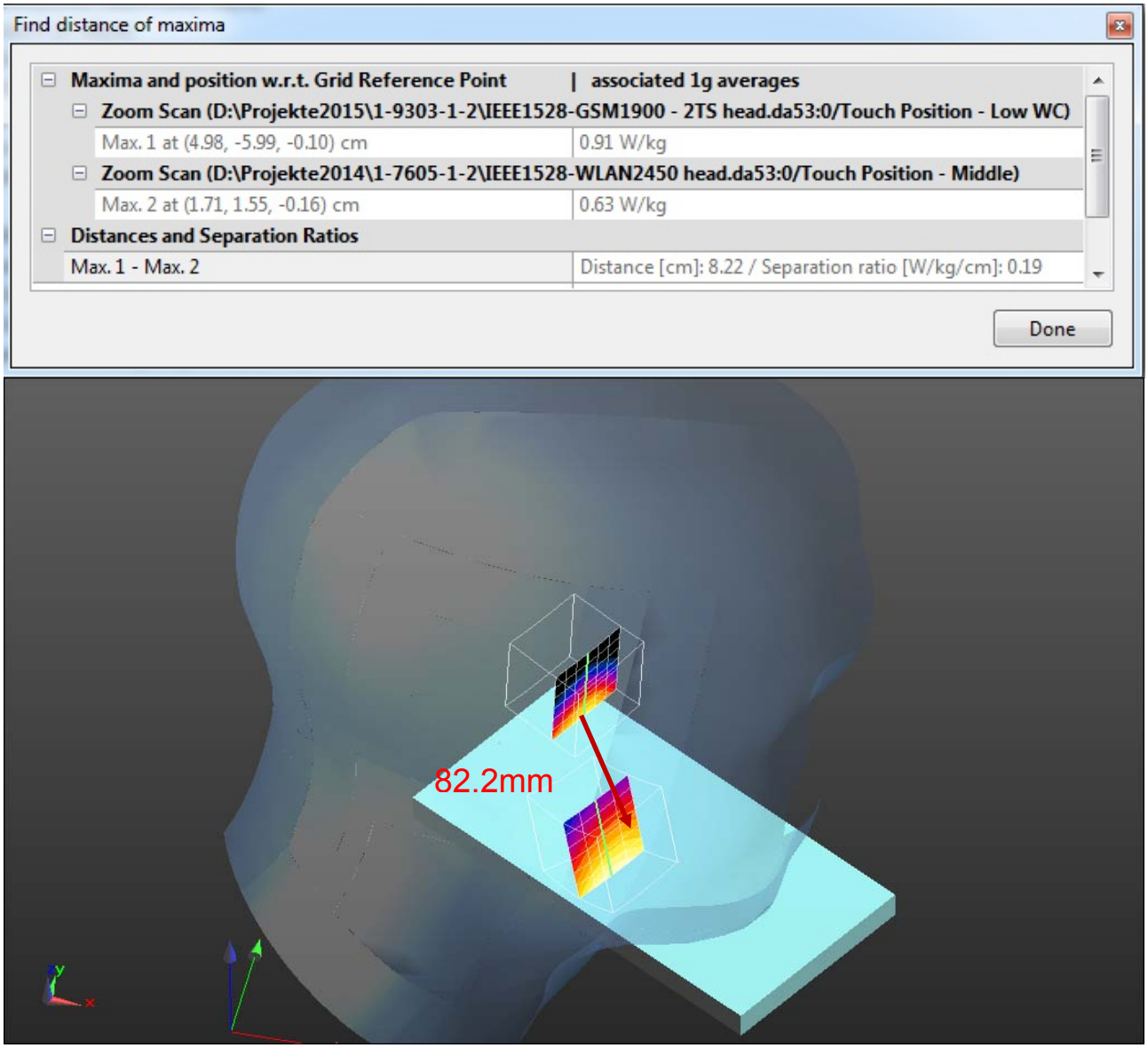


GSM850 + WLAN2450 rear hotspot



GSM1900 + WLAN2450 left cheek

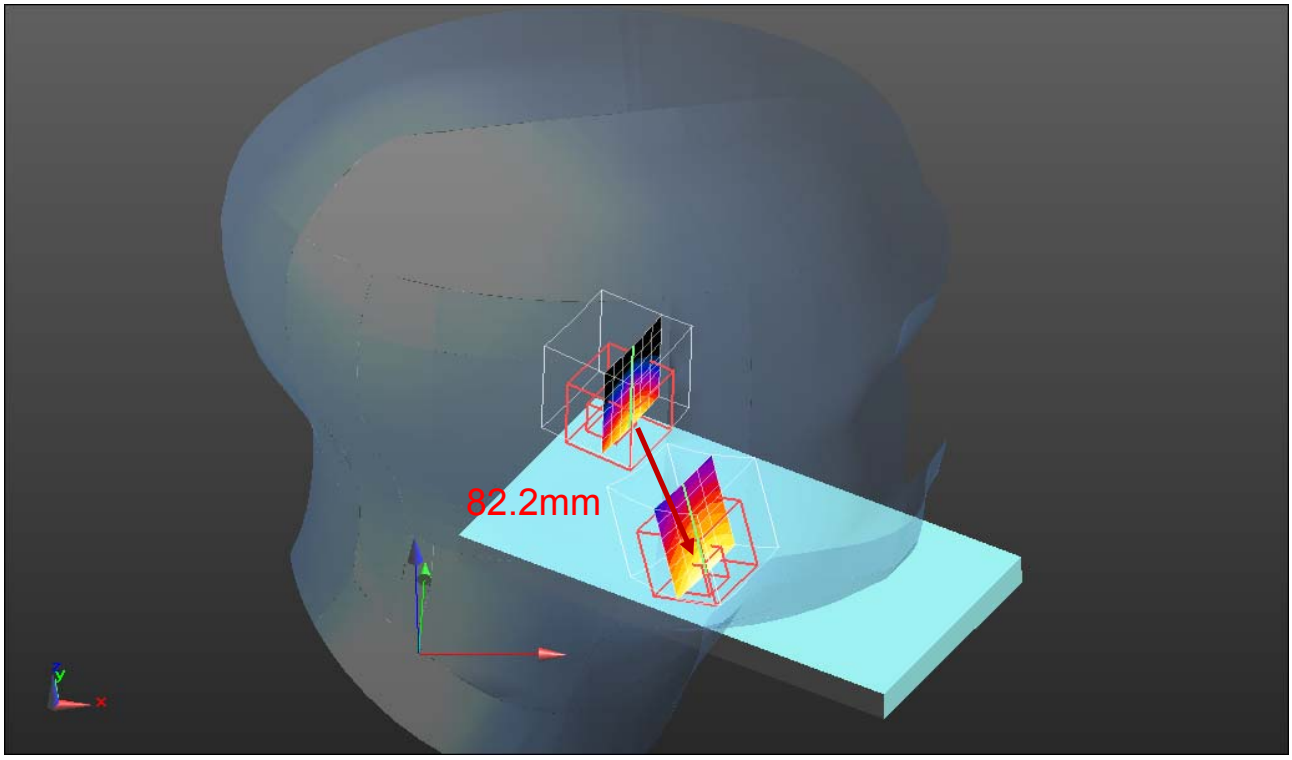


UMTS FDD II + WLAN2450 left cheek

Find distance of maxima

| | |
|---|---|
| **Maxima and position w.r.t. Grid Reference Point** | **associated 1g averages** |
| **Zoom Scan (D:\Projekte2014\1-7605-1-2\IEEE1528-WLAN2450 head.da53:0/Touch Position - Middle)** | |
| Max. 1 at (1.71, 1.55, -0.16) cm | 0.63 W/kg |
| **Zoom Scan (D:\Projekte2015\1-9303-1-2\IEEE1528-UMTS FDD II head.da53:0/Touch Position - Hi)** | |
| Max. 2 at (4.98, -5.99, -0.10) cm | 0.87 W/kg |
| **Distances and Separation Ratios** | |
| Max. 1 - Max. 2 | Distance [cm]: 8.22 / Separation ratio [W/kg/cm]: 0.18 |

Done

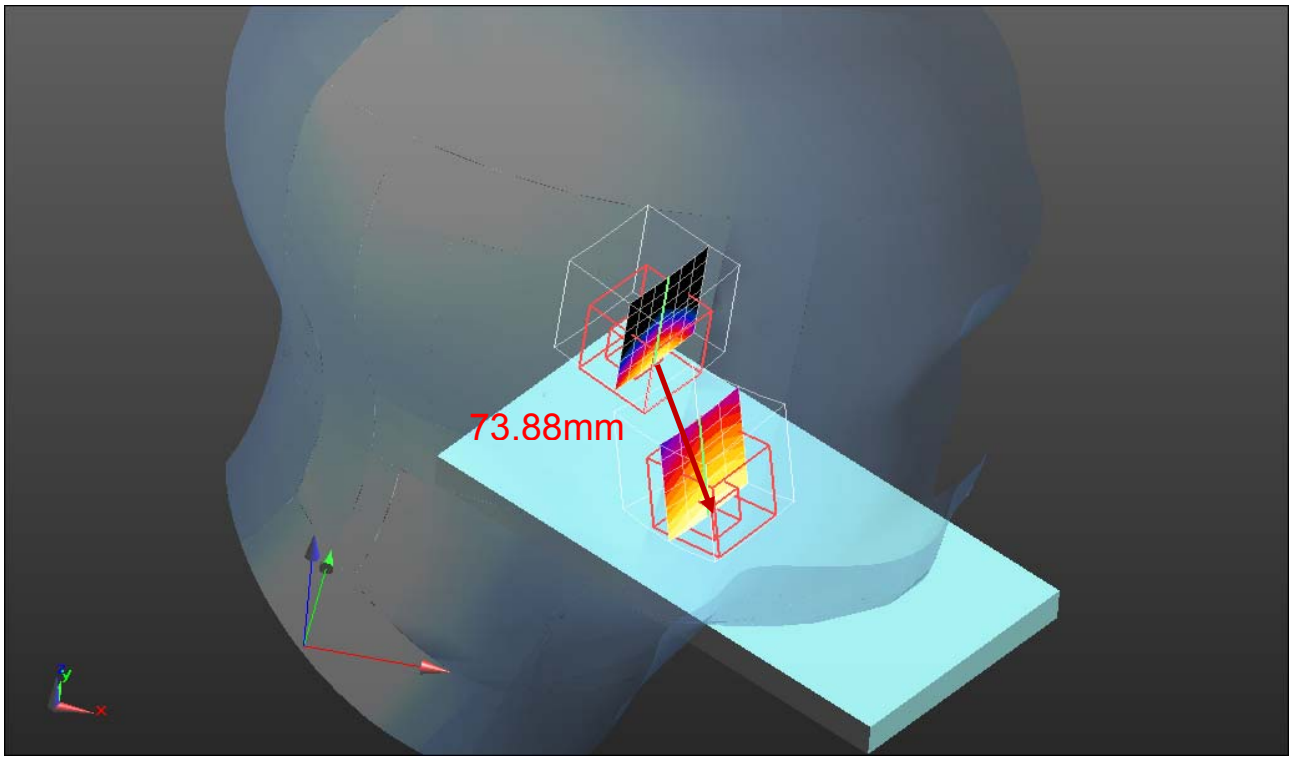


UMTS FDD V + WLAN2450 left cheek

Find distance of maxima

| Maxima and position w.r.t. Grid Reference Point | associated 1g averages |
|---|---|
| Zoom Scan (D:\Projekte2015\1-9303-1-2\IEEE1528_EN62209-UMTS FDD V head.da53:0/Touch Position - ... | |
| Max. 1 at (4.76, -5.17, -0.20) cm | 0.69 W/kg |
| Zoom Scan (D:\Projekte2014\1-7605-1-2\IEEE1528-WLAN2450 head.da53:0/Touch Position - Middle) | |
| Max. 2 at (1.71, 1.55, -0.16) cm | 0.63 W/kg |
| Distances and Separation Ratios | |
| Max. 1 - Max. 2 | Distance [cm]: 7.38 / Separation ratio [W/kg/cm]: 0.18 |

Done



## 8 Test equipment and ancillaries used for tests

To simplify the identification of the test equipment and/or ancillaries which were used, the reporting of the relevant test cases only refer to the test item number as specified in the table below.

| Equipment | Type | Manufacturer | Serial No. | Last Calibration | Frequency (months) |
|---|---|---|---|---|---|
| Dosimetric E-Field Probe | ES3DV3 | Schmid & Partner Engineering AG | 3320 | May 09, 2014 | 12 |
| Dosimetric E-Field Probe | EX3DV4 | Schmid & Partner Engineering AG | 3944 | August 19, 2014 | 12 |
| 835 MHz System Validation Dipole | D835V2 | Schmid & Partner Engineering AG | 4d153 | June 06, 2013 | 24 |
| 1900 MHz System Validation Dipole | D1900V2 | Schmid & Partner Engineering AG | 5d009 | May 15, 2013 | 24 |
| Data acquisition electronics | DAE3V1 | Schmid & Partner Engineering AG | 477 | May 14, 2014 | 12 |
| Software | DASY52 52.8.7 | Schmid & Partner Engineering AG | --- | N/A | -- |
| Triple Modular Flat Phantom V5.1 | QD 000 P51 C | Schmid & Partner Engineering AG | 1154 | N/A | -- |
| SAM Twin Phantom V5.0 | QD 000 P40 C | Schmid & Partner Engineering AG | 1813 | N/A | -- |
| Universal Radio Communication Tester | CMU 200 | Rohde & Schwarz | 106826 | January 27, 2014 | 24 |
| Network Analyser 300 kHz to 6 GHz | 8753ES | Hewlett Packard)* | US39174436 | January 28, 2014 | 24 |
| Dielectric Probe Kit | 85070C | Hewlett Packard | US99360146 | N/A | 12 |
| Signal Generator | 8671B | Hewlett Packard | 2823A00656 | January 22, 2014 | 24 |
| Amplifier | 25S1G4 (25 Watt) | Amplifier Reasearch | 20452 | N/A | -- |
| Power Meter | NRP | Rohde & Schwarz | 101367 | January 21, 2014 | 24 |
| Power Meter Sensor | NRP Z22 | Rohde & Schwarz | 100227 | January 21, 2014 | 12 |
| Power Meter Sensor | NRP Z22 | Rohde & Schwarz | 100234 | January 21, 2014 | 12 |
| Directional Coupler | 778D | Hewlett Packard | 19171 | January 21, 2014 | 12 |

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

## 9 Observations

No observations exceeding those reported with the single test cases have been made.

## Annex A: System performance check

Date/Time: 06.02.2015 14:21:13

# SystemPerformanceCheck-D835 head 2015-02-06

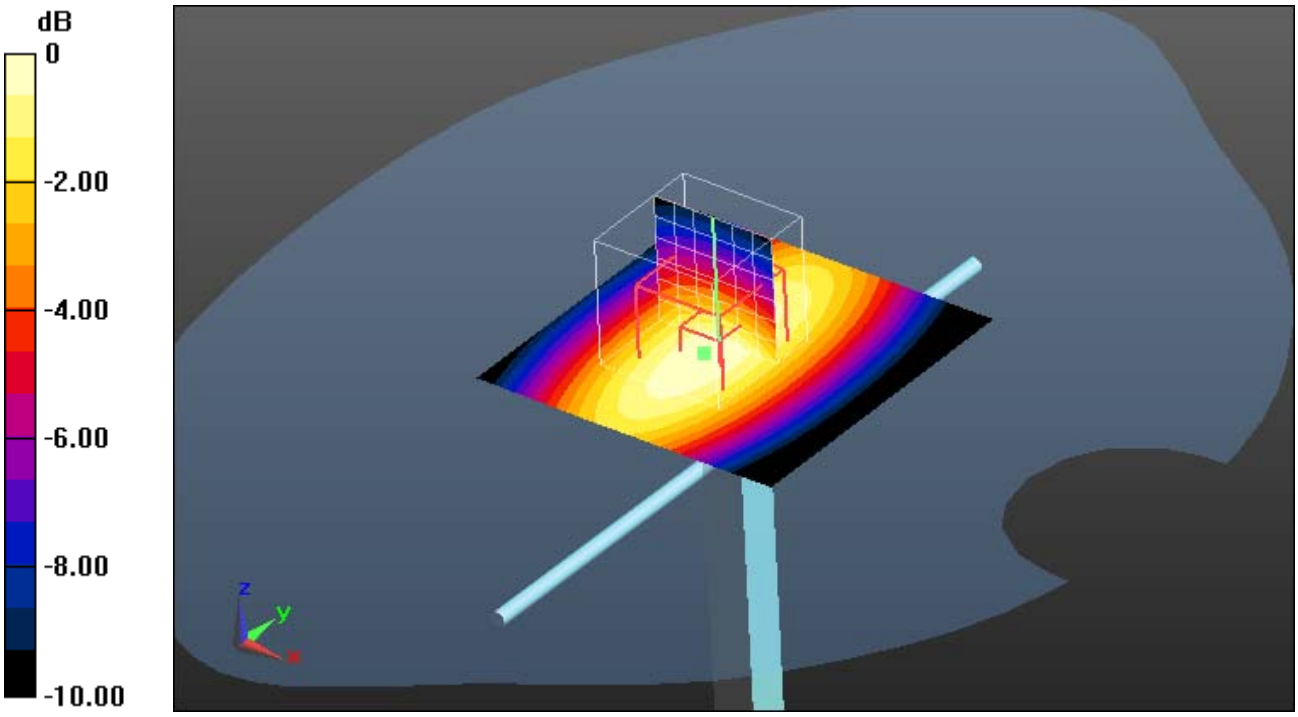
**DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d153**
Communication System: UID 0, CW (0); Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 835 MHz; $\sigma$ = 0.934 S/m; $\varepsilon_r$ = 41.634; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: ES3DV3 - SN3320; ConvF(6.15, 6.15, 6.15); Calibrated: 09.05.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 2.0, 32.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: SAM front; Type: QD000P40CC; Serial: TP-1042
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## HSL900/d=15mm, Pin=1000 mW, dist=4.0mm/Area Scan (51x51x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 10.5 W/kg

## HSL900/d=15mm, Pin=1000 mW, dist=4.0mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 107.5 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 14.2 W/kg
**SAR(1 g) = 9.87 W/kg; SAR(10 g) = 6.53 W/kg**
Maximum value of SAR (measured) = 10.7 W/kg




0 dB = 10.7 W/kg = 10.29 dBW/kg

**Additional information:**
ambient temperature: 23.5°C; liquid temperature: 22.2°C

Date/Time: 11.02.2015 10:25:26

## SystemPerformanceCheck-D835 body 2015-02-11

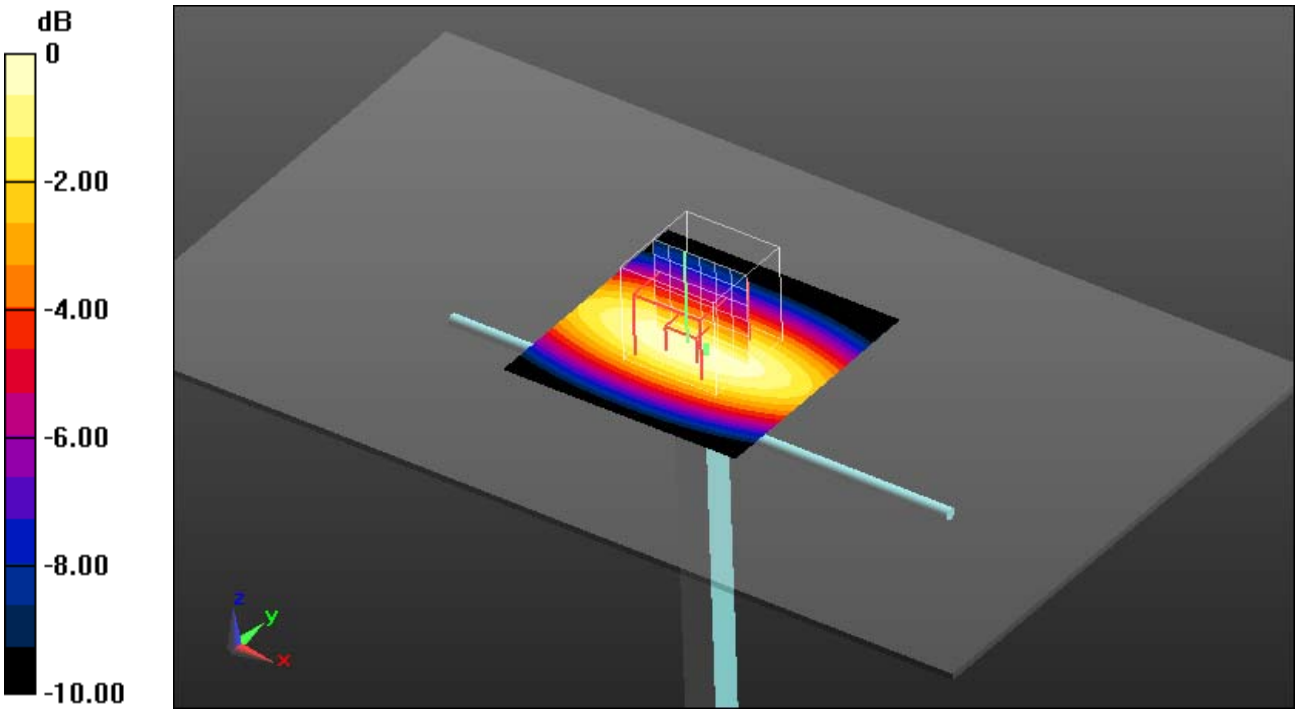
**DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d153**
Communication System: UID 0, CW (0); Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 835 MHz; $\sigma$ = 1.013 S/m; $\varepsilon_r$ = 54.197; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(9.82, 9.82, 9.82); Calibrated: 19.08.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## MSL835/d=15mm, Pin=1000 mW, dist=2.0mm/Area Scan (51x51x1):

Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 12.1 W/kg

## MSL835/d=15mm, Pin=1000 mW, dist=2.0mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 112.2 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 14.4 W/kg
**SAR(1 g) = 9.75 W/kg; SAR(10 g) = 6.46 W/kg**
Maximum value of SAR (measured) = 12.3 W/kg




0 dB = 12.3 W/kg = 10.90 dBW/kg

**Additional information:**
ambient temperature: 23.8°C; liquid temperature: 22.7°C

Date/Time: 09.02.2015 11:59:41

## SystemPerformanceCheck-D1900 head 2015-02-09

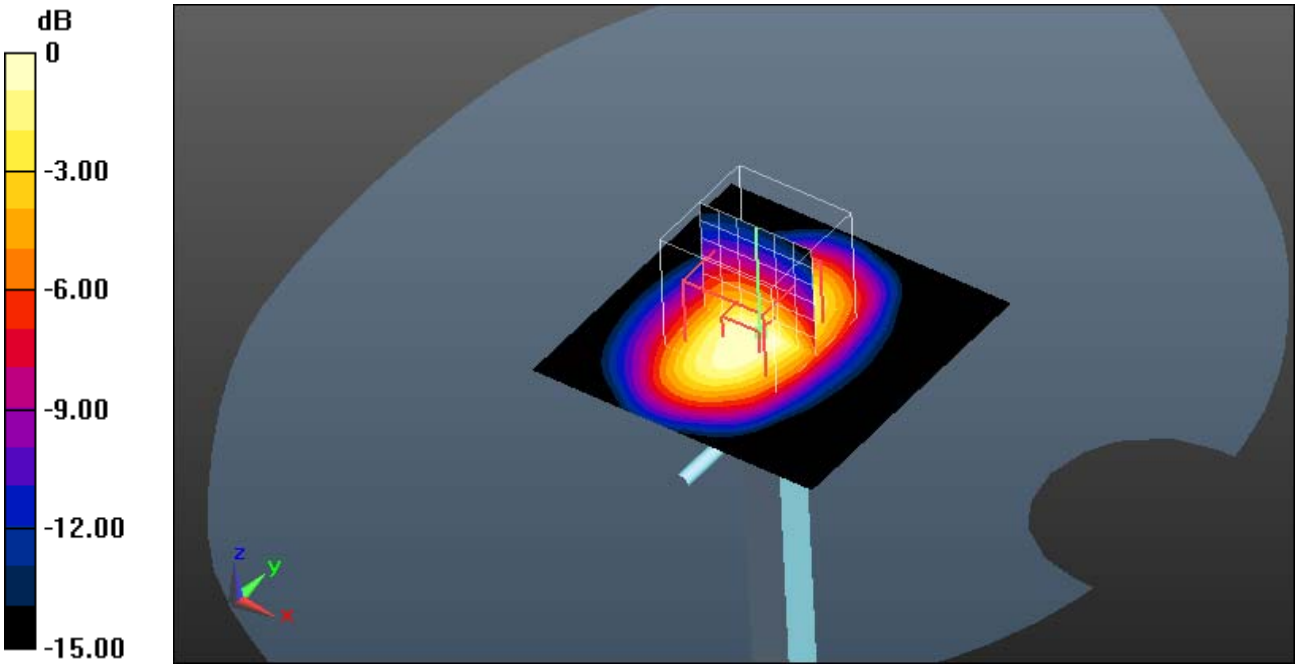
**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d009**
Communication System: UID 0, CW (0); Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.373 S/m; $\varepsilon_r$ = 38.911; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: ES3DV3 - SN3320; ConvF(4.94, 4.94, 4.94); Calibrated: 09.05.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 2.0, 32.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: SAM front; Type: QD000P40CC; Serial: TP-1042
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## HSL1900/d=10mm, Pin=1000 mW, dist=4.0mm/Area Scan (51x51x1):

Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 53.2 W/kg

## HSL1900/d=10mm, Pin=1000 mW, dist=4.0mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 177.7 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 76.4 W/kg
**SAR(1 g) = 40.8 W/kg; SAR(10 g) = 21.3 W/kg**
Maximum value of SAR (measured) = 46.0 W/kg




0 dB = 46.0 W/kg = 16.63 dBW/kg

**Additional information:**
ambient temperature: 22.9°C; liquid temperature: 22.6°C

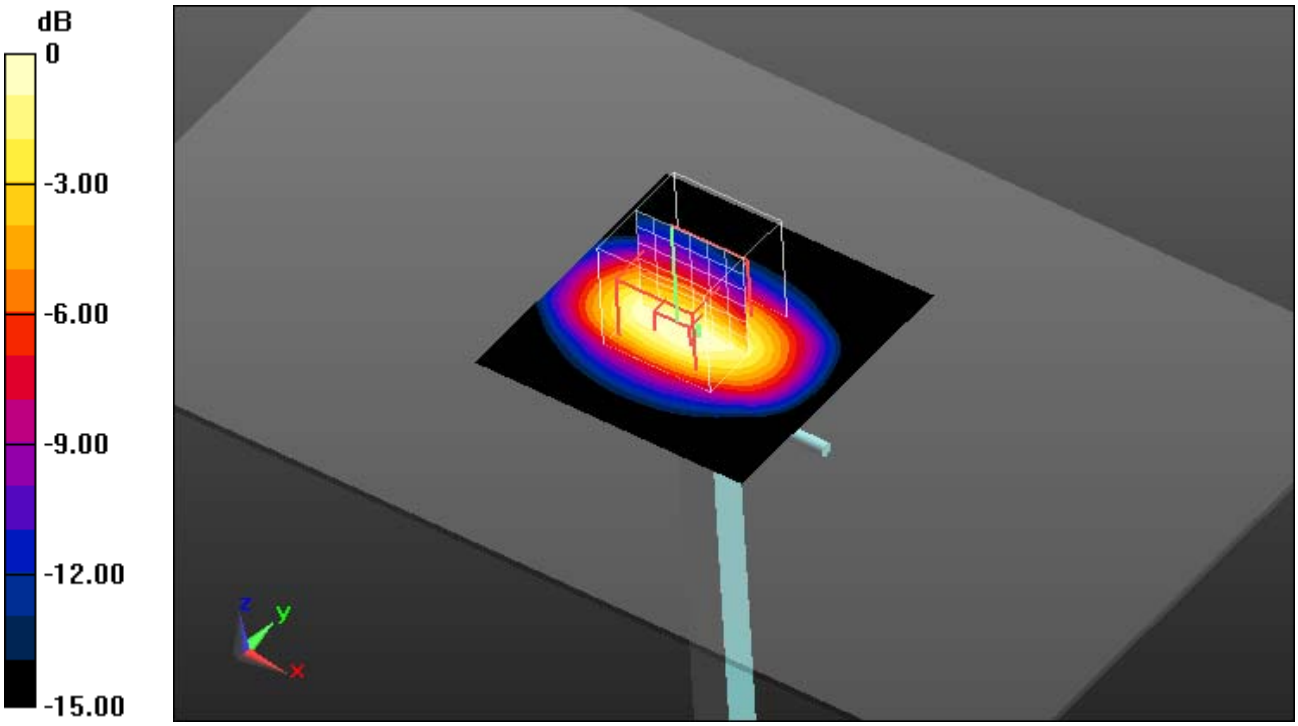
Date/Time: 10.02.2015 11:44:36

## SystemPerformanceCheck-D1900 body 2015-02-10

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d009**
Communication System: UID 0, CW (0); Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.511 S/m; $\varepsilon_r$ = 52.654; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(7.85, 7.85, 7.85); Calibrated: 19.08.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

**MSL1900/D1900/Area Scan (51x51x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 55.5 W/kg

**MSL1900/D1900/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 172.2 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 73.1 W/kg
**SAR(1 g) = 40.9 W/kg; SAR(10 g) = 21.6 W/kg**
Maximum value of SAR (measured) = 46.0 W/kg




0 dB = 46.0 W/kg = 16.63 dBW/kg

**Additional information:**
ambient temperature: 23.5°C; liquid temperature: 22.8°C

## Annex B: DASY5 measurement results

SAR plots for **the highest measured SAR** in each exposure configuration, wireless mode and frequency band combination according to FCC KDB 865664 D02

## Annex B.1: GSM 850MHz

Date/Time: 06.02.2015 20:03:59

# IEEE1528_EN62209-GSM850 head

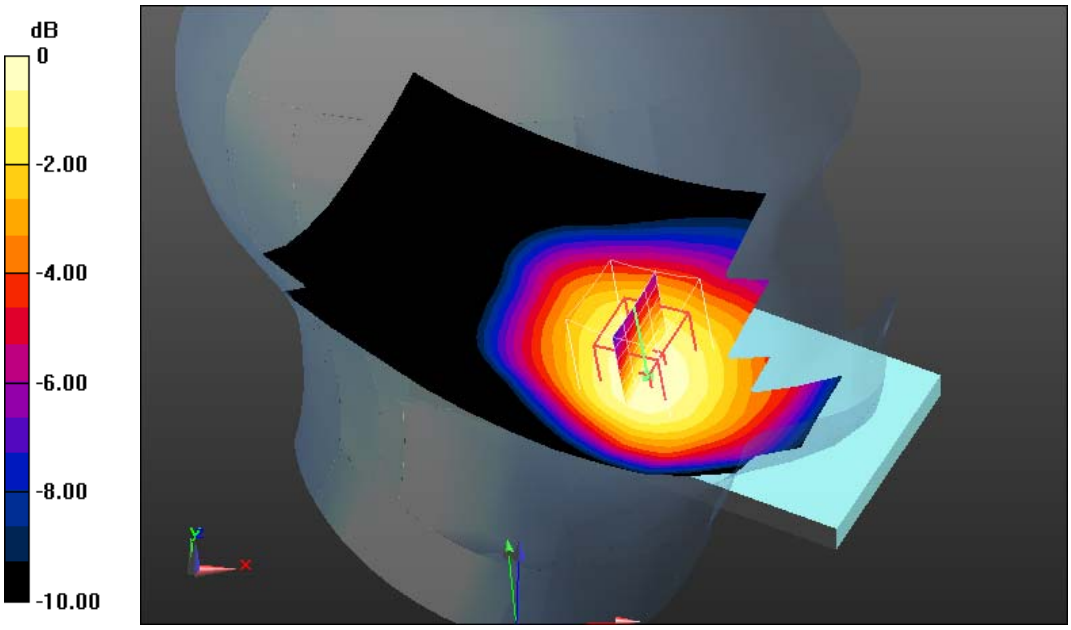
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 2**
Communication System: UID 0, GSM/GPRS 2TS (0); Communication System Band: GSM 850; Frequency: 848.8 MHz; Communication System PAR: 6.021 dB; PMF: 2.00009
Medium parameters used: f = 849 MHz; σ = 0.948 S/m; $\varepsilon_r$ = 41.459; ρ = 1000 kg/m$^3$
Phantom section: Left Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: ES3DV3 - SN3320; ConvF(6.15, 6.15, 6.15); Calibrated: 09.05.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 2.0, 32.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: SAM front; Type: QD000P40CC; Serial: TP-1042
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## Left-Hand-Side HSL/Touch Position - Hi/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.20 W/kg

## Left-Hand-Side HSL/Touch Position - Hi/Zoom Scan (5x5x7)/Cube 0:

Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 33.931 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.37 W/kg
**SAR(1 g) = 1.14 W/kg; SAR(10 g) = 0.881 W/kg**
Maximum value of SAR (measured) = 1.20 W/kg




0 dB = 1.20 W/kg = 0.79 dBW/kg

**Additional information:**
ambient temperature: 23.1°C; liquid temperature: 22.2°C

Date/Time: 11.02.2015 15:27:42

# FCC GSM850 hotspot

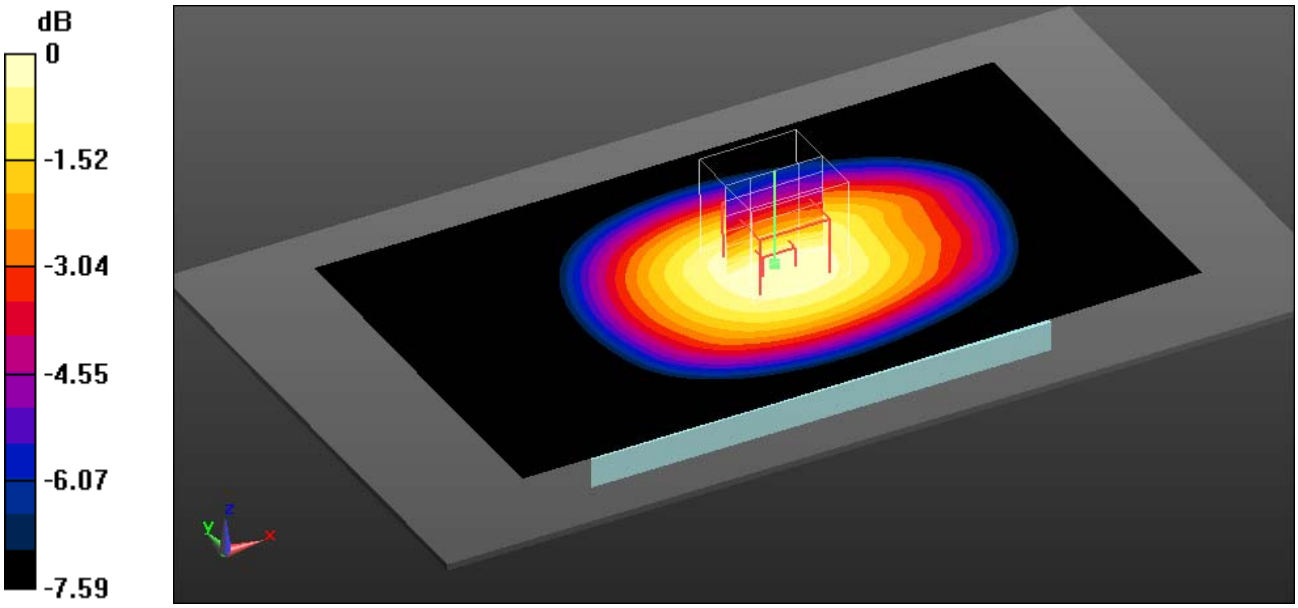
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 1**
Communication System: UID 0, GSM/GPRS 2TS (0); Communication System Band: GSM 850; Frequency: 848.8 MHz; Communication System PAR: 6.021 dB; PMF: 2.00009
Medium parameters used: f = 849 MHz; $\sigma$ = 1.025 S/m; $\varepsilon_r$ = 54.082; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(9.82, 9.82, 9.82); Calibrated: 19.08.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## MSL835-10mm/Rear High WC/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.22 W/kg

## MSL835-10mm/Rear High WC/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 34.617 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 1.45 W/kg
**SAR(1 g) = 1.17 W/kg; SAR(10 g) = 0.904 W/kg**
Maximum value of SAR (measured) = 1.23 W/kg




0 dB = 1.23 W/kg = 0.90 dBW/kg

**Additional information:**
position or distance of DUT to SAM: 10mm
ambient temperature: 23.8°C; liquid temperature: 22.7°C

Date/Time: 11.02.2015 15:41:48

# FCC GSM850 body worn

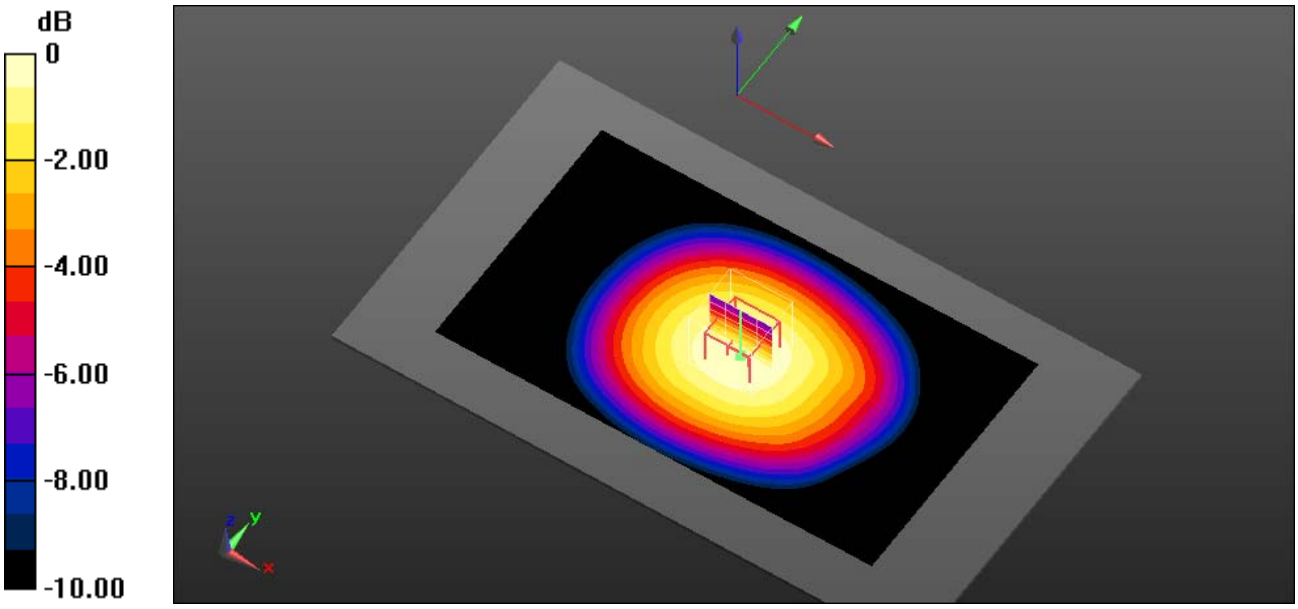
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 1**
Communication System: UID 0, GSM/GPRS 2TS (0); Communication System Band: GSM 850; Frequency: 848.8 MHz; Communication System PAR: 6.021 dB; PMF: 2.00009
Medium parameters used: f = 849 MHz; $\sigma$ = 1.025 S/m; $\varepsilon_r$ = 54.082; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(9.82, 9.82, 9.82); Calibrated: 19.08.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## MSL835-15mm/Rear High/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.978 W/kg

## MSL835-15mm/Rear High/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 30.997 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.17 W/kg
**SAR(1 g) = 0.937 W/kg; SAR(10 g) = 0.713 W/kg**
Maximum value of SAR (measured) = 0.985 W/kg




0 dB = 0.985 W/kg = -0.07 dBW/kg

**Additional information:**
position or distance of DUT to SAM: 15mm
ambient temperature: 23.8°C; liquid temperature: 22.7°C

## Annex B.2: GSM 1900MHz

Date/Time: 09.02.2015 16:00:37

# IEEE1528-GSM1900 - 2TS head

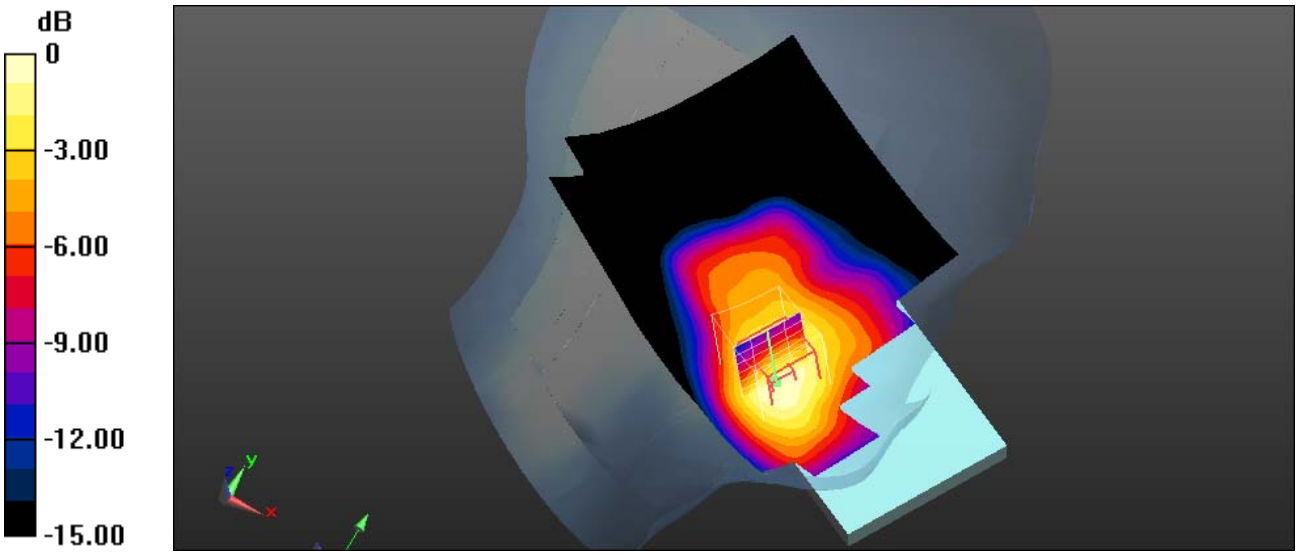
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 3**
Communication System: UID 0, GSM/GPRS 2TS (0); Communication System Band: GSM 1900; Frequency: 1850.2 MHz; Communication System PAR: 6.021 dB; PMF: 2.00009
Medium parameters used (interpolated): f = 1850.2 MHz; $\sigma$ = 1.332 S/m; $\varepsilon_r$ = 39.079; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: ES3DV3 - SN3320; ConvF(4.94, 4.94, 4.94); Calibrated: 09.05.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 2.0, 32.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: SAM front; Type: QD000P40CC; Serial: TP-1042
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## Left-Hand-Side HSL/Touch Position - Low WC/Area Scan (81x141x1):

Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.01 W/kg

## Left-Hand-Side HSL/Touch Position - Low WC/Zoom Scan (5x5x7)/Cube 0:

Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 21.322 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 1.36 W/kg
**SAR(1 g) = 0.908 W/kg; SAR(10 g) = 0.579 W/kg**
Maximum value of SAR (measured) = 0.980 W/kg




0 dB = 0.980 W/kg = -0.09 dBW/kg

**Additional information:**
ambient temperature: 22.9°C; liquid temperature: 22.6°C

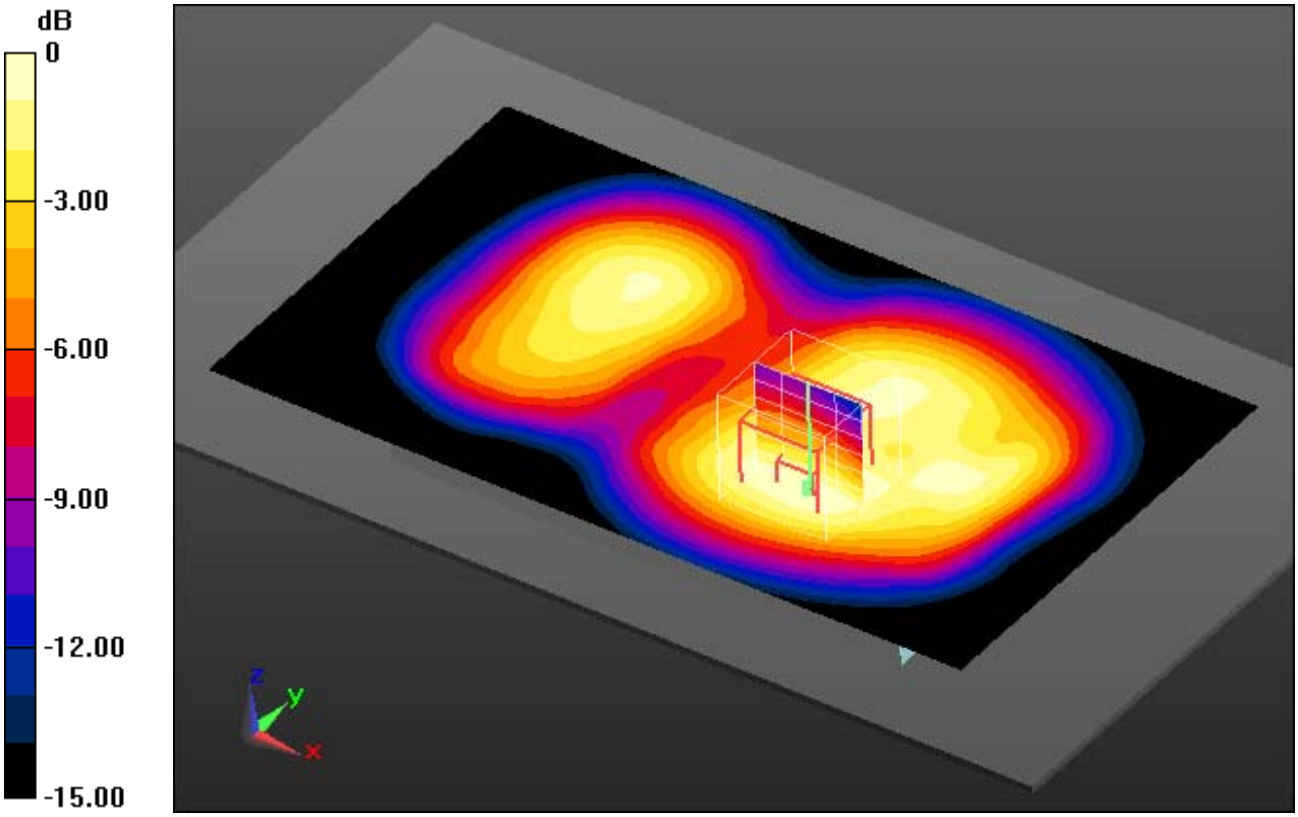
Date/Time: 10.02.2015 15:17:09

## FCC GSM1900 hotspot

**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 3**
Communication System: UID 0, GSM/GPRS 2TS (0); Communication System Band: GSM 1900; Frequency: 1850.2 MHz; Communication System PAR: 6.021 dB; PMF: 2.00009
Medium parameters used (interpolated): f = 1850.2 MHz; $\sigma$ = 1.467 S/m; $\varepsilon_r$ = 52.745; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(7.85, 7.85, 7.85); Calibrated: 19.08.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

**MSL1900-10mm/Front Low/Area Scan (81x141x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.825 W/kg

**MSL1900-10mm/Front Low/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 23.692 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 1.15 W/kg
**SAR(1 g) = 0.788 W/kg; SAR(10 g) = 0.518 W/kg**
Maximum value of SAR (measured) = 0.841 W/kg




0 dB = 0.841 W/kg = -0.75 dBW/kg

**Additional information:**
position or distance of DUT to SAM: 10 mm
ambient temperature: 23.5°C; liquid temperature: 22.8°C

Date/Time: 10.02.2015 14:25:59

# FCC GSM1900 body worn

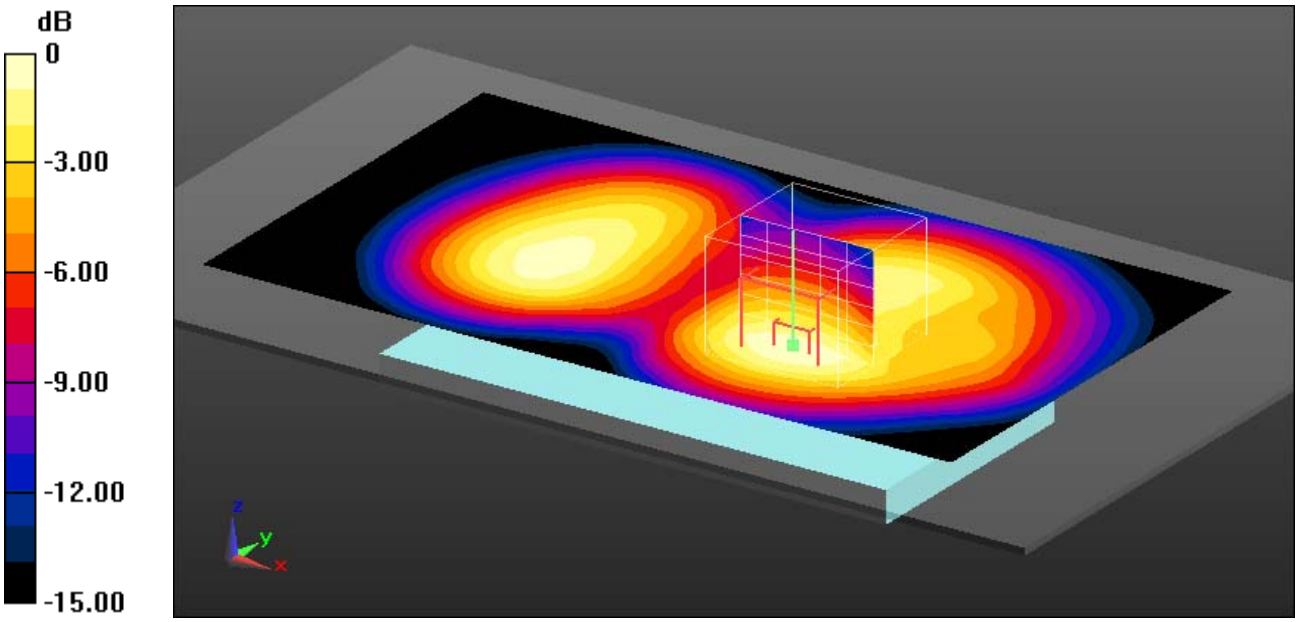
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 3**
Communication System: UID 0, GSM/GPRS 2TS (0); Communication System Band: GSM 1900; Frequency: 1909.8 MHz; Communication System PAR: 6.021 dB; PMF: 2.00009
Medium parameters used: f = 1910 MHz; $\sigma$ = 1.522 S/m; $\varepsilon_r$ = 52.696; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(7.85, 7.85, 7.85); Calibrated: 19.08.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## MSL1900-15mm/Front High/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.595 W/kg

## MSL1900-15mm/Front High/Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 19.191 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.844 W/kg
**SAR(1 g) = 0.559 W/kg; SAR(10 g) = 0.361 W/kg**
Maximum value of SAR (measured) = 0.593 W/kg




0 dB = 0.593 W/kg = -2.27 dBW/kg

**Additional information:**
position or distance of DUT to SAM: 15 mm
ambient temperature: 23.5°C; liquid temperature: 22.8°C

## Annex B.3: UMTS FDD II

Date/Time: 09.02.2015 16:51:27

# IEEE1528-UMTS FDD II head

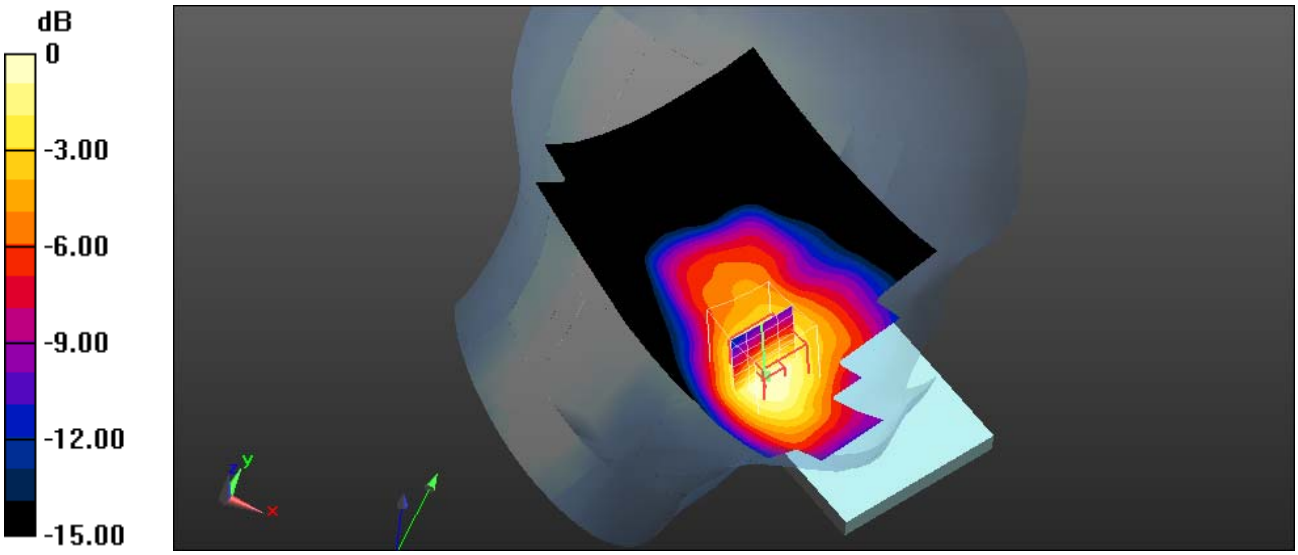
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 3**
Communication System: UID 0, UMTS FDD (0); Communication System Band: UMTS FDD II; Frequency: 1907.6 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1908 MHz; σ = 1.381 S/m; $\varepsilon_r$ = 38.909; ρ = 1000 kg/m$^3$
Phantom section: Left Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: ES3DV3 - SN3320; ConvF(4.94, 4.94, 4.94); Calibrated: 09.05.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 2.0, 32.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: SAM front; Type: QD000P40CC; Serial: TP-1042
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## Left-Hand-Side HSL/Touch Position - Hi/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.00 W/kg

## Left-Hand-Side HSL/Touch Position - Hi/Zoom Scan (5x5x7)/Cube 0:

Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 20.752 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 1.35 W/kg
**SAR(1 g) = 0.873 W/kg; SAR(10 g) = 0.545 W/kg**
Maximum value of SAR (measured) = 0.947 W/kg




0 dB = 0.947 W/kg = -0.24 dBW/kg

**Additional information:**
ambient temperature: 22.9°C; liquid temperature: 22.6°C

Date/Time: 10.02.2015 12:48:14

# FCC UMTS FDDII hotspot

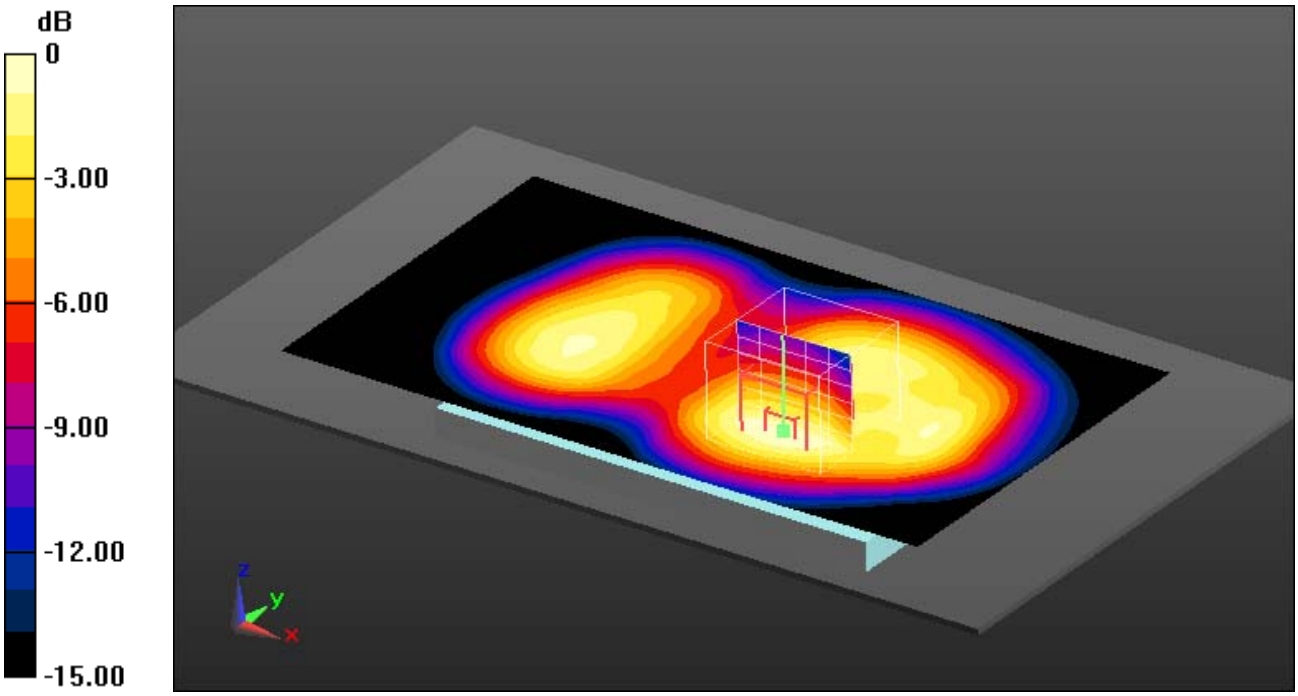
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 3**
Communication System: UID 0, UMTS FDD (0); Communication System Band: UMTS FDD II; Frequency: 1907.6 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1908 MHz; $\sigma$ = 1.519 S/m; $\varepsilon_r$ = 52.698; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(7.85, 7.85, 7.85); Calibrated: 19.08.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## MSL1900-10mm/Front High/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.838 W/kg

## MSL1900-10mm/Front High/Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 22.619 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 1.17 W/kg
**SAR(1 g) = 0.776 W/kg; SAR(10 g) = 0.506 W/kg**
Maximum value of SAR (measured) = 0.826 W/kg




0 dB = 0.826 W/kg = -0.83 dBW/kg

**Additional information:**
position or distance of DUT to SAM: 10 mm
ambient temperature: 23.5°C; liquid temperature: 22.8°C

Date/Time: 10.02.2015 13:05:10

# FCC UMTS FDDII body worn

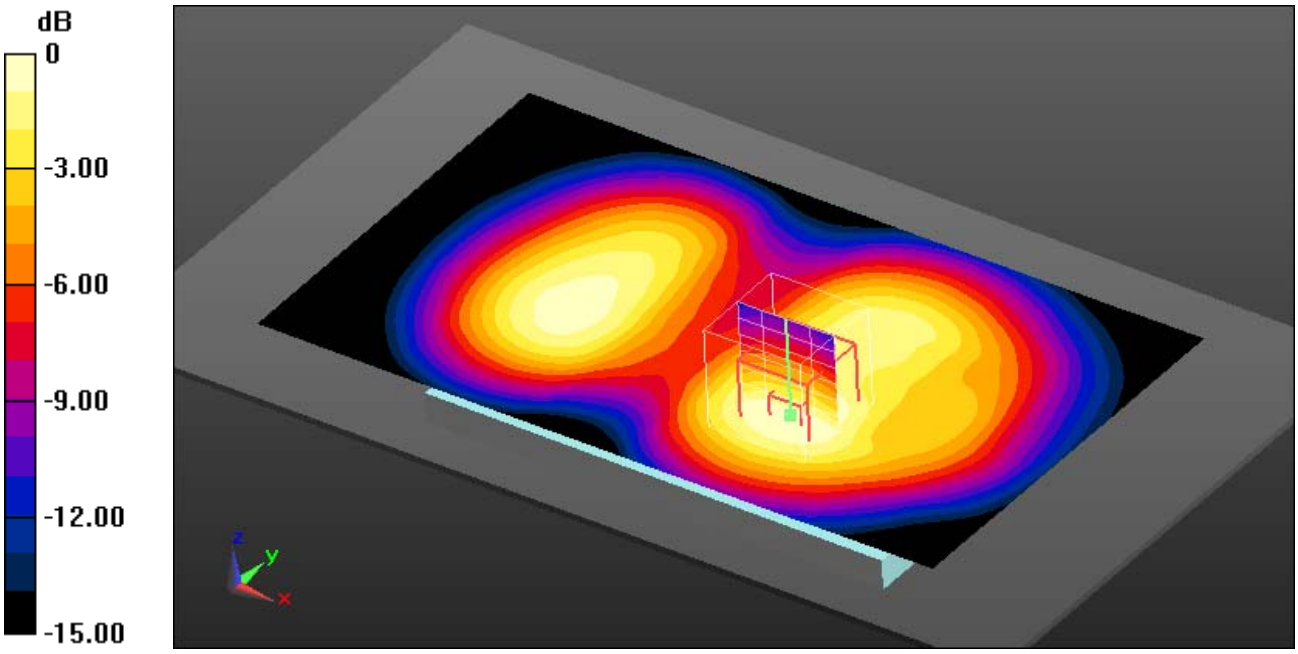
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 3**
Communication System: UID 0, UMTS FDD (0); Communication System Band: UMTS FDD II; Frequency: 1907.6 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1908 MHz; $\sigma$ = 1.519 S/m; $\varepsilon_r$ = 52.698; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(7.85, 7.85, 7.85); Calibrated: 19.08.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## MSL1900-15mm/Front High/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.606 W/kg

## MSL1900-15mm/Front High/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 19.548 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 0.823 W/kg
**SAR(1 g) = 0.557 W/kg; SAR(10 g) = 0.364 W/kg**
Maximum value of SAR (measured) = 0.587 W/kg




0 dB = 0.587 W/kg = -2.31 dBW/kg

**Additional information:**
position or distance of DUT to SAM: 15 mm
ambient temperature: 23.5°C; liquid temperature: 22.8°C

## Annex B.4: UMTS FDD V

Date/Time: 06.02.2015 19:12:28

# IEEE1528_EN62209-UMTS FDD V head

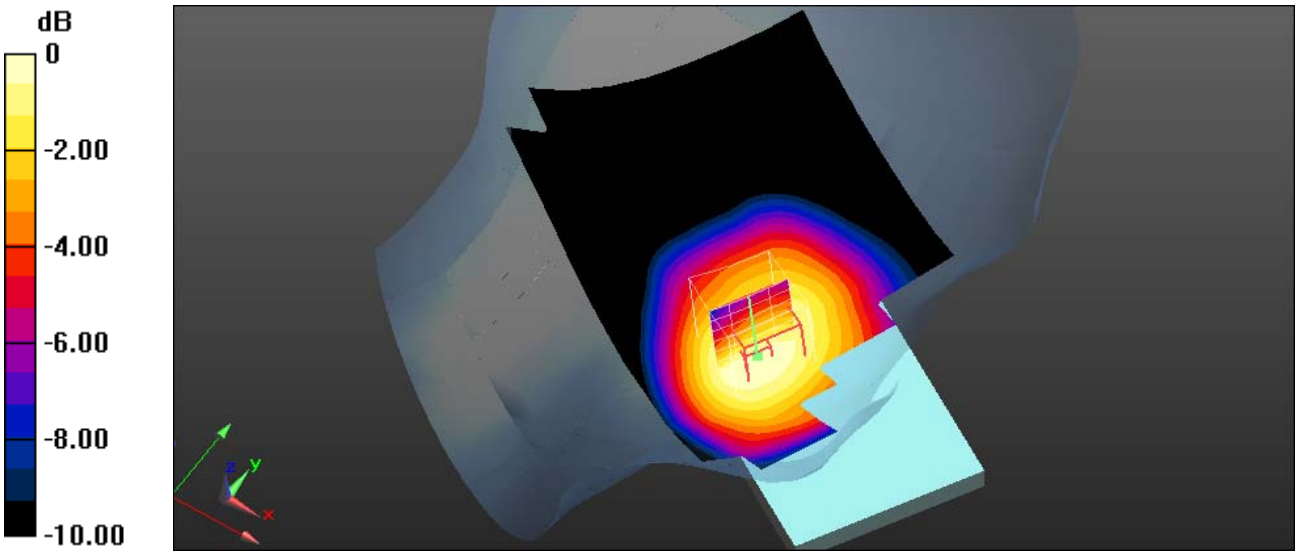
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 1**
Communication System: UID 0, UMTS FDD (0); Communication System Band: UMTS FDD V; Frequency: 846.6 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 847 MHz; $\sigma$ = 0.946 S/m; $\varepsilon_r$ = 41.487; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: ES3DV3 - SN3320; ConvF(6.15, 6.15, 6.15); Calibrated: 09.05.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 2.0, 32.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: SAM front; Type: QD000P40CC; Serial: TP-1042
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## Left-Hand-Side HSL/Touch Position - Hi/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.735 W/kg

## Left-Hand-Side HSL/Touch Position - Hi/Zoom Scan (5x5x7)/Cube 0:

Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 26.772 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.868 W/kg
**SAR(1 g) = 0.695 W/kg; SAR(10 g) = 0.527 W/kg**
Maximum value of SAR (measured) = 0.721 W/kg




0 dB = 0.721 W/kg = -1.42 dBW/kg

**Additional information:**
ambient temperature: 23,1°C; liquid temperature: 22,2°C

Date/Time: 11.02.2015 13:53:15

# FCC UMTS FDDV hotspot

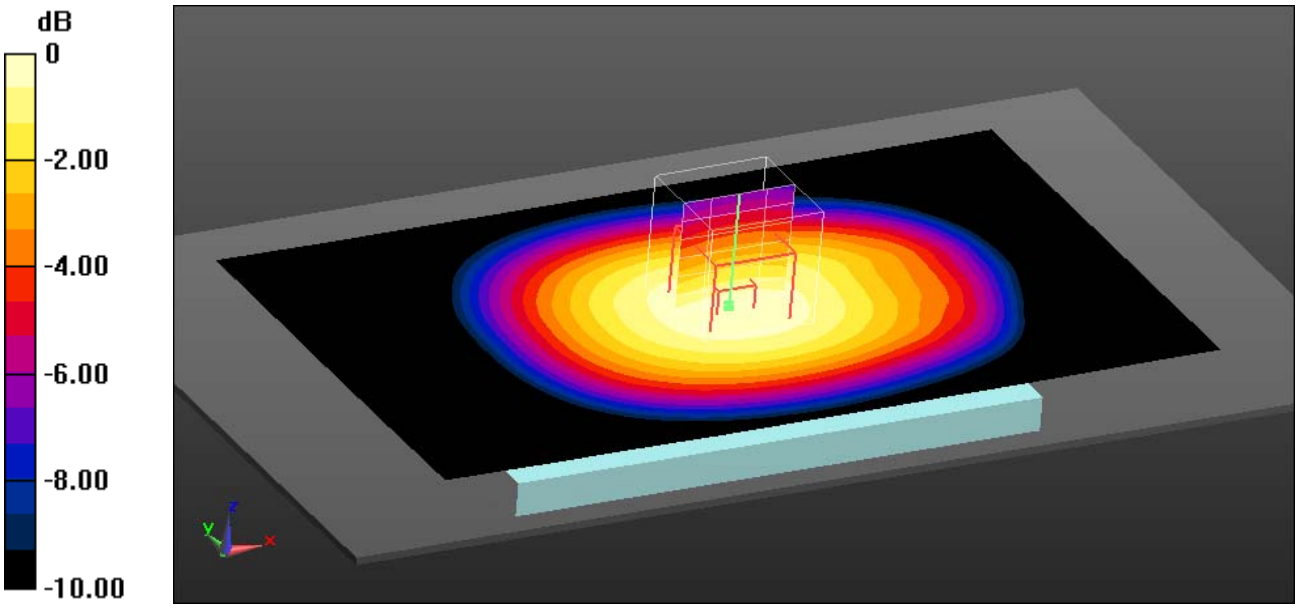
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 1**
Communication System: UID 0, UMTS FDD (0); Communication System Band: UMTS FDD V; Frequency: 846.6 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 847 MHz; $\sigma$ = 1.023 S/m; $\varepsilon_r$ = 54.116; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(9.82, 9.82, 9.82); Calibrated: 19.08.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## MSL835-10mm/Rear High/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.813 W/kg

## MSL835-10mm/Rear High/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 28.230 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.983 W/kg
**SAR(1 g) = 0.786 W/kg; SAR(10 g) = 0.601 W/kg**
Maximum value of SAR (measured) = 0.822 W/kg




0 dB = 0.822 W/kg = -0.85 dBW/kg

**Additional information:**
position or distance of DUT to SAM: 10mm
ambient temperature: 23.8°C; liquid temperature: 22.7°C

Date/Time: 11.02.2015 16:25:59

# FCC UMTS FDD V body worn

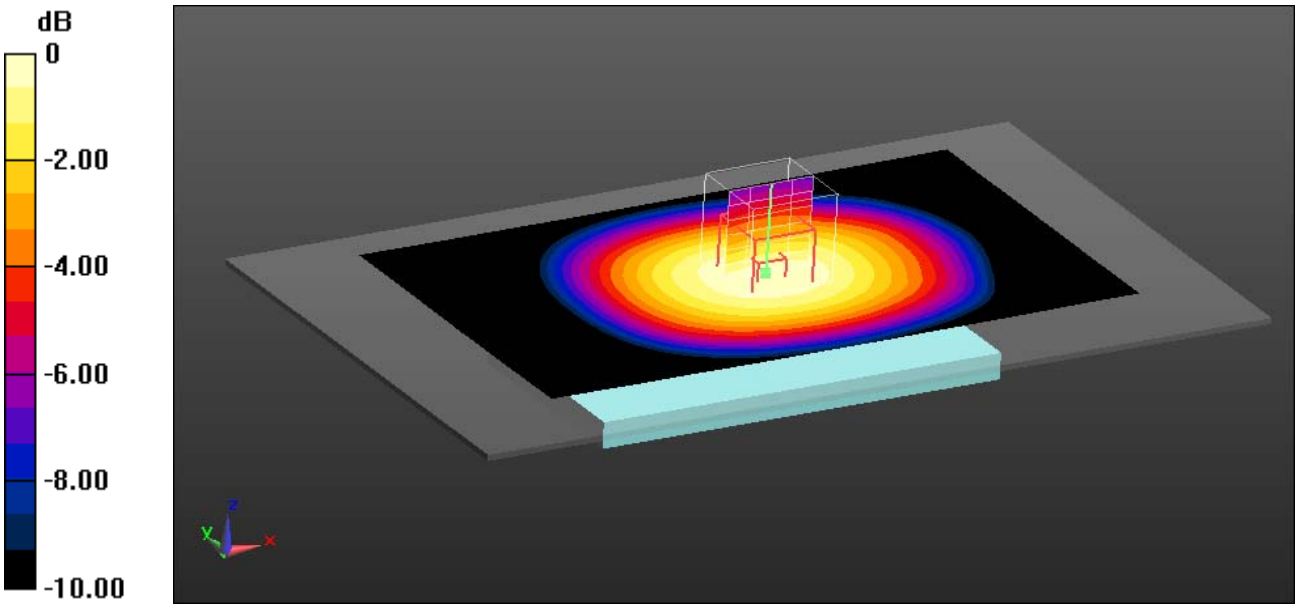
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 1**
Communication System: UID 0, UMTS FDD (0); Communication System Band: UMTS FDD V; Frequency: 826.4 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 826.4 MHz; $\sigma$ = 1.004 S/m; $\varepsilon_r$ = 54.381; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(9.82, 9.82, 9.82); Calibrated: 19.08.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## MSL835-15mm/Rear Low/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.671 W/kg

## MSL835-15mm/Rear Low/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 25.766 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.791 W/kg
**SAR(1 g) = 0.635 W/kg; SAR(10 g) = 0.485 W/kg**
Maximum value of SAR (measured) = 0.667 W/kg




0 dB = 0.667 W/kg = -1.76 dBW/kg

**Additional information:**
position or distance of DUT to SAM: 15mm
ambient temperature: 23.8°C; liquid temperature: 22.7°C

## Annex B.5: Combined Multi Band Fast SAR

In SEMCAD combining was used same scaling factor for each band as was used for calculating reported/extrapolated SAR results.

# Multi-Band Fast SAR-WLAN+GSM850 head left cheek

**DASY Configuration for Left-Hand-Side HSL/Touch Position - Low/Area Scan:**
Date/Time: 22.12.2014 12:03:27
Test Laboratory: Cetecom ICT Services GmbH
File Name: IEEE1528-WLAN2450 head.da53:0
**DUT: Microsoft; Type: RM-1077; Serial: SAR 5**
Communication System: UID 0, WLAN 2450 (0); Frequency: 2412 MHz; Duty Cycle: 1:1; PMF: 1
Medium: HSL2450 Medium parameters used: f = 2412 MHz; $\sigma$ = 1.759 S/m; $\varepsilon_r$ = 38.82; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

- Probe: ES3DV3 - SN3320; ConvF(4.4, 4.4, 4.4); Calibrated: 09.05.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used))
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: SAM front; Type: QD000P40CC; Serial: TP-1042
- Measurement SW: DASY52, Version 52.8 (7)

---

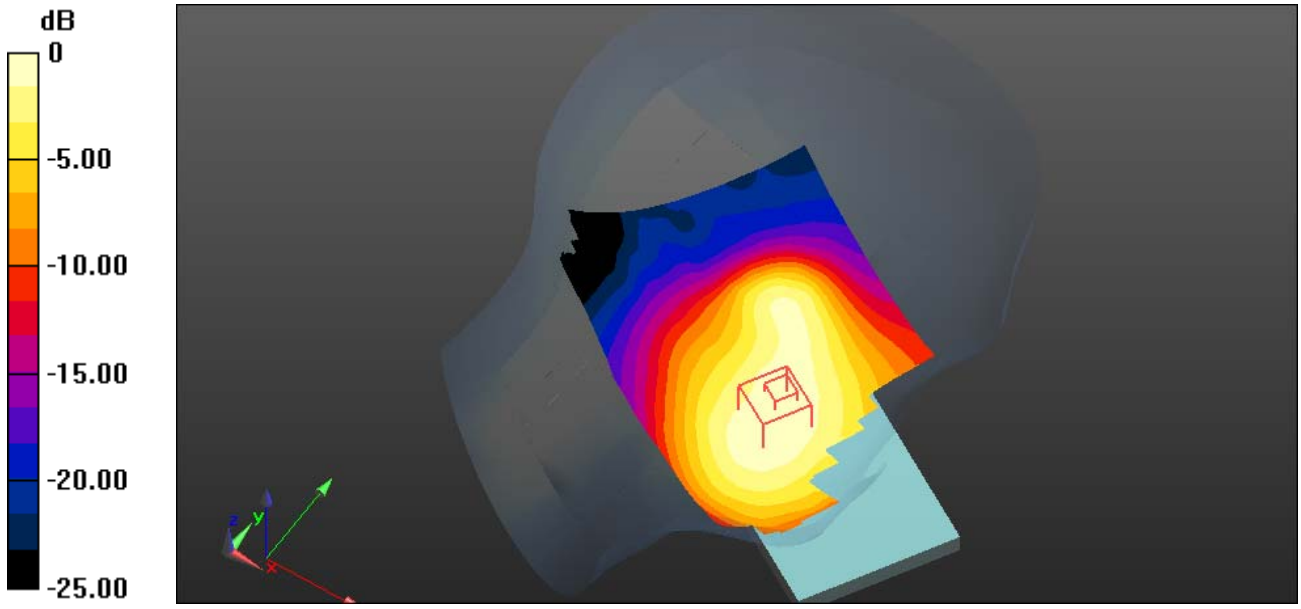
**DASY Configuration for Left-Hand-Side HSL/Touch Position - Hi/Area Scan:**
Date/Time: 06.02.2015 20:03:59
Test Laboratory: Cetecom ICT Services GmbH
File Name: IEEE1528_EN62209-GSM850 head.da53:0
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 2**
Communication System: UID 0, GSM/GPRS 2TS (0); Frequency: 848.8 MHz; Duty Cycle: 1:4.00037; PMF: 2.00009
Medium: HSL900 Medium parameters used: f = 849 MHz; $\sigma$ = 0.948 S/m; $\varepsilon_r$ = 41.459; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

- Probe: ES3DV3 - SN3320; ConvF(6.15, 6.15, 6.15); Calibrated: 09.05.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used))
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: SAM front; Type: QD000P40CC; Serial: TP-1042
- Measurement SW: DASY52, Version 52.8 (7)

---

**Fast SAR of Combined Scans: SAR(1 g) = 1.29 W/kg; SAR(10 g) = 0.857 W/kg**

Maximum value of SAR (interpolated) = 1.42 W/kg




0 dB = 1.42 W/kg = 1.52 dBW/kg

## Multi-Band Fast SAR-WLAN+GSM850 hotspot

**DASY Configuration for MSL2450-10mm/Rear Mid/Area Scan:**
Date/Time: 23.12.2014 14:37:25
Test Laboratory: Cetecom ICT Services GmbH
File Name: FCC WLAN2450 hotspot.da52:0
**DUT: Microsoft; Type: RM-1077; Serial: SAR 5**
Communication System: UID 0, WLAN 2450 (0); Frequency: 2437 MHz; Duty Cycle: 1:1; PMF: 1
Medium: MSL2450 Medium parameters used: f = 2437 MHz; $\sigma$ = 1.955 S/m; $\varepsilon_r$ = 51.228; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

- Probe: ES3DV3 - SN3320; ConvF(4.3, 4.3, 4.3); Calibrated: 09.05.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used))
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- Measurement SW: DASY52, Version 52.8 (7)

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**DASY Configuration for MSL835-10mm/Rear High WC/Area Scan:**
Date/Time: 11.02.2015 15:27:42
Test Laboratory: Cetecom ICT Services GmbH
File Name: FCC GSM850 hotspot.da52:0
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 1**
Communication System: UID 0, GSM/GPRS 2TS (0); Frequency: 848.8 MHz; Duty Cycle: 1:4.00037; PMF: 2.00009
Medium: MSL835 Medium parameters used: f = 849 MHz; $\sigma$ = 1.025 S/m; $\varepsilon_r$ = 54.082; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

- Probe: EX3DV4 - SN3944; ConvF(9.82, 9.82, 9.82); Calibrated: 19.08.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used))
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- Measurement SW: DASY52, Version 52.8 (7)

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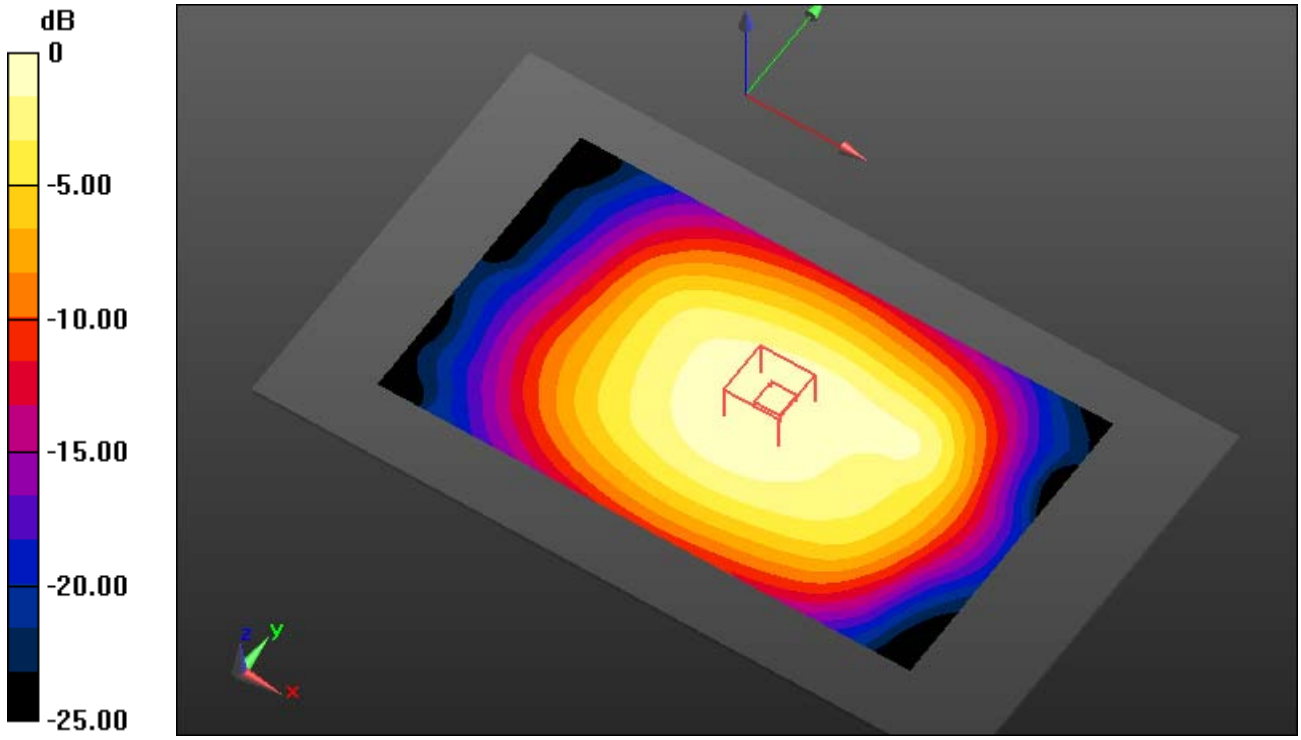
**Fast SAR of Combined Scans: SAR(1 g) = 1.33 W/kg; SAR(10 g) = 0.925 W/kg**

Maximum value of SAR (interpolated) = 1.41 W/kg




0 dB = 1.41 W/kg = 1.49 dBW/kg

## Multi-Band Fast SAR-WLAN+GSM850 body worn

**DASY Configuration for MSL2450/Rear Mid 15 mm with headset/Area Scan:**
Date/Time: 23.12.2014 15:25:10
Test Laboratory: Cetecom ICT Services GmbH
File Name: FCC WLAN2450 body worn.da52:0
**DUT: Microsoft; Type: RM-1077; Serial: SAR 5**
Communication System: UID 0, WLAN 2450 (0); Frequency: 2437 MHz; Duty Cycle: 1:1; PMF: 1
Medium: MSL2450 Medium parameters used: f = 2437 MHz; $\sigma$ = 1.955 S/m; $\varepsilon_r$ = 51.228; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

- Probe: ES3DV3 - SN3320; ConvF(4.3, 4.3, 4.3); Calibrated: 09.05.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used))
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- Measurement SW: DASY52, Version 52.8 (7)

---

**DASY Configuration for MSL835-15mm/Rear High/Area Scan:**
Date/Time: 11.02.2015 15:41:48
Test Laboratory: Cetecom ICT Services GmbH
File Name: FCC GSM850 body worn.da52:0
**DUT: Microsoft; Type: RM-1077 BOM2; Serial: SAR 1**
Communication System: UID 0, GSM/GPRS 2TS (0); Frequency: 848.8 MHz; Duty Cycle: 1:4.00037; PMF: 2.00009
Medium: MSL835 Medium parameters used: f = 849 MHz; $\sigma$ = 1.025 S/m; $\varepsilon_r$ = 54.082; $\rho$ = 1000 kg/m$^3$
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

- Probe: EX3DV4 - SN3944; ConvF(9.82, 9.82, 9.82); Calibrated: 19.08.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used))
- Electronics: DAE3 Sn477; Calibrated: 14.05.2014
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1154
- Measurement SW: DASY52, Version 52.8 (7)

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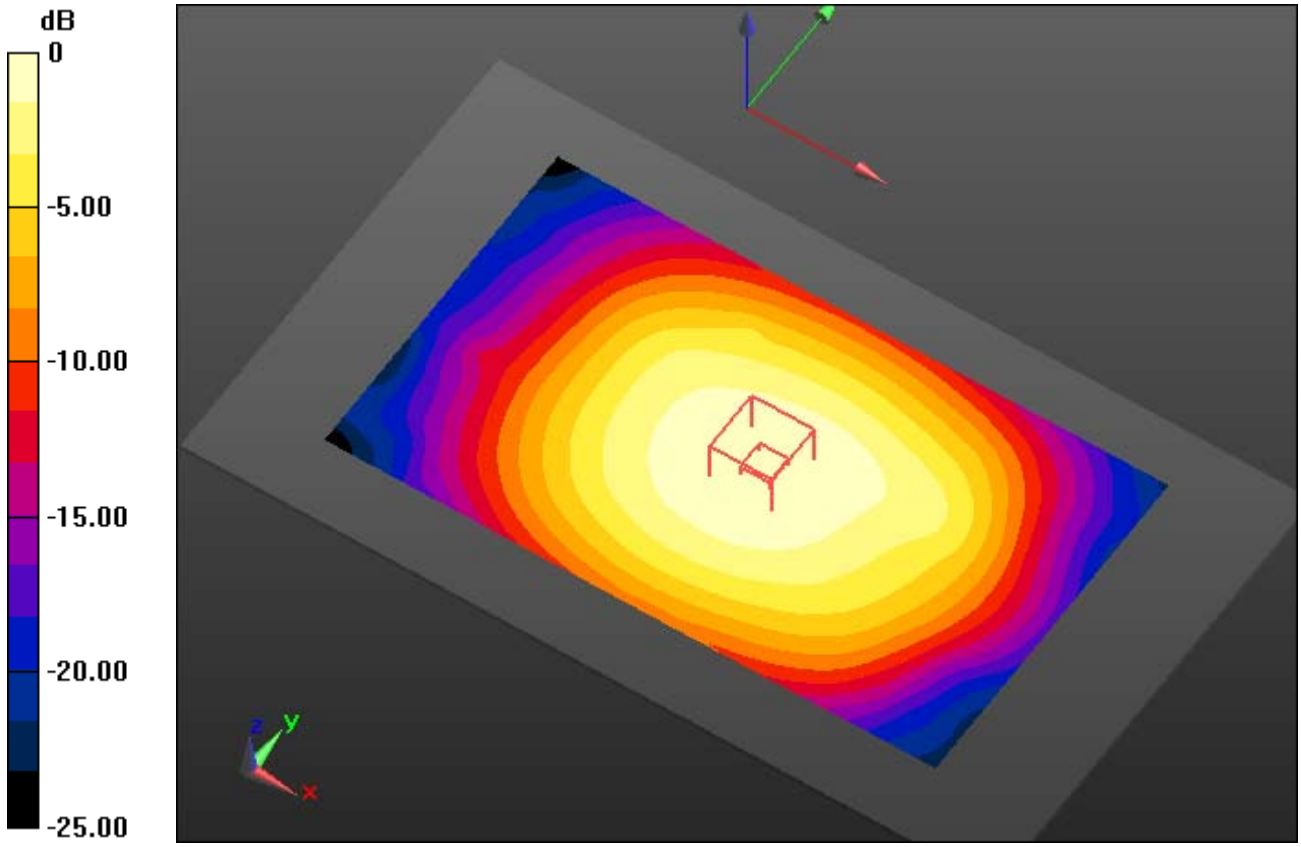
**Fast SAR of Combined Scans: SAR(1 g) = 1.04 W/kg; SAR(10 g) = 0.727 W/kg**

Maximum value of SAR (interpolated) = 1.10 W/kg




0 dB = 1.10 W/kg = 0.41 dBW/kg

## Annex B.6: Liquid depth

Photo 1: Liquid depth 850 MHz head simulating liquid

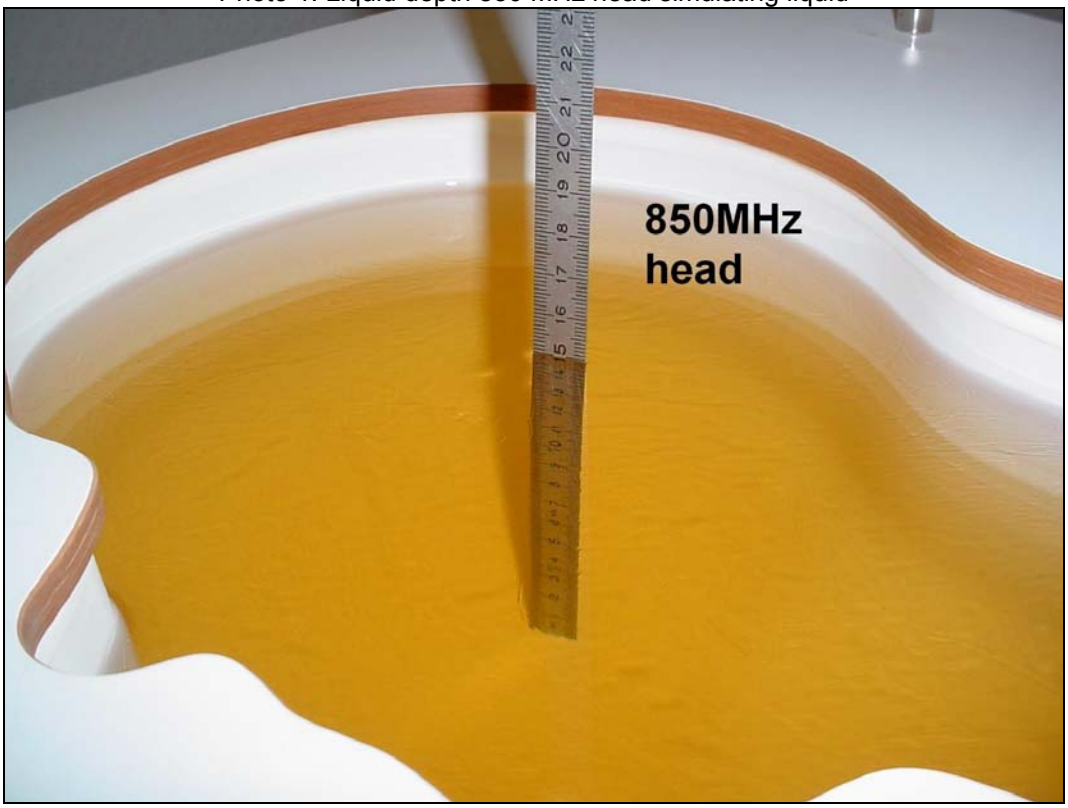



Photo 2: Liquid depth 850 MHz body simulating liquid

Photo 3: Liquid depth 1900MHz head simulating liquid

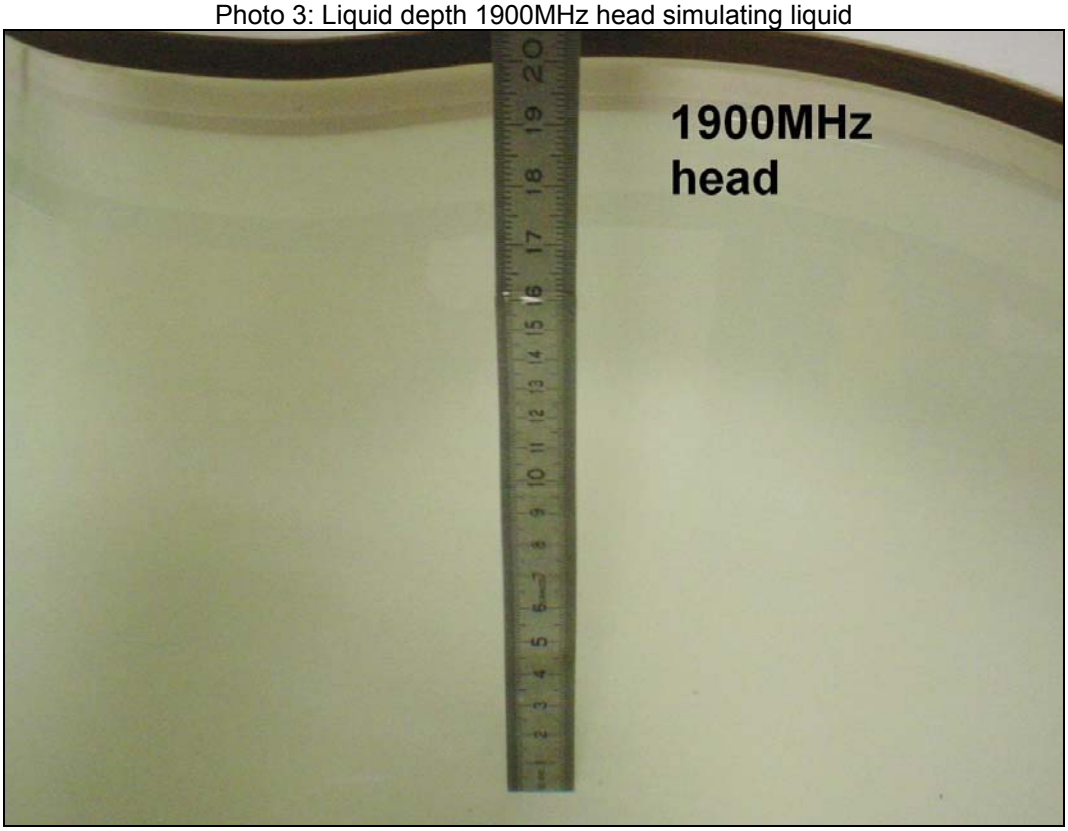
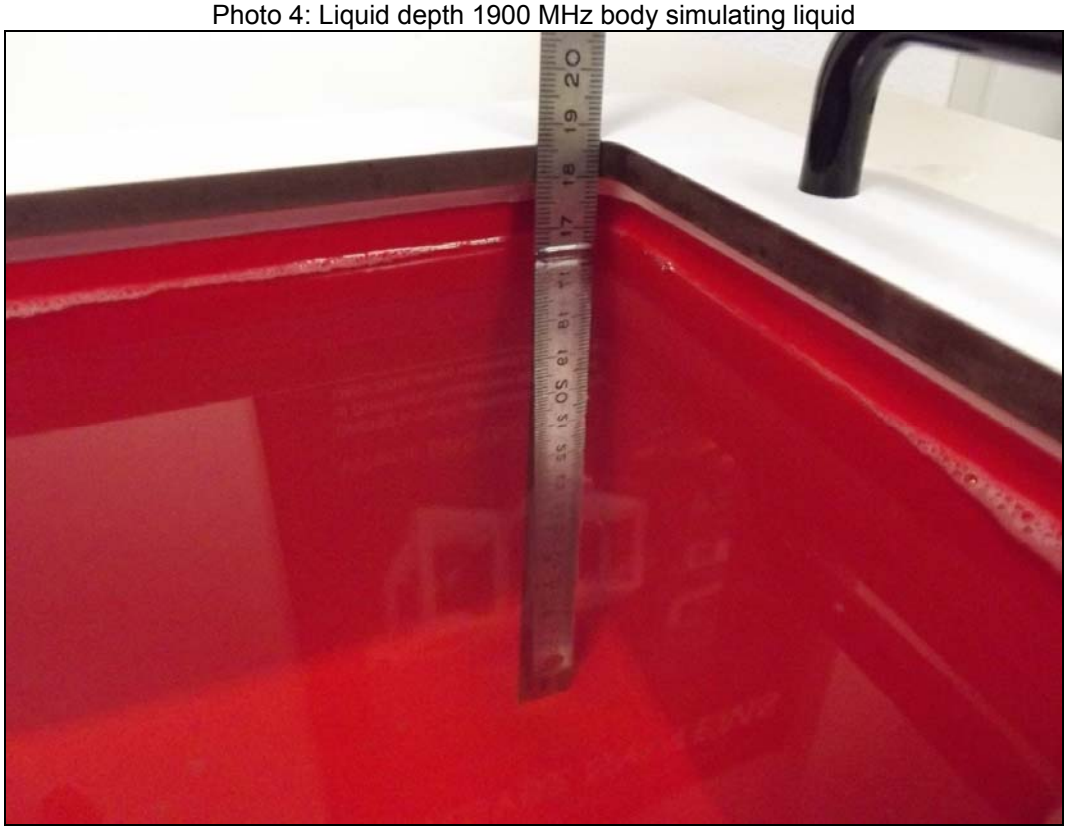



Photo 4: Liquid depth 1900 MHz body simulating liquid



## Annex C: Photo documentation

Photo documentation is described in the additional document:

**Appendix to test report no. 1-9303/15-01-02-A Photo documentation**

## Annex D: Calibration parameters

Calibration parameters are described in the additional document:

**Appendix to test report no. 1-9303/15-01-02-A**
**Calibration data, Phantom certificate**
**and detail information of the DASY5 System**

## Annex E: Document History

| Version | Applied Changes | Date of Release |
|---|---|---|
| | Initial Release | 2015-02-17 |
| -A | Corrected the Applicant and the Manufacturer | 2015-02-20 |

## Annex F: Further Information

**Glossary**

BW - Bandwidth
DTS - Distributed Transmission System
DUT - Device under Test
EUT - Equipment under Test
FCC - Federal Communication Commission
FCC ID - Company Identifier at FCC
HW - Hardware
IC - Industry Canada
Inv. No. - Inventory number
LTE - Long Term Evolution
N/A - not applicable
PCE - Personal Consumption Expenditure
OET - Office of Engineering and Technology
RB - resource block(s)
SAR - Specific Absorption Rate
S/N - Serial Number
$SPLSR_i$ - SAR-to-(peak-locations spacing) ratio
SW - Software
UNII - Unlicensed National Information Infrastructure