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# SAR EVALUATION REPORT

**Applicant Name:**
Samsung Electronics, Co. Ltd.
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Yeongtong-gu, Suwon-si
Gyeonggi-do 443-742, Korea

**Date of Testing:**
07/22/13 - 07/25/13
**Test Site/Location:**
PCTEST Lab, Columbia, MD, USA
**Document Serial No.:**
0Y1307251418.A3L

**FCC ID:** **A3LSMN900**

**APPLICANT:** **SAMSUNG ELECTRONICS, CO. LTD.**

**DUT Type:** Portable Handset
**Application Type:** Certification
**FCC Rule Part(s):** CFR §2.1093
**Model(s):** SM-N900

| Equipment Class | Band & Mode | Tx Frequency | Measured Conducted Power [dBm] | SAR | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1 gm Head (W/kg) | 1 gm Body-Worn (W/kg) | 1 gm Hotspot (W/kg) | 10 gm Hand SAR (W/kg) |
| PCE | GSM/GPRS/EDGE 850 | 824.20 - 848.80 MHz | 33.43 | 0.18 | 0.27 | 0.37 | |
| PCE | UMTS 850 | 826.40 - 846.60 MHz | 23.41 | 0.17 | 0.30 | 0.30 | |
| PCE | GSM/GPRS/EDGE 1900 | 1850.20 - 1909.80 MHz | 28.93 | 0.15 | 0.30 | 0.66 | |
| PCE | UMTS 1900 | 1852.4 - 1907.6 MHz | 22.25 | 0.19 | 0.32 | 0.60 | |
| DTS | 2.4 GHz WLAN | 2412 - 2462 MHz | 16.81 | 0.16 | 0.27 | 0.27 | |
| DTS | 5.8 GHz WLAN | 5745 - 5825 MHz | 13.17 | 0.71 | < 0.1 | | 0.32 |
| NII | 5.2 GHz WLAN | 5180 - 5240 MHz | 13.27 | 0.17 | 0.11 | | 0.39 |
| NII | 5.3 GHz WLAN | 5260 - 5320 MHz | 13.24 | 0.26 | 0.10 | | 0.47 |
| NII | 5.5 GHz WLAN | 5500 - 5700 MHz | 13.17 | 0.70 | < 0.1 | | 0.44 |
| DSS/DTS | Bluetooth | 2402 - 2480 MHz | 9.53 | N/A | | | |
| **Simultaneous SAR per KDB 690783 D01v01r02:** | | | | 0.90 | 0.58 | 0.72 | 0.47 |

Note: Powers in the above table represent output powers for the SAR test configurations and may not represent the highest output powers for all configurations for each mode.

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 1.8 of this report; for North American frequency bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested.

Randy Ortanez
President

ACCREDITED
TESTING LABORATORY
CERTIFICATE #2041.01

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# 1 DEVICE UNDER TEST

## 1.1 Device Overview

| Band & Mode | Operating Modes | Tx Frequency |
|---|---|---|
| GSM/GPRS/EDGE 850 | Voice/Data | 824.20 - 848.80 MHz |
| UMTS 850 | Voice/Data | 826.40 - 846.60 MHz |
| GSM/GPRS/EDGE 1900 | Voice/Data | 1850.20 - 1909.80 MHz |
| UMTS 1900 | Voice/Data | 1852.4 - 1907.6 MHz |
| 2.4 GHz WLAN | Data | 2412 - 2462 MHz |
| 5.8 GHz WLAN | Data | 5745 - 5825 MHz |
| 5.2 GHz WLAN | Data | 5180 - 5240 MHz |
| 5.3 GHz WLAN | Data | 5260 - 5320 MHz |
| 5.5 GHz WLAN | Data | 5500 - 5700 MHz |
| Bluetooth | Data | 2402 - 2480 MHz |
| ANT+ | Data | 2402-2480 MHz |
| NFC | Data | 13.56 MHz |

## 1.2 Nominal and Maximum Output Power Specifications

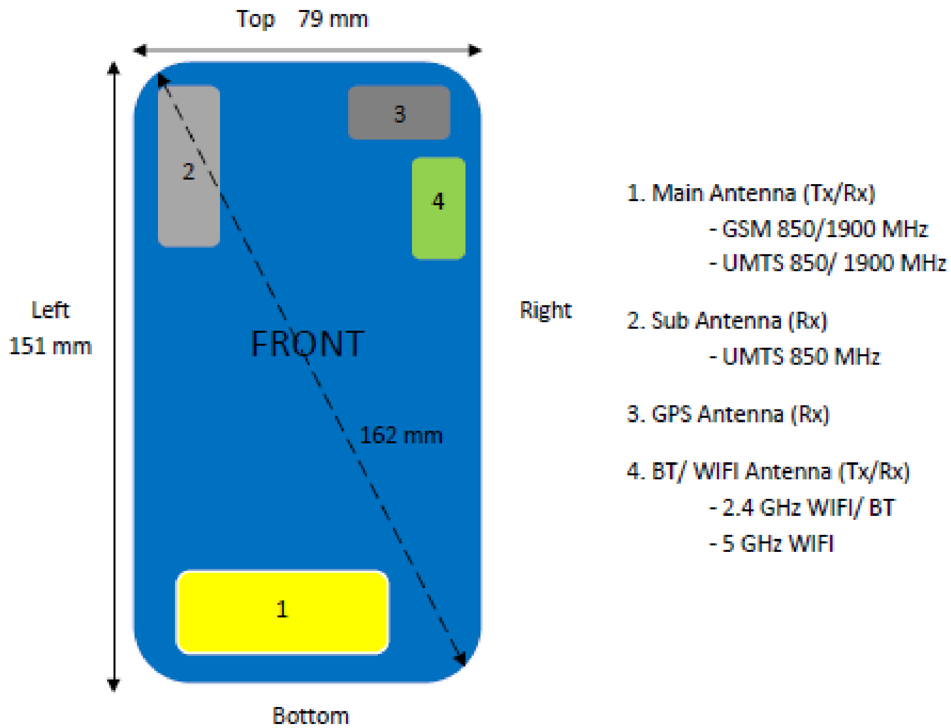
This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v05.

| Mode / Band | | Voice (dBm) | Burst Average GMSK (dBm) | | | | Burst Average 8-PSK (dBm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 TX Slot | *1 TX* | *2 TX* | *3 TX* | *4 TX* | *1 TX* | *2 TX* | *3 TX* | *4 TX* |
| GSM/GPRS/EDGE 850 | Maximum | **34.0** | **34.0** | **32.0** | **30.0** | **29.0** | **27.0** | **24.5** | **23.0** | **22.0** |
| | Nominal | **33.5** | **33.5** | **31.5** | **29.5** | **28.5** | **26.5** | **24.0** | **22.5** | **21.5** |
| GSM/GPRS/EDGE 1900 | Maximum | **30.0** | **30.0** | **28.0** | **26.0** | **25.0** | **26.0** | **24.0** | **22.5** | **21.0** |
| | Nominal | **29.5** | **29.5** | **27.5** | **25.5** | **24.5** | **25.5** | **23.5** | **22.0** | **20.5** |

| Mode / Band | | Modulated Average (dBm) | | | |
|---|---|---|---|---|---|
| | | *3GPP WCDMA* | *3GPP HSDPA* | *3GPP HSUPA* | *3GPP DC-HSDPA* |
| | | *Rel 99* | *Rel 5* | *Rel 6* | *Rel 8* |
| UMTS Band 5 (850 MHz) | Maximum | **24.0** | **23.5** | **23.0** | **23.0** |
| | Nominal | **23.5** | **23.0** | **22.5** | **22.5** |
| UMTS Band 2 (1900 MHz) | Maximum | **23.0** | **22.5** | **22.0** | **22.0** |
| | Nominal | **22.5** | **22.0** | **21.5** | **21.5** |

| Mode / Band | | Modulated Average (dBm) |
|---|---|---|
| IEEE 802.11b (2.4 GHz) | Maximum | **17.5** |
| | Nominal | **17.0** |
| IEEE 802.11g (2.4 GHz) | Maximum | **14.5** |
| | Nominal | **14.0** |
| IEEE 802.11n (2.4 GHz) | Maximum | **13.5** |
| | Nominal | **13.0** |
| IEEE 802.11a (5 GHz) | Maximum | **13.5** |
| | Nominal | **13.0** |
| IEEE 802.11n 20 MHz BW (5 GHz) | Maximum | **13.5** |
| | Nominal | **13.0** |
| IEEE 802.11n 40 MHz BW (5 GHz) | Maximum | **12.5** |
| | Nominal | **12.0** |
| IEEE 802.11ac (5 GHz) | Maximum | **11.5** |
| | Nominal | **11.0** |
| Bluetooth | Maximum | **10.0** |
| | Nominal | **9.5** |
| Bluetooth LE | Maximum | **6.0** |
| | Nominal | **5.5** |

## 1.3 DUT Antenna Locations




Notes:
1. Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC Filing.
2. Because the diagonal distance of this device is > 160 mm, it is considered a "phablet"

**Figure 1-1**
**DUT Antenna Locations**

**Table 1-1**
**Mobile Wireless Router Sides for SAR Testing**

| Mobile Wireless Router Sides for SAR Testing | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mode | Exposure Condition | Back | Front | Top | Bottom | Right | Left |
| GPRS 850 | Hotspot | Yes | Yes | No | Yes | Yes | Yes |
| UMTS 850 | Hotspot | Yes | Yes | No | Yes | Yes | Yes |
| GPRS 1900 | Hotspot | Yes | Yes | No | Yes | Yes | Yes |
| UMTS 1900 | Hotspot | Yes | Yes | No | Yes | Yes | Yes |
| 2.4 GHz WLAN | Hotspot | Yes | Yes | Yes | No | Yes | No |
| 5 GHz WLAN | Hand | Yes | Yes | Yes | No | Yes | No |

Note: Particular DUT edges were not required to be evaluated for Wireless Router or Hand SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v01 and FCC KDB Publication 648474 D04 Handset SAR v01r01 guidance, page 2. The FCC Filing shows the distance between the transmit antennas and the edges of the device.

## 1.4 NFC Antenna Locations

This DUT has NFC operations. The NFC antenna is integrated into the battery and will be the only battery available from the manufacturer for this model (Model: B800BE). Therefore, all SAR tests were performed with the battery which already integrates the NFC antenna.

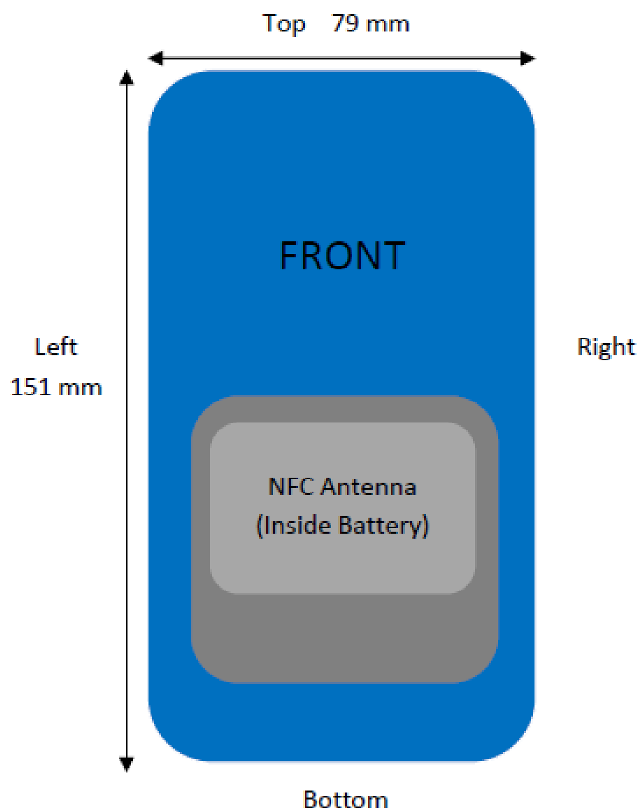



**Figure 1-2**
**DUT Antenna Locations**

## 1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D05v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v05 3) procedures.

**Table 1-2**
**Simultaneous Transmission Scenarios**

| No. | Capable Transmit Configurations | Head | Body-Worn Accessory | Hotspot | Extremity | Note |
|---|---|---|---|---|---|---|
| | | IEEE 1528, Supplement C | Supplement C | FCC KDB 941225 D06 Edges/Sides | FCC KDB 648474 D04 Edges/Sides | |
| 1 | GSM 850/1900 MHz Voice + Wifi 2.4 GHz | Yes | Yes | N/A | Yes | |
| 2 | UMTS 850/1900 MHz Voice + Wifi 2.4 GHz | Yes | Yes | N/A | Yes | |
| 3 | 850/1900 MHz GPRS/EDGE Data + Wifi 2.4 GHz | N/A | N/A | Yes | Yes | 2G Hotspot |
| 4 | 850/1900 MHz UMTS Data + Wifi 2.4 GHz | Yes | Yes | Yes | Yes | 3G Hotspot |
| 5 | GSM 850/1900 MHz Voice + Wifi 5 GHz | Yes | Yes | N/A | Yes | |
| 6 | UMTS 850/1900 MHz Voice + Wifi 5 GHz | Yes | Yes | N/A | Yes | |
| 7 | GSM 850/1900 MHz Voice + 2.4 GHz Bluetooth | N/A | Yes | N/A | Yes | |
| 8 | UMTS 850/1900 MHz Voice + 2.4 GHz Bluetooth | N/A | Yes | N/A | Yes | |
| 9 | GPRS/ EDGE 850/1900 MHz Data + WiFi 5 GHz | N/A | N/A | N/A | Yes (WIFI Direct Only) | |
| 10 | UMTS 850/1900 MHz Data + WiFi 5 GHz | N/A | N/A | N/A | Yes (WIFI Direct Only) | |

Notes:

1. When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.
2. Per the manufacturer, WIFI Direct is not expected to be used in conjunction with a held-to-ear or body-worn accessory voice call. Therefore, there are no simultaneous transmission scenarios involving WIFI direct beyond that listed in the above table.

## 1.6 SAR Test Exclusions Applied

### (A) WIFI/BT

Since Wireless Router operations are not allowed by the chipset firmware using 5 GHz WIFI, only 2.4 GHz WIFI Hotspot SAR tests and combinations are considered for SAR with respect to Wireless Router configurations according to FCC KDB 941225 D06v01.

Per FCC KDB Publication 648474 D03-D04, this device is considered a "phablet" since its diagonal distance, 162 mm, is greater than 160 mm. Therefore hand SAR tests are required. Because wireless router operations are not supported for 5 GHz WIFI, hand SAR was evaluated for 5 GHz WIFI. However, hand SAR was not evaluated for 2.4 GHz WIFI since Hotspot SAR for 2.4 GHz WIFI was <1.2 W/kg.

Per FCC KDB 447498 D01v05, the SAR exclusion threshold for distances <50mm is defined by the following equation:

$$\frac{Max\ Power\ of\ Channel\ (mW)}{Test\ Separation\ Dist\ (mm)} * \sqrt{Frequency(GHz)} \leq 3.0$$

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth body-worn accessory SAR was not required; [(10/10)* √2.441] = 1.6< 3.0. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth extremity SAR was not required; [(10/5)* √2.441] = 3.1< 7.5. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

This device supports 20 MHz and 40 MHz Bandwidths for IEEE 802.11n for 5 GHz WIFI only. IEEE 802.11n was not evaluated for SAR since the average output power of 20 MHz and 40 MHz bandwidths was not more than 0.25 dB higher than the average output power of IEEE 802.11a.

This device supports IEEE 802.11ac with the following features:

a) Up to 80 MHz Bandwidth only
b) No aggregate channel configurations
c) 1 Tx antenna output
d) 256 QAM is supported
e) No new 5 GHz channels

Full SAR evaluations for all IEEE 802.11ac configurations were not required since the average output power was not more than 0.25 dB higher than IEEE 802.11a mode. IEEE 802.11ac was evaluated for the highest IEEE 802.11a position in each 5 GHz band and exposure condition.

**(B) Licensed Transmitter(s)**

GSM/GPRS/EDGE DTM is not supported for US bands. Therefore, the GSM Voice modes in this report do not transmit simultaneously with GPRS/EDGE Data.

This device is only capable of QPSK HSUPA in the uplink. Therefore, no additional SAR tests are required beyond that described for devices with HSUPA in KDB 941225 D01v02.

Per FCC KDB Publication 648474 D04 Handset SAR v01r01, since the device is a phablet and all hotspot SAR was < 1.2 W/kg, hand SAR was not required for licensed transmitters.

## 1.7 Power Reduction for SAR

There is no power reduction used for any band/mode implemented in this device for SAR purposes.

## 1.8 Guidance Applied

- FCC OET Bulletin 65 Supplement C [June 2001]
- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (2G/3G and Hotspot)
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05 (General SAR Guidance)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)
- April 2013 TCB Workshop Notes (IEEE 802.11ac)
- FCC KDB Publication 648474 D03-D04 (Phablet Procedures)

## 1.9 Device Serial Numbers

Several samples were used with identical hardware to support SAR testing. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.

| | Head Serial Number | Body-Worn Serial Number | Hotspot Serial Number | Extremity Serial Number |
|---|---|---|---|---|
| GSM/GPRS/EDGE 850 | 142FD | 142FD | 142FD | - |
| UMTS 850 | 1438C | 1438C | 1438C | - |
| GSM/GPRS/EDGE 1900 | 142FD | 142FD | 142FD | - |
| UMTS 1900 | 1438C | 1438C | 1438C | - |
| 2.4 GHz WLAN | 14309 | 14309 | 14309 | - |
| 5 GHz WLAN | 150BE | 150BE | - | 150BE |

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# 2 INTRODUCTION

The FCC and Industry Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. [1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [24]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

## 2.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density ($\rho$). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 3-1).

**Equation 2-1**
**SAR Mathematical Equation**

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{\rho dv}\right)$$

**SAR is expressed in units of Watts per Kilogram (W/kg).**

$$SAR = \frac{\sigma \cdot E^2}{\rho}$$

where:

$\sigma$ = conductivity of the tissue-simulating material (S/m)
$\rho$ = mass density of the tissue-simulating material (kg/m$^3$)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

# 3 DOSIMETRIC ASSESSMENT

## 3.1 Measurement Procedure

The evaluation was performed using the following procedure:

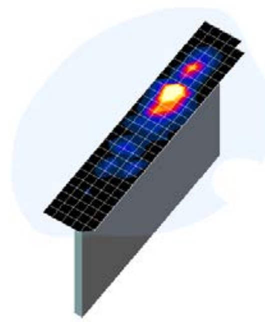


**Figure 3-1**
**Sample SAR Area Scan**

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01 (See Table 3-1).
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table 4-1). On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

   a. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

**Table 3-1**
**Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01**

| Frequency | Maximum Area Scan Resolution (mm) ($\Delta x_{area}$, $\Delta y_{area}$) | Maximum Zoom Scan Resolution (mm) ($\Delta x_{zoom}$, $\Delta y_{zoom}$) | Maximum Zoom Scan Spatial Resolution (mm) | | | Minimum Zoom Scan Volume (mm) (x,y,z) |
|---|---|---|---|---|---|---|
| | | | Uniform Grid | Graded Grid | | |
| | | | $\Delta z_{zoom}(n)$ | $\Delta z_{zoom}(1)$* | $\Delta z_{zoom}(n>1)$* | |
| ≤ 2 GHz | ≤ 15 | ≤ 8 | ≤ 5 | ≤ 4 | $\leq 1.5^*\Delta z_{zoom}(n-1)$ | ≥ 30 |
| 2-3 GHz | ≤ 12 | ≤ 5 | ≤ 5 | ≤ 4 | $\leq 1.5^*\Delta z_{zoom}(n-1)$ | ≥ 30 |
| 3-4 GHz | ≤ 12 | ≤ 5 | ≤ 4 | ≤ 3 | $\leq 1.5^*\Delta z_{zoom}(n-1)$ | ≥ 28 |
| 4-5 GHz | ≤ 10 | ≤ 4 | ≤ 3 | ≤ 2.5 | $\leq 1.5^*\Delta z_{zoom}(n-1)$ | ≥ 25 |
| 5-6 GHz | ≤ 10 | ≤ 4 | ≤ 2 | ≤ 2 | $\leq 1.5^*\Delta z_{zoom}(n-1)$ | ≥ 22 |

# 4 DEFINITION OF REFERENCE POINTS

## 4.1 EAR REFERENCE POINT

Figure 4-2 shows the front, back and side views of the SAM Twin Phantom. The point "M" is the reference point for the center of the mouth, "LE" is the left ear reference point (ERP), and "RE" is the right ERP. The ERP is 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 4-1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 4-1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].

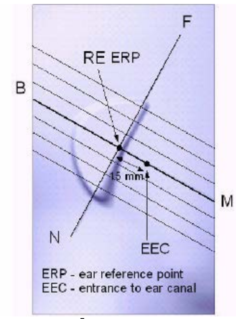



**Figure 4-1**
**Close-Up Side view of ERP**

## 4.2 HANDSET REFERENCE POINTS

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Figure 4-3). The "test device reference point" was than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at its top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.


**Figure 4-2**
**Front, back and side view of SAM Twin Phantom**

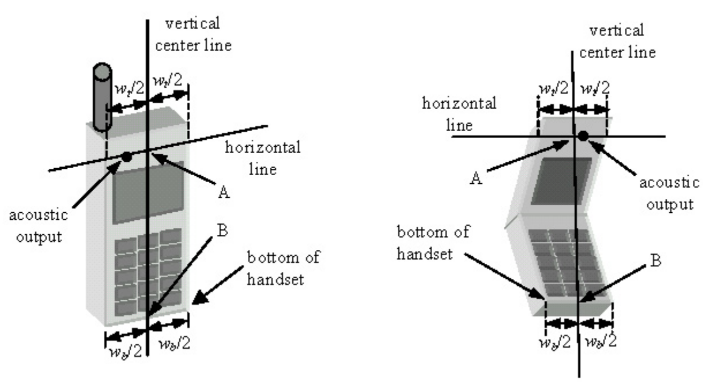



**Figure 4-3**
**Handset Vertical Center & Horizontal Line Reference Points**

# 5 TEST CONFIGURATION POSITIONS FOR HANDSETS

## 5.1 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity $\varepsilon = 3$ and loss tangent $\delta = 0.02$.

## 5.2 Positioning for Cheek

1. The test device was positioned with the device close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 5-1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

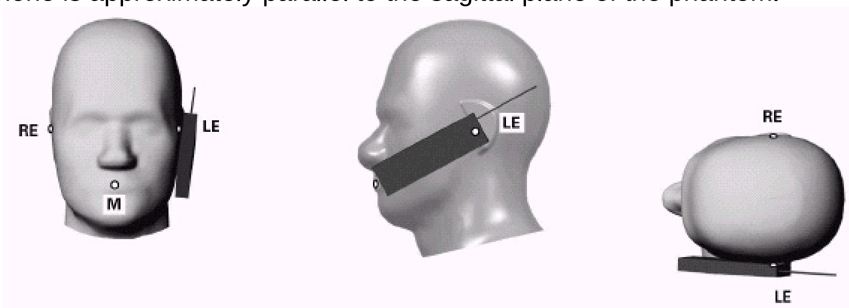



**Figure 5-1 Front, Side and Top View of Cheek Position**

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).
4. The phone was then rotated around the vertical centerline until the phone (horizontal line) was symmetrical was respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the device contact with the ear, the device was rotated about the NF line until any point on the handset made contact with a phantom point below the ear (cheek) (See Figure 5-2).

## 5.3 Positioning for Ear / 15º Tilt

With the test device aligned in the "Cheek Position":

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15 degrees.
2. The phone was then rotated around the horizontal line by 15 degrees.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the handset touched the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 5-2).

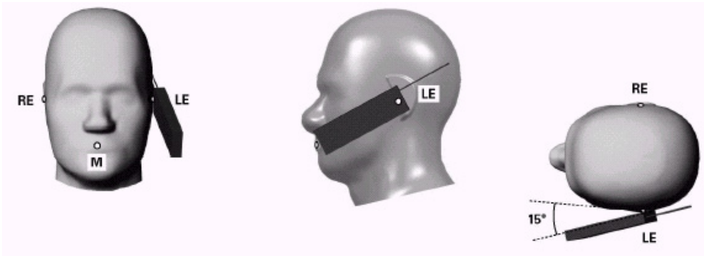



**Figure 5-2 Front, Side and Top View of Ear/15º Tilt Position**

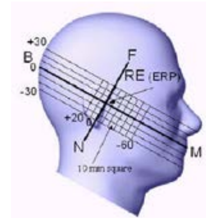



**Figure 5-3**
**Side view w/ relevant markings**

## 5.4 SAR Evaluations near the Mouth/Jaw Regions of the SAM Phantom

Antennas located near the bottom of a phone may require SAR measurements around the mouth and jaw regions of the SAM head phantom. This typically applies to clam-shell style phones that are generally longer in the unfolded normal use positions or to certain older style long rectangular phones.

Under these circumstances, the following procedures apply, adopted from the FCC guidance on SAR handsets document FCC KDB Publication 648474 D04_v01. The SAR required in these regions of SAM should be measured using a flat phantom. The phone should be positioned with a separation distance of 4 mm between the ear reference point (ERP) and the outer surface of the flat phantom shell. While maintaining this distance at the ERP location, the low (bottom) edge of the phone should be lowered from the phantom to establish the same separation distance between the peak SAR location identified by the truncated partial SAR distribution measured with the SAM phantom. The distance from the peak SAR location to the phone is determined by the straight line passing perpendicularly through the phantom surface. When it is not feasible to maintain 4 mm separation at the ERP while also establishing the required separation at the peak SAR location, the top edge of the phone will be allowed to touch the phantom with a separation < 4 mm at the ERP. The phone should not be tilted to the left or right while placed in this inclined position to the flat phantom.

The latest IEEE 1528 committee developments propose the usage of a tilted phantom when the antenna of the phone is mounted at the bottom or in all cases the peak absorption is in the chin region. Both SAM heads of the TwinSAM-Chin20 are rotated 20 degrees around the NF line. Each head can be removed individually from the table for emptying and cleaning.

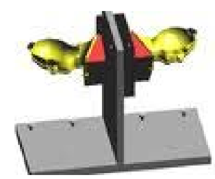


**Figure 5-4 Twin SAM Chin20**

## 5.5 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 5-5). Per FCC KDB Publication 648474 D04v01, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v05 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

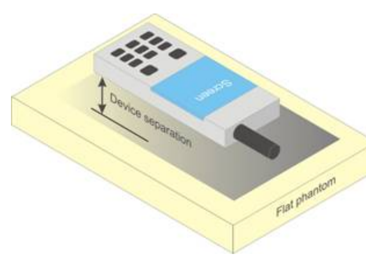



**Figure 5-5**
**Sample Body-Worn Diagram**

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented. Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

## 5.6 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 44798 D01v05 should be applied to determine SAR test requirements.

For smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC minitablets that support voice calls next to the ear, the phablets procedures outlined in KDB Publication 648474 D04 v01r01DR04 should be applied to evaluate SAR compliance. A device marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance. In addition to the normally required head and body-worn accessory SAR test procedures required for handsets, the UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna ≤ 25 mm from that surface or edge, in direct contact with the phantom, for 10-g SAR. The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g SAR > 1.2 W/kg.

## 5.7 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v05 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

# 6 RF EXPOSURE LIMITS

## 6.1 Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

## 6.2 Controlled Environment

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). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Table 6-1**
**SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6**

| HUMAN EXPOSURE LIMITS | | |
|---|---|---|
| | UNCONTROLLED ENVIRONMENT<br>*General Population*<br>(W/kg) or (mW/g) | CONTROLLED ENVIRONMENT<br>*Occupational*<br>(W/kg) or (mW/g) |
| **Peak Spatial Average SAR**<br>Head | 1.6 | 8.0 |
| **Whole Body SAR** | 0.08 | 0.4 |
| **Peak Spatial Average SAR**<br>Hands, Feet, Ankle, Wrists, etc. | 4.0 | 20 |

1. 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.
2. The Spatial Average value of the SAR averaged over the whole body.
3. 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.

# 7 FCC MEASUREMENT PROCEDURES

## 7.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v05, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r02.

## 7.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01 "SAR Measurement Procedures for 3G Devices" v02, October 2007.

The device was placed into a simulated call using a base station simulator in a RF shielded chamber. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. Devices under test were evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device was tested throughout the SAR test at maximum output power, the SAR measurement system measures a "point SAR" at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. If the power drift deviated by more than 5%, the SAR test and drift measurements were repeated.

## 7.3 SAR Measurement Conditions for UMTS

### 7.3.1 Output Power Verification

Maximum output power is measured on the High, Middle and Low channels for each applicable transmission band according to the general descriptions in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all "1s".

Maximum output power is verified on the High, Middle and Low channels according to the general descriptions in section 5.2 of 3GPP TS 34.121 (release 5), using the appropriate RMC with TPC (transmit power control) set to all "1s" or applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HS-DPCCH etc) are tabulated in this test report. All configurations that are not supported by the DUT or cannot be measured due to technical or equipment limitations are identified.

### 7.3.2 Head SAR Measurements for Handsets

SAR for head exposure configurations is measured using the 12.2 kbps RMC with TPC bits configured to all "1s". SAR in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than 0.25 dB higher than that measured in 12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a 3.4 kbps SRB (signaling radio bearer) using the exposure configuration that resulted in the highest SAR for that RF channel in the 12.2 kbps RMC mode.

### 7.3.3 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all "1s".

### 7.3.4 SAR Measurements for Handsets with Rel 5 HSDPA

Body SAR for HSDPA is not required for handsets with HSDPA capabilities when the maximum average output power of each RF channel with HSDPA active is less than 0.25 dB higher than that measured without HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2 kbps RMC is $\leq$ 75% of the SAR limit. Otherwise, SAR is measured for HSDPA, using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration measured in 12.2 kbps RMC without HSDPA, on the maximum output channel with the body exposure configuration that resulted in the highest SAR in 12.2 kbps RMC mode for that RF channel.

The H-set used in FRC for HSDPA should be configured according to the UE category of a test device. The number of HS-DSCH/HSPDSCHs, HARQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the applicable H-set. To maintain a consistent test configuration and stable transmission conditions, QPSK is used in the FRC for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 2 ms to maintain a constant rate of active CQI slots. DPCCH and DPDCH gain factors of βc=9 and βd=15, and power offset parameters of ΔACK= ΔNACK =5 and ΔCQI=2 is used. The CQI value is determined by the UE category, transport block size, number of HS-PDSCHs and modulation used in the FRC.

| Sub-Test | $\beta_c$ | $\beta_d$ | $\beta_d$ (SF) | $\beta_c/\beta_d$ | $\beta_{HS}$ (Note1, Note 2) | CM (dB) (Note 3) | MPR (dB) (Note 3) |
|---|---|---|---|---|---|---|---|
| 1 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 0.0 | 0.0 |
| 2 | 12/15 (Note 4) | 15/15 (Note 4) | 64 | 12/15 (Note 4) | 24/15 | 1.0 | 0.0 |
| 3 | 15/15 | 8/15 | 64 | 15/8 | 30/15 | 1.5 | 0.5 |
| 4 | 15/15 | 4/15 | 64 | 15/4 | 30/15 | 1.5 | 0.5 |

Note 1: $\Delta_{ACK}$, $\Delta_{NACK}$ and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, $\Delta_{ACK}$ and $\Delta_{NACK} = 8$ ($A_{hs} = 30/15$) with $\beta_{hs} = 30/15 * \beta_c$, and $\Delta_{CQI} = 7$ ($A_{hs} = 24/15$) with $\beta_{hs} = 24/15 * \beta_c$.

Note 3: CM = 1 for $\beta_c/\beta_d$ =12/15, $\beta_{hs}/\beta_c$=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

**Figure 7-1**
**Table C.10.1.4 of TS 234.121-1**

### 7.3.5 SAR Measurements for Handsets with Rel 6 HSUPA

Body SAR for HSUPA is not required when the maximum average output of each RF channel with HSUPA/HSDPA active is less than 0.25 dB higher than as measured without HSUPA/HSDPA using 12.2 kbps RMC and maximum SAR for 12.2 kbps RMC is ≤ 75 % of the SAR limit. Otherwise SAR is measured on the maximum output channel for the body exposure configuration produced highest SAR in 12.2 kbps RMC for that RF channel, using the additional procedures under “Release 6 HSPA data devices”

Head SAR for VOIP operations under HSPA is not required when maximum average output of each RF channel with HSPA is less than 0.25 dB higher than as measured using 12.2 kbps RMC. Otherwise SAR is measured using same HSPA configuration as used for body SAR.

| Sub-test | $\beta_c$ | $\beta_d$ | $\beta_d$ (SF) | $\beta_c/\beta_d$ | $\beta_{hs}^{(1)}$ | $\beta_{ec}$ | $\beta_{ed}$ | $\beta_{ed}$ (SF) | $\beta_{ed}$ (codes) | 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: $\Delta_{ACK}$, $\Delta_{NACK}$ and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.

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 signaled 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 signaled 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.

### 7.3.6 SAR Measurements for DC-HSDPA

SAR test exclusion for DC-HSDPA devices is determined by power measurements according to the H-Set 12, Fixed Reference Channel (FRC) configuration in Table C.8.1.12 of 3GPP TS 34.121-1. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to qualify for SAR test exclusion. DC-HSDPA uplink maximum output power measurements using the four Rel. 5 HSDPA subtests in Table C.10.1.4 of TS 234.121-1 is required.

When the maximum average output power of each RF channel with DC-HSDPA active is ≤ ¼ dB higher than that measured using 12.2 kbps RMC, or the maximum reported SAR for 12.2 kbps RMC is ≤ 75% of the SAR limit, SAR evaluation for DC-HSDPA is not required.

## 7.4 SAR Testing with 802.11 Transmitters

Normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g/n /ac transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v01r02 for more details.

### 7.4.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

### 7.4.2 Frequency Channel Configurations [27]

For 2.4 GHz, the highest average RF output power channel between the low, mid and high channel at the lowest data rate was selected for SAR evaluation in 802.11b mode. 802.11g/n modes and higher data rates for 802.11b were additionally evaluated for SAR if the output power of the respective mode was 0.25 dB or higher than the powers of the SAR configurations tested in the 802.11b mode.

For 5 GHz, the highest average RF output power channel across the default test channels at the lowest data rate was selected for SAR evaluation in 802.11a. When the adjacent channels are higher in power then the default channels, these “required channels” were considered instead of the default channels for SAR testing. 802.11n modes and higher data rates for 802.11a/n were evaluated only if the respective mode was 0.25 dB or higher than the 802.11a mode. 802.11ac SAR was evaluated for highest 802.11a configuration in each 5 GHz band and each exposure condition. 802.11ac modes were additionally evaluated for SAR if the output power for the respective mode was more than 0.25 dB higher than powers of 802.11a modes.

If the maximum extrapolated peak SAR of the zoom scan for the highest output channel was less than 1.6 W/kg and if the 1g averaged SAR was less than 0.8 W/kg, SAR testing was not required for the other test channels in the band.

# 8 RF CONDUCTED POWERS

## 8.1 GSM Conducted Powers

| | | Maximum Burst-Averaged Output Power | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Voice | GPRS/EDGE Data (GMSK) | | | | EDGE Data (8-PSK) | | | |
| Band | Channel | GSM [dBm] CS (1 Slot) | GPRS [dBm] 1 Tx Slot | GPRS [dBm] 2 Tx Slot | GPRS [dBm] 3 Tx Slot | GPRS [dBm] 4 Tx Slot | EDGE [dBm] 1 Tx Slot | EDGE [dBm] 2 Tx Slot | EDGE [dBm] 3 Tx Slot | EDGE [dBm] 4 Tx Slot |
| GSM 850 | 128 | 33.39 | 33.39 | 31.31 | 29.29 | **28.30** | 26.17 | 23.94 | 22.36 | 21.17 |
| | 190 | 33.43 | 33.41 | 31.32 | 29.33 | **28.31** | 26.20 | 23.98 | 22.40 | 21.22 |
| | 251 | 33.47 | 33.47 | 31.38 | 29.41 | **28.41** | 26.23 | 24.01 | 22.42 | 21.26 |
| GSM 1900 | 512 | 28.97 | 29.00 | 26.81 | 25.07 | **23.96** | 25.32 | 23.42 | 21.53 | 20.16 |
| | 661 | 28.93 | 28.96 | 26.79 | 25.08 | **23.94** | 25.29 | 23.33 | 21.52 | 20.14 |
| | 810 | 29.10 | 29.15 | 26.95 | 25.21 | **24.05** | 25.32 | 23.35 | 21.50 | 20.15 |

| | | Calculated Maximum Frame-Averaged Output Power | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Voice | GPRS/EDGE Data (GMSK) | | | | EDGE Data (8-PSK) | | | |
| Band | Channel | GSM [dBm] CS (1 Slot) | GPRS [dBm] 1 Tx Slot | GPRS [dBm] 2 Tx Slot | GPRS [dBm] 3 Tx Slot | GPRS [dBm] 4 Tx Slot | EDGE [dBm] 1 Tx Slot | EDGE [dBm] 2 Tx Slot | EDGE [dBm] 3 Tx Slot | EDGE [dBm] 4 Tx Slot |
| GSM 850 | 128 | 24.36 | 24.36 | 25.29 | 25.03 | **25.29** | 17.14 | 17.92 | 18.10 | 18.16 |
| | 190 | 24.40 | 24.38 | 25.30 | 25.07 | **25.30** | 17.17 | 17.96 | 18.14 | 18.21 |
| | 251 | 24.44 | 24.44 | 25.36 | 25.15 | **25.40** | 17.20 | 17.99 | 18.16 | 18.25 |
| GSM 1900 | 512 | 19.94 | 19.97 | 20.79 | 20.81 | **20.95** | 16.29 | 17.40 | 17.27 | 17.15 |
| | 661 | 19.90 | 19.93 | 20.77 | 20.82 | **20.93** | 16.26 | 17.31 | 17.26 | 17.13 |
| | 810 | 20.07 | 20.12 | 20.93 | 20.95 | **21.04** | 16.29 | 17.33 | 17.24 | 17.14 |

Note:

1. Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
2. The bolded GPRS modes were selected for SAR testing according to the highest frame-averaged output power table according to KDB 941225 D03v01.
3. GPRS/EDGE (GMSK) output powers were measured with coding scheme setting of 1 (CS1) on the base station simulator. CS1 was configured to measure GPRS output power measurements and SAR to ensure GMSK modulation in the signal. Our Investigation has shown that CS1 - CS4 settings do not have any impact on the output levels or modulation in the GPRS modes.
4. EDGE (8-PSK) output powers were measured with MCS7 on the base station simulator. MCS7 coding scheme was used to measure the output powers for EDGE since investigation has shown that choosing MCS7 coding scheme will ensure 8-PSK modulation. It has been shown that MCS levels that produce 8PSK modulation do not have an impact on output power.

**GSM Class:** B
**GPRS Multislot class:** 33 (Max 4 Tx uplink slots)
**EDGE Multislot class:** 33 (Max 4 Tx uplink slots)
**DTM Multislot Class:** N/A

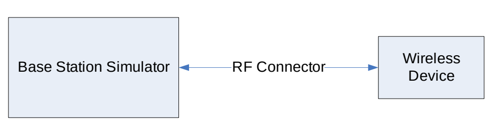



**Figure 8-1**
**Power Measurement Setup**

## 8.2 UMTS Conducted Powers

| 3GPP Release Version | Mode | 3GPP 34.121 Subtest | Cellular Band [dBm] | | | PCS Band [dBm] | | | 3GPP MPR [dB] |
|---|---|---|---|---|---|---|---|---|---|
| | | | 4132 | 4183 | 4233 | 9262 | 9400 | 9538 | |
| 99 | WCDMA | 12.2 kbps RMC | 23.45 | 23.41 | 23.35 | 22.26 | 22.25 | 22.21 | - |
| 99 | | 12.2 kbps AMR | 23.38 | 23.33 | 23.32 | 22.21 | 22.23 | 22.21 | - |
| 6 | HSDPA | Subtest 1 | 23.48 | 23.50 | 23.44 | 22.30 | 22.38 | 22.35 | 0 |
| 6 | | Subtest 2 | 22.34 | 22.38 | 22.26 | 21.11 | 21.15 | 21.25 | 0 |
| 6 | | Subtest 3 | 21.70 | 21.85 | 21.64 | 20.59 | 20.61 | 20.72 | 0.5 |
| 6 | | Subtest 4 | 21.34 | 21.36 | 21.30 | 20.16 | 20.20 | 20.35 | 0.5 |
| 6 | HSUPA | Subtest 1 | 22.32 | 22.29 | 22.23 | 21.72 | 21.80 | 21.82 | 0 |
| 6 | | Subtest 2 | 20.56 | 20.54 | 20.51 | 20.18 | 20.32 | 20.30 | 2 |
| 6 | | Subtest 3 | 21.78 | 22.29 | 22.26 | 21.33 | 21.43 | 21.40 | 1 |
| 6 | | Subtest 4 | 21.00 | 20.71 | 20.62 | 20.46 | 20.58 | 20.57 | 2 |
| 6 | | Subtest 5 | 22.69 | 22.47 | 22.39 | 21.24 | 21.21 | 21.26 | 0 |
| 8 | DC-HSDPA | Subtest 1 | 22.95 | 22.94 | 22.92 | 21.93 | 21.97 | 21.94 | 0 |
| 8 | | Subtest 2 | 22.61 | 22.63 | 22.67 | 21.82 | 21.87 | 21.80 | 0 |
| 8 | | Subtest 3 | 22.43 | 22.26 | 21.94 | 21.58 | 21.64 | 21.55 | 0.5 |
| 8 | | Subtest 4 | 21.76 | 22.21 | 22.19 | 21.26 | 21.39 | 21.31 | 0.5 |

UMTS SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v02. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.

DC-HSDPA considerations

- 3GPP Specification 34.121-1 Release 8 Ver 8.10.0 was used for DC-HSDPA guidance
- H-Set 12 (QPSK) was confirmed to be used during DC-HSDPA measurements
- Measured maximum output powers for DC-HSDPA were not greater than 1/4 dB higher than the WCDMA 12.2 kbps RMC maximum output, as a result, SAR is not required for DC-HSDPA
- The DUT supports UE category 24 for HSDPA

It is expected by the manufacturer that MPR for some HSUPA subtests may be up to 1 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model.

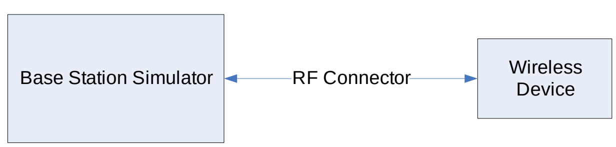



**Figure 8-2**
**Power Measurement Setup**

## 8.3 WLAN Conducted Powers

**Table 8-1**
**IEEE 802.11b Average RF Power**

| Mode | Freq | Channel | 802.11b (2.4 GHz) Conducted Power [dBm] | | | |
|---|---|---|---|---|---|---|
| | | | Data Rate [Mbps] | | | |
| | [MHz] | | 1 | 2 | 5.5 | 11 |
| 802.11b | 2412 | 1* | **16.81** | 16.91 | 17.01 | 16.99 |
| 802.11b | 2437 | 6* | 16.71 | 16.79 | 16.89 | 16.85 |
| 802.11b | 2462 | 11* | 16.56 | 16.64 | 16.76 | 16.80 |

**Table 8-2**
**IEEE 802.11g Average RF Power**

| Mode | Freq | Channel | 802.11g (2.4 GHz) Conducted Power [dBm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Data Rate [Mbps] | | | | | | | |
| | [MHz] | | 6 | 9 | 12 | 18 | 24 | 36 | 48 | 54 |
| 802.11g | 2412 | 1 | 13.82 | 13.89 | 13.88 | 13.86 | 13.89 | 13.72 | 13.89 | 13.82 |
| 802.11g | 2437 | 6 | 13.81 | 13.88 | 13.86 | 13.81 | 13.83 | 13.85 | 13.92 | 13.81 |
| 802.11g | 2462 | 11 | 14.38 | 14.43 | 14.49 | 14.40 | 14.38 | 14.38 | 14.41 | 14.45 |

**Table 8-3**
**IEEE 802.11n Average RF Power**

| Mode | Freq | Channel | 802.11n (2.4 GHz) Conducted Power [dBm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Data Rate [Mbps] | | | | | | | |
| | [MHz] | | 6.5 | 13 | 20 | 26 | 39 | 52 | 58 | 65 |
| 802.11n | 2412 | 1 | 13.00 | 13.05 | 13.04 | 12.98 | 12.96 | 12.99 | 13.06 | 13.01 |
| 802.11n | 2437 | 6 | 12.88 | 13.01 | 13.00 | 12.94 | 13.01 | 12.90 | 13.02 | 12.99 |
| 802.11n | 2462 | 11 | 13.29 | 13.32 | 13.43 | 13.36 | 13.37 | 13.40 | 13.40 | 13.38 |

**Table 8-4**
**IEEE 802.11a Average RF Power**

| Mode | Freq | Channel | 802.11a (5GHz) Conducted Power [dBm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Data Rate [Mbps] | | | | | | | |
| | [MHz] | | 6 | 9 | 12 | 18 | 24 | 36 | 48 | 54 |
| 802.11a | 5180 | 36* | 13.23 | 13.21 | 13.30 | 13.25 | 13.23 | 13.18 | 13.17 | 13.16 |
| 802.11a | 5200 | 40 | 13.25 | 13.23 | 13.26 | 13.19 | 13.18 | 13.33 | 13.15 | 13.19 |
| 802.11a | 5220 | 44 | **13.27** | 13.27 | 13.36 | 13.17 | 13.18 | 13.27 | 13.18 | 13.32 |
| 802.11a | 5240 | 48* | 13.21 | 13.22 | 13.17 | 13.11 | 13.21 | 13.15 | 13.22 | 13.26 |
| 802.11a | 5260 | 52* | 13.20 | 13.15 | 13.24 | 13.29 | 13.16 | 13.11 | 13.17 | 13.14 |
| 802.11a | 5280 | 56 | **13.24** | 13.23 | 13.28 | 13.25 | 13.14 | 13.26 | 13.23 | 13.29 |
| 802.11a | 5300 | 60 | 13.19 | 13.23 | 13.17 | 13.23 | 13.27 | 13.09 | 13.26 | 13.18 |
| 802.11a | 5320 | 64* | 13.13 | 13.05 | 13.17 | 13.14 | 13.21 | 13.14 | 13.17 | 13.12 |
| 802.11a | 5500 | 100 | **13.17** | 13.08 | 13.21 | 13.15 | 13.19 | 13.18 | 13.25 | 13.09 |
| 802.11a | 5520 | 104* | 13.12 | 13.12 | 13.04 | 13.10 | 13.14 | 13.18 | 13.09 | 13.05 |
| 802.11a | 5540 | 108 | 13.09 | 13.17 | 13.14 | 13.13 | 13.00 | 13.03 | 13.08 | 13.08 |
| 802.11a | 5560 | 112 | **13.11** | 13.17 | 13.14 | 13.19 | 13.12 | 13.02 | 13.18 | 13.17 |
| 802.11a | 5580 | 116* | 13.04 | 12.94 | 13.08 | 13.07 | 12.94 | 13.12 | 13.12 | 13.03 |
| 802.11a | 5600 | 120 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 802.11a | 5620 | 124 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 802.11a | 5640 | 128 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 802.11a | 5660 | 132 | 12.99 | 12.93 | 13.01 | 12.95 | 12.91 | 13.01 | 12.98 | 13.00 |
| 802.11a | 5680 | 136* | **13.01** | 12.96 | 13.02 | 13.01 | 12.94 | 12.97 | 12.91 | 13.04 |
| 802.11a | 5700 | 140 | 12.94 | 12.84 | 12.92 | 12.84 | 12.96 | 12.87 | 12.95 | 12.91 |
| 802.11a | 5745 | 149* | **13.17** | 13.19 | 13.18 | 13.12 | 13.10 | 13.17 | 13.12 | 13.15 |
| 802.11a | 5765 | 153 | **13.04** | 13.14 | 13.08 | 13.15 | 13.09 | 13.17 | 13.13 | 13.07 |
| 802.11a | 5785 | 157* | 13.01 | 13.01 | 13.12 | 13.12 | 13.09 | 13.11 | 13.02 | 13.09 |
| 802.11a | 5805 | 161* | **12.97** | 13.03 | 12.97 | 13.03 | 13.02 | 13.04 | 12.98 | 13.01 |
| 802.11a | 5825 | 165 | 12.95 | 12.96 | 13.05 | 12.96 | 13.05 | 13.09 | 13.05 | 12.96 |

Per FCC KDB Publication 443999 and RSS-210 A9.2(3), transmission on channels which overlap the 5600-5650 MHz is prohibited as a client. This device does not transmit any beacons or initiate any transmissions in 5.3 and 5.5 GHz Band.

(*) – indicates default channels per KDB Publication 248227 D01v01r02. When the adjacent channels are higher in power then the default channels, these “required channels” are considered for SAR testing instead of the default channels.

## Table 8-5
## IEEE 802.11n Average RF Power – 20 MHz Bandwidth

| Mode | Freq | Channel | 20MHz BW 802.11n (5GHz) Conducted Power [dBm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Data Rate [Mbps] | | | | | | | |
| | [MHz] | | 6.5 | 13 | 19.5 | 26 | 39 | 52 | 58.5 | 65 |
| 802.11n | 5180 | 36 | 13.18 | 13.22 | 13.17 | 13.11 | 13.17 | 13.12 | 13.20 | 13.11 |
| 802.11n | 5200 | 40 | 13.21 | 13.12 | 13.13 | 13.14 | 13.12 | 13.22 | 13.13 | 13.12 |
| 802.11n | 5220 | 44 | 13.25 | 13.23 | 13.22 | 13.28 | 13.29 | 13.18 | 13.28 | 13.21 |
| 802.11n | 5240 | 48 | 13.19 | 13.15 | 13.20 | 13.22 | 13.29 | 13.30 | 13.24 | 13.26 |
| 802.11n | 5260 | 52 | 13.14 | 13.16 | 13.10 | 13.04 | 13.17 | 13.08 | 13.17 | 13.10 |
| 802.11n | 5280 | 56 | 13.16 | 13.14 | 13.13 | 13.20 | 13.10 | 13.06 | 13.12 | 13.13 |
| 802.11n | 5300 | 60 | 13.14 | 13.09 | 13.18 | 13.10 | 13.09 | 13.07 | 13.10 | 13.14 |
| 802.11n | 5320 | 64 | 13.16 | 13.19 | 13.13 | 13.06 | 13.10 | 13.19 | 13.11 | 13.14 |
| 802.11n | 5500 | 100 | 13.09 | 12.99 | 13.04 | 13.07 | 13.05 | 13.07 | 13.03 | 13.02 |
| 802.11n | 5520 | 104 | 13.12 | 13.09 | 13.06 | 13.02 | 13.16 | 13.07 | 13.16 | 13.09 |
| 802.11n | 5540 | 108 | 13.13 | 13.11 | 13.12 | 13.15 | 13.04 | 13.12 | 13.16 | 13.05 |
| 802.11n | 5560 | 112 | 13.11 | 13.01 | 13.01 | 13.06 | 13.13 | 13.14 | 13.02 | 13.10 |
| 802.11n | 5580 | 116 | 13.12 | 13.10 | 13.12 | 13.13 | 13.09 | 13.03 | 13.06 | 13.02 |
| 802.11n | 5600 | 120 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 802.11n | 5620 | 124 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 802.11n | 5640 | 128 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 802.11n | 5660 | 132 | 12.99 | 12.97 | 12.94 | 12.99 | 12.93 | 13.02 | 12.91 | 12.95 |
| 802.11n | 5680 | 136 | 12.88 | 12.82 | 13.15 | 12.77 | 13.07 | 12.83 | 12.77 | 13.04 |
| 802.11n | 5700 | 140 | 12.91 | 12.97 | 12.96 | 12.91 | 13.01 | 12.91 | 12.93 | 12.92 |
| 802.11n | 5745 | 149 | 13.08 | 13.20 | 13.01 | 13.07 | 13.36 | 13.14 | 13.18 | 13.10 |
| 802.11n | 5765 | 153 | 13.03 | 13.26 | 13.05 | 13.15 | 12.93 | 13.27 | 12.91 | 13.13 |
| 802.11n | 5785 | 157 | 13.02 | 13.05 | 13.01 | 13.02 | 13.01 | 13.09 | 13.07 | 13.17 |
| 802.11n | 5805 | 161 | 12.93 | 12.87 | 13.16 | 12.93 | 12.93 | 12.89 | 13.17 | 13.08 |
| 802.11n | 5825 | 165 | 13.01 | 13.08 | 13.01 | 13.07 | 13.08 | 13.03 | 13.10 | 13.08 |

## Table 8-6
## IEEE 802.11n Average RF Power – 40 MHz Bandwidth

| Mode | Freq | Channel | 40MHz BW 802.11n (5GHz) Conducted Power [dBm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Data Rate [Mbps] | | | | | | | |
| | [MHz] | | 13.5 | 27 | 40.5 | 54 | 81 | 108 | 121.5 | 135 |
| 802.11n | 5190 | 38 | 11.95 | 11.90 | 11.99 | 11.99 | 11.85 | 11.85 | 11.93 | 11.92 |
| 802.11n | 5230 | 46 | 12.05 | 11.97 | 12.05 | 12.02 | 11.97 | 12.00 | 12.02 | 12.00 |
| 802.11n | 5270 | 54 | 12.01 | 12.03 | 11.99 | 11.99 | 12.03 | 12.00 | 11.94 | 12.04 |
| 802.11n | 5310 | 62 | 11.96 | 11.92 | 11.89 | 11.88 | 11.92 | 11.99 | 11.98 | 11.90 |
| 802.11n | 5510 | 102 | 11.86 | 11.77 | 11.84 | 11.86 | 11.97 | 11.85 | 11.89 | 11.97 |
| 802.11n | 5550 | 110 | 11.78 | 11.69 | 11.81 | 11.82 | 11.82 | 11.72 | 11.69 | 11.79 |
| 802.11n | 5590 | 118 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 802.11n | 5630 | 126 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 802.11n | 5670 | 134 | 11.55 | 11.46 | 11.56 | 11.59 | 11.49 | 11.58 | 11.53 | 11.52 |
| 802.11n | 5755 | 151 | 11.85 | 11.86 | 11.69 | 11.81 | 11.83 | 11.85 | 11.89 | 11.89 |
| 802.11n | 5795 | 159 | 11.65 | 11.93 | 11.66 | 11.90 | 11.74 | 11.73 | 11.81 | 11.79 |

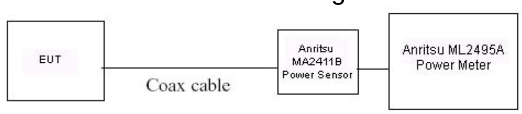
## Table 8-7
## IEEE 802.11ac Average RF Power – 80 MHz Bandwidth

| Mode | Freq [MHz] | Channel | 80MHz BW 802.11ac (5GHz) Conducted Power [dBm] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Data Rate [Mbps] | | | | | | | | | |
| | | | 29.3 | 58.5 | 87.8 | 117 | 175.5 | 234 | 263.3 | 292.5 | 351 | 390 |
| | | | MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 | MCS8 | MCS9 |
| 802.11ac | 5210 | 42 | **10.90** | 10.95 | 11.00 | 10.91 | 10.96 | 10.99 | 10.99 | 10.83 | 10.85 | 10.95 |
| 802.11ac | 5290 | 58 | **11.13** | 11.13 | 11.24 | 11.11 | 11.08 | 11.06 | 11.11 | 11.10 | 11.12 | 11.17 |
| 802.11ac | 5530 | 106 | **10.78** | 10.79 | 10.82 | 10.86 | 10.72 | 10.84 | 10.74 | 10.90 | 10.81 | 10.81 |
| 802.11ac | 5775 | 155 | **10.94** | 10.83 | 10.85 | 10.92 | 10.96 | 11.03 | 10.98 | 10.89 | 10.97 | 10.93 |

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012/April 2013 FCC/TCB Meeting Notes:

- For 2.4 GHz, highest average RF output power channel for the lowest data rate for IEEE 802.11b were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
- For 5 GHz, highest average RF output power channel for the lowest data rate for IEEE 802.11a were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11n 20 MHz and 40 MHz) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
- Full SAR tests for all IEEE 802.11ac configurations were not required because the average output power was not more than 0.25 dB higher than IEEE 802.11a mode. IEEE 802.11ac was evaluated for the highest IEEE 802.11a position in each 5 GHz band and exposure condition.
- When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is <1.6 W/kg and the reported 1g averaged SAR is <0.8 W/kg, SAR testing on other channels is not required. Otherwise, the other default (or corresponding required) test channels were additionally tested using the lowest data rate.
- The bolded data rate and channel above were tested for SAR.

Power Measurements for signals < 50 MHz




Power Measurements for signals > 50 MHz

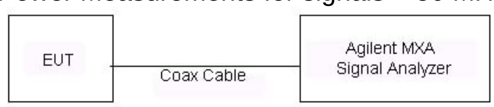



**Figure 8-3**
**Power Measurement Setup**

# 9 SYSTEM VERIFICATION

## 9.1 Tissue Verification

**Table 9-1**
**Measured Tissue Properties**

| Calibrated for Tests Performed on: | Tissue Type | Tissue Temp During Calibration (C°) | Measured Frequency (MHz) | Measured Conductivity, σ (S/m) | Measured Dielectric Constant, ε | TARGET Conductivity, σ (S/m) | TARGET Dielectric Constant, ε | % dev σ | % dev ε |
|---|---|---|---|---|---|---|---|---|---|
| 07/22/2013 | 835H | 23.4 | 820 | 0.904 | 40.855 | 0.898 | 41.571 | 0.67% | -1.72% |
| | | | 835 | 0.918 | 40.674 | 0.900 | 41.500 | 2.00% | -1.99% |
| | | | 850 | 0.932 | 40.490 | 0.916 | 41.500 | 1.75% | -2.43% |
| 07/25/2013 | 835H | 22.8 | 820 | 0.922 | 41.430 | 0.898 | 41.571 | 2.67% | -0.34% |
| | | | 835 | 0.936 | 41.226 | 0.900 | 41.500 | 4.00% | -0.66% |
| | | | 850 | 0.950 | 41.027 | 0.916 | 41.500 | 3.71% | -1.14% |
| 07/22/2013 | 1900H | 23.2 | 1850 | 1.371 | 39.761 | 1.400 | 40.000 | -2.07% | -0.60% |
| | | | 1880 | 1.401 | 39.627 | 1.400 | 40.000 | 0.07% | -0.93% |
| | | | 1910 | 1.430 | 39.496 | 1.400 | 40.000 | 2.14% | -1.26% |
| 07/25/2013 | 2450H | 22.9 | 2401 | 1.831 | 38.382 | 1.758 | 39.298 | 4.15% | -2.33% |
| | | | 2450 | 1.871 | 37.996 | 1.800 | 39.200 | 3.94% | -3.07% |
| | | | 2499 | 1.909 | 37.908 | 1.852 | 39.135 | 3.08% | -3.14% |
| 07/25/2013 | 5200H-5800H | 22.3 | 5200 | 4.704 | 35.357 | 4.660 | 36.000 | 0.94% | -1.79% |
| | | | 5220 | 4.743 | 35.352 | 4.680 | 35.980 | 1.35% | -1.75% |
| | | | 5280 | 4.794 | 35.279 | 4.740 | 35.920 | 1.14% | -1.78% |
| | | | 5300 | 4.811 | 35.150 | 4.760 | 35.900 | 1.07% | -2.09% |
| | | | 5500 | 5.075 | 34.639 | 4.965 | 35.650 | 2.22% | -2.84% |
| | | | 5520 | 5.099 | 34.716 | 4.986 | 35.620 | 2.27% | -2.54% |
| | | | 5540 | 5.105 | 34.642 | 5.007 | 35.590 | 1.96% | -2.66% |
| | | | 5560 | 5.116 | 34.602 | 5.028 | 35.560 | 1.75% | -2.69% |
| | | | 5600 | 5.182 | 34.384 | 5.070 | 35.500 | 2.21% | -3.14% |
| | | | 5680 | 5.252 | 34.284 | 5.150 | 35.420 | 1.98% | -3.21% |
| | | | 5745 | 5.362 | 34.078 | 5.215 | 35.355 | 2.82% | -3.61% |
| | | | 5765 | 5.405 | 34.021 | 5.235 | 35.335 | 3.25% | -3.72% |
| | | | 5785 | 5.404 | 34.053 | 5.255 | 35.315 | 2.84% | -3.57% |
| | | | 5800 | 5.422 | 33.994 | 5.270 | 35.300 | 2.88% | -3.70% |
| | | | 5805 | 5.411 | 33.993 | 5.275 | 35.295 | 2.58% | -3.69% |
| 07/22/2013 | 835B | 22.7 | 820 | 0.983 | 54.480 | 0.969 | 55.258 | 1.44% | -1.41% |
| | | | 835 | 0.999 | 54.331 | 0.970 | 55.200 | 2.99% | -1.57% |
| | | | 850 | 1.013 | 54.182 | 0.988 | 55.154 | 2.53% | -1.76% |
| 07/25/2013 | 1900B | 23.7 | 1850 | 1.468 | 53.286 | 1.520 | 53.300 | -3.42% | -0.03% |
| | | | 1880 | 1.498 | 53.173 | 1.520 | 53.300 | -1.45% | -0.24% |
| | | | 1910 | 1.527 | 53.079 | 1.520 | 53.300 | 0.46% | -0.41% |
| 07/22/2013 | 2450B | 22.6 | 2401 | 1.966 | 52.854 | 1.903 | 52.765 | 3.31% | 0.17% |
| | | | 2450 | 2.031 | 52.669 | 1.950 | 52.700 | 4.15% | -0.06% |
| | | | 2499 | 2.099 | 52.471 | 2.019 | 52.638 | 3.96% | -0.32% |
| 07/22/2013 | 5200B-5800B | 24.0 | 5200 | 5.505 | 48.968 | 5.299 | 49.014 | 3.89% | -0.09% |
| | | | 5220 | 5.495 | 48.894 | 5.323 | 48.987 | 3.23% | -0.19% |
| | | | 5280 | 5.580 | 48.936 | 5.393 | 48.879 | 3.47% | 0.12% |
| | | | 5300 | 5.593 | 48.806 | 5.416 | 48.851 | 3.27% | -0.09% |
| | | | 5500 | 5.816 | 48.430 | 5.650 | 48.580 | 2.94% | -0.31% |
| | | | 5520 | 5.832 | 48.368 | 5.673 | 48.553 | 2.80% | -0.38% |
| | | | 5540 | 5.861 | 48.331 | 5.696 | 48.526 | 2.90% | -0.40% |
| | | | 5745 | 6.197 | 47.965 | 5.936 | 48.248 | 4.40% | -0.59% |
| | | | 5765 | 6.215 | 47.951 | 5.959 | 48.220 | 4.30% | -0.56% |
| | | | 5785 | 6.244 | 47.942 | 5.982 | 48.242 | 4.38% | -0.62% |
| | | | 5800 | 6.296 | 47.918 | 6.000 | 48.200 | 4.93% | -0.59% |

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per IEEE 1528 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

## 9.2 Test System Verification

Prior to SAR assessment, the system is verified to ±10% of the SAR measurement on the reference dipole at the time of calibration by the calibration facility. Full system validation status and result summary can be found in Appendix E.

**Table 9-2**
**System Verification Results**

| System Verification TARGET & MEASURED | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAR System # | Tissue Frequency (MHz) | Tissue Type | Date: | Amb. Temp (°C) | Liquid Temp (°C) | Input Power (W) | Dipole SN | Probe SN | Measured SAR$_{1g}$ (W/kg) | 1 W Target SAR$_{1g}$ (W/kg) | 1 W Normalized SAR$_{1g}$ (W/kg) | Deviation$_{1g}$ (%) |
| D | 835 | HEAD | 07/22/2013 | 23.5 | 23.4 | 0.100 | 4d026 | 3288 | 0.918 | 9.390 | 9.180 | -2.24% |
| D | 835 | HEAD | 07/25/2013 | 23.4 | 23.4 | 0.100 | 4d026 | 3288 | 0.996 | 9.390 | 9.960 | 6.07% |
| G | 1900 | HEAD | 07/22/2013 | 24.5 | 23.8 | 0.100 | 5d148 | 3209 | 3.870 | 39.700 | 38.700 | -2.52% |
| C | 2450 | HEAD | 07/25/2013 | 23.6 | 22.7 | 0.100 | 719 | 3022 | 5.570 | 52.700 | 55.700 | 5.69% |
| A | 5200 | HEAD | 07/25/2013 | 24.2 | 23.4 | 0.100 | 1057 | 3589 | 7.410 | 75.900 | 74.100 | -2.37% |
| A | 5300 | HEAD | 07/25/2013 | 24.2 | 23.4 | 0.100 | 1057 | 3589 | 7.370 | 76.900 | 73.700 | -4.16% |
| A | 5500 | HEAD | 07/25/2013 | 24.2 | 23.4 | 0.100 | 1057 | 3589 | 7.910 | 80.100 | 79.100 | -1.25% |
| A | 5600 | HEAD | 07/25/2013 | 24.2 | 23.4 | 0.100 | 1057 | 3589 | 7.990 | 80.400 | 79.900 | -0.62% |
| A | 5800 | HEAD | 07/25/2013 | 24.2 | 23.4 | 0.100 | 1057 | 3589 | 7.400 | 76.100 | 74.000 | -2.76% |
| G | 835 | BODY | 07/22/2013 | 24.1 | 22.9 | 0.100 | 4d026 | 3209 | 0.992 | 9.580 | 9.920 | 3.55% |
| E | 1900 | BODY | 07/25/2013 | 24.3 | 23.7 | 0.100 | 5d148 | 3920 | 4.100 | 40.800 | 41.000 | 0.49% |
| C | 2450 | BODY | 07/22/2013 | 23.0 | 22.6 | 0.100 | 719 | 3022 | 5.480 | 51.600 | 54.800 | 6.20% |
| A | 5200 | BODY | 07/22/2013 | 24.3 | 23.6 | 0.100 | 1057 | 3589 | 7.360 | 75.500 | 73.600 | -2.52% |
| A | 5300 | BODY | 07/22/2013 | 24.3 | 23.6 | 0.100 | 1057 | 3589 | 8.000 | 75.300 | 80.000 | 6.24% |
| A | 5500 | BODY | 07/22/2013 | 24.5 | 23.6 | 0.100 | 1057 | 3589 | 7.900 | 80.800 | 79.000 | -2.23% |
| A | 5800 | BODY | 07/22/2013 | 24.5 | 23.6 | 0.100 | 1057 | 3589 | 7.480 | 75.100 | 74.800 | -0.40% |

**Table 9-3**
**System Verification Results – Extremity SAR**

| System Verification TARGET & MEASURED | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAR System # | Tissue Frequency (MHz) | Tissue Type | Date: | Amb. Temp (°C) | Liquid Temp (°C) | Input Power (W) | Dipole SN | Probe SN | Measured SAR$_{10g}$ (W/kg) | 1 W Target SAR$_{10g}$ (W/kg) | 1 W Normalized SAR$_{10g}$ (W/kg) | Deviation$_{10g}$ (%) |
| A | 5200 | BODY | 07/22/2013 | 24.3 | 23.6 | 0.100 | 1057 | 3589 | 2.080 | 21.100 | 20.800 | -1.42% |
| A | 5300 | BODY | 07/22/2013 | 24.3 | 23.6 | 0.100 | 1057 | 3589 | 2.240 | 21.100 | 22.400 | 6.16% |
| A | 5500 | BODY | 07/22/2013 | 24.5 | 23.6 | 0.100 | 1057 | 3589 | 2.190 | 22.400 | 21.900 | -2.23% |
| A | 5800 | BODY | 07/22/2013 | 24.5 | 23.6 | 0.100 | 1057 | 3589 | 2.060 | 20.700 | 20.600 | -0.48% |

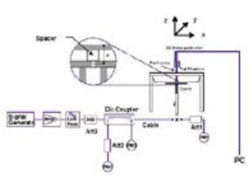


**Figure 9-1**
**System Verification Setup Diagram**

**Figure 9-2**
**System Verification Setup Photo**

# 10 SAR DATA SUMMARY

## 10.1 Standalone Head SAR Data

**Table 10-1**
**GSM 850 Head SAR**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode/Band | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Side | Test Position | Device Serial Number | Duty Cycle | SAR (1g) | Scaling Factor | Scaled SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | (W/kg) | | (W/kg) | |
| 836.60 | 190 | GSM 850 | GSM | 34.0 | 33.43 | 0.15 | Right | Cheek | 142FD | 1:8.3 | 0.120 | 1.140 | 0.137 | |
| 836.60 | 190 | GSM 850 | GSM | 34.0 | 33.43 | -0.01 | Right | Tilt | 142FD | 1:8.3 | 0.081 | 1.140 | 0.092 | |
| 836.60 | 190 | GSM 850 | GSM | 34.0 | 33.43 | 0.01 | Left | Cheek | 142FD | 1:8.3 | 0.158 | 1.140 | 0.180 | A1 |
| 836.60 | 190 | GSM 850 | GSM | 34.0 | 33.43 | 0.03 | Left | Tilt | 142FD | 1:8.3 | 0.066 | 1.140 | 0.075 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | Head<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | |

**Table 10-2**
**UMTS 850 Head SAR**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode/Band | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Side | Test Position | Device Serial Number | Duty Cycle | SAR (1g) | Scaling Factor | Scaled SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | (W/kg) | | (W/kg) | |
| 836.60 | 4183 | UMTS 850 | RMC | 24.0 | 23.41 | 0.04 | Right | Cheek | 1438C | 1:1 | 0.111 | 1.146 | 0.127 | |
| 836.60 | 4183 | UMTS 850 | RMC | 24.0 | 23.41 | 0.06 | Right | Tilt | 1438C | 1:1 | 0.087 | 1.146 | 0.100 | |
| 836.60 | 4183 | UMTS 850 | RMC | 24.0 | 23.41 | 0.10 | Left | Cheek | 1438C | 1:1 | 0.149 | 1.146 | 0.171 | A2 |
| 836.60 | 4183 | UMTS 850 | RMC | 24.0 | 23.41 | 0.08 | Left | Tilt | 1438C | 1:1 | 0.083 | 1.146 | 0.095 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | Head<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | |

**Table 10-3**
**GSM 1900 Head SAR**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode/Band | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Side | Test Position | Device Serial Number | Duty Cycle | SAR (1g) | Scaling Factor | Scaled SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | (W/kg) | | (W/kg) | |
| 1880.00 | 661 | GSM 1900 | GSM | 30.0 | 28.93 | 0.01 | Right | Cheek | 142FD | 1:8.3 | 0.067 | 1.279 | 0.086 | |
| 1880.00 | 661 | GSM 1900 | GSM | 30.0 | 28.93 | -0.16 | Right | Tilt | 142FD | 1:8.3 | 0.058 | 1.279 | 0.074 | |
| 1880.00 | 661 | GSM 1900 | GSM | 30.0 | 28.93 | -0.01 | Left | Cheek | 142FD | 1:8.3 | 0.119 | 1.279 | 0.152 | A3 |
| 1880.00 | 661 | GSM 1900 | GSM | 30.0 | 28.93 | 0.03 | Left | Tilt | 142FD | 1:8.3 | 0.042 | 1.279 | 0.054 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | Head<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | |

**Table 10-4**
**UMTS 1900 Head SAR**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode/Band | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Side | Test Position | Device Serial Number | Duty Cycle | SAR (1g) | Scaling Factor | Scaled SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | (W/kg) | | (W/kg) | |
| 1880.00 | 9400 | UMTS 1900 | RMC | 23.0 | 22.25 | -0.05 | Right | Cheek | 1438C | 1:1 | 0.072 | 1.189 | 0.086 | |
| 1880.00 | 9400 | UMTS 1900 | RMC | 23.0 | 22.25 | 0.02 | Right | Tilt | 1438C | 1:1 | 0.064 | 1.189 | 0.076 | |
| 1880.00 | 9400 | UMTS 1900 | RMC | 23.0 | 22.25 | -0.01 | Left | Cheek | 1438C | 1:1 | 0.161 | 1.189 | **0.191** | A4 |
| 1880.00 | 9400 | UMTS 1900 | RMC | 23.0 | 22.25 | 0.06 | Left | Tilt | 1438C | 1:1 | 0.054 | 1.189 | 0.064 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | Head<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | |

## Table 10-5
## DTS Head SAR

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Side | Test Position | Device Serial Number | Data Rate (Mbps) | Duty Cycle | SAR (1g) | Scaling Factor | Scaled SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 2412 | 1 | IEEE 802.11b | DSSS | 17.5 | 16.81 | 0.04 | Right | Cheek | 14309 | 1 | 1:1 | 0.091 | 1.172 | 0.107 | |
| 2412 | 1 | IEEE 802.11b | DSSS | 17.5 | 16.81 | -0.02 | Right | Tilt | 14309 | 1 | 1:1 | 0.057 | 1.172 | 0.067 | |
| 2412 | 1 | IEEE 802.11b | DSSS | 17.5 | 16.81 | -0.01 | Left | Cheek | 14309 | 1 | 1:1 | 0.139 | 1.172 | 0.163 | A5 |
| 2412 | 1 | IEEE 802.11b | DSSS | 17.5 | 16.81 | 0.05 | Left | Tilt | 14309 | 1 | 1:1 | 0.093 | 1.172 | 0.109 | |
| 5745 | 149 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.05 | Right | Cheek | 150BE | 6 | 1:1 | 0.211 | 1.079 | 0.228 | |
| 5745 | 149 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.00 | Right | Tilt | 150BE | 6 | 1:1 | 0.172 | 1.079 | 0.186 | |
| 5745 | 149 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.09 | Left | Cheek | 150BE | 6 | 1:1 | 0.592 | 1.079 | 0.639 | |
| 5765 | 153 | IEEE 802.11a | OFDM | 13.5 | 13.04 | 0.06 | Left | Cheek | 150BE | 6 | 1:1 | 0.634 | 1.112 | **0.705** | A6 |
| 5805 | 161 | IEEE 802.11a | OFDM | 13.5 | 12.97 | 0.04 | Left | Cheek | 150BE | 6 | 1:1 | 0.579 | 1.130 | 0.654 | |
| 5775 | 155 | IEEE 802.11ac | OFDM | 11.5 | 10.94 | -0.05 | Left | Cheek | 150BE | 29.3 | 1:1 | 0.387 | 1.138 | 0.440 | |
| 5745 | 149 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.03 | Left | Tilt | 150BE | 6 | 1:1 | 0.445 | 1.079 | 0.480 | |
| 5765 | 153 | IEEE 802.11a | OFDM | 13.5 | 13.04 | 0.04 | Left | Tilt | 150BE | 6 | 1:1 | 0.449 | 1.112 | 0.499 | |
| 5805 | 161 | IEEE 802.11a | OFDM | 13.5 | 12.97 | 0.00 | Left | Tilt | 150BE | 6 | 1:1 | 0.419 | 1.130 | 0.473 | |
| **ANSI / IEEE C95.1 1992 - SAFETY LIMIT**<br>**Spatial Peak**<br>**Uncontrolled Exposure/General Population** | | | | | | | **Head**<br>**1.6 W/kg (mW/g)**<br>averaged over 1 gram | | | | | | | | |

## Table 10-6
## NII Head SAR

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Side | Test Position | Device Serial Number | Data Rate (Mbps) | Duty Cycle | SAR (1g) | Scaling Factor | Scaled SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 5220 | 44 | IEEE 802.11a | OFDM | 13.5 | 13.27 | 0.02 | Right | Cheek | 150BE | 6 | 1:1 | 0.028 | 1.054 | 0.030 | |
| 5220 | 44 | IEEE 802.11a | OFDM | 13.5 | 13.27 | 0.03 | Right | Tilt | 150BE | 6 | 1:1 | 0.019 | 1.054 | 0.020 | |
| 5220 | 44 | IEEE 802.11a | OFDM | 13.5 | 13.27 | 0.09 | Left | Cheek | 150BE | 6 | 1:1 | 0.163 | 1.054 | 0.172 | |
| 5210 | 42 | IEEE 802.11ac | OFDM | 11.5 | 10.90 | -0.17 | Left | Cheek | 150BE | 29.3 | 1:1 | 0.125 | 1.148 | 0.144 | |
| 5220 | 44 | IEEE 802.11a | OFDM | 13.5 | 13.27 | -0.02 | Left | Tilt | 150BE | 6 | 1:1 | 0.087 | 1.054 | 0.092 | |
| 5280 | 56 | IEEE 802.11a | OFDM | 13.5 | 13.24 | 0.08 | Right | Cheek | 150BE | 6 | 1:1 | 0.052 | 1.062 | 0.055 | |
| 5280 | 56 | IEEE 802.11a | OFDM | 13.5 | 13.24 | 0.03 | Right | Tilt | 150BE | 6 | 1:1 | 0.029 | 1.062 | 0.031 | |
| 5280 | 56 | IEEE 802.11a | OFDM | 13.5 | 13.24 | 0.00 | Left | Cheek | 150BE | 6 | 1:1 | 0.249 | 1.062 | 0.264 | |
| 5290 | 58 | IEEE 802.11ac | OFDM | 11.5 | 11.13 | -0.05 | Left | Cheek | 150BE | 29.3 | 1:1 | 0.175 | 1.089 | 0.191 | |
| 5280 | 56 | IEEE 802.11a | OFDM | 13.5 | 13.24 | 0.02 | Left | Tilt | 150BE | 6 | 1:1 | 0.135 | 1.062 | 0.143 | |
| 5500 | 100 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.09 | Right | Cheek | 150BE | 6 | 1:1 | 0.149 | 1.079 | 0.161 | |
| 5500 | 100 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.04 | Right | Tilt | 150BE | 6 | 1:1 | 0.123 | 1.079 | 0.133 | |
| 5500 | 100 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.03 | Left | Cheek | 150BE | 6 | 1:1 | 0.538 | 1.079 | 0.581 | |
| 5560 | 112 | IEEE 802.11a | OFDM | 13.5 | 13.11 | 0.04 | Left | Cheek | 150BE | 6 | 1:1 | 0.545 | 1.094 | 0.596 | |
| 5680 | 136 | IEEE 802.11a | OFDM | 13.5 | 13.01 | 0.03 | Left | Cheek | 150BE | 6 | 1:1 | 0.629 | 1.119 | **0.704** | A7 |
| 5530 | 106 | IEEE 802.11ac | OFDM | 11.5 | 10.78 | -0.08 | Left | Cheek | 150BE | 29.3 | 1:1 | 0.320 | 1.180 | 0.378 | |
| 5500 | 100 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.04 | Left | Tilt | 150BE | 6 | 1:1 | 0.339 | 1.079 | 0.366 | |
| **ANSI / IEEE C95.1 1992 - SAFETY LIMIT**<br>**Spatial Peak**<br>**Uncontrolled Exposure/General Population** | | | | | | | **Head**<br>**1.6 W/kg (mW/g)**<br>averaged over 1 gram | | | | | | | | |

## 10.2 Standalone Body-Worn SAR Data

### Table 10-7
### GSM/UMTS Body-Worn SAR Data

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Spacing | Device Serial Number | # of Time Slots | Duty Cycle | Side | SAR (1g) | Scaling Factor | Scaled SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 836.60 | 190 | GSM 850 | GSM | 34.0 | 33.43 | -0.02 | 10 mm | 142FD | 1 | 1:8.3 | back | 0.239 | 1.140 | 0.272 | A8 |
| 836.60 | 4183 | UMTS 850 | RMC | 24.0 | 23.41 | -0.02 | 10 mm | 1438C | N/A | 1:1 | back | 0.265 | 1.146 | 0.304 | A10 |
| 1880.00 | 661 | GSM 1900 | GSM | 30.0 | 28.93 | 0.01 | 10 mm | 142FD | 1 | 1:8.3 | back | 0.234 | 1.279 | 0.299 | A11 |
| 1880.00 | 9400 | UMTS 1900 | RMC | 23.0 | 22.25 | 0.02 | 10 mm | 1438C | N/A | 1:1 | back | 0.265 | 1.189 | **0.315** | A13 |
| **ANSI / IEEE C95.1 1992 - SAFETY LIMIT**<br>**Spatial Peak**<br>**Uncontrolled Exposure/General Population** | | | | | | | | **Body**<br>**1.6 W/kg (mW/g)**<br>averaged over 1 gram | | | | | | | |

### Table 10-8
### DTS Body-Worn SAR

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Spacing | Device Serial Number | Data Rate (Mbps) | Side | Duty Cycle | SAR (1g) | Scaling Factor | Scaled SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 2412 | 1 | IEEE 802.11b | DSSS | 17.5 | 16.81 | 0.12 | 10 mm | 14309 | 1 | back | 1:1 | 0.226 | 1.172 | **0.265** | A15 |
| 5745 | 149 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.04 | 10 mm | 150BE | 6 | back | 1:1 | 0.039 | 1.079 | 0.042 | A16 |
| 5775 | 155 | IEEE 802.11ac | OFDM | 11.5 | 10.94 | -0.05 | 10 mm | 150BE | 29.3 | back | 1:1 | 0.019 | 1.138 | 0.022 | |
| **ANSI / IEEE C95.1 1992 - SAFETY LIMIT**<br>**Spatial Peak**<br>**Uncontrolled Exposure/General Population** | | | | | | | | **Body**<br>**1.6 W/kg (mW/g)**<br>averaged over 1 gram | | | | | | | |

### Table 10-9
### NII Body-Worn SAR

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Spacing | Device Serial Number | Data Rate (Mbps) | Side | Duty Cycle | SAR (1g) | Scaling Factor | Scaled SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 5220 | 44 | IEEE 802.11a | OFDM | 13.5 | 13.27 | 0.00 | 10 mm | 150BE | 6 | back | 1:1 | 0.102 | 1.054 | **0.108** | A17 |
| 5210 | 42 | IEEE 802.11ac | OFDM | 11.5 | 10.90 | 0.04 | 10 mm | 150BE | 29.3 | back | 1:1 | 0.042 | 1.148 | 0.048 | |
| 5280 | 56 | IEEE 802.11a | OFDM | 13.5 | 13.24 | -0.19 | 10 mm | 150BE | 6 | back | 1:1 | 0.096 | 1.062 | 0.102 | |
| 5290 | 58 | IEEE 802.11ac | OFDM | 11.5 | 11.13 | 0.01 | 10 mm | 150BE | 29.3 | back | 1:1 | 0.056 | 1.089 | 0.061 | |
| 5500 | 100 | IEEE 802.11a | OFDM | 13.5 | 13.17 | -0.01 | 10 mm | 150BE | 6 | back | 1:1 | 0.072 | 1.079 | 0.078 | |
| 5530 | 106 | IEEE 802.11ac | OFDM | 11.5 | 10.78 | -0.07 | 10 mm | 150BE | 29.3 | back | 1:1 | 0.034 | 1.180 | 0.040 | |
| **ANSI / IEEE C95.1 1992 - SAFETY LIMIT**<br>**Spatial Peak**<br>**Uncontrolled Exposure/General Population** | | | | | | | | **Body**<br>**1.6 W/kg (mW/g)**<br>averaged over 1 gram | | | | | | | |

## 10.3 Standalone Wireless Router SAR Data

### Table 10-10
### GPRS/UMTS Hotspot SAR Data

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Spacing | Device Serial Number | # of GPRS Slots | Duty Cycle | Side | SAR (1g) | Scaling Factor | Scaled SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 836.60 | 190 | GSM 850 | GPRS | 29.0 | 28.31 | -0.01 | 10 mm | 142FD | 4 | 1:2.076 | back | 0.319 | 1.172 | 0.374 | A9 |
| 836.60 | 190 | GSM 850 | GPRS | 29.0 | 28.31 | 0.11 | 10 mm | 142FD | 4 | 1:2.076 | front | 0.217 | 1.172 | 0.254 | |
| 836.60 | 190 | GSM 850 | GPRS | 29.0 | 28.31 | 0.05 | 10 mm | 142FD | 4 | 1:2.076 | bottom | 0.187 | 1.172 | 0.219 | |
| 836.60 | 190 | GSM 850 | GPRS | 29.0 | 28.31 | 0.01 | 10 mm | 142FD | 4 | 1:2.076 | right | 0.088 | 1.172 | 0.103 | |
| 836.60 | 190 | GSM 850 | GPRS | 29.0 | 28.31 | 0.08 | 10 mm | 142FD | 4 | 1:2.076 | left | 0.216 | 1.172 | 0.253 | |
| 836.60 | 4183 | UMTS 850 | RMC | 24.0 | 23.41 | -0.02 | 10 mm | 1438C | N/A | 1:1 | back | 0.265 | 1.146 | 0.304 | A10 |
| 836.60 | 4183 | UMTS 850 | RMC | 24.0 | 23.41 | -0.03 | 10 mm | 1438C | N/A | 1:1 | front | 0.191 | 1.146 | 0.219 | |
| 836.60 | 4183 | UMTS 850 | RMC | 24.0 | 23.41 | -0.01 | 10 mm | 1438C | N/A | 1:1 | bottom | 0.138 | 1.146 | 0.158 | |
| 836.60 | 4183 | UMTS 850 | RMC | 24.0 | 23.41 | -0.01 | 10 mm | 1438C | N/A | 1:1 | right | 0.093 | 1.146 | 0.107 | |
| 836.60 | 4183 | UMTS 850 | RMC | 24.0 | 23.41 | -0.04 | 10 mm | 1438C | N/A | 1:1 | left | 0.181 | 1.146 | 0.207 | |
| 1880.00 | 661 | GSM 1900 | GPRS | 25.0 | 23.94 | 0.02 | 10 mm | 142FD | 4 | 1:2.076 | back | 0.282 | 1.276 | 0.360 | |
| 1880.00 | 661 | GSM 1900 | GPRS | 25.0 | 23.94 | -0.04 | 10 mm | 142FD | 4 | 1:2.076 | front | 0.520 | 1.276 | **0.664** | A12 |
| 1880.00 | 661 | GSM 1900 | GPRS | 25.0 | 23.94 | 0.01 | 10 mm | 142FD | 4 | 1:2.076 | bottom | 0.281 | 1.276 | 0.359 | |
| 1880.00 | 661 | GSM 1900 | GPRS | 25.0 | 23.94 | 0.08 | 10 mm | 142FD | 4 | 1:2.076 | right | 0.052 | 1.276 | 0.066 | |
| 1880.00 | 661 | GSM 1900 | GPRS | 25.0 | 23.94 | -0.08 | 10 mm | 142FD | 4 | 1:2.076 | left | 0.175 | 1.276 | 0.223 | |
| 1880.00 | 9400 | UMTS 1900 | RMC | 23.0 | 22.25 | 0.02 | 10 mm | 1438C | N/A | 1:1 | back | 0.265 | 1.189 | 0.315 | |
| 1880.00 | 9400 | UMTS 1900 | RMC | 23.0 | 22.25 | 0.03 | 10 mm | 1438C | N/A | 1:1 | front | 0.502 | 1.189 | 0.597 | A14 |
| 1880.00 | 9400 | UMTS 1900 | RMC | 23.0 | 22.25 | 0.01 | 10 mm | 1438C | N/A | 1:1 | bottom | 0.240 | 1.189 | 0.285 | |
| 1880.00 | 9400 | UMTS 1900 | RMC | 23.0 | 22.25 | -0.01 | 10 mm | 1438C | N/A | 1:1 | right | 0.044 | 1.189 | 0.052 | |
| 1880.00 | 9400 | UMTS 1900 | RMC | 23.0 | 22.25 | 0.04 | 10 mm | 1438C | N/A | 1:1 | left | 0.165 | 1.189 | 0.196 | |
| **ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population** | | | | | | | **Body<br>1.6 W/kg (mW/g)**<br>averaged over 1 gram | | | | | | | | |

### Table 10-11
### WLAN Hotspot SAR

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Spacing | Device Serial Number | Data Rate (Mbps) | Side | Duty Cycle | SAR (1g) | Scaling Factor | Scaled SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 2412 | 1 | IEEE 802.11b | DSSS | 17.5 | 16.81 | 0.12 | 10 mm | 14309 | 1 | back | 1:1 | 0.226 | 1.172 | **0.265** | A15 |
| 2412 | 1 | IEEE 802.11b | DSSS | 17.5 | 16.81 | 0.02 | 10 mm | 14309 | 1 | front | 1:1 | 0.048 | 1.172 | 0.056 | |
| 2412 | 1 | IEEE 802.11b | DSSS | 17.5 | 16.81 | -0.07 | 10 mm | 14309 | 1 | top | 1:1 | 0.045 | 1.172 | 0.053 | |
| 2412 | 1 | IEEE 802.11b | DSSS | 17.5 | 16.81 | 0.06 | 10 mm | 14309 | 1 | right | 1:1 | 0.082 | 1.172 | 0.096 | |
| **ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population** | | | | | | | **Body<br>1.6 W/kg (mW/g)**<br>averaged over 1 gram | | | | | | | | |

## 10.4 Standalone Hand SAR Data

**Table 10-12**
**WLAN Hand SAR**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Spacing | Device Serial Number | Data Rate (Mbps) | Side | Duty Cycle | SAR (10g) | Scaling Factor | Scaled SAR (10g) | Plot # |
| MHz | Ch. | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 5745 | 149 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.05 | 0 mm | 150BE | 6 | back | 1:1 | 0.294 | 1.079 | **0.317** | A18 |
| 5775 | 155 | IEEE 802.11ac | OFDM | 11.5 | 10.94 | 0.09 | 0 mm | 150BE | 29.3 | back | 1:1 | 0.170 | 1.138 | 0.193 | |
| 5745 | 149 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.04 | 0 mm | 150BE | 6 | front | 1:1 | 0.245 | 1.079 | 0.264 | |
| 5745 | 149 | IEEE 802.11a | OFDM | 13.5 | 13.17 | -0.04 | 0 mm | 150BE | 6 | top | 1:1 | 0.204 | 1.079 | 0.220 | |
| 5745 | 149 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.11 | 0 mm | 150BE | 6 | right | 1:1 | 0.221 | 1.079 | 0.238 | |
| 5220 | 44 | IEEE 802.11a | OFDM | 13.5 | 13.27 | 0.14 | 0 mm | 150BE | 6 | back | 1:1 | 0.372 | 1.054 | 0.392 | |
| 5210 | 42 | IEEE 802.11ac | OFDM | 11.5 | 10.90 | 0.09 | 0 mm | 150BE | 29.3 | back | 1:1 | 0.202 | 1.148 | 0.232 | |
| 5220 | 44 | IEEE 802.11a | OFDM | 13.5 | 13.27 | 0.19 | 0 mm | 150BE | 6 | front | 1:1 | 0.115 | 1.054 | 0.121 | |
| 5220 | 44 | IEEE 802.11a | OFDM | 13.5 | 13.27 | 0.09 | 0 mm | 150BE | 6 | top | 1:1 | 0.032 | 1.054 | 0.034 | |
| 5220 | 44 | IEEE 802.11a | OFDM | 13.5 | 13.27 | -0.03 | 0 mm | 150BE | 6 | right | 1:1 | 0.164 | 1.054 | 0.173 | |
| 5280 | 56 | IEEE 802.11a | OFDM | 13.5 | 13.24 | -0.06 | 0 mm | 150BE | 6 | back | 1:1 | 0.439 | 1.062 | **0.466** | A19 |
| 5290 | 58 | IEEE 802.11ac | OFDM | 11.5 | 11.13 | 0.07 | 0 mm | 150BE | 29.3 | back | 1:1 | 0.244 | 1.089 | 0.266 | |
| 5280 | 56 | IEEE 802.11a | OFDM | 13.5 | 13.24 | -0.02 | 0 mm | 150BE | 6 | front | 1:1 | 0.144 | 1.062 | 0.153 | |
| 5280 | 56 | IEEE 802.11a | OFDM | 13.5 | 13.24 | 0.06 | 0 mm | 150BE | 6 | top | 1:1 | 0.059 | 1.062 | 0.063 | |
| 5280 | 56 | IEEE 802.11a | OFDM | 13.5 | 13.24 | -0.04 | 0 mm | 150BE | 6 | right | 1:1 | 0.204 | 1.062 | 0.217 | |
| 5500 | 100 | IEEE 802.11a | OFDM | 13.5 | 13.17 | -0.18 | 0 mm | 150BE | 6 | back | 1:1 | 0.409 | 1.079 | 0.441 | |
| 5530 | 106 | IEEE 802.11ac | OFDM | 11.5 | 10.78 | -0.04 | 0 mm | 150BE | 29.3 | back | 1:1 | 0.195 | 1.180 | 0.230 | |
| 5500 | 100 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.03 | 0 mm | 150BE | 6 | front | 1:1 | 0.264 | 1.079 | 0.285 | |
| 5500 | 100 | IEEE 802.11a | OFDM | 13.5 | 13.17 | -0.04 | 0 mm | 150BE | 6 | top | 1:1 | 0.220 | 1.079 | 0.237 | |
| 5500 | 100 | IEEE 802.11a | OFDM | 13.5 | 13.17 | 0.08 | 0 mm | 150BE | 6 | right | 1:1 | 0.197 | 1.079 | 0.213 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | Hand<br>4.0 W/kg (mW/g)<br>averaged over 10 grams | | | | | | | |

## 10.5 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, FCC/OET Bulletin 65, Supplement C [June 2001] and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements. A specialized battery was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01, SAR was evaluated without a headset connected to the device. Since the standalone reported SAR was ≤ 1.2 W/kg, no additional SAR evaluations using a headset cable were required.
8. Per FCC KDB 865664 D01 v01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Please see Section 12 for variability analysis.
9. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 5.7 for more details).

GSM Test Notes:

1. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
2. Justification for reduced test configurations per KDB Publication 941225 D03v01: The source-based time-averaged output power was evaluated for all multi-slot operations. The multi-slot configuration with the highest frame averaged output power was evaluated for SAR for hotspot SAR.
3. Per FCC KDB Publication 447498 D01v05, since the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg, testing at the other channels is not required for such test configuration(s). Since the maximum output power variation across the required test channels is ≤ ½ dB, middle channel was the default channel used.

UMTS Notes:

1. UMTS mode in Body SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v02. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.
2. Per FCC KDB Publication 447498 D01v05, since the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg, testing at the other channels is not required for such test configuration(s). Since the maximum output power variation across the required test channels is ≤ ½ dB, middle channel was the default channel used.

WLAN Notes:

1. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 2.4 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11b. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
2. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 5 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11a. Other IEEE 802.11 modes (including 802.11n 20 MHz and 40 MHz bandwidths) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
3. Per April 2013 TCB Workshop notes, full SAR tests for all IEEE 802.11ac configurations were not required because the average output power was not more than 0.25 dB higher than IEEE 802.11a mode. IEEE 802.11ac was evaluated for the highest IEEE 802.11a position in each 5 GHz band and exposure condition.
4. When Hotspot is enabled, all 5 GHz bands are disabled. Therefore no 5 GHz WIFI Wireless Router SAR Data was required.
5. WIFI transmission was verified using an uncalibrated spectrum analyzer.
6. When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is >1.6 W/kg, SAR testing on other default channels was required.
7. Per FCC KDB Publication 648474 D04v01r01, this device is considered a "phablet" since the diagonal distance is greater than 160mm and less than 200mm. Therefore, hand SAR tests are required when hotspot mode does not apply or if hotspot 1g SAR>1.2 W/kg. Because wireless router operations are not supported for 5 GHz WLAN hand SAR was evaluated for 5 GHz WIFI.

# 11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

## 11.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05 are applicable to handsets with built-in unlicensed transmitters such as 802.11a/b/g/n/ac and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

## 11.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05 IV.C.1.iii, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05 4.3.2 2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

$$\text{Estimated SAR} = \frac{\sqrt{f(GHz)}}{7.5} * \frac{\text{(Max Power of channel, mW)}}{\text{Min. Separation Distance, mm}}$$

**Table 11-1**
**Estimated SAR**

| Mode | Frequency | Maximum Allowed Power | Separation Distance (Body) | Estimated SAR (Body) |
|---|---|---|---|---|
| | [MHz] | [dBm] | [mm] | [W/kg] |
| Bluetooth | 2441 | 10.00 | 10 | **0.208** |

Note:

1. Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.
2. Main Antenna SAR testing was not required per KDB 648474 for extremity exposure conditions. Therefore, no further analysis was required to determine that possible simultaneous scenarios (including those with WIFI direct) would not exceed the SAR limit.

## 11.3 Head SAR Simultaneous Transmission Analysis

**Table 11-2**
**Simultaneous Transmission Scenario with 2.4 GHz WLAN (Held to Ear)**

| Simult Tx | Configuration | GSM 850 SAR (W/kg) | 2.4 GHz WLAN SAR (W/kg) | Σ SAR (W/kg) | Simult Tx | Configuration | UMTS 850 SAR (W/kg) | 2.4 GHz WLAN SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|
| Head SAR | Right Cheek | 0.137 | 0.107 | 0.244 | Head SAR | Right Cheek | 0.127 | 0.107 | 0.234 |
| | Right Tilt | 0.092 | 0.067 | 0.159 | | Right Tilt | 0.100 | 0.067 | 0.167 |
| | Left Cheek | 0.180 | 0.163 | 0.343 | | Left Cheek | 0.171 | 0.163 | 0.334 |
| | Left Tilt | 0.075 | 0.109 | 0.184 | | Left Tilt | 0.095 | 0.109 | 0.204 |
| Simult Tx | Configuration | GSM 1900 SAR (W/kg) | 2.4 GHz WLAN SAR (W/kg) | Σ SAR (W/kg) | Simult Tx | Configuration | UMTS 1900 SAR (W/kg) | 2.4 GHz WLAN SAR (W/kg) | Σ SAR (W/kg) |
| Head SAR | Right Cheek | 0.086 | 0.107 | 0.193 | Head SAR | Right Cheek | 0.086 | 0.107 | 0.193 |
| | Right Tilt | 0.074 | 0.067 | 0.141 | | Right Tilt | 0.076 | 0.067 | 0.143 |
| | Left Cheek | 0.152 | 0.163 | 0.315 | | Left Cheek | 0.191 | 0.163 | 0.354 |
| | Left Tilt | 0.054 | 0.109 | 0.163 | | Left Tilt | 0.064 | 0.109 | 0.173 |

**Table 11-3**
**Simultaneous Transmission Scenario with 5 GHz WLAN (Held to Ear)**

| Simult Tx | Configuration | GSM 850 SAR (W/kg) | 5 GHz WLAN SAR (W/kg) | Σ SAR (W/kg) | Simult Tx | Configuration | UMTS 850 SAR (W/kg) | 5 GHz WLAN SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|
| Head SAR | Right Cheek | 0.137 | 0.228 | 0.365 | Head SAR | Right Cheek | 0.127 | 0.228 | 0.355 |
| | Right Tilt | 0.092 | 0.186 | 0.278 | | Right Tilt | 0.100 | 0.186 | 0.286 |
| | Left Cheek | 0.180 | 0.705 | 0.885 | | Left Cheek | 0.171 | 0.705 | 0.876 |
| | Left Tilt | 0.075 | 0.499 | 0.574 | | Left Tilt | 0.095 | 0.499 | 0.594 |
| Simult Tx | Configuration | GSM 1900 SAR (W/kg) | 5 GHz WLAN SAR (W/kg) | Σ SAR (W/kg) | Simult Tx | Configuration | UMTS 1900 SAR (W/kg) | 5 GHz WLAN SAR (W/kg) | Σ SAR (W/kg) |
| Head SAR | Right Cheek | 0.086 | 0.228 | 0.314 | Head SAR | Right Cheek | 0.086 | 0.228 | 0.314 |
| | Right Tilt | 0.074 | 0.186 | 0.260 | | Right Tilt | 0.076 | 0.186 | 0.262 |
| | Left Cheek | 0.152 | 0.705 | 0.857 | | Left Cheek | 0.191 | 0.705 | **0.896** |
| | Left Tilt | 0.054 | 0.499 | 0.553 | | Left Tilt | 0.064 | 0.499 | 0.563 |

## 11.4 Body-Worn Simultaneous Transmission Analysis

**Table 11-4**
**Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 10 mm)**

| Configuration | Mode | 2G/3G SAR (W/kg) | 2.4 GHz WLAN SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|
| Back Side | GSM 850 | 0.272 | 0.265 | 0.537 |
| Back Side | UMTS 850 | 0.304 | 0.265 | 0.569 |
| Back Side | GSM 1900 | 0.299 | 0.265 | 0.564 |
| Back Side | UMTS 1900 | 0.315 | 0.265 | **0.580** |

**Table 11-5**
**Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 10 mm)**

| Configuration | Mode | 2G/3G SAR (W/kg) | 5 GHz WLAN SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|
| Back Side | GSM 850 | 0.272 | 0.108 | 0.380 |
| Back Side | UMTS 850 | 0.304 | 0.108 | 0.412 |
| Back Side | GSM 1900 | 0.299 | 0.108 | 0.407 |
| Back Side | UMTS 1900 | 0.315 | 0.108 | 0.423 |

**Table 11-6**
**Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 10 mm)**

| Configuration | Mode | 2G/3G SAR (W/kg) | Bluetooth SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|
| Back Side | GSM 850 | 0.272 | 0.208 | 0.480 |
| Back Side | UMTS 850 | 0.304 | 0.208 | 0.512 |
| Back Side | GSM 1900 | 0.299 | 0.208 | 0.507 |
| Back Side | UMTS 1900 | 0.315 | 0.208 | 0.523 |

Note: Bluetooth SAR was not required to be measured per FCC KDB 447498. Estimated SAR results were used in the above table to determine simultaneous transmission SAR test exclusion.

## 11.5 Hotspot SAR Simultaneous Transmission Analysis

Per FCC KDB Publication 941225 D06v01, the devices edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR (“-“).

**Table 11-7**
**Simultaneous Transmission Scenario (2.4 GHz Hotspot at 1.0 cm)**

| Simult Tx | Configuration | GPRS 850 SAR (W/kg) | 2.4 GHz WLAN SAR (W/kg) | Σ SAR (W/kg) | Simult Tx | Configuration | UMTS 850 SAR (W/kg) | 2.4 GHz WLAN SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|
| Body SAR | Back | 0.374 | 0.265 | 0.639 | Body SAR | Back | 0.304 | 0.265 | 0.569 |
| | Front | 0.254 | 0.056 | 0.310 | | Front | 0.219 | 0.056 | 0.275 |
| | Top | - | 0.053 | 0.053 | | Top | - | 0.053 | 0.053 |
| | Bottom | 0.219 | - | 0.219 | | Bottom | 0.158 | - | 0.158 |
| | Right | 0.103 | 0.096 | 0.199 | | Right | 0.107 | 0.096 | 0.203 |
| | Left | 0.253 | - | 0.253 | | Left | 0.207 | - | 0.207 |
| **Simult Tx** | **Configuration** | **GPRS 1900 SAR (W/kg)** | **2.4 GHz WLAN SAR (W/kg)** | **Σ SAR (W/kg)** | **Simult Tx** | **Configuration** | **UMTS 1900 SAR (W/kg)** | **2.4 GHz WLAN SAR (W/kg)** | **Σ SAR (W/kg)** |
| Body SAR | Back | 0.360 | 0.265 | 0.625 | Body SAR | Back | 0.315 | 0.265 | 0.580 |
| | Front | 0.664 | 0.056 | **0.720** | | Front | 0.597 | 0.056 | 0.653 |
| | Top | - | 0.053 | 0.053 | | Top | - | 0.053 | 0.053 |
| | Bottom | 0.359 | - | 0.359 | | Bottom | 0.285 | - | 0.285 |
| | Right | 0.066 | 0.096 | 0.162 | | Right | 0.052 | 0.096 | 0.148 |
| | Left | 0.223 | - | 0.223 | | Left | 0.196 | - | 0.196 |

## 11.6 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v05.

# 12 SAR MEASUREMENT VARIABILITY

## 12.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01, SAR measurement variability was assessed when measured 1 gram SAR is > 0.80 W/kg or when measured 10 gram is > 2.00 W/kg. Since all measured 1 gram SAR values were < 0.8 W/kg and all measured 10 gram SAR values were < 2.00 W/kg for this device, SAR measurement variability was not assessed.

## 12.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664 D01v01, the extended measurement uncertainty analysis per IEEE 1528-2003 was not required.

# 13 EQUIPMENT LIST

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|---|---|---|---|---|---|---|
| Gigatronics | 80701A | (0.05-18GHz) Power Sensor | 10/10/2012 | Annual | 10/10/2013 | 1833460 |
| Agilent | E8257D | (250kHz-20GHz) Signal Generator | 4/16/2013 | Annual | 4/16/2014 | MY45470194 |
| Agilent | 8753E | (30kHz-6GHz) Network Analyzer | 4/16/2013 | Annual | 4/16/2014 | JP38020182 |
| Agilent | 8594A | (9kHz-2.9GHz) Spectrum Analyzer | N/A | N/A | N/A | 3051A00187 |
| Agilent | 8648D | (9kHz-4GHz) Signal Generator | 4/17/2013 | Annual | 4/17/2014 | 3629U00687 |
| Agilent | N9020A | MXA Signal Anaylzer | 10/9/2012 | Annual | 10/9/2013 | US46470561 |
| SPEAG | D1900V2 | 1900 MHz SAR Dipole | 2/6/2013 | Annual | 2/6/2014 | 5d148 |
| SPEAG | D2450V2 | 2450 MHz SAR Dipole | 8/23/2012 | Annual | 8/23/2013 | 719 |
| Narda | 4014C-6 | 4 - 8 GHz SMA 6 dB Directional Coupler | CBT | N/A | CBT | N/A |
| SPEAG | D5GHzV2 | 5 GHz SAR Dipole | 1/11/2013 | Annual | 1/11/2014 | 1057 |
| Amplifier Research | 5S1G4 | 5W, 800MHz-4.2GHz | CBT | N/A | CBT | 21910 |
| MCL | BW-N6W5+ | 6dB Attenuator | CBT | N/A | CBT | 1139 |
| SPEAG | D835V2 | 835 MHz SAR Dipole | 8/23/2012 | Annual | 8/23/2013 | 4d026 |
| Narda | 4772-3 | Attenuator (3dB) | CBT | N/A | CBT | 9406 |
| Narda | BW-S3W2 | Attenuator (3dB) | CBT | N/A | CBT | 120 |
| Rohde & Schwarz | CMU200 | Base Station Simulator | 5/3/2013 | Annual | 5/3/2014 | 836371/0079 |
| Pasternack | PE2208-6 | Bidirectional Coupler | CBT | N/A | CBT | N/A |
| Pasternack | PE2209-10 | Bidirectional Coupler | CBT | N/A | CBT | N/A |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 8/24/2012 | Annual | 8/24/2013 | 1322 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 9/19/2012 | Annual | 9/19/2013 | 1323 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 1/17/2013 | Annual | 1/17/2014 | 1272 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 2/6/2013 | Annual | 2/6/2014 | 649 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 3/8/2013 | Annual | 3/8/2014 | 1334 |
| Mini-Circuits | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator | CBT | N/A | CBT | N/A |
| SPEAG | DAK-3.5 | Dielectric Assessment Kit | 12/11/2012 | Annual | 12/11/2013 | 1091 |
| SPEAG | DAK-3.5 | Dielectric Assessment Kit | 5/14/2013 | Annual | 5/14/2014 | 1070 |
| Agilent | 85070C | Dielectric Probe Kit | 2/14/2013 | Annual | 2/14/2014 | MY44300633 |
| Rohde & Schwarz | NRVD | Dual Channel Power Meter | 10/12/2012 | Biennial | 10/12/2014 | 101695 |
| VWR | 23226-658 | Long Stem Thermometer | 3/30/2012 | Biennial | 3/30/2014 | 122179874 |
| MiniCircuits | SLP-2400+ | Low Pass Filter | CBT | N/A | CBT | R8979500903 |
| MiniCircuits | VLF-6000+ | Low Pass Filter | CBT | N/A | CBT | N/A |
| Mini-Circuits | NLP-1200+ | Low Pass Filter DC to 1000 MHz | CBT | N/A | CBT | N/A |
| Mini-Circuits | NLP-2950+ | Low Pass Filter DC to 2700 MHz | CBT | N/A | CBT | N/A |
| VWR | 62344-925 | Mini-Thermometer | 10/24/2011 | Biennial | 10/24/2013 | 111886430 |
| Rohde & Schwarz | NRV-Z32 | Peak Power Sensor | 10/12/2012 | Biennial | 10/12/2014 | 836019/013 |
| Mini-Circuits | BW-N20W5 | Power Attenuator | CBT | N/A | CBT | 1226 |
| Anritsu | ML2495A | Power Meter | 10/11/2012 | Annual | 10/11/2013 | 1039008 |
| Anritsu | ML2496A | Power Meter | 11/28/2012 | Annual | 11/28/2013 | 1138001 |
| Anritsu | MA2481A | Power Sensor | 2/14/2013 | Annual | 2/14/2014 | 5318 |
| Anritsu | MA2481A | Power Sensor | 2/14/2013 | Annual | 2/14/2014 | 5821 |
| Anritsu | MA2411B | Pulse Power Sensor | 12/4/2012 | Annual | 12/4/2013 | 1207364 |
| Anritsu | MA2411B | Pulse Power Sensor | 12/5/2012 | Annual | 12/5/2013 | 1126066 |
| Anritsu | MA2411B | Pulse Sensor | 9/19/2012 | Annual | 9/19/2013 | 1027293 |
| Anritsu | MT8820C | Radio Communication Analyzer | 6/28/2013 | Annual | 6/28/2014 | 6201240328 |
| Anritsu | MT8820C | Radio Communication Tester | 11/6/2012 | Annual | 11/6/2013 | 6200901190 |
| Tektronix | RSA6114A | Real Time Spectrum Analyzer | 4/17/2013 | Annual | 4/17/2014 | B010177 |
| SPEAG | ES3DV2 | SAR Probe | 8/28/2012 | Annual | 8/28/2013 | 3022 |
| SPEAG | ES3DV3 | SAR Probe | 9/20/2012 | Annual | 9/20/2013 | 3288 |
| SPEAG | EX3DV4 | SAR Probe | 1/17/2013 | Annual | 1/17/2014 | 3589 |
| SPEAG | EX3DV4 | SAR Probe | 2/27/2013 | Annual | 2/27/2014 | 3920 |
| SPEAG | ES3DV3 | SAR Probe | 3/15/2013 | Annual | 3/15/2014 | 3209 |
| Rohde & Schwarz | SME06 | Signal Generator | 10/11/2012 | Annual | 10/11/2013 | 832026 |
| Rohde & Schwarz | SMIQ03B | Signal Generator | 4/17/2013 | Annual | 4/17/2014 | DE27259 |
| COMTECH | AR85729-5/5759B | Solid State Amplifier | CBT | N/A | CBT | M3W1A00-1002 |
| COMTech | AR85729-5 | Solid State Amplifier | CBT | N/A | CBT | M1S5A00-009 |
| Agilent | 85047A | S-Parameter Test Set | N/A | N/A | N/A | 2904A00579 |
| Fisher Scientific | 15-077-960 | Thermometer | 11/6/2012 | Biennial | 11/6/2014 | 122640025 |
| Seekonk | NC-100 | Torque Wrench (8" lb) | 11/29/2011 | Triennial | 11/29/2014 | 21053 |
| Gigatronics | 8651A | Universal Power Meter | 10/10/2012 | Annual | 10/10/2013 | 8650319 |
| Anritsu | MA2481D | Universal Sensor | 12/17/2012 | Annual | 12/17/2013 | 1204419 |
| Anritsu | MA2481D | Universal Sensor | 12/17/2012 | Annual | 12/17/2013 | 1204343 |
| Anritsu | MA24106A | USB Power Sensor | 8/22/2012 | Annual | 8/22/2013 | 1231538 |
| Anritsu | MA24106A | USB Power Sensor | 8/22/2012 | Annual | 8/22/2013 | 1231535 |
| VWR | 36934-158 | Wall-Mounted Thermometer | 9/30/2011 | Biennial | 9/30/2013 | 111859323 |

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

# 14 MEASUREMENT UNCERTAINTIES

Applicable for frequencies less than 3000 MHz:

| a | b | c | d | e= f(d,k) | f | g | h = c x f/e | i = c x g/e | k |
|---|---|---|---|---|---|---|---|---|---|
| **Uncertainty Component** | **IEEE 1528 Sec.** | **Tol. (± %)** | **Prob. Dist.** | **Div.** | **$c_i$ 1gm** | **$c_i$ 10 gms** | **1gm $u_i$ (± %)** | **10gms $u_i$ (± %)** | **$v_i$** |
| **Measurement System** | | | | | | | | | |
| Probe Calibration | E.2.1 | 6.0 | N | 1 | 1.0 | 1.0 | 6.0 | 6.0 | ∞ |
| Axial Isotropy | E.2.2 | 0.25 | N | 1 | 0.7 | 0.7 | 0.2 | 0.2 | ∞ |
| Hemishperical Isotropy | E.2.2 | 1.3 | N | 1 | 1.0 | 1.0 | 1.3 | 1.3 | ∞ |
| Boundary Effect | E.2.3 | 0.4 | N | 1 | 1.0 | 1.0 | 0.4 | 0.4 | ∞ |
| Linearity | E.2.4 | 0.3 | N | 1 | 1.0 | 1.0 | 0.3 | 0.3 | ∞ |
| System Detection Limits | E.2.5 | 5.1 | N | 1 | 1.0 | 1.0 | 5.1 | 5.1 | ∞ |
| Readout Electronics | E.2.6 | 1.0 | N | 1 | 1.0 | 1.0 | 1.0 | 1.0 | ∞ |
| Response Time | E.2.7 | 0.8 | R | 1.73 | 1.0 | 1.0 | 0.5 | 0.5 | ∞ |
| Integration Time | E.2.8 | 2.6 | R | 1.73 | 1.0 | 1.0 | 1.5 | 1.5 | ∞ |
| RF Ambient Conditions | E.6.1 | 3.0 | R | 1.73 | 1.0 | 1.0 | 1.7 | 1.7 | ∞ |
| Probe Positioner Mechanical Tolerance | E.6.2 | 0.4 | R | 1.73 | 1.0 | 1.0 | 0.2 | 0.2 | ∞ |
| Probe Positioning w/ respect to Phantom | E.6.3 | 2.9 | R | 1.73 | 1.0 | 1.0 | 1.7 | 1.7 | ∞ |
| Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation | E.5 | 1.0 | R | 1.73 | 1.0 | 1.0 | 0.6 | 0.6 | ∞ |
| **Test Sample Related** | | | | | | | | | |
| Test Sample Positioning | E.4.2 | 6.0 | N | 1 | 1.0 | 1.0 | 6.0 | 6.0 | 287 |
| Device Holder Uncertainty | E.4.1 | 3.32 | R | 1.73 | 1.0 | 1.0 | 1.9 | 1.9 | ∞ |
| Output Power Variation - SAR drift measurement | 6.6.2 | 5.0 | R | 1.73 | 1.0 | 1.0 | 2.9 | 2.9 | ∞ |
| **Phantom & Tissue Parameters** | | | | | | | | | |
| Phantom Uncertainty (Shape & Thickness tolerances) | E.3.1 | 4.0 | R | 1.73 | 1.0 | 1.0 | 2.3 | 2.3 | ∞ |
| Liquid Conductivity - deviation from target values | E.3.2 | 5.0 | R | 1.73 | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| Liquid Conductivity - measurement uncertainty | E.3.3 | 3.8 | N | 1 | 0.64 | 0.43 | 2.4 | 1.6 | 6 |
| Liquid Permittivity - deviation from target values | E.3.2 | 5.0 | R | 1.73 | 0.60 | 0.49 | 1.7 | 1.4 | ∞ |
| Liquid Permittivity - measurement uncertainty | E.3.3 | 4.5 | N | 1 | 0.60 | 0.49 | 2.7 | 2.2 | 6 |
| **Combined Standard Uncertainty (k=1)** | | | RSS | | | | 12.1 | 11.7 | 299 |
| **Expanded Uncertainty** (95% CONFIDENCE LEVEL) | | | k=2 | | | | 24.2 | 23.5 | |

The above measurement uncertainties are according to IEEE Std. 1528-2003

Applicable for frequencies up to 6 GHz:

| a | b | c | d | e= f(d,k) | f | g | h = c x f/e | i = c x g/e | k |
|---|---|---|---|---|---|---|---|---|---|
| **Uncertainty Component** | **IEEE 1528 Sec.** | **Tol. (± %)** | **Prob. Dist.** | **Div.** | **$c_i$ 1gm** | **$c_i$ 10 gms** | **1gm $u_i$ (± %)** | **10gms $u_i$ (± %)** | **$v_i$** |
| **Measurement System** | | | | | | | | | |
| Probe Calibration | E.2.1 | 6.55 | N | 1 | 1.0 | 1.0 | 6.6 | 6.6 | ∞ |
| Axial Isotropy | E.2.2 | 0.25 | N | 1 | 0.7 | 0.7 | 0.2 | 0.2 | ∞ |
| Hemishperical Isotropy | E.2.2 | 1.3 | N | 1 | 1.0 | 1.0 | 1.3 | 1.3 | ∞ |
| Boundary Effect | E.2.3 | 0.4 | N | 1 | 1.0 | 1.0 | 0.4 | 0.4 | ∞ |
| Linearity | E.2.4 | 0.3 | N | 1 | 1.0 | 1.0 | 0.3 | 0.3 | ∞ |
| System Detection Limits | E.2.5 | 5.1 | N | 1 | 1.0 | 1.0 | 5.1 | 5.1 | ∞ |
| Readout Electronics | E.2.6 | 1.0 | N | 1 | 1.0 | 1.0 | 1.0 | 1.0 | ∞ |
| Response Time | E.2.7 | 0.8 | R | 1.73 | 1.0 | 1.0 | 0.5 | 0.5 | ∞ |
| Integration Time | E.2.8 | 2.6 | R | 1.73 | 1.0 | 1.0 | 1.5 | 1.5 | ∞ |
| RF Ambient Conditions | E.6.1 | 3.0 | R | 1.73 | 1.0 | 1.0 | 1.7 | 1.7 | ∞ |
| Probe Positioner Mechanical Tolerance | E.6.2 | 0.4 | R | 1.73 | 1.0 | 1.0 | 0.2 | 0.2 | ∞ |
| Probe Positioning w/ respect to Phantom | E.6.3 | 2.9 | R | 1.73 | 1.0 | 1.0 | 1.7 | 1.7 | ∞ |
| Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation | E.5 | 1.0 | R | 1.73 | 1.0 | 1.0 | 0.6 | 0.6 | ∞ |
| **Test Sample Related** | | | | | | | | | |
| Test Sample Positioning | E.4.2 | 6.0 | N | 1 | 1.0 | 1.0 | 6.0 | 6.0 | 287 |
| Device Holder Uncertainty | E.4.1 | 3.32 | R | 1.73 | 1.0 | 1.0 | 1.9 | 1.9 | ∞ |
| Output Power Variation - SAR drift measurement | 6.6.2 | 5.0 | R | 1.73 | 1.0 | 1.0 | 2.9 | 2.9 | ∞ |
| **Phantom & Tissue Parameters** | | | | | | | | | |
| Phantom Uncertainty (Shape & Thickness tolerances) | E.3.1 | 4.0 | R | 1.73 | 1.0 | 1.0 | 2.3 | 2.3 | ∞ |
| Liquid Conductivity - deviation from target values | E.3.2 | 5.0 | R | 1.73 | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| Liquid Conductivity - measurement uncertainty | E.3.3 | 3.8 | N | 1 | 0.64 | 0.43 | 2.4 | 1.6 | 6 |
| Liquid Permittivity - deviation from target values | E.3.2 | 5.0 | R | 1.73 | 0.60 | 0.49 | 1.7 | 1.4 | ∞ |
| Liquid Permittivity - measurement uncertainty | E.3.3 | 4.5 | N | 1 | 0.60 | 0.49 | 2.7 | 2.2 | 6 |
| **Combined Standard Uncertainty (k=1)** | | | RSS | | | | 12.4 | 12.0 | 299 |
| **Expanded Uncertainty** (95% CONFIDENCE LEVEL) | | | k=2 | | | | 24.7 | 24.0 | |

The above measurement uncertainties are according to IEEE Std. 1528-2003

# 15 CONCLUSION

## 15.1 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC and Industry Canada, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

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# APPENDIX A: SAR TEST DATA

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 142FD**

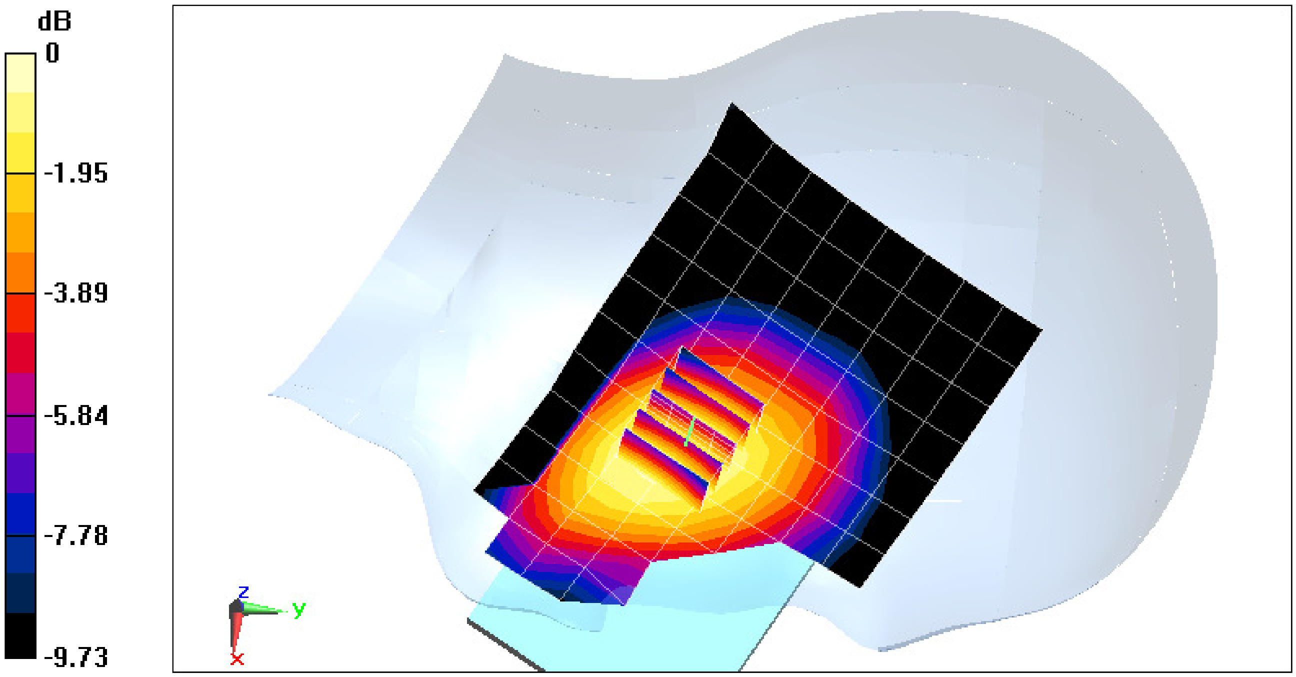
Communication System: GSM; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium: 835 Head, Medium parameters used (interpolated):
f = 836.6 MHz; $\sigma$ = 0.919 S/m; $\varepsilon_r$ = 40.654; $\rho$ = 1000 kg/$m^3$
Phantom section: Left Section

Test Date: 07-22-2013; Ambient Temp: 23.5°C; Tissue Temp: 23.4°C

Probe: ES3DV3 - SN3288; ConvF(6.41, 6.41, 6.41); Calibrated: 9/20/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/19/2012
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

## Mode: GSM 850, Left Head, Cheek, Mid.ch

**Area Scan (9x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.170 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.205 W/kg
**SAR(1 g) = 0.158 W/kg**




0 dB = 0.165 W/kg = -7.83 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 1438C**

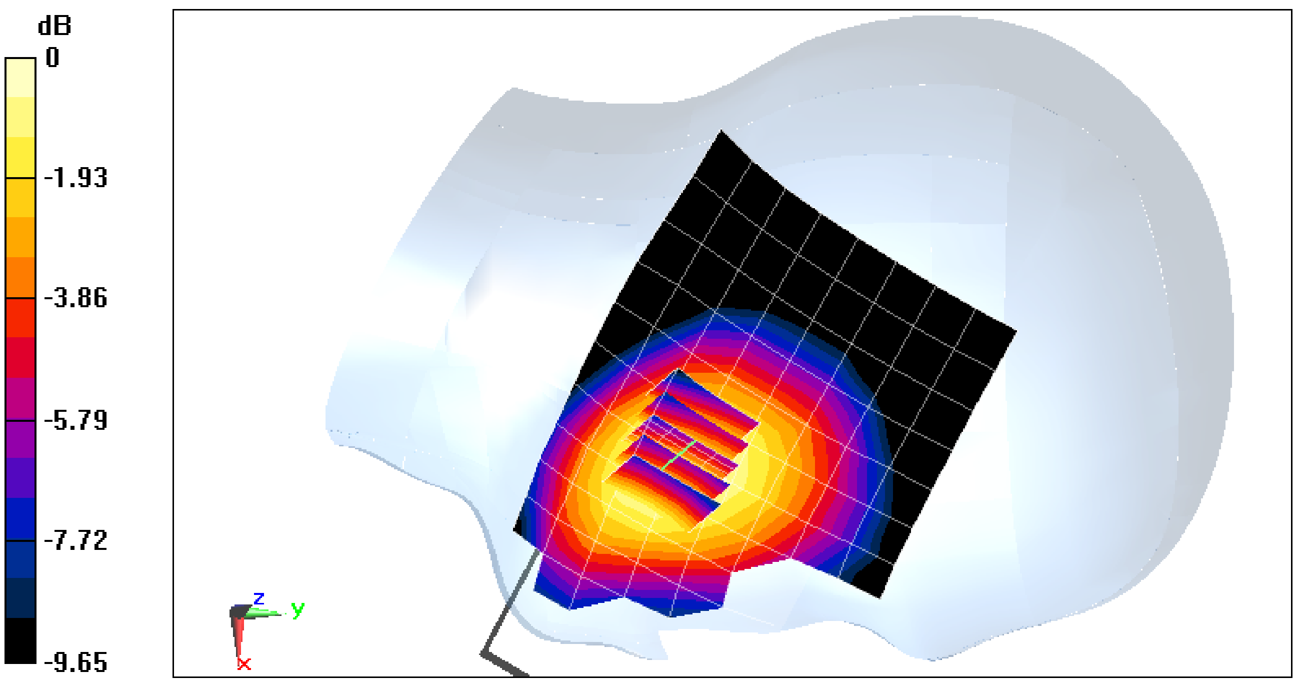
Communication System: UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Head, Medium parameters used (interpolated):
f = 836.6 MHz; $\sigma$ = 0.937 S/m; $\varepsilon_r$ = 41.205; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section

Test Date: 07-25-2013; Ambient Temp: 23.4°C; Tissue Temp: 23.4°C

Probe: ES3DV3 - SN3288; ConvF(6.41, 6.41, 6.41); Calibrated: 9/20/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/19/2012
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP- 1646
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Mode: UMTS 850, Left Head, Cheek, Mid.ch**

**Area Scan (9x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.203 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.167 W/kg
**SAR(1 g) = 0.149 W/kg**




0 dB = 0.136 W/kg = -8.66 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 142FD**

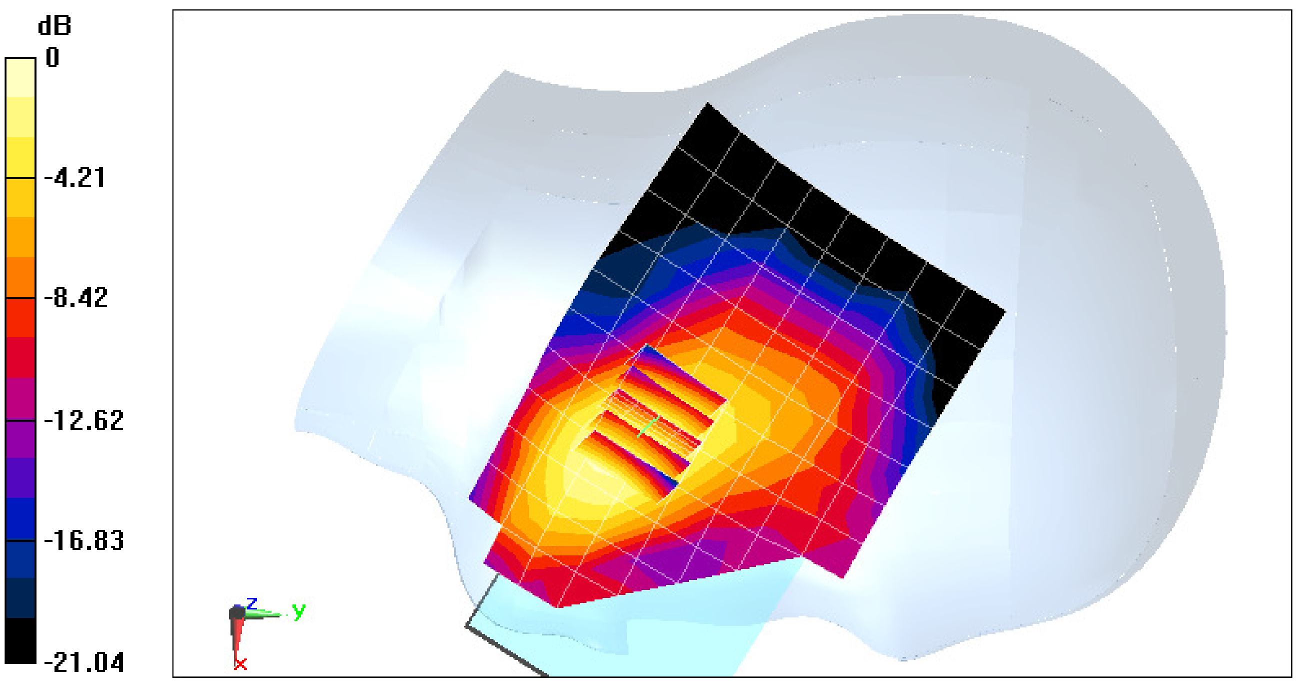
Communication System: GSM; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium: 1900 Head, Medium parameters used:
$f = 1880$ MHz; $\sigma = 1.401$ S/m; $\varepsilon_r = 39.627$; $\rho = 1000$ kg/m$^3$
Phantom section: Left Section

Test Date: 07-22-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.8°C

Probe: ES3DV3 - SN3209; ConvF(5.21, 5.21, 5.21); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: SAM Right; Type: QD000P40CD; Serial: 1686
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

## Mode: GSM 1900, Left Head, Cheek, Mid.ch

**Area Scan (9x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.208 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.180 W/kg
**SAR(1 g) = 0.119 W/kg**




0 dB = 0.127 W/kg = -8.96 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 1438C**

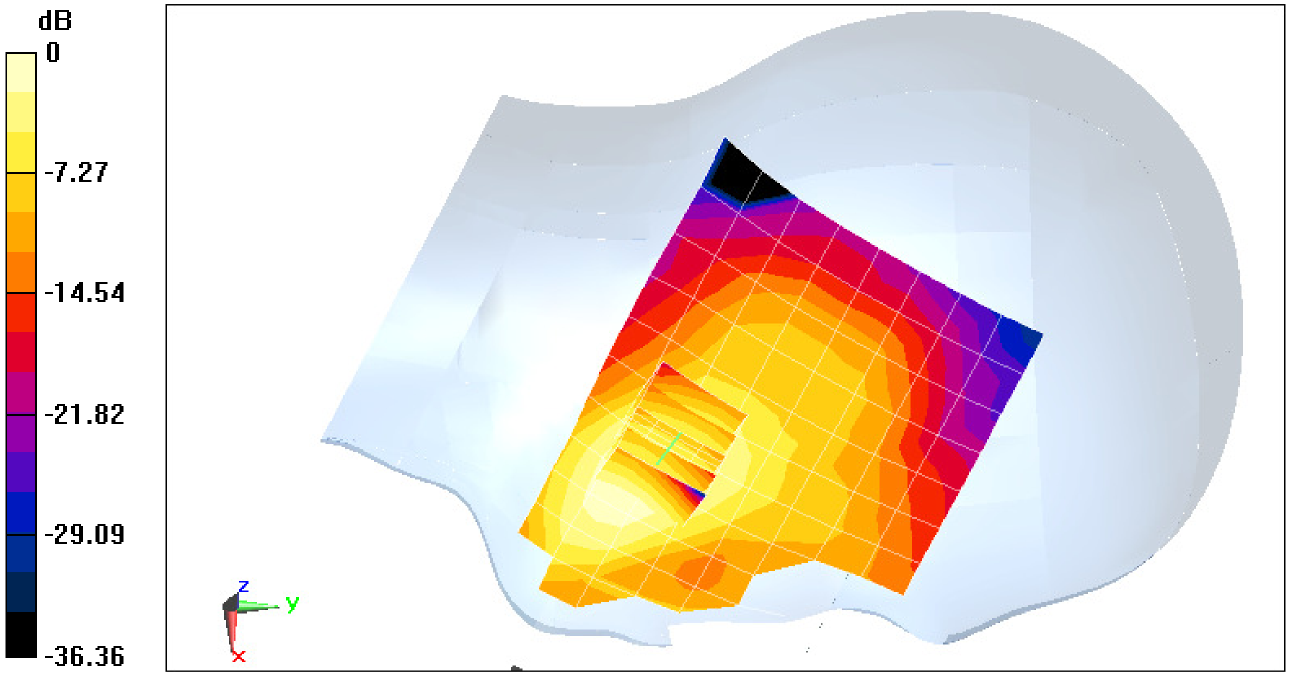
Communication System: UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Head, Medium parameters used:
f = 1880 MHz; $\sigma$ = 1.401 S/m; $\varepsilon_r$ = 39.627; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section

Test Date: 07-22-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.8°C

Probe: ES3DV3 - SN3209; ConvF(5.21, 5.21, 5.21); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: SAM Right; Type: QD000P40CD; Serial: 1686
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

## Mode: UMTS 1900, Left Head, Cheek, Mid.ch

**Area Scan (9x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.894 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.238 W/kg
**SAR(1 g) = 0.161 W/kg**




0 dB = 0.170 W/kg = -7.70 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 14309**

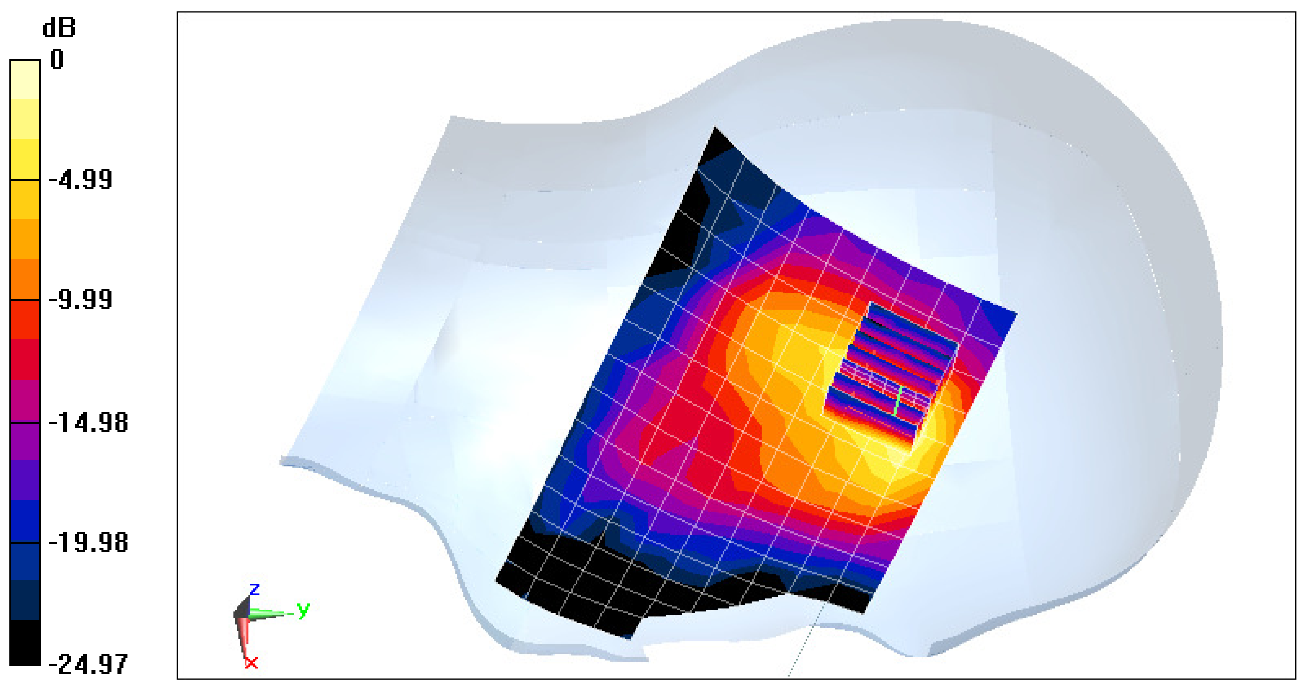
Communication System: IEEE 802.11b; Frequency: 2462 MHz; Duty Cycle: 1:1
Medium: 2450 Head, Medium parameters used (interpolated):
f = 2412 MHz; $\sigma$ = 1.84 S/m; $\varepsilon_r$ = 38.295; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section

Test Date: 07-25-2013; Ambient Temp: 23.6°C; Tissue Temp: 22.7°C

Probe: ES3DV2 - SN3022; ConvF(4.23, 4.23, 4.23); Calibrated: 8/28/2012;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## Mode: IEEE 802.11b, Left Head, Cheek, Ch 1, 1 Mbps

**Area Scan (10x15x1):** Measurement grid: dx=12mm, dy=12mm
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.865 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.344 W/kg
**SAR(1 g) = 0.139 W/kg**




0 dB = 0.190 W/kg = -7.21 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 150BE**

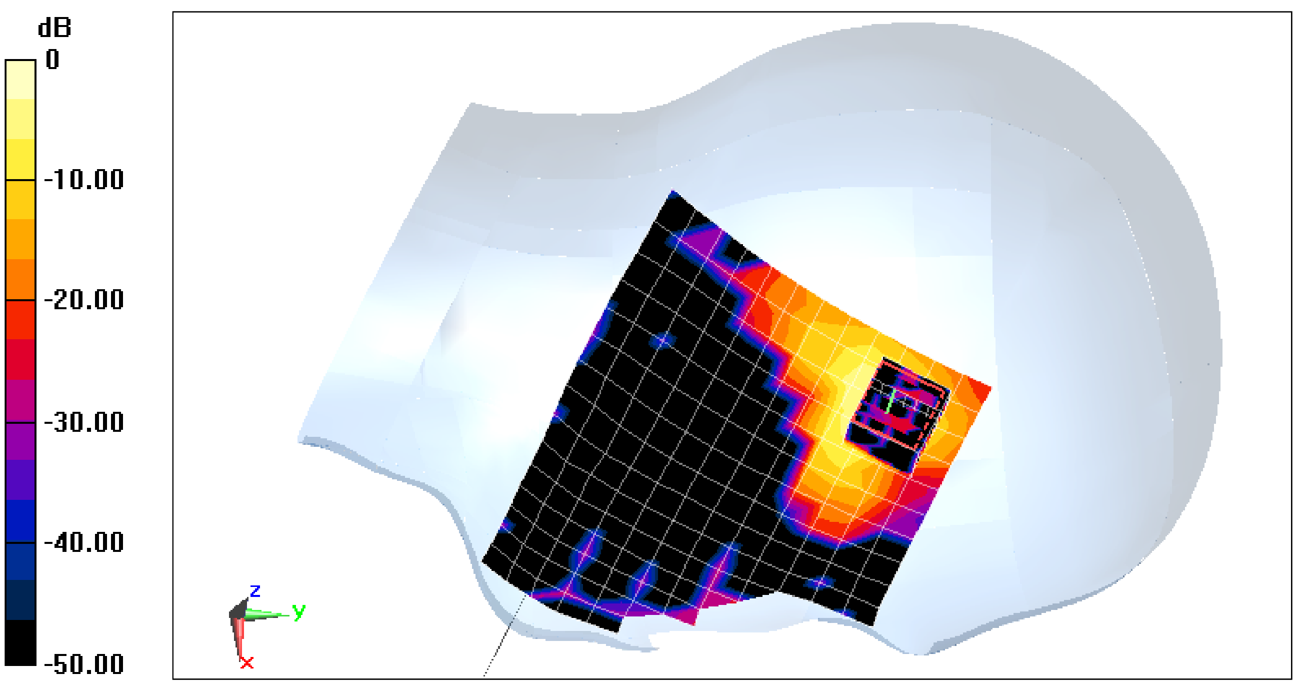
Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5765 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5765 MHz; $\sigma$ = 5.405 S/m; $\varepsilon_r$ = 34.021; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section

Test Date: 07-25-2013; Ambient Temp: 24.2°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(3.85, 3.85, 3.85); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main New; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## Mode: IEEE 802.11a, 5.8 GHz Left Head, Cheek, Ch 153, 6 Mbps

**Area Scan (13x16x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio:1.4
Reference Value = 10.971 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 4.31 W/kg
**SAR(1 g) = 0.634 W/kg**




0 dB = 1.87 W/kg = 2.72 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 150BE**

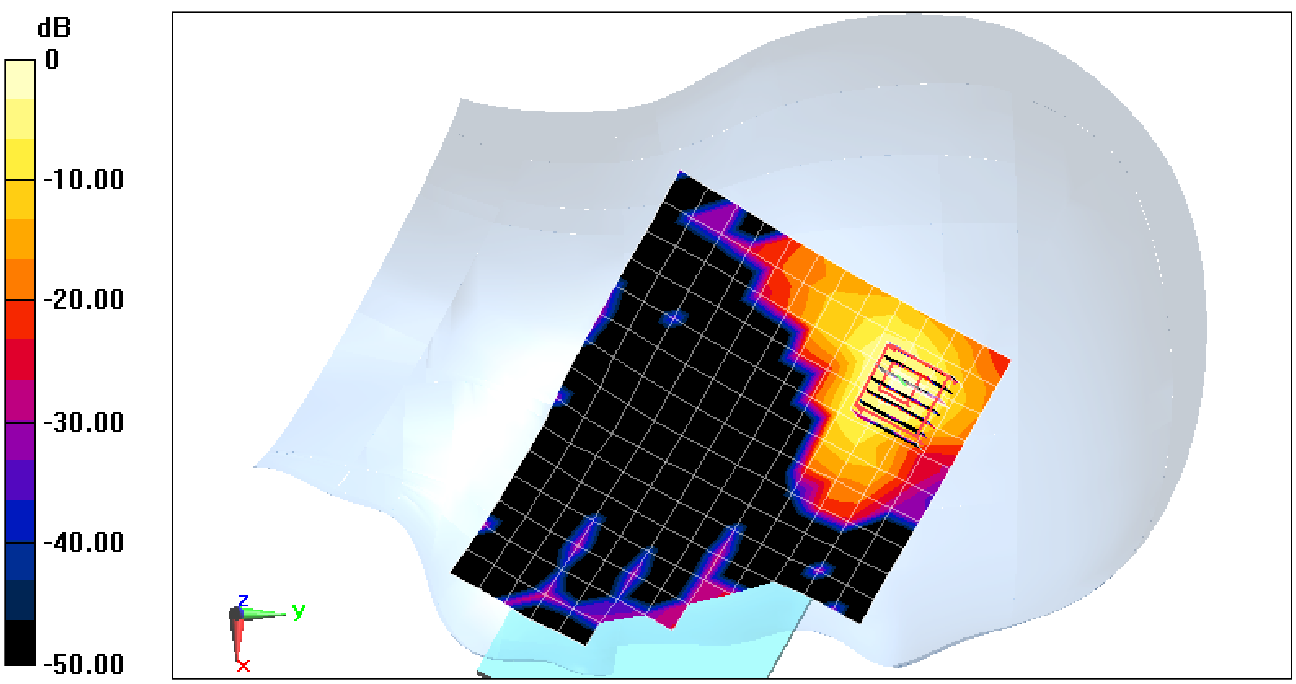
Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5680 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5680 MHz; $\sigma$ = 5.252 S/m; $\varepsilon_r$ = 34.284; $\rho$ = 1000 kg/m$^3$
Phantom section: Left Section

Test Date: 07-25-2013; Ambient Temp: 24.2°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(3.81, 3.81, 3.81); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main New; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## Mode: IEEE 802.11a, 5.5-5.7 GHz Left Head, Cheek, Ch 136, 6 Mbps

**Area Scan (13x16x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4
Reference Value = 11.259 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 2.93 W/kg
**SAR(1 g) = 0.629 W/kg**




0 dB = 1.82 W/kg = 2.60 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 142FD**

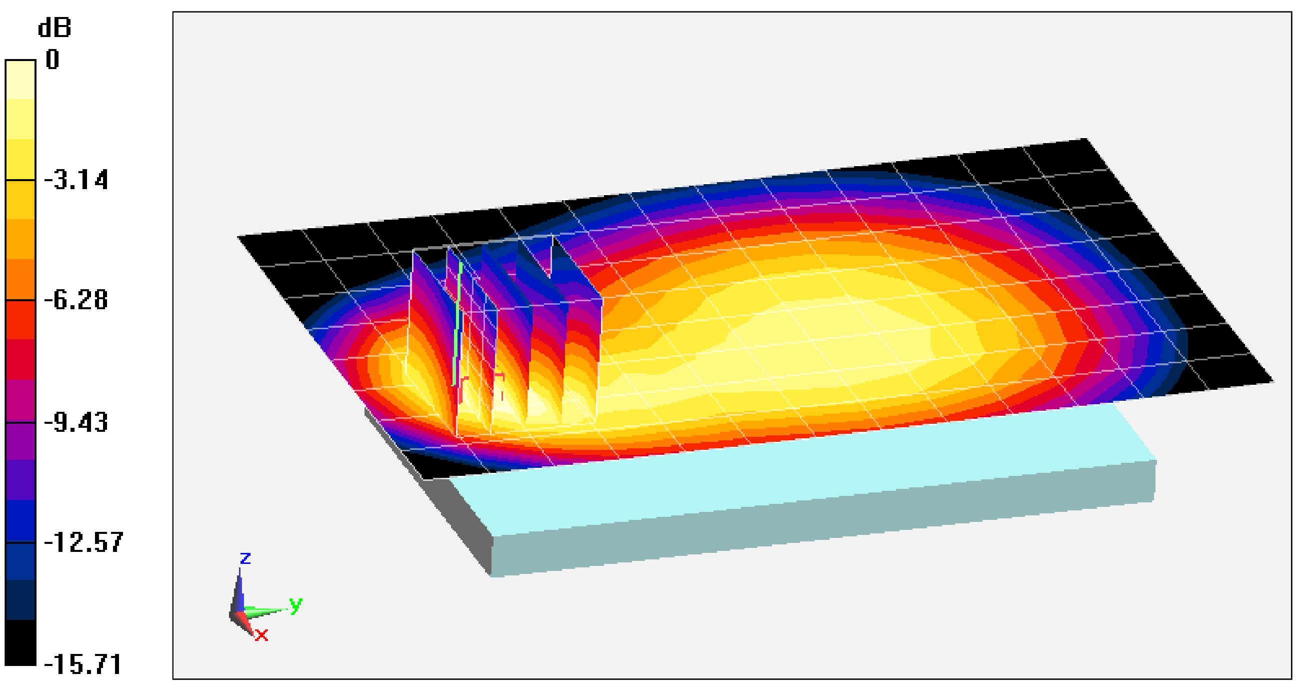
Communication System: GSM; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium: 835 Body, Medium parameters used (interpolated):
f = 836.6 MHz; $\sigma$ = 1 S/m; $\varepsilon_r$ = 54.315; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.1°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

## Mode: GSM 850, Body SAR, Back side, Mid.ch

**Area Scan (9x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.857 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.423 W/kg
**SAR(1 g) = 0.239 W/kg**




0 dB = 0.255 W/kg = -5.93 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 142FD**

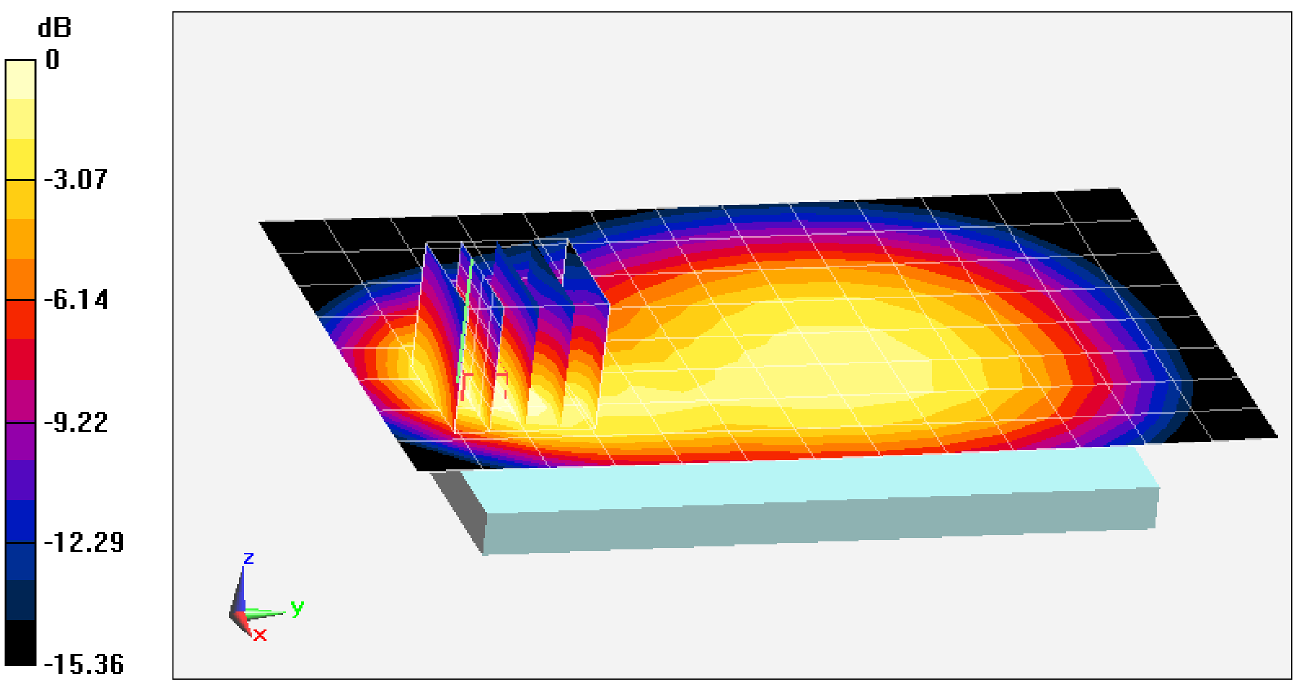
Communication System: GSM GPRS; 4 Tx slots; Frequency: 836.6 MHz; Duty Cycle: 1:2.076
Medium: 835 Body, Medium parameters used (interpolated):
f = 836.6 MHz; $\sigma = 1$ S/m; $\varepsilon_r = 54.315$; $\rho = 1000$ kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.1°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

## Mode: GPRS 850, Body SAR, Back side, Mid.ch, 4 Tx Slots

**Area Scan (9x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.235 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.566 W/kg
**SAR(1 g) = 0.319 W/kg**




0 dB = 0.339 W/kg = -4.70 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 1438C**

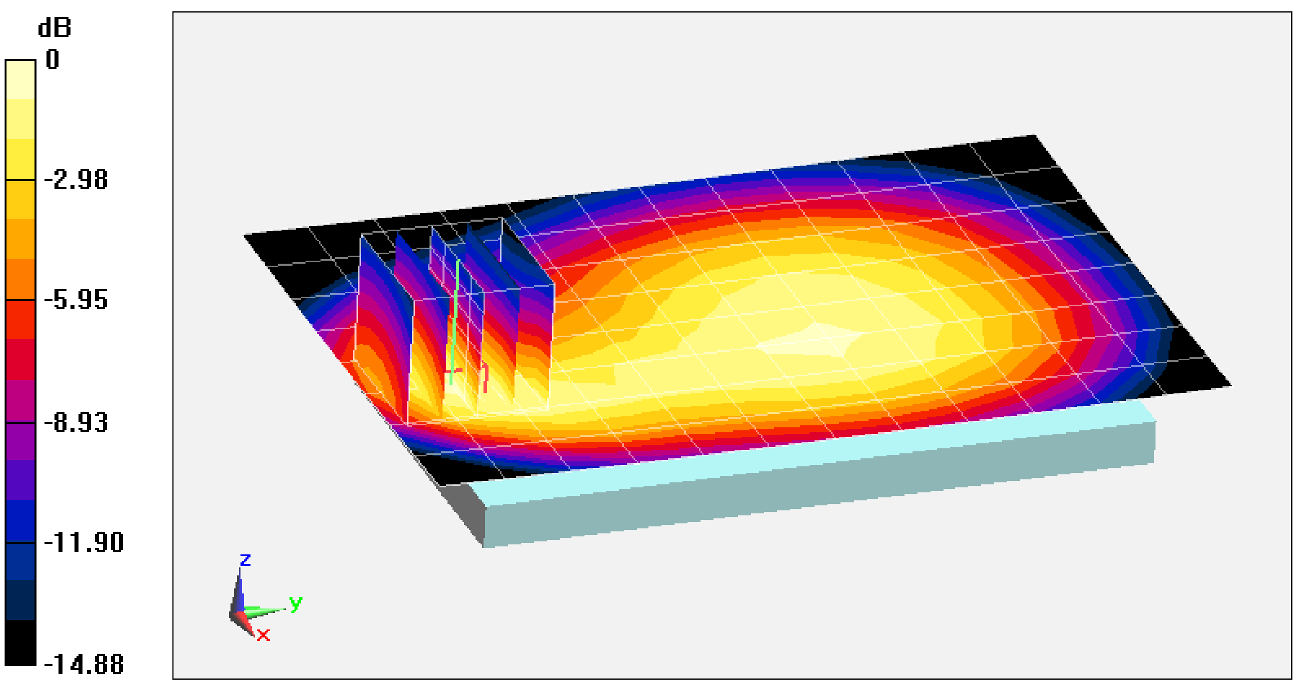
Communication System: UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Body, Medium parameters used (interpolated):
f = 836.6 MHz; $\sigma$ = 1 S/m; $\varepsilon_r$ = 54.315; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.1°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

## Mode: UMTS 850, Body SAR, Back side, Mid.ch

**Area Scan (9x13x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.048 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.464 W/kg
**SAR(1 g) = 0.265 W/kg**




0 dB = 0.295 W/kg = -5.30 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 142FD**

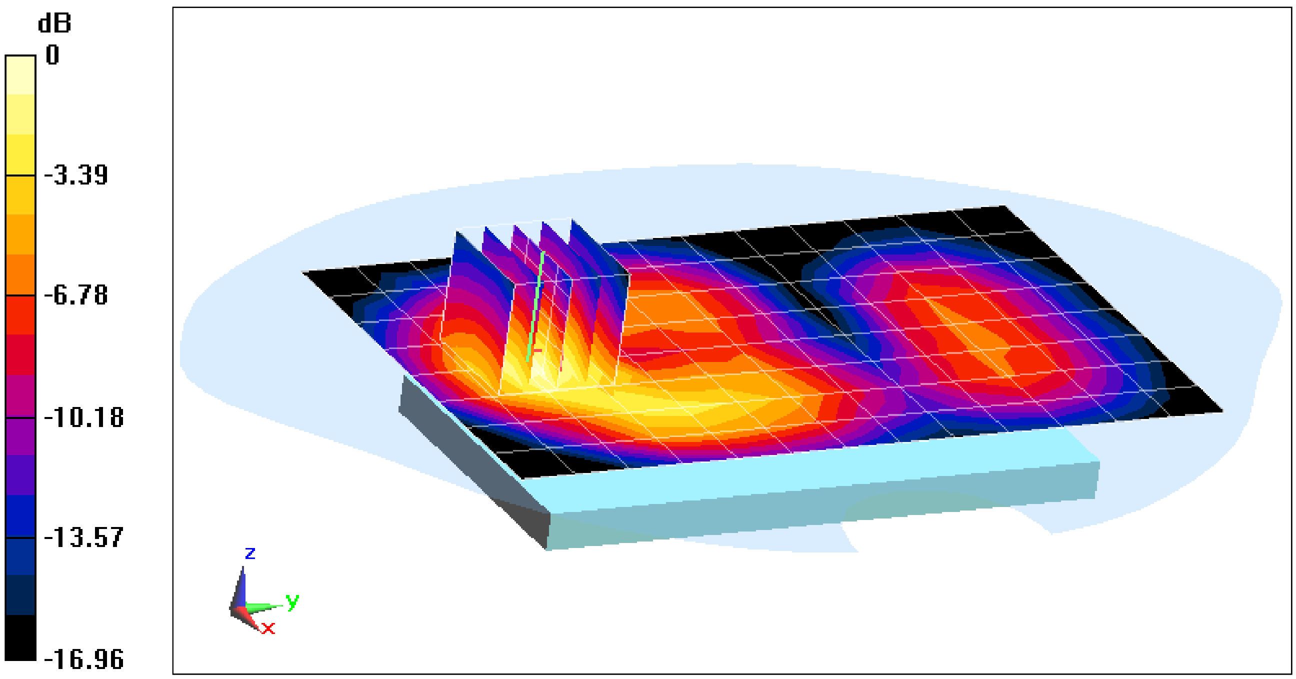
Communication System: GSM; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium: 1900 Body, Medium parameters used:
f = 1880 MHz; $\sigma$ = 1.498 S/m; $\varepsilon_r$ = 53.173; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

## Mode: GSM 1900, Body SAR, Back side, Mid.ch

**Area Scan (9x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.838 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.385 W/kg
**SAR(1 g) = 0.234 W/kg**




0 dB = 0.257 W/kg = -5.90 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 142FD**

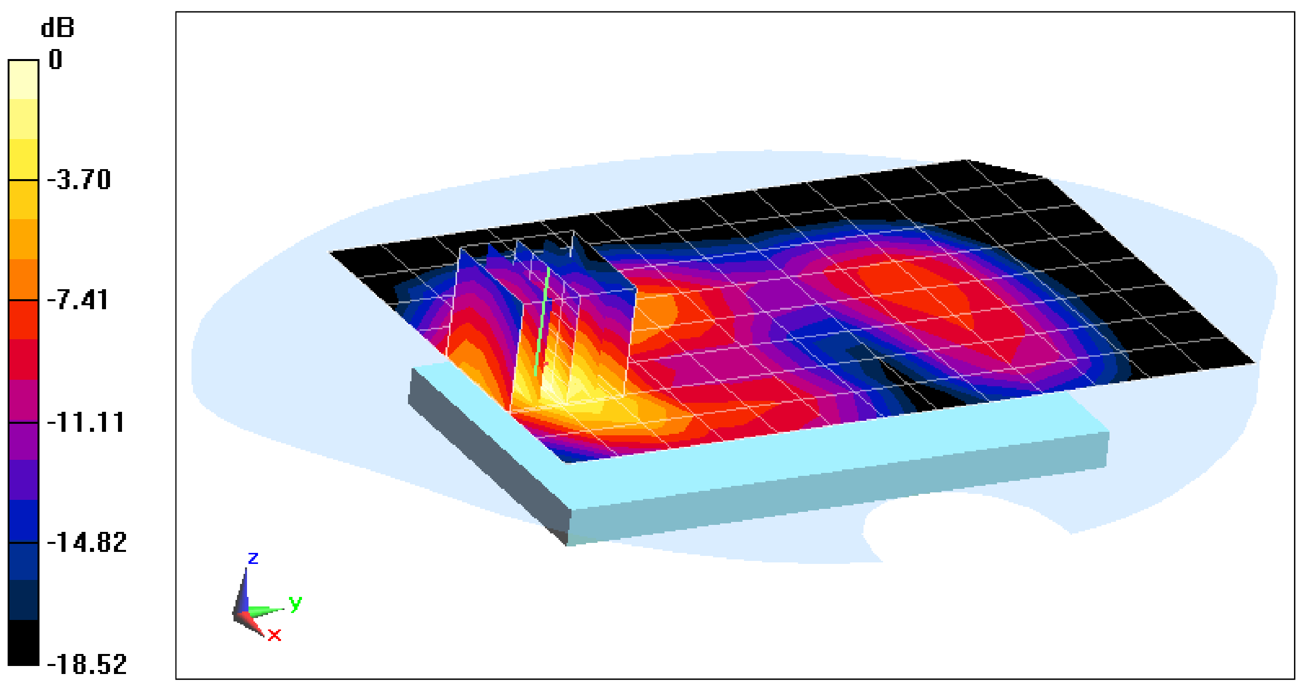
Communication System: GSM GPRS; 4 Tx slots; Frequency: 1880 MHz; Duty Cycle: 1:2.076
Medium: 1900 Body, Medium parameters used:
$f = 1880$ MHz; $\sigma = 1.498$ S/m; $\varepsilon_r = 53.173$; $\rho = 1000$ kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

## Mode: GPRS 1900, Body SAR, Front side, Mid.ch, 4 Tx Slots

**Area Scan (9x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.967 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.903 W/kg
**SAR(1 g) = 0.520 W/kg**




0 dB = 0.582 W/kg = -2.35 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 1438C**

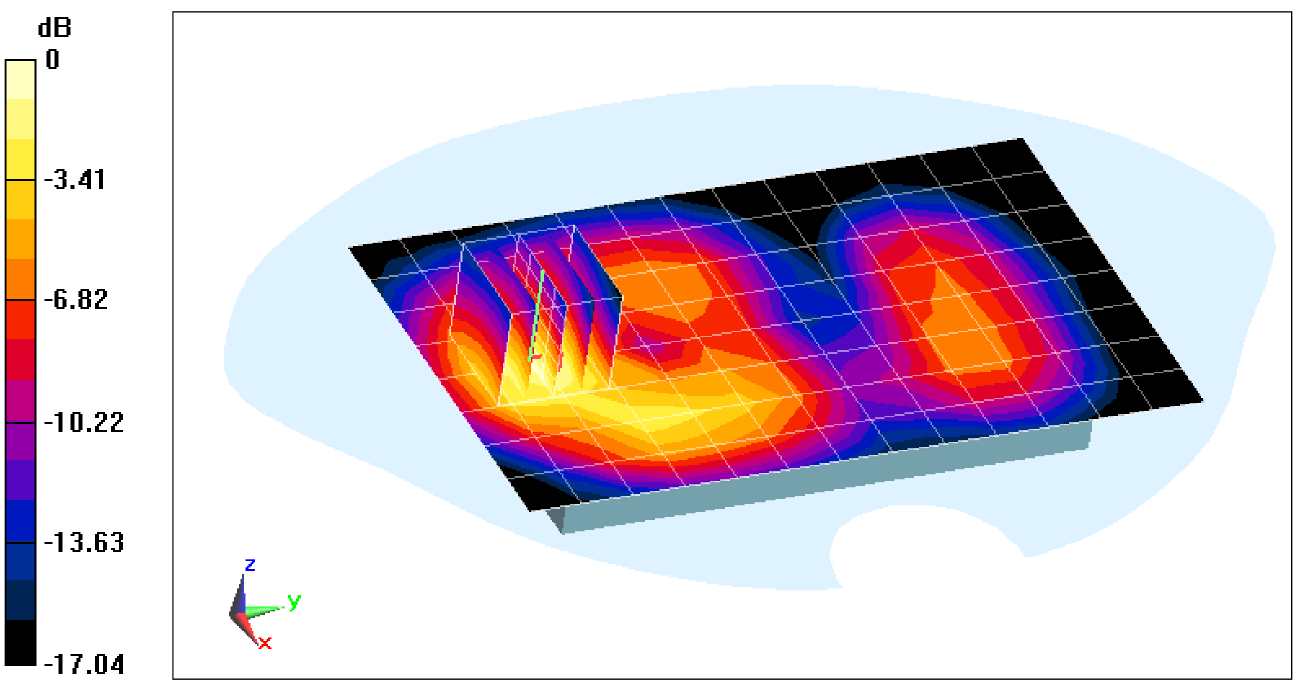
Communication System: UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used:
f = 1880 MHz; $\sigma$ = 1.498 S/m; $\varepsilon_r$ = 53.173; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Mode: UMTS 1900, Body SAR, Back side, Mid.ch**

**Area Scan (9x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.785 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.433 W/kg
**SAR(1 g) = 0.265 W/kg**




0 dB = 0.289 W/kg = -5.39 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 1438C**

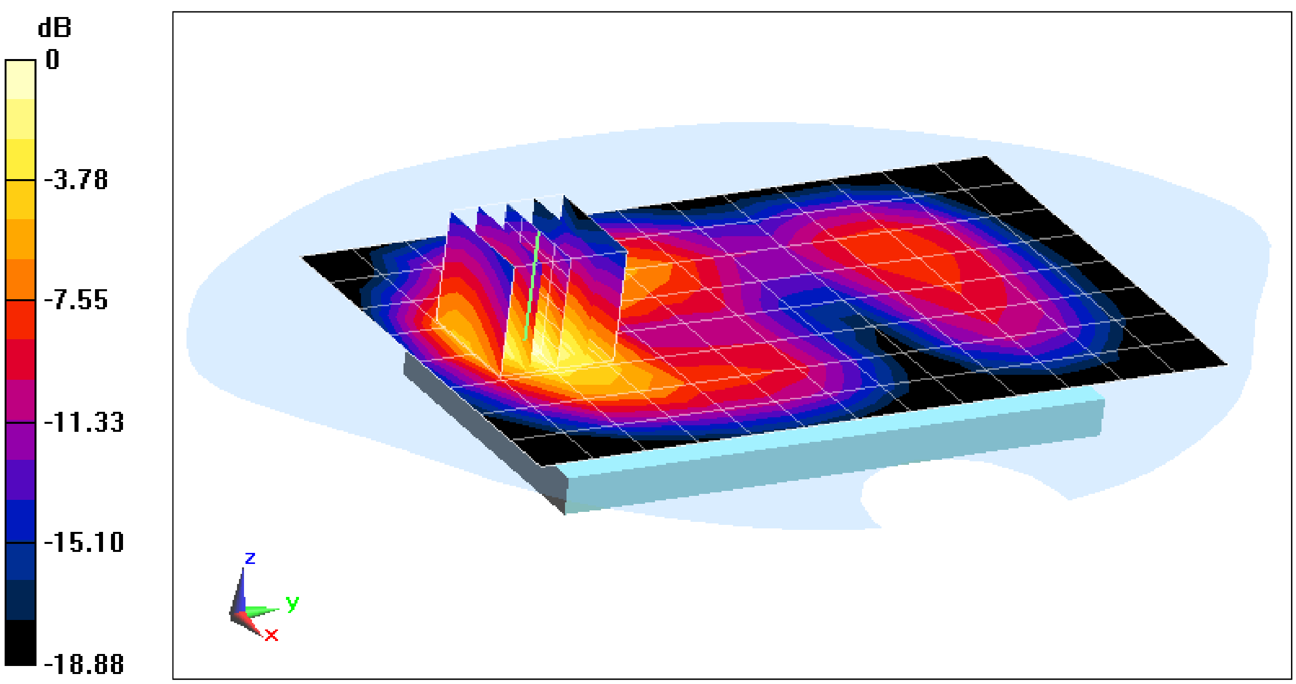
Communication System: UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used:
f = 1880 MHz; $\sigma$ = 1.498 S/m; $\varepsilon_r$ = 53.173; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

## Mode: UMTS 1900, Body SAR, Front side, Mid.ch

**Area Scan (9x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.854 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.889 W/kg
**SAR(1 g) = 0.502 W/kg**




0 dB = 0.545 W/kg = -2.64 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 14309**

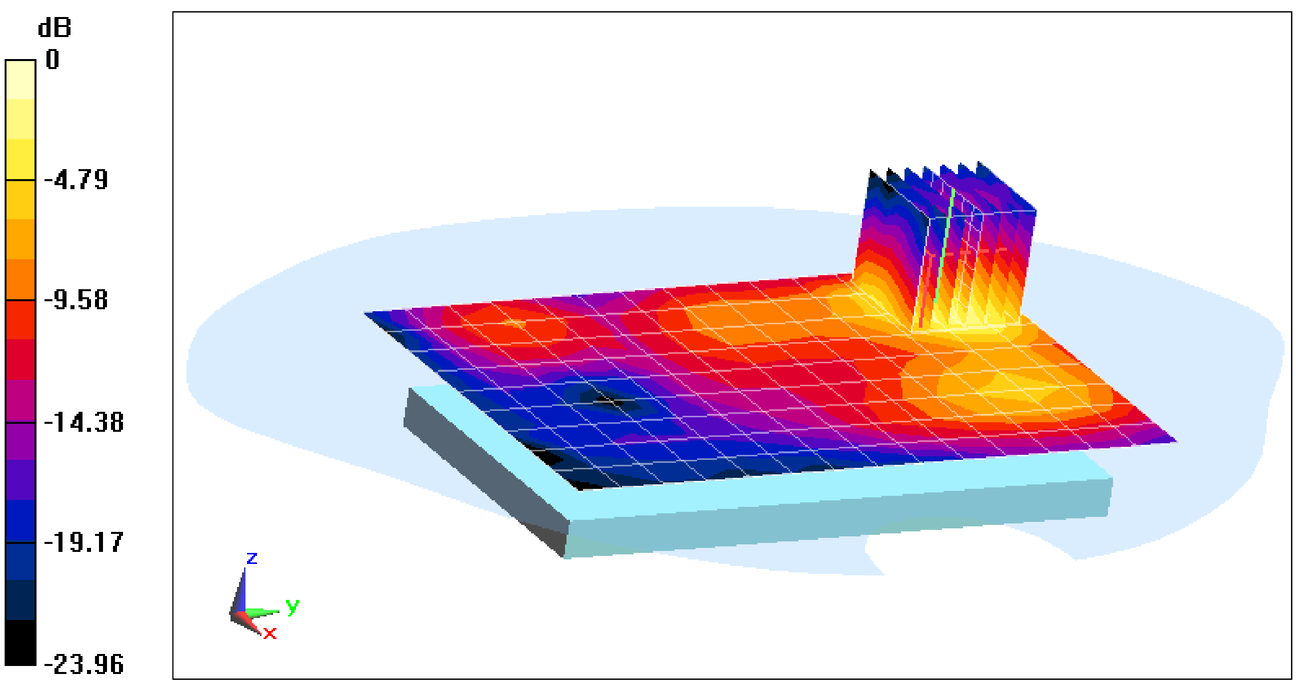
Communication System: IEEE 802.11b; Frequency: 2462 MHz; Duty Cycle: 1:1
Medium: 2450 Body, Medium parameters used (interpolated):
f = 2412 MHz; σ = 1.981 S/m; $\varepsilon_r$ = 52.812; ρ = 1000 kg/$m^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 23.0°C; Tissue Temp: 22.6°C

Probe: ES3DV2 - SN3022; ConvF(3.97, 3.97, 3.97); Calibrated: 8/28/2012;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## Mode: IEEE 802.11b, Body SAR, Ch 1, 1 Mbps, Back Side

**Area Scan (10x15x1):** Measurement grid: dx=12mm, dy=12mm
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.647 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 0.514 W/kg
**SAR(1 g) = 0.226 W/kg**




0 dB = 0.309 W/kg = -5.10 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 150BE**

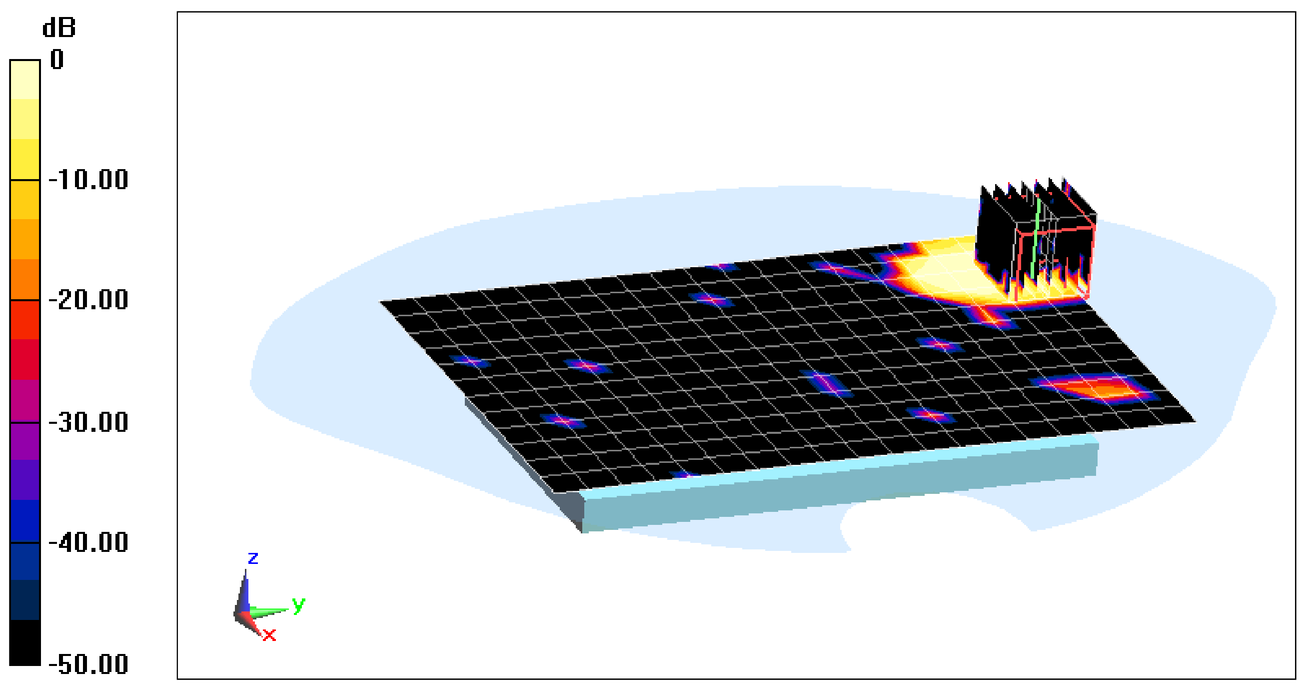
Communication System: IEEE 802.11a 5.2-5.8 GHz Band;Frequency: 5745 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5745 MHz; σ = 6.197 S/m; $\varepsilon_r$ = 47.965; ρ = 1000 kg/$m^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.66, 3.66, 3.66); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

**Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 149, 6 Mbps, Back Side**

**Area Scan (13x20x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4
Reference Value = 2.148 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.573 W/kg
**SAR(1 g) = 0.039 W/kg**




0 dB = 0.112 W/kg = -9.51 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 150BE**

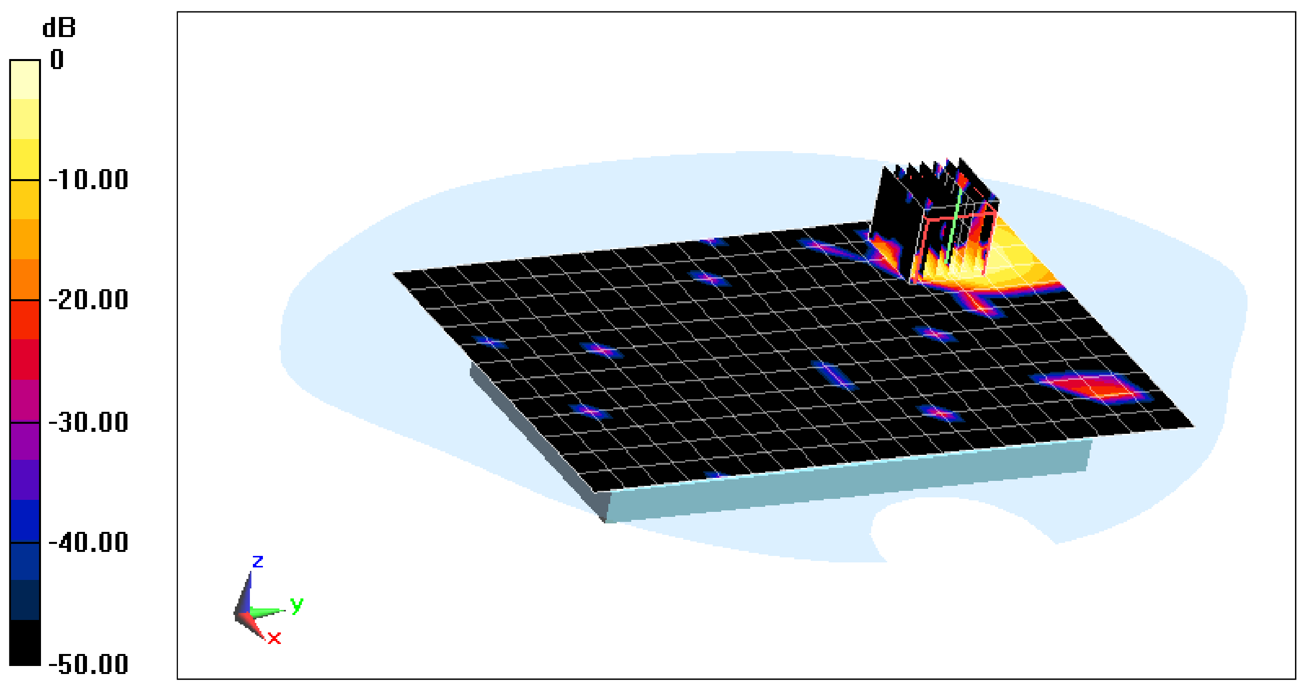
Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5220 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5220 MHz; $\sigma$ = 5.495 S/m; $\varepsilon_r$ = 48.894; $\rho$ = 1000 $kg/m^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.99, 3.99, 3.99); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## Mode: IEEE 802.11a, 5.2 GHz, Body SAR, Ch 44, 6 Mbps, Back Side

**Area Scan (13x20x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4
Reference Value = 4.520 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.493 W/kg
**SAR(1 g) = 0.102 W/kg**




0 dB = 0.271 W/kg = -5.67 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial: 150BE**

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5745 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5745 MHz; $\sigma$ = 6.197 S/m; $\varepsilon_r$ = 47.965; $\rho$ = 1000 kg/$m^3$

Phantom section: Flat Section; Space: 0.0 cm

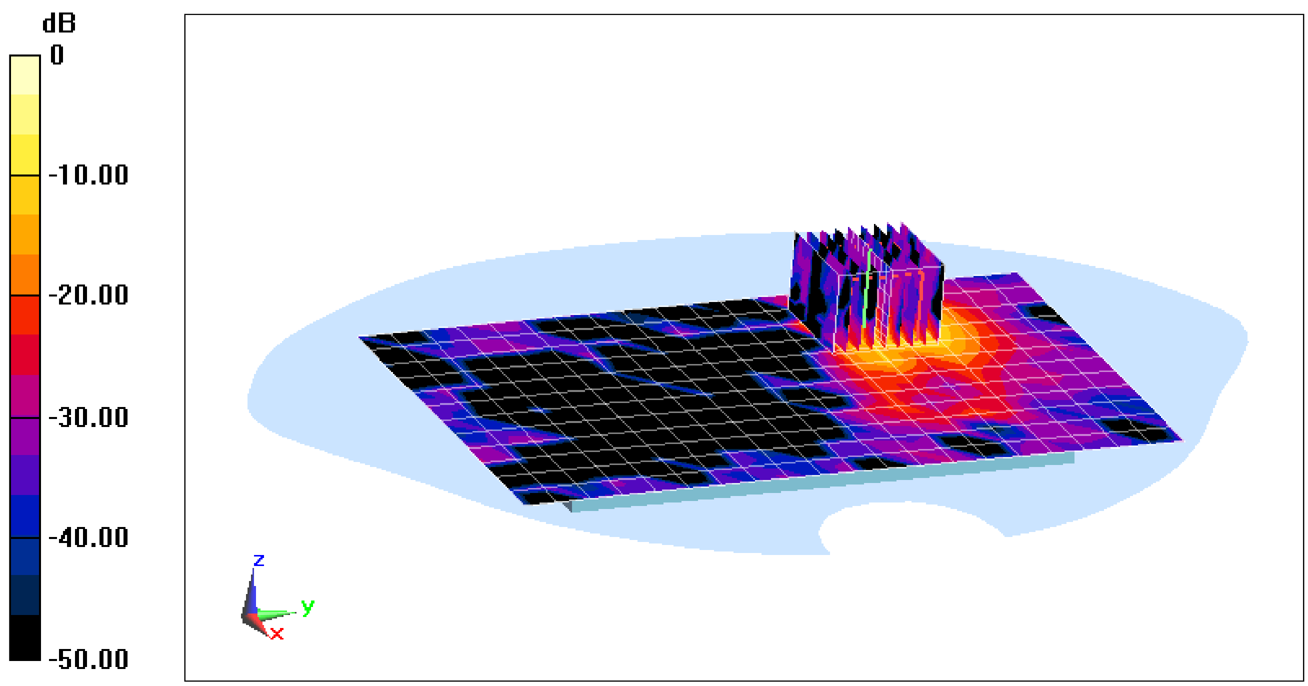
Test Date: 07-22-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.66, 3.66, 3.66); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## Mode: IEEE 802.11a, 5.8 GHz, Hand SAR, Ch 149, 6 Mbps, Back Side

**Area Scan (13x21x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (9x9x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4

Reference Value = 17.013 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 8.00 W/kg
**SAR(10 g) = 0.294 W/kg**




0 dB = 5.45 W/kg = 7.36 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMN900; Type: Portable Handset; Serial:150BE**

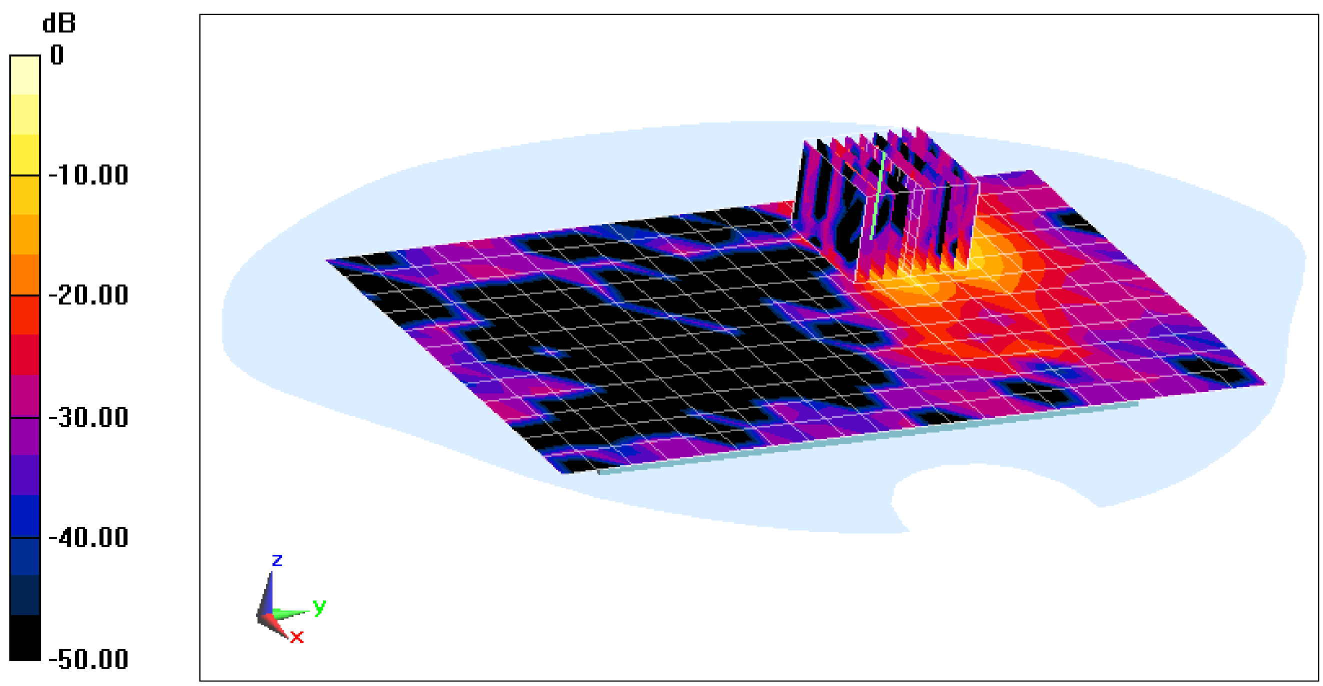
Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5280 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
$f = 5280$ MHz; $\sigma = 5.58$ S/m; $\varepsilon_r = 48.936$; $\rho = 1000$ kg/m$^3$
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.81, 3.81, 3.81); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## Mode: IEEE 802.11a, 5.3 GHz, Hand SAR, Ch 56, 6 Mbps, Back Side

**Area Scan (13x21x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (9x9x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4
Reference Value = 23.103 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 19.0 W/kg
**SAR(10 g) = 0.439 W/kg**




0 dB = 6.40 W/kg = 8.06 dBW/kg

# APPENDIX B: SYSTEM VERIFICATION

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: SAR Dipole 835 MHz; Type: D835V2; Serial: 4d026**

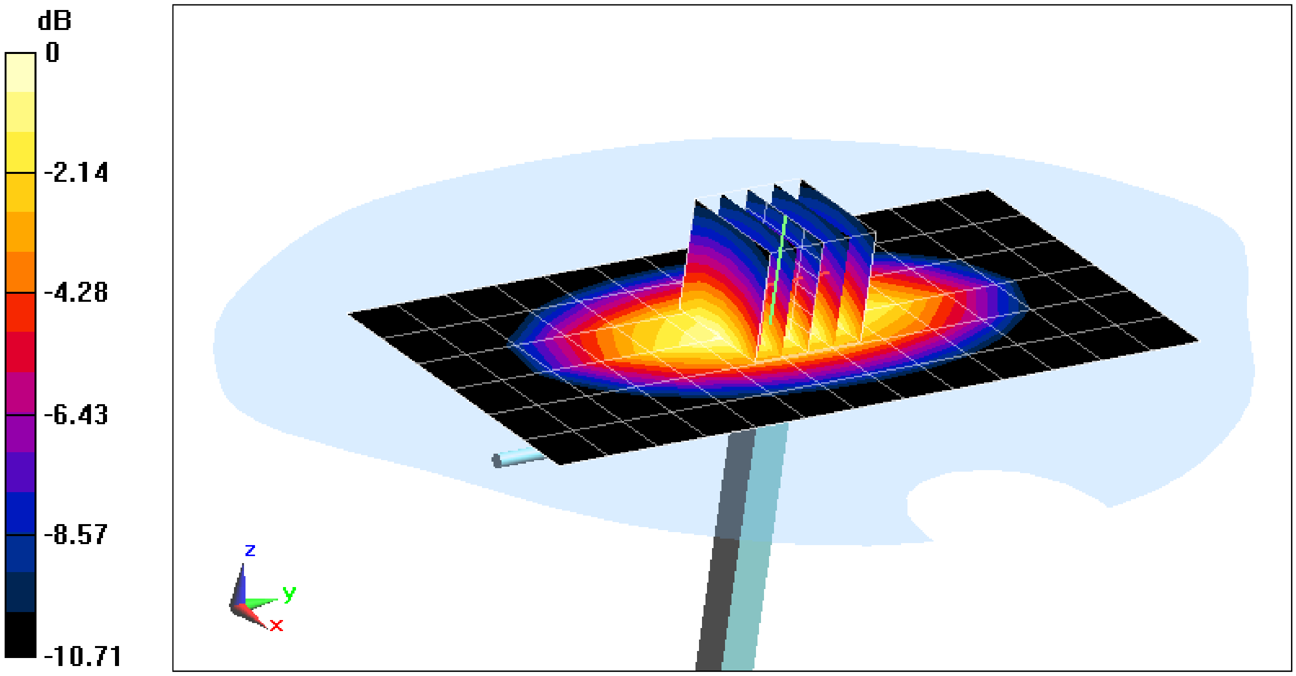
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Head, Medium parameters used:
f = 835 MHz; $\sigma$ = 0.936 S/m; $\varepsilon_r$ = 41.226; $\rho$ = 1000 $kg/m^3$
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-25-2013; Ambient Temp: 23.4°C; Tissue Temp: 23.4°C

Probe: ES3DV3 - SN3288; ConvF(6.41, 6.41, 6.41); Calibrated: 9/20/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/19/2012
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

## 835 MHz System Verification

**Area Scan (7x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 1.47 W/kg
**SAR(1 g) = 0.996 W/kg**
Deviation = 6.07%




0 dB = 1.07 W/kg = 0.29 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: SAR Dipole 1900 MHz; Type: D1900V2; Serial: 5d148**

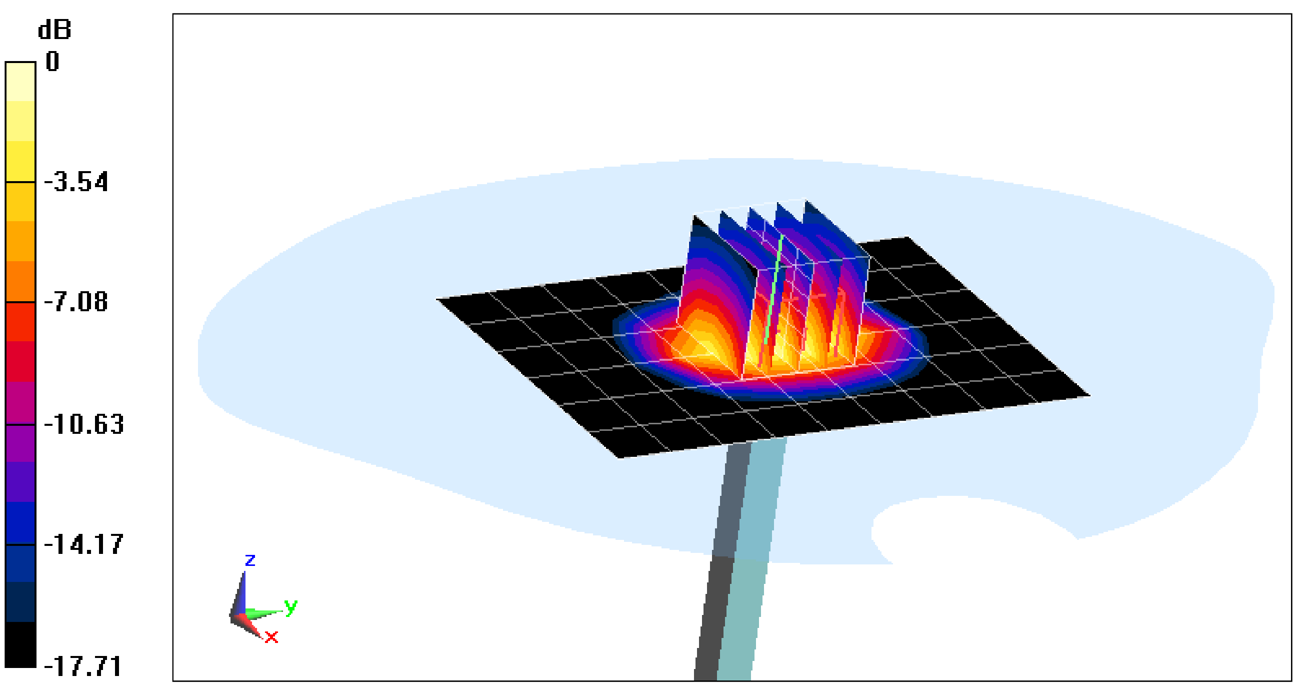
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Head, Medium parameters used (interpolated):
f = 1900 MHz; $\sigma$ = 1.42 S/m; $\varepsilon_r$ = 39.54; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.8°C

Probe: ES3DV3 - SN3209; ConvF(5.21, 5.21, 5.21); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: SAM Right; Type: QD000P40CD; Serial: 1686
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

## 1900 MHz System Verification

**Area Scan (7x10x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 7.08 W/kg
**SAR(1 g) = 3.87 W/kg**
Deviation = -2.52%




0 dB = 4.33 W/kg = 6.36 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: SAR Dipole 2450 MHz; Type: D2450V2; Serial: 719**

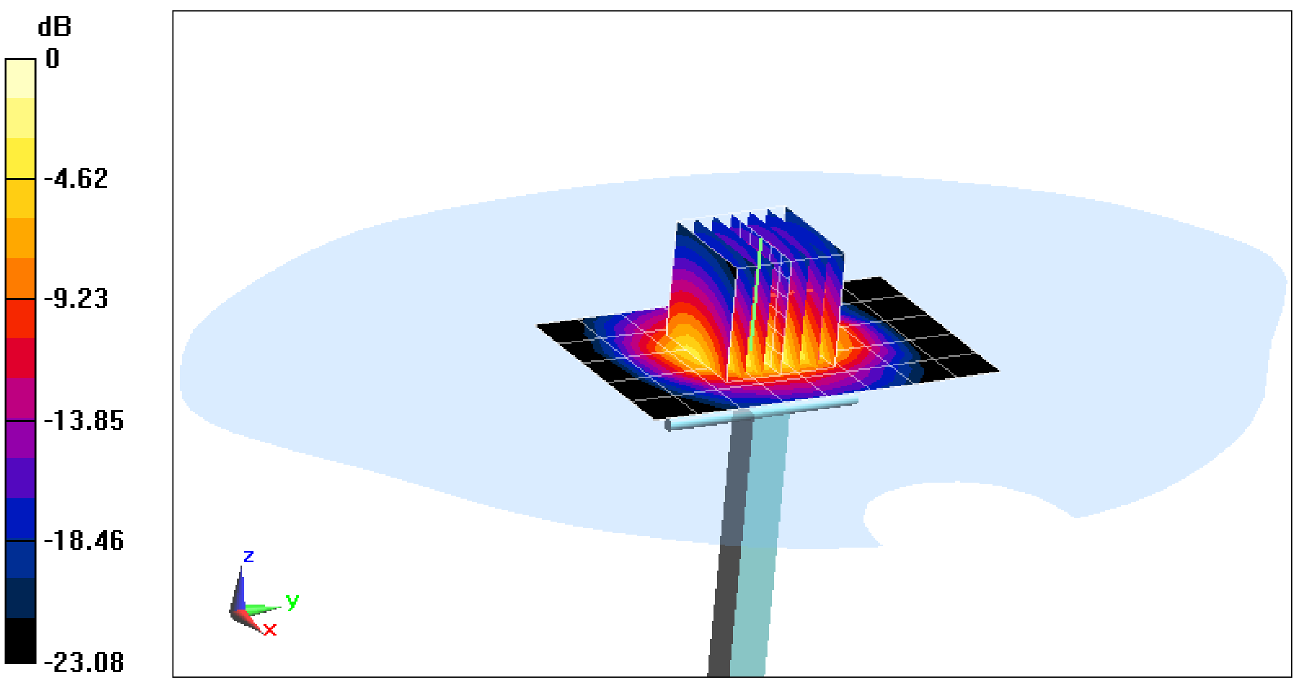
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Head, Medium parameters used:
$f = 2450$ MHz; $\sigma = 1.871$ S/m; $\varepsilon_r = 37.996$; $\rho = 1000$ kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2013; Ambient Temp: 23.6°C; Tissue Temp: 22.7°C

Probe: ES3DV2 - SN3022; ConvF(4.23, 4.23, 4.23); Calibrated: 8/28/2012;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## 2450 MHz System Verification

**Area Scan (6x9x1):** Measurement grid: dx=12mm, dy=12mm
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 11.4 W/kg
**SAR(1 g) = 5.57 W/kg**
Deviation = 5.69%




0 dB = 7.09 W/kg = 8.51 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5200 MHz; Type: D5GHzV2; Serial: 1057**

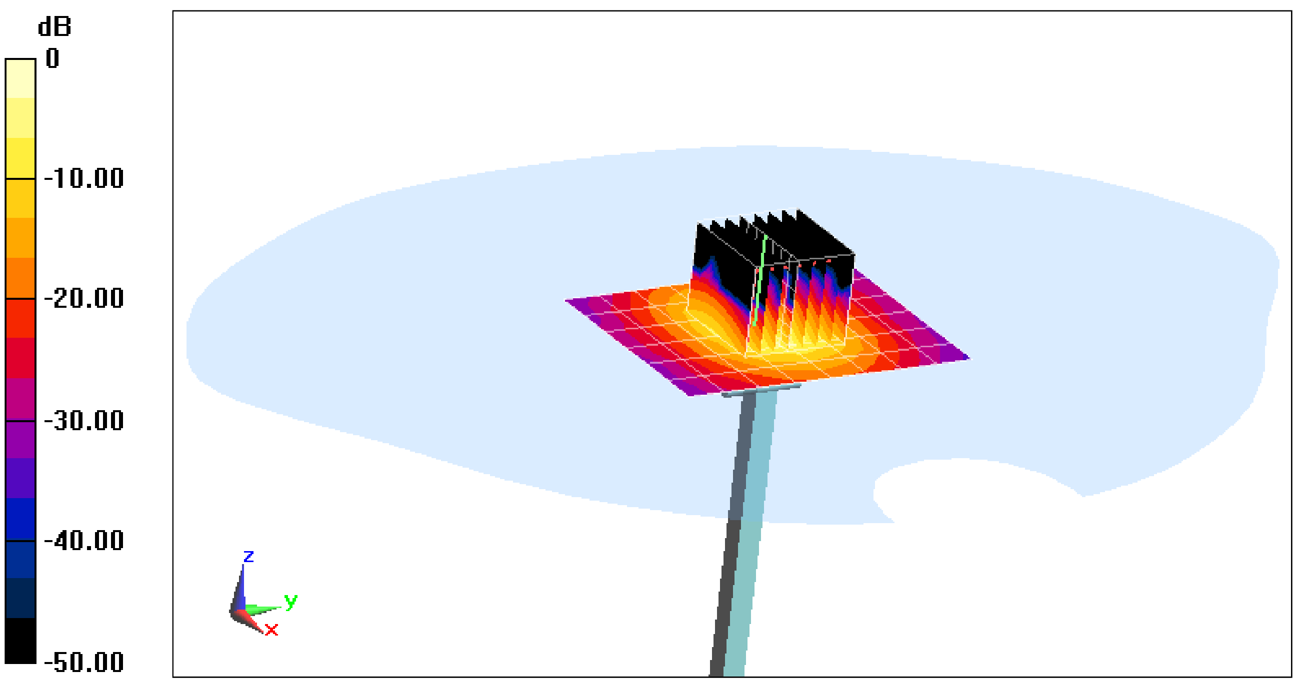
Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5200 MHz; $\sigma$ = 4.704 S/m; $\varepsilon_r$ = 35.357; $\rho$ = 1000 kg/$m^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2013; Ambient Temp: 24.2°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(4.48, 4.48, 4.48); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## 5200 MHz System Verification

**Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 30.6 W/kg
**SAR(1 g) = 7.41 W/kg**
Deviation = -2.37%




0 dB = 18.0 W/kg = 12.55 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1057**

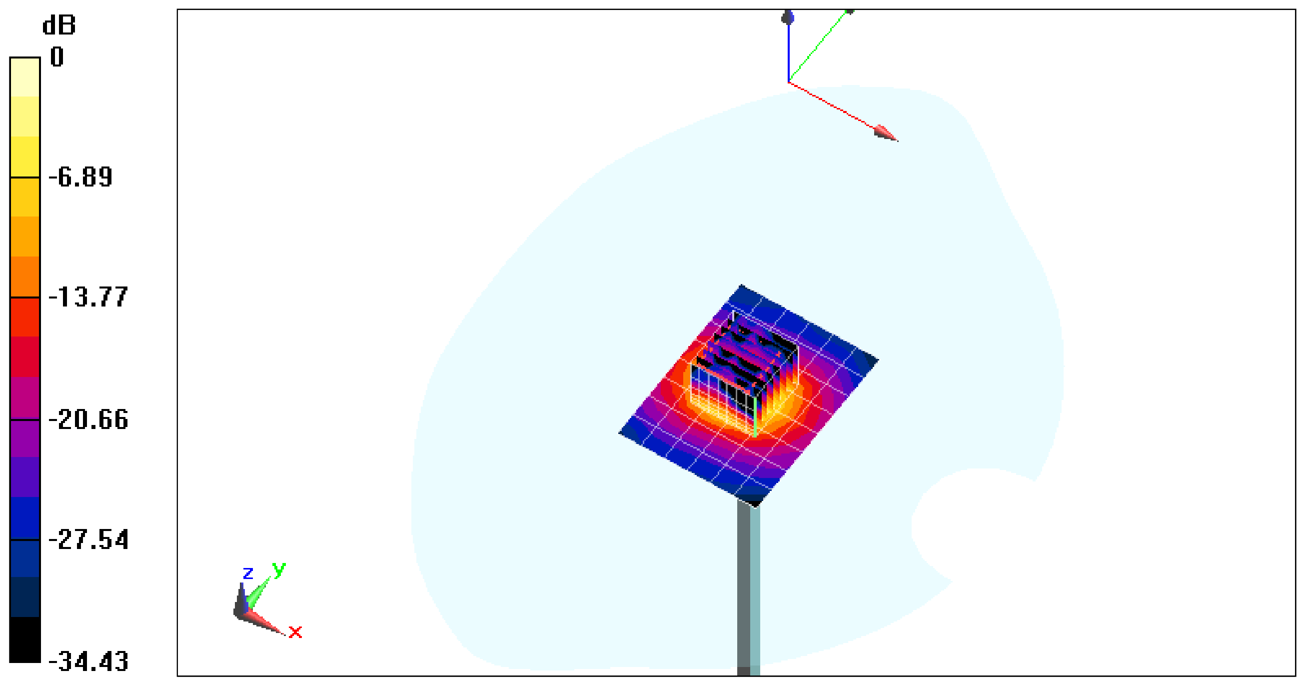
Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5300 MHz; $\sigma$ = 4.811 S/m; $\varepsilon_r$ = 35.15; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2013; Ambient Temp: 24.2°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(4.27, 4.27, 4.27); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## 5300 MHz System Verification

**Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 31.3 W/kg
**SAR(1 g) = 7.37 W/kg**
Deviation = -4.16%




0 dB = 17.9 W/kg = 12.52 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1057**

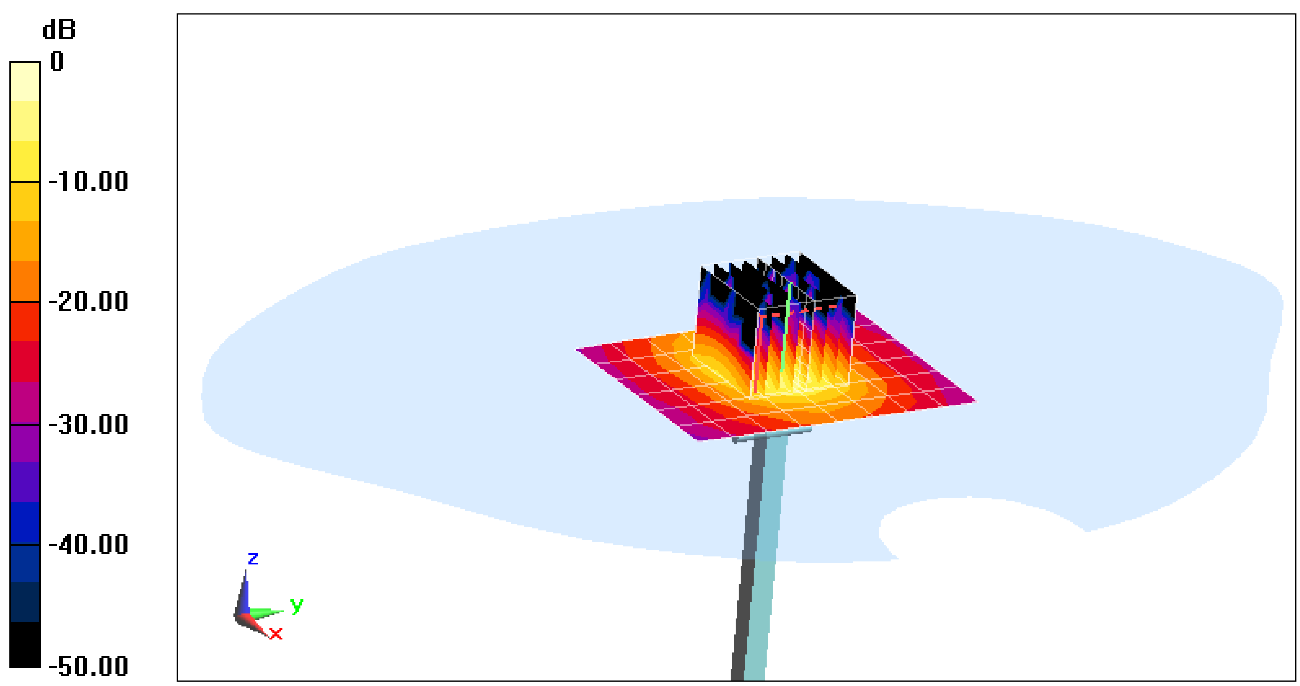
Communication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5500 MHz; $\sigma$ = 5.075 S/m; $\varepsilon_r$ = 34.639; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2013; Ambient Temp: 24.2°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(4.14, 4.14, 4.14); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## 5500 MHz System Verification

**Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 37.6 W/kg
**SAR(1 g) = 7.91 W/kg**
Deviation = -1.25%




0 dB = 17.8 W/kg = 12.50 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1057**

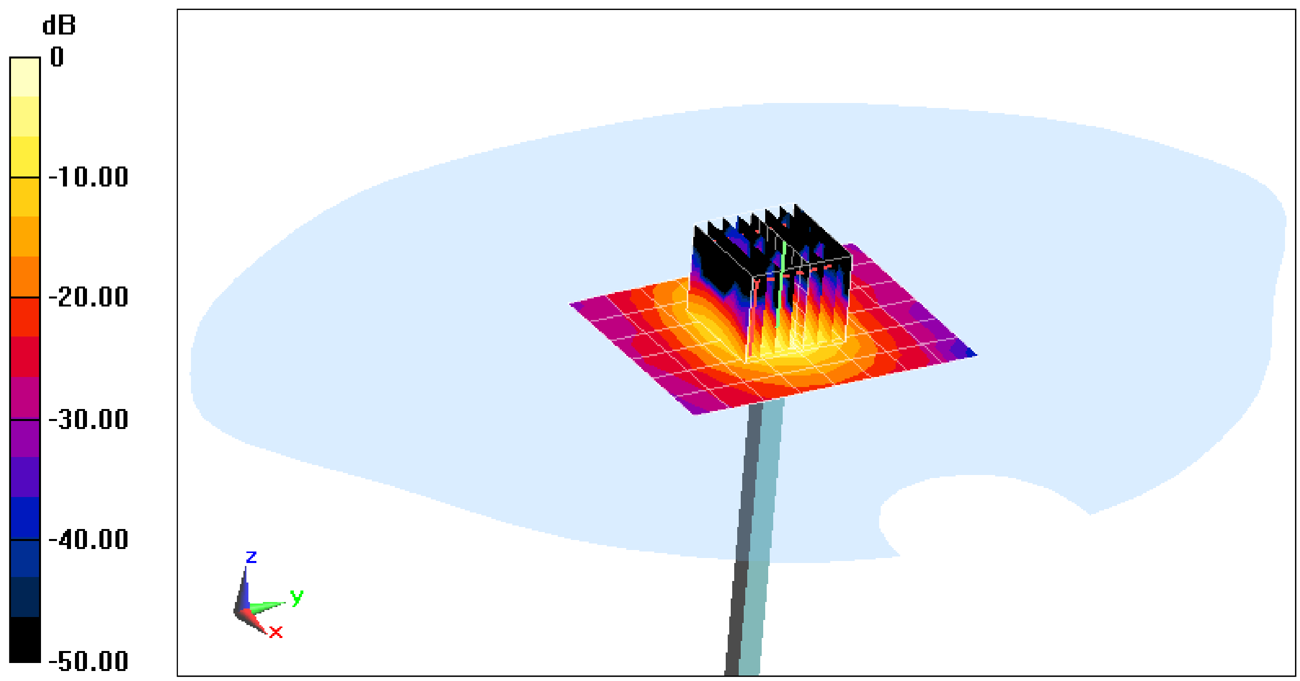
Communication System: CW; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5600 MHz; $\sigma$ = 5.182 S/m; $\varepsilon_r$ = 34.384; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2013; Ambient Temp: 24.2°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(3.81, 3.81, 3.81); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## 5600 MHz System Verification

**Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 37.8 W/kg
**SAR(1 g) = 7.99 W/kg**
Deviation = -0.62%




0 dB = 18.4 W/kg = 12.65 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5800 MHz; Type: D5GHzV2; Serial: 1057**

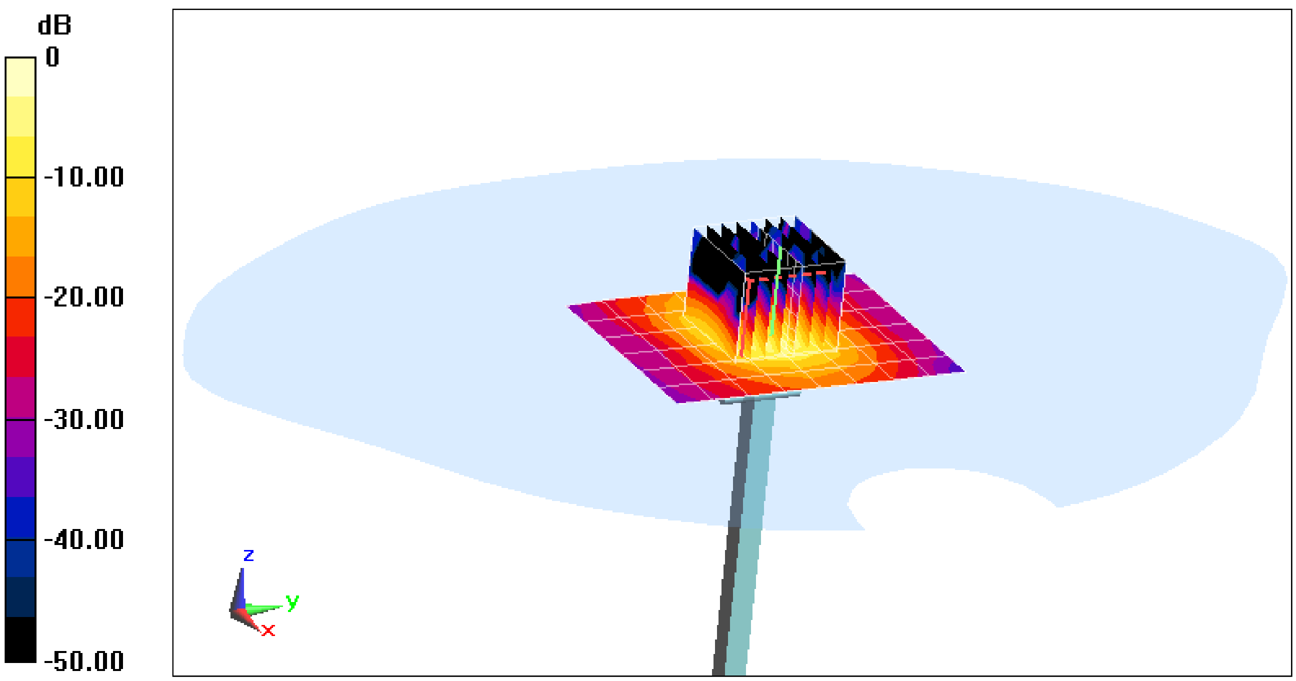
Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
$f = 5800$ MHz; $\sigma = 5.422$ S/m; $\varepsilon_r = 33.994$; $\rho = 1000$ kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2013; Ambient Temp: 24.2°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(3.85, 3.85, 3.85); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## 5800 MHz System Verification

**Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Grid: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 37.7 W/kg
**SAR(1 g) = 7.4 W/kg**
Deviation = -2.76%




0 dB = 17.6 W/kg = 12.46 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: SAR Dipole 835 MHz; Type: D835V2; Serial: 4d026**

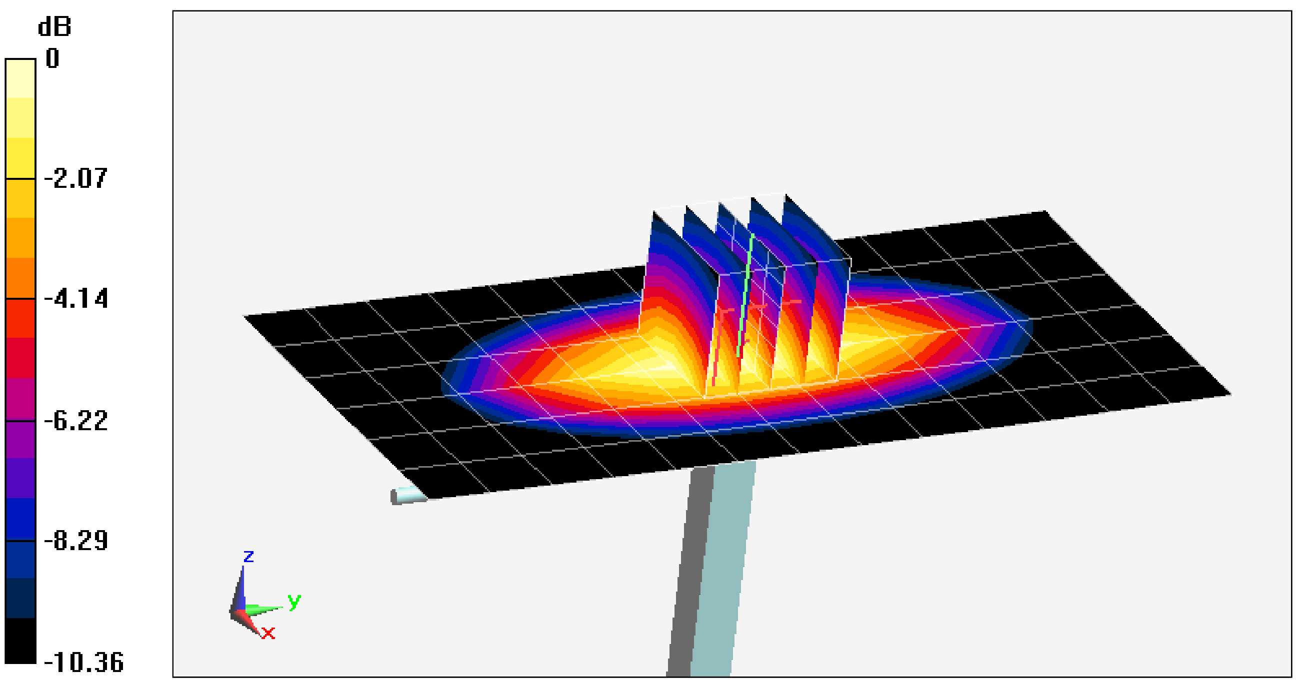
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Body, Medium parameters used:
$f = 835$ MHz; $\sigma = 0.999$ S/m; $\varepsilon_r = 54.331$; $\rho = 1000$ kg/m$^3$
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-22-2013; Ambient Temp: 24.1°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

## 835 MHz System Verification

**Area Scan (7x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 1.44 W/kg
**SAR(1 g) = 0.992 W/kg**
Deviation = 3.55%




0 dB = 1.07 W/kg = 0.29 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: SAR Dipole 1900 MHz; Type: D1900V2; Serial: 5d148**

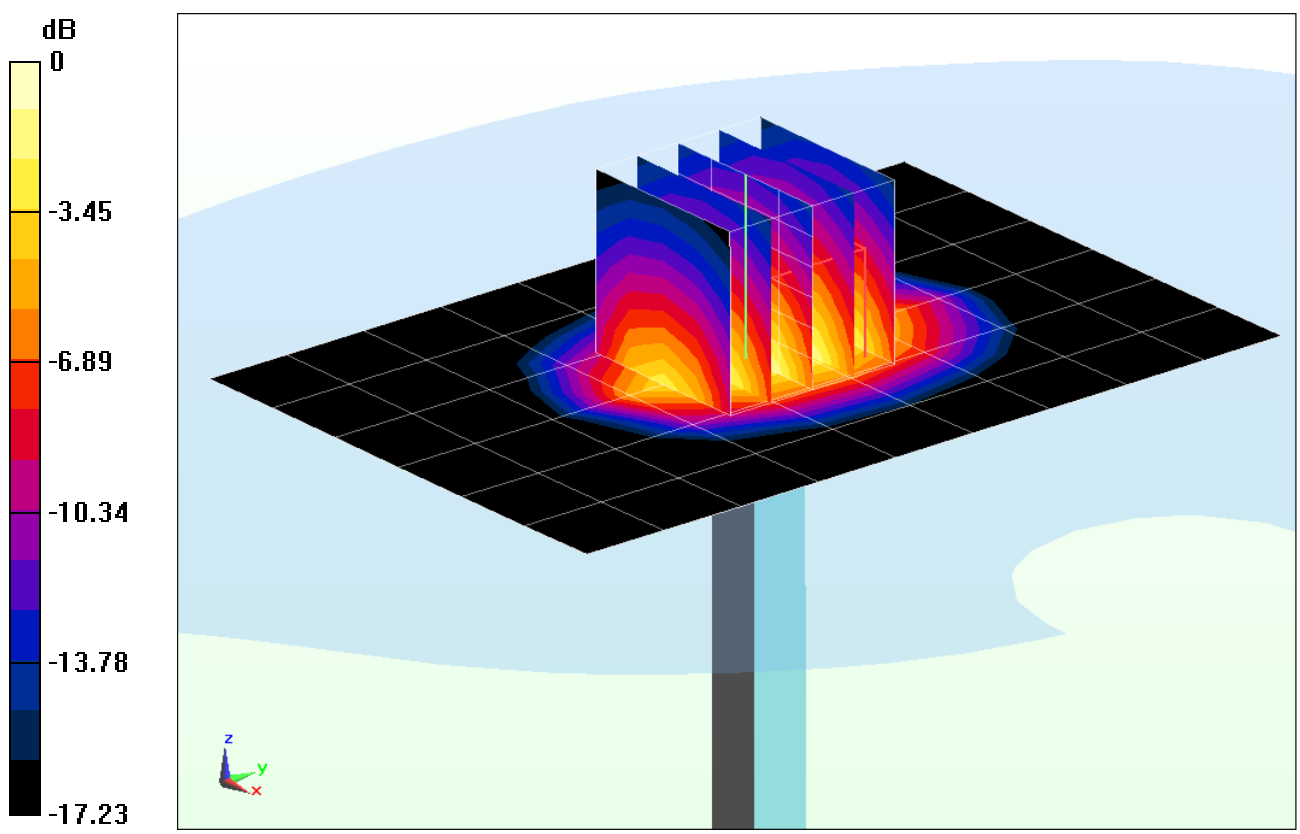
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body; Medium parameters used (interpolated):
f = 1900 MHz; $\sigma$ = 1.517 S/m; $\varepsilon_r$ = 53.11; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

**1900 MHz System Verification**

**Area Scan (7x10x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 7.29 W/kg
**SAR(1 g) = 4.1 W/kg**
Deviation = 0.49%




0 dB = 4.53 W/kg = 6.56 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: SAR Dipole 2450 MHz; Type: D2450V2; Serial: 719**

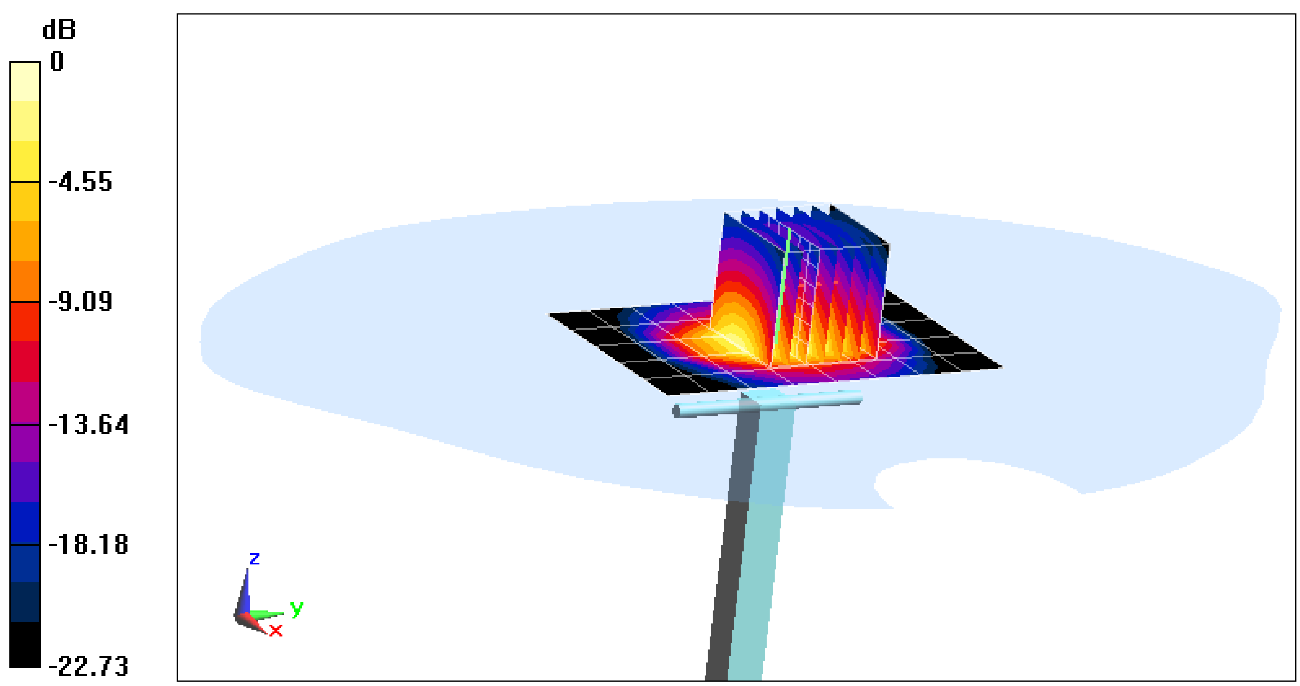
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Body, Medium parameters used:
f = 2450 MHz; $\sigma$ = 2.031 S/m; $\varepsilon_r$ = 52.669; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 23.0°C; Tissue Temp: 22.6°C

Probe: ES3DV2 - SN3022; ConvF(3.97, 3.97, 3.97); Calibrated: 8/28/2012;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1403
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## 2450 MHz System Verification

**Area Scan (6x9x1):** Measurement grid: dx=12mm, dy=12mm
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 12.0 W/kg
**SAR(1 g) = 5.48 W/kg**
Deviation = 6.20%




0 dB = 7.03 W/kg = 8.47 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5200 MHz; Type: D5GHzV2; Serial: 1057**

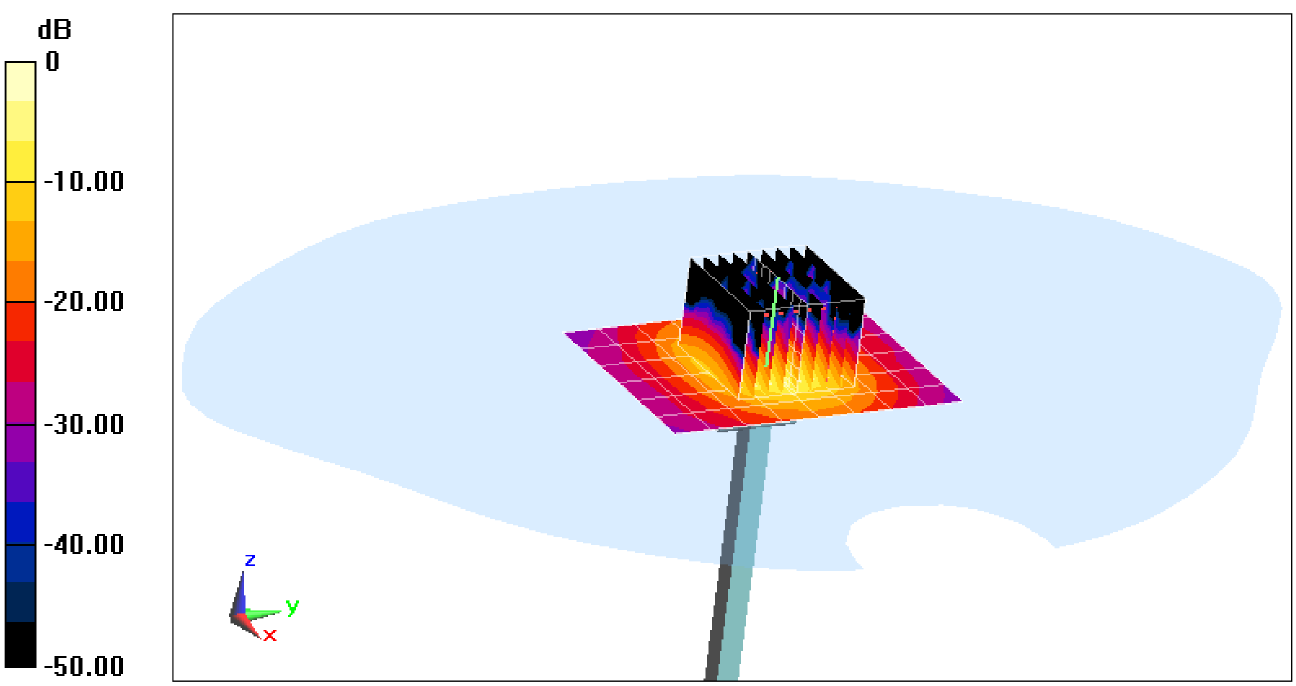
Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5200 MHz; $\sigma$ = 5.505 S/m; $\varepsilon_r$ = 48.968; $\rho$ = 1000 kg/$m^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.99, 3.99, 3.99); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## 5200 MHz System Verification

**Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (9x9x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 27.4 W/kg
**SAR(1 g) = 7.36 W/kg; SAR(10 g) = 2.08 W/kg**
Deviation (1g) = -2.52%; Deviation (10g) = -1.42%




0 dB = 18.2 W/kg = 12.60 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1057**

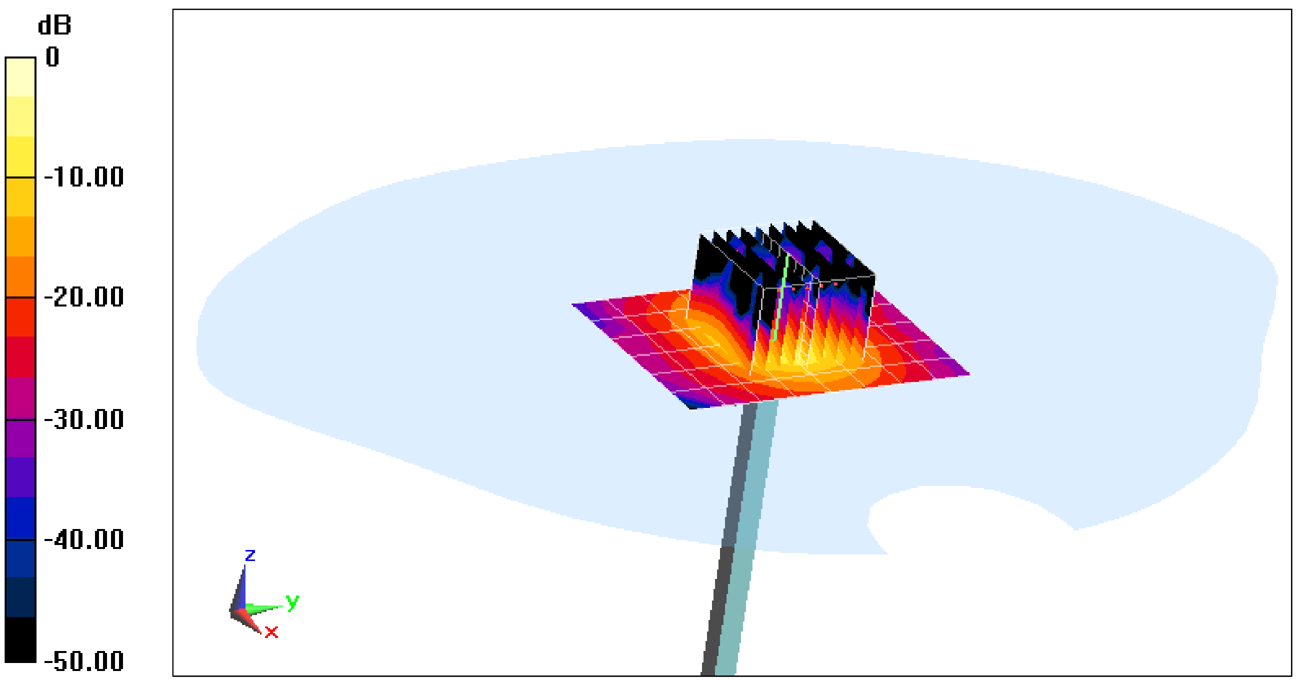
Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5300 MHz; $\sigma$ = 5.593 S/m; $\varepsilon_r$ = 48.806; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.81, 3.81, 3.81); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## 5300 MHz System Verification

**Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (9x9x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 31.5 W/kg
**SAR(1 g) = 8 W/kg; SAR(10 g) = 2.24 W/kg**
Deviation (1g) = 6.24%; Deviation (10g) = 6.16%




0 dB = 19.2 W/kg = 12.83 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1057**

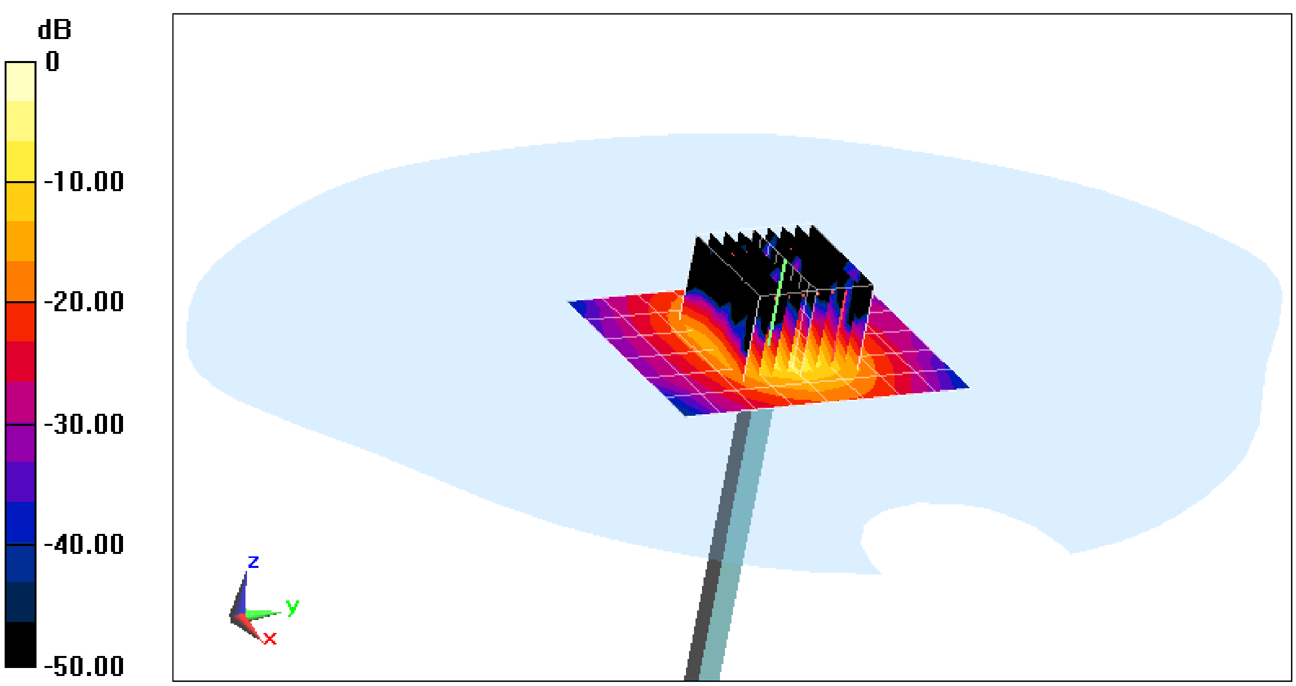
Communication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5500 MHz; $\sigma$ = 5.816 S/m; $\varepsilon_r$ = 48.43; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.52, 3.52, 3.52); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## 5500 MHz System Verification

**Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (9x9x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 32.1 W/kg
**SAR(1 g) = 7.9 W/kg; SAR(10 g) = 2.19 W/kg**
Deviation (1g) = -2.23%; Deviation (10g) = -2.23%




0 dB = 20.0 W/kg = 13.01 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5800 MHz; Type: D5GHzV2; Serial: 1057**

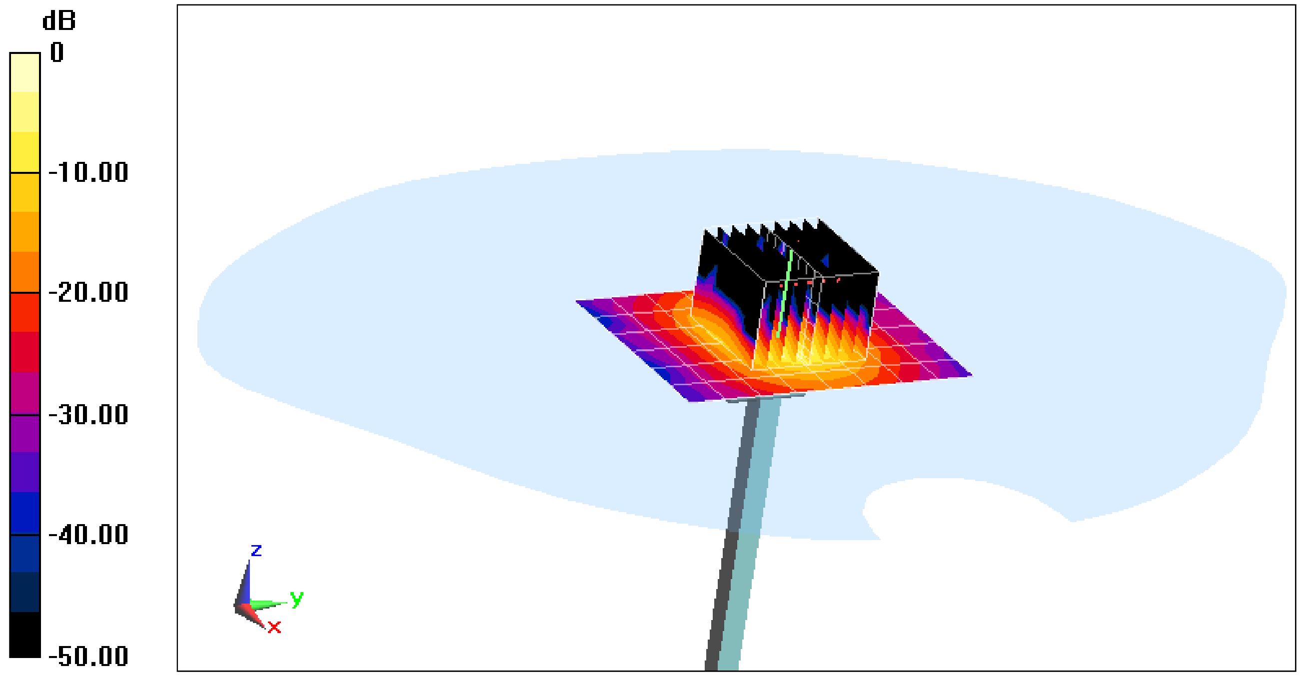
Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
$f = 5800$ MHz; $\sigma = 6.296$ S/m; $\varepsilon_r = 47.918$; $\rho = 1000$ kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.66, 3.66, 3.66); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

## 5800 MHz System Verification

**Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (9x9x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 32.0 W/kg
**SAR(1 g) = 7.48 W/kg; SAR(10 g) = 2.06 W/kg**
Deviation (1g) = -0.40%; Deviation (10g) = -0.48%




0 dB = 18.8 W/kg = 12.74 dBW/kg

# APPENDIX C: PROBE CALIBRATION

**Calibration Laboratory of**
Schmid & Partner
Engineering AG
**Zeughausstrasse 43, 8004 Zurich, Switzerland**

**S** Schweizerischer Kalibrierdienst
**C** Service suisse d'étalonnage
Servizio svizzero di taratura
**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

**Accreditation No.: SCS 108**

**Client** **PC Test**

**Certificate No: D835V2-4d026_Aug12**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D835V2 - SN: 4d026 |
| Calibration procedure(s) | QA CAL-05.v8<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | August 23, 2012 |

✓ KOK 9/17/12

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 05-Oct-11 (No. 217-01451) | Oct-12 |
| Power sensor HP 8481A | US37292783 | 05-Oct-11 (No. 217-01451) | Oct-12 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 27-Mar-12 (No. 217-01530) | Apr-13 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 27-Mar-12 (No. 217-01533) | Apr-13 |
| Reference Probe ES3DV3 | SN: 3205 | 30-Dec-11 (No. ES3-3205_Dec11) | Dec-12 |
| DAE4 | SN: 601 | 27-Jun-12 (No. DAE4-601_Jun12) | Jun-13 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-11) | In house check: Oct-13 |
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-11) | In house check: Oct-13 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-11) | In house check: Oct-12 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Israe El-Naouq | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: August 23, 2012

**Calibration Laboratory of**
Schmid & Partner
Engineering AG
**Zeughausstrasse 43, 8004 Zurich, Switzerland**

**S** Schweizerischer Kalibrierdienst
**C** Service suisse d'étalonnage
Servizio svizzero di taratura
**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

Accreditation No.: **SCS 108**

## Glossary:

| | |
|---|---|
| TSL | tissue simulating liquid |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A | not applicable or not measured |

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

## Additional Documentation:

d) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.2 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 15 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 835 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 41.5 | 0.90 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 41.3 ± 6 % | 0.90 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.35 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **9.39 mW /g ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.53 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **6.12 mW /g ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 55.2 | 0.97 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 53.2 ± 6 % | 1.00 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.47 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **9.58 mW / g ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.62 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **6.33 mW / g ± 16.5 % (k=2)** |

## Appendix

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 53.7 Ω - 3.4 jΩ |
| Return Loss | - 26.4 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 49.6 Ω - 4.8 jΩ |
| Return Loss | - 26.4 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.389 ns |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | December 17, 2004 |

## DASY5 Validation Report for Head TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

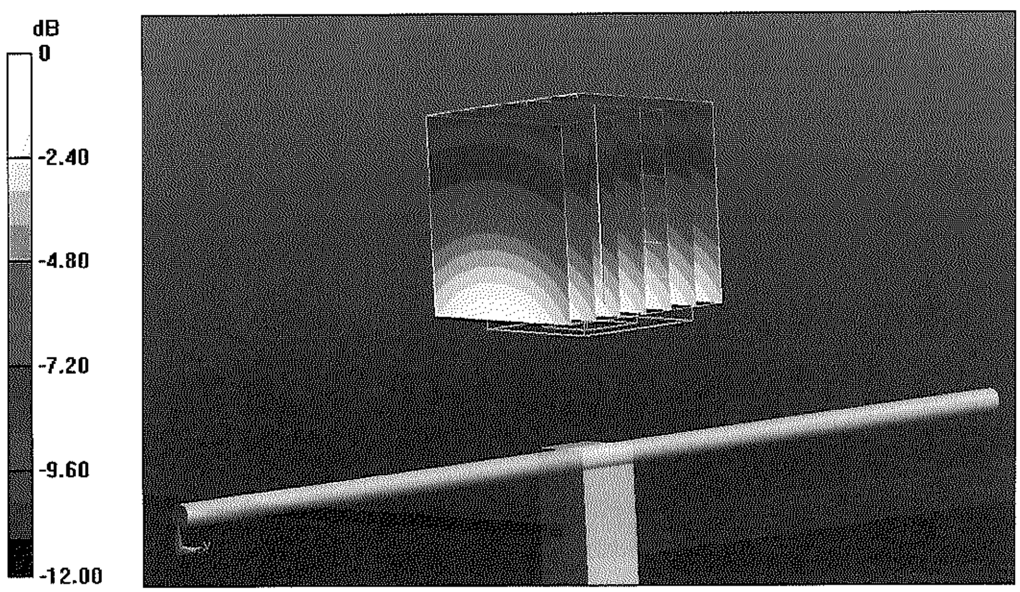
**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d026**

Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 0.9 mho/m; $\varepsilon_r$ = 41.3; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

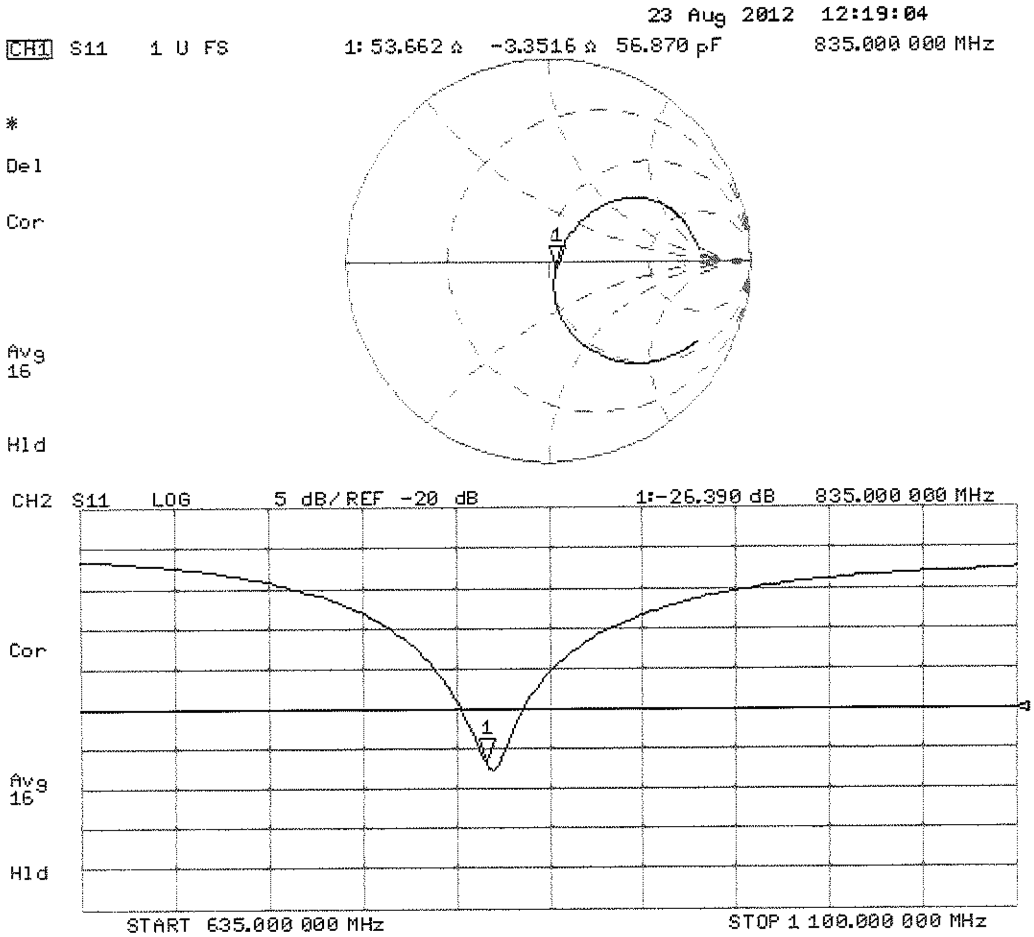
- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm 2/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.824 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.482 mW/g
**SAR(1 g) = 2.35 mW/g; SAR(10 g) = 1.53 mW/g**
Maximum value of SAR (measured) = 2.72 W/kg




0 dB = 2.72 W/kg = 8.69 dB W/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

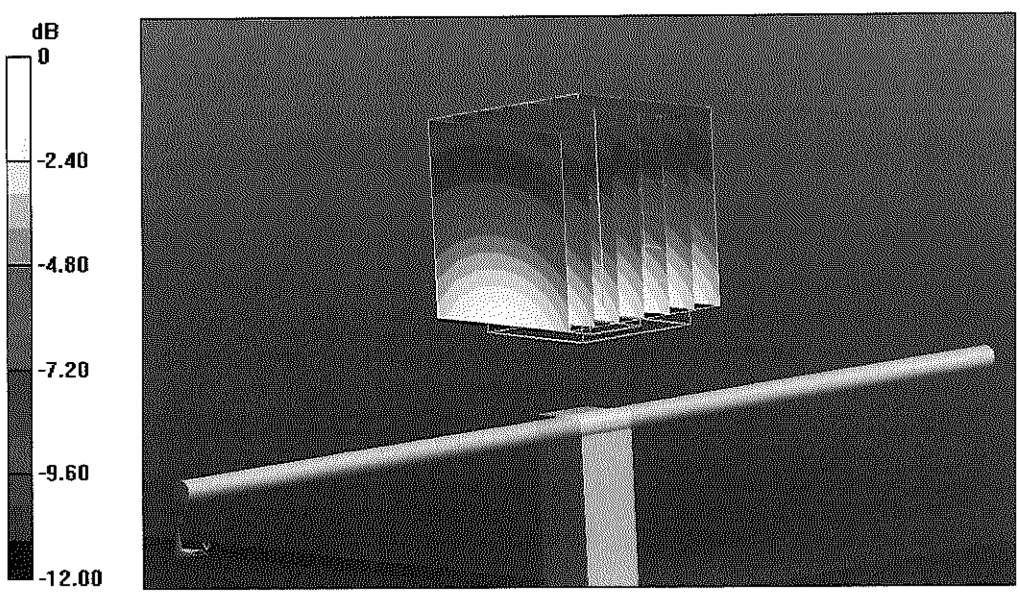
**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d026**

Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 1 mho/m; $\varepsilon_r$ = 53.2; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

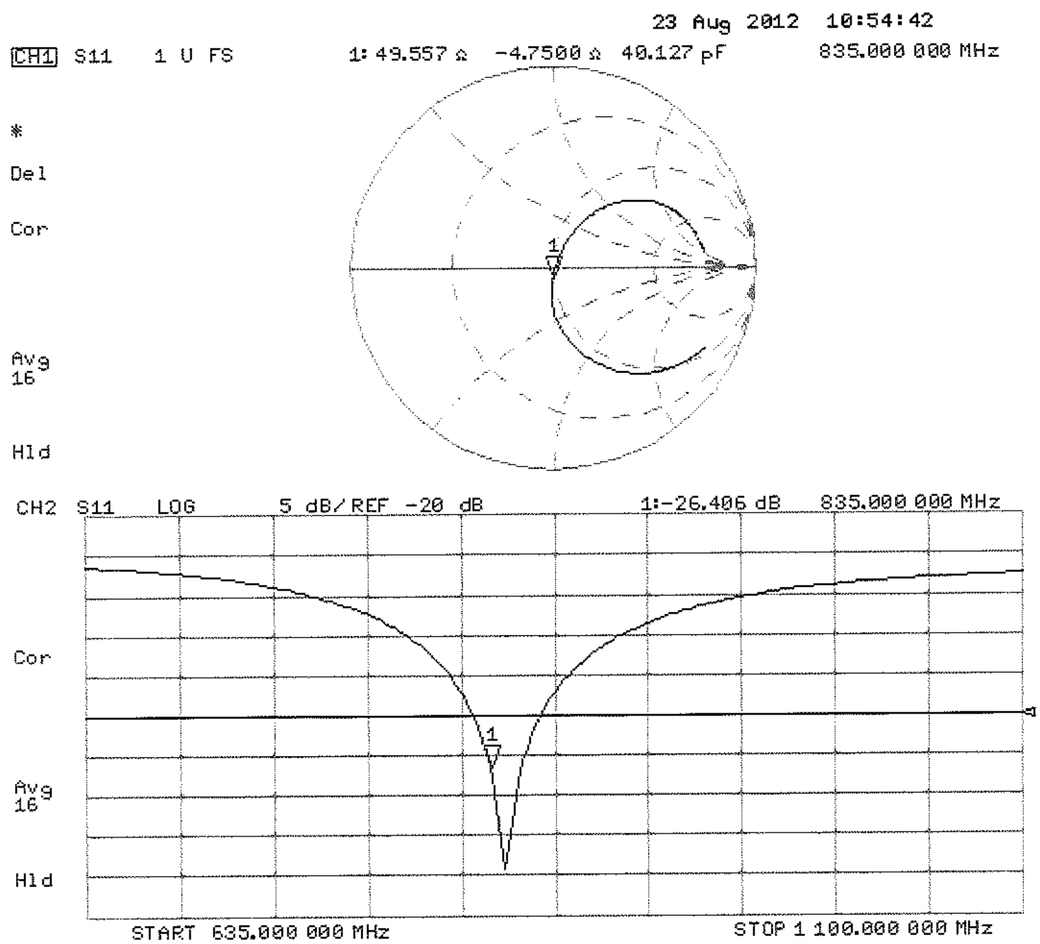
- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.339 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 3.592 mW/g
**SAR(1 g) = 2.47 mW/g; SAR(10 g) = 1.62 mW/g**
Maximum value of SAR (measured) = 2.87 W/kg




0 dB = 2.87 W/kg = 9.16 dB W/kg

## Impedance Measurement Plot for Body TSL



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**Accreditation No.: SCS 108**

**Client** PC Test

**Certificate No: D2450V2-719_Aug12**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D2450V2 - SN: 719 |
| Calibration procedure(s) | QA CAL-05.v8<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | August 23, 2012 |

✓ KOK 9/17/12

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 05-Oct-11 (No. 217-01451) | Oct-12 |
| Power sensor HP 8481A | US37292783 | 05-Oct-11 (No. 217-01451) | Oct-12 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 27-Mar-12 (No. 217-01530) | Apr-13 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 27-Mar-12 (No. 217-01533) | Apr-13 |
| Reference Probe ES3DV3 | SN: 3205 | 30-Dec-11 (No. ES3-3205_Dec11) | Dec-12 |
| DAE4 | SN: 601 | 27-Jun-12 (No. DAE4-601_Jun12) | Jun-13 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-11) | In house check: Oct-13 |
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-11) | In house check: Oct-13 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-11) | In house check: Oct-12 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Israe El-Naouq | Laboratory Technician | Israe El-Naouq |
| Approved by: | Katja Pokovic | Technical Manager | [signature] |

Issued: August 23, 2012

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**Accreditation No.: SCS 108**

## Glossary:

| | |
|---|---|
| TSL | tissue simulating liquid |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A | not applicable or not measured |

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

## Additional Documentation:

d) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.2 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 10 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 2450 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 39.2 | 1.80 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 39.2 ± 6 % | 1.81 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.2 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **52.7 mW /g ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.19 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.7 mW /g ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 52.7 | 1.95 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 51.3 ± 6 % | 1.99 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.1 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **51.6 mW / g ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.16 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **24.4 mW / g ± 16.5 % (k=2)** |

# Appendix

## Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 54.4 Ω + 3.8 jΩ |
| Return Loss | - 25.1 dB |

## Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 50.7 Ω + 5.9 jΩ |
| Return Loss | - 24.6 dB |

## General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.150 ns |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

## Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | September 10, 2002 |

## DASY5 Validation Report for Head TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 719**

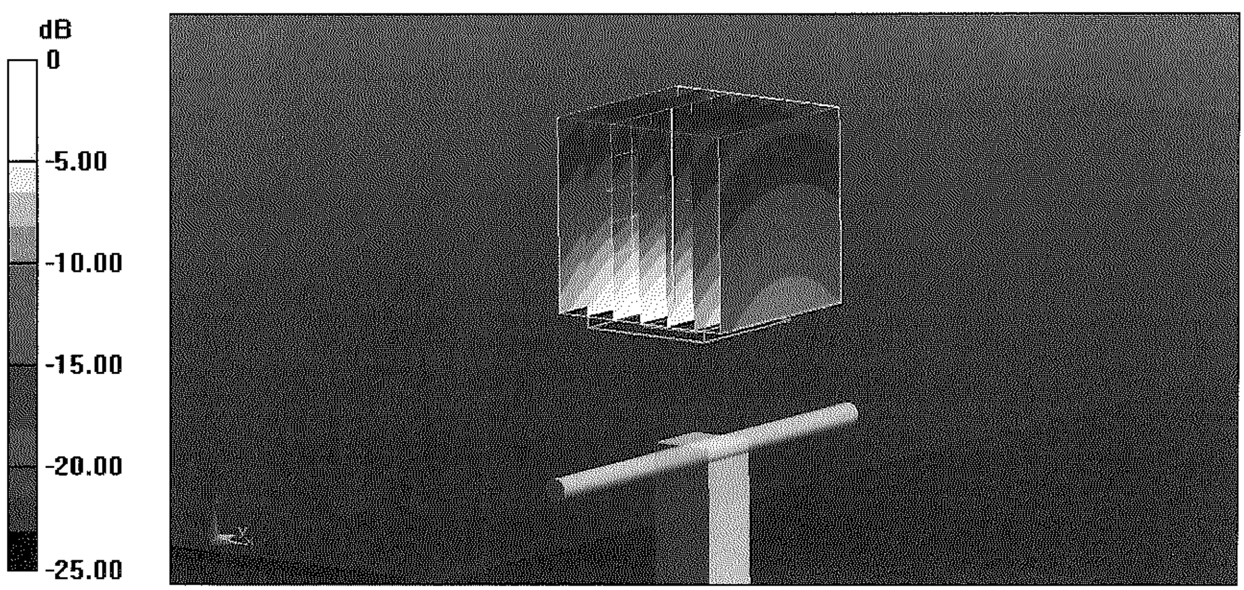
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.81 mho/m; $\varepsilon_r$ = 39.2; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

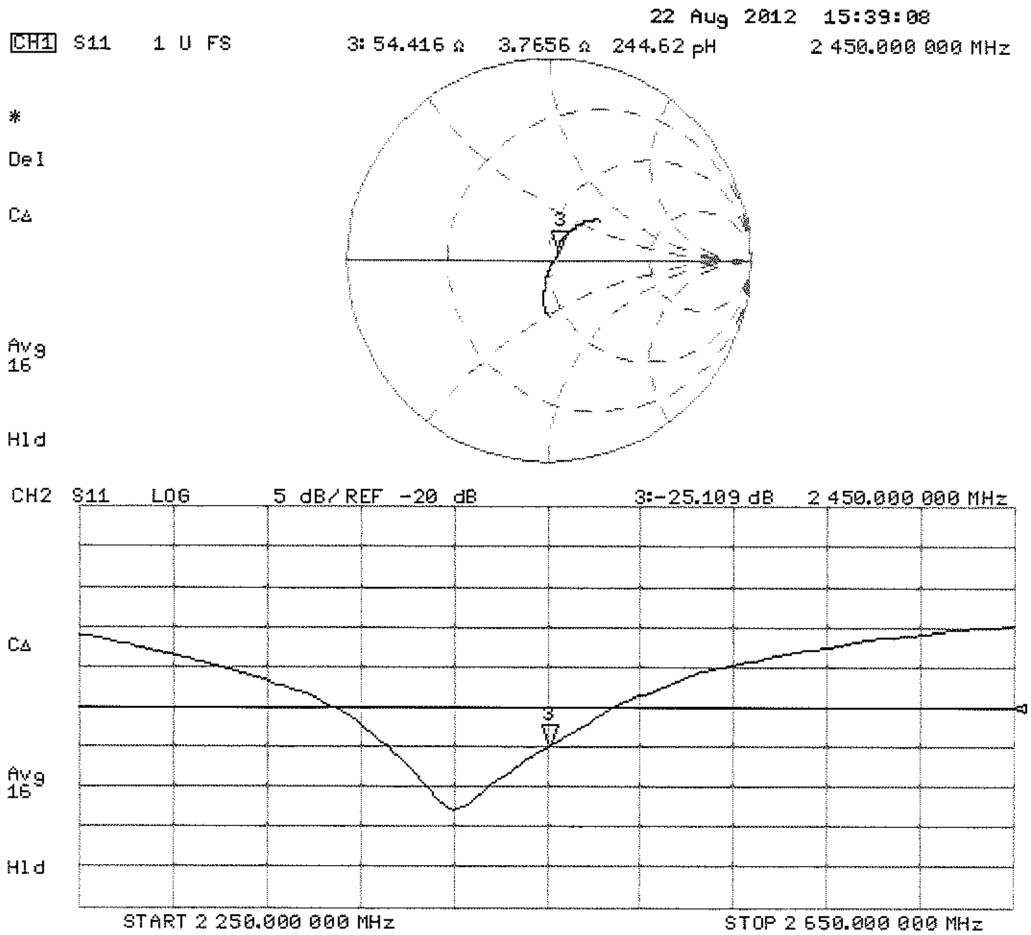
### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.219 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 26.633 mW/g
**SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.19 mW/g**
Maximum value of SAR (measured) = 16.5 W/kg




0 dB = 16.5 W/kg = 24.35 dB W/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 22.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 719**

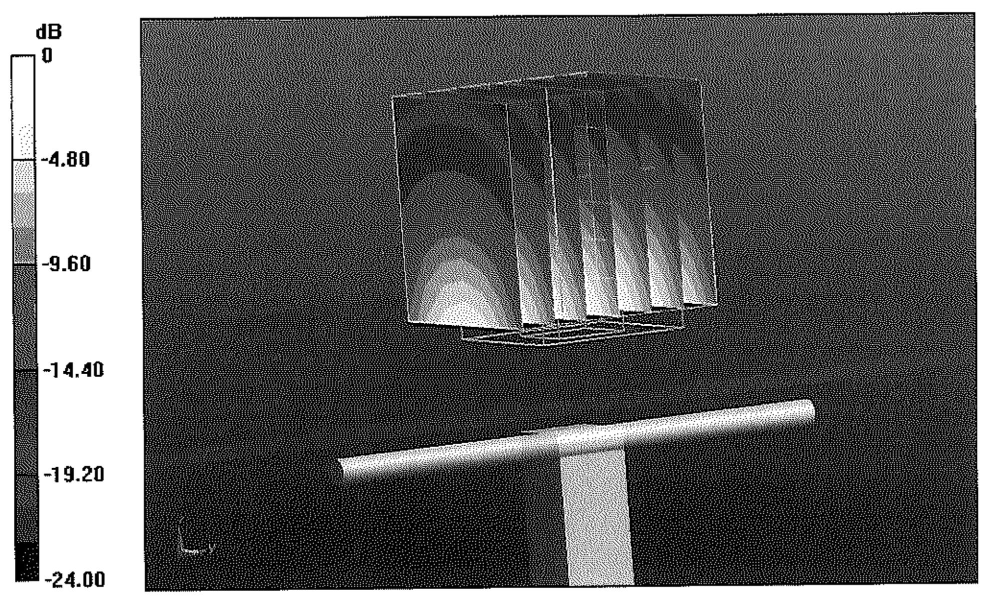
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.99 mho/m; $\varepsilon_r$ = 51.3; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

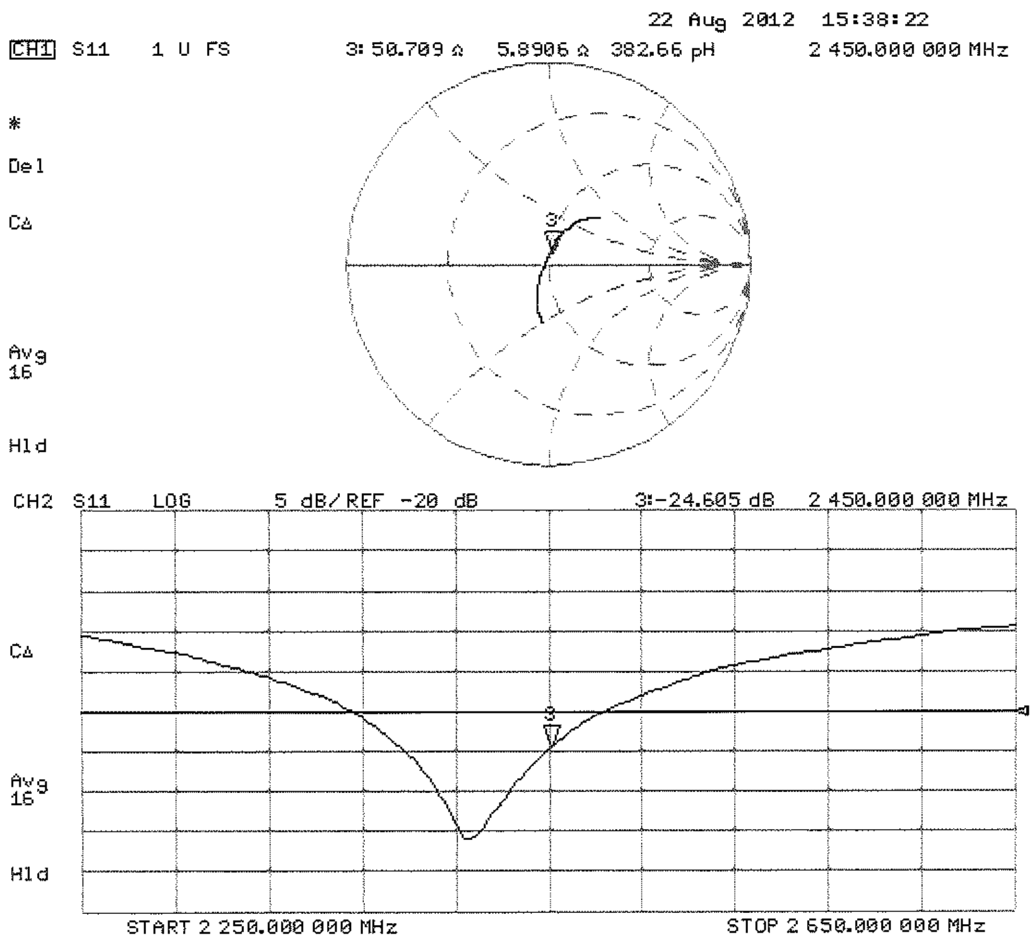
### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.970 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 26.692 mW/g
**SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.16 mW/g**
Maximum value of SAR (measured) = 17.1 W/kg




0 dB = 17.1 W/kg = 24.66 dB W/kg

## Impedance Measurement Plot for Body TSL



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**Accreditation No.: SCS 108**

**Client** PC Test

**Certificate No: D1900V2-5d148_Feb13**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D1900V2 - SN: 5d148 |
| Calibration procedure(s) | QA CAL-05.v9<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | February 06, 2013 |

✓ KOK 2/21/13

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 01-Nov-12 (No. 217-01640) | Oct-13 |
| Power sensor HP 8481A | US37292783 | 01-Nov-12 (No. 217-01640) | Oct-13 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 27-Mar-12 (No. 217-01530) | Apr-13 |
| Type-N mismatch combination | SN: 5047.3 / 06327 | 27-Mar-12 (No. 217-01533) | Apr-13 |
| Reference Probe ES3DV3 | SN: 3205 | 28-Dec-12 (No. ES3-3205_Dec12) | Dec-13 |
| DAE4 | SN: 601 | 27-Jun-12 (No. DAE4-601_Jun12) | Jun-13 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-11) | In house check: Oct-13 |
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-11) | In house check: Oct-13 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-12) | In house check: Oct-13 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Leif Klysner | Laboratory Technician | Leif Klysner |
| Approved by: | Katja Pokovic | Technical Manager | Katja Pokovic |

Issued: February 6, 2013

## Glossary:

| | |
|---|---|
| TSL | tissue simulating liquid |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A | not applicable or not measured |

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

## Additional Documentation:

d) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.5 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 10 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 1900 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 40.0 | 1.40 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 39.4 ± 6 % | 1.38 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 9.87 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **39.7 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.18 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **20.8 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 53.3 | 1.52 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 51.9 ± 6 % | 1.53 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 10.3 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **40.8 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.45 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **21.7 W/kg ± 16.5 % (k=2)** |

## Appendix

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 52.1 Ω + 5.9 jΩ |
| Return Loss | - 24.3 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 48.3 Ω + 6.3 jΩ |
| Return Loss | - 23.6 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.199 ns |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | March 11, 2011 |

**DASY5 Validation Report for Head TSL**

Date: 06.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d148**

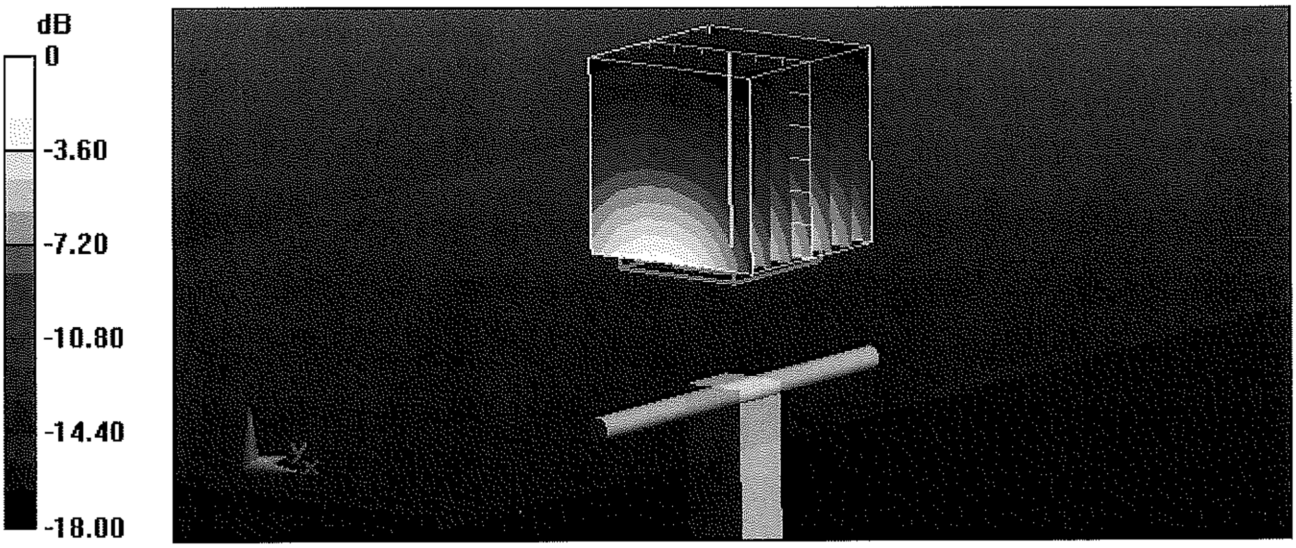
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.38 S/m; $\varepsilon_r$ = 39.4; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

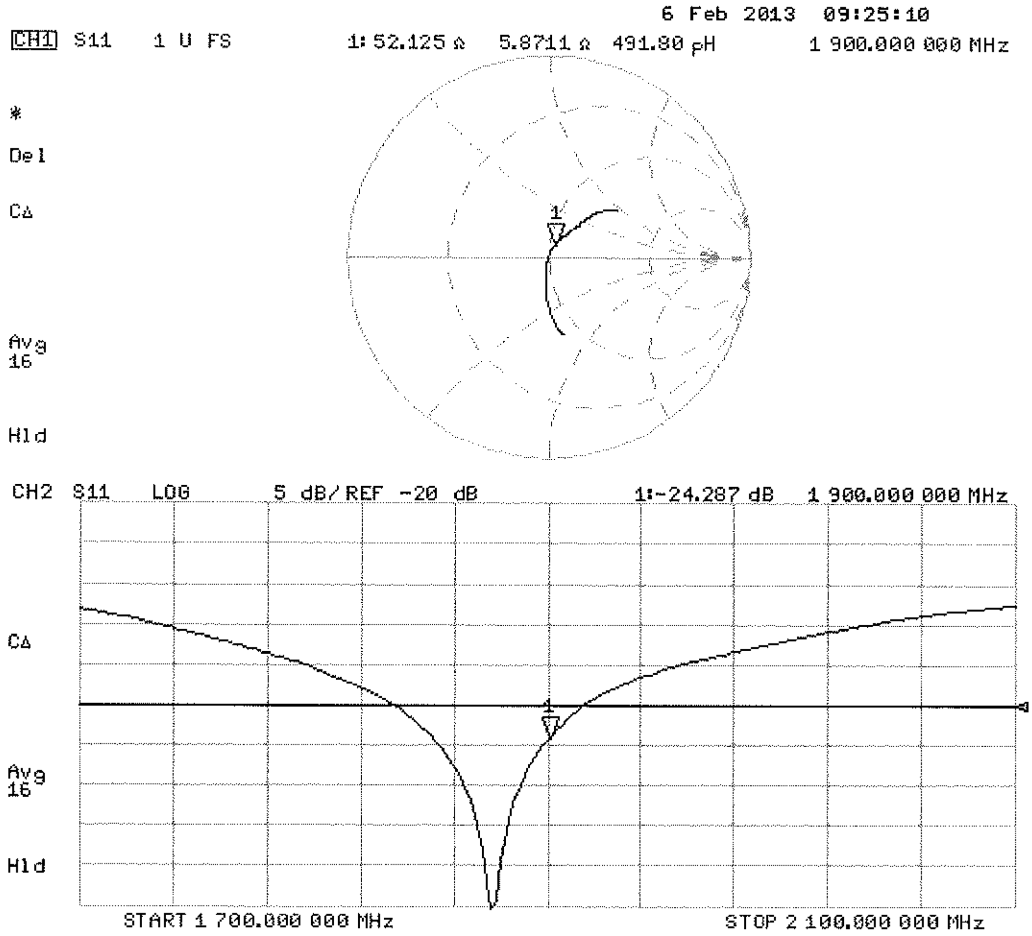
## Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.534 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 17.8 W/kg
**SAR(1 g) = 9.87 W/kg; SAR(10 g) = 5.18 W/kg**
Maximum value of SAR (measured) = 12.1 W/kg




0 dB = 12.1 W/kg = 10.83 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 06.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d148**

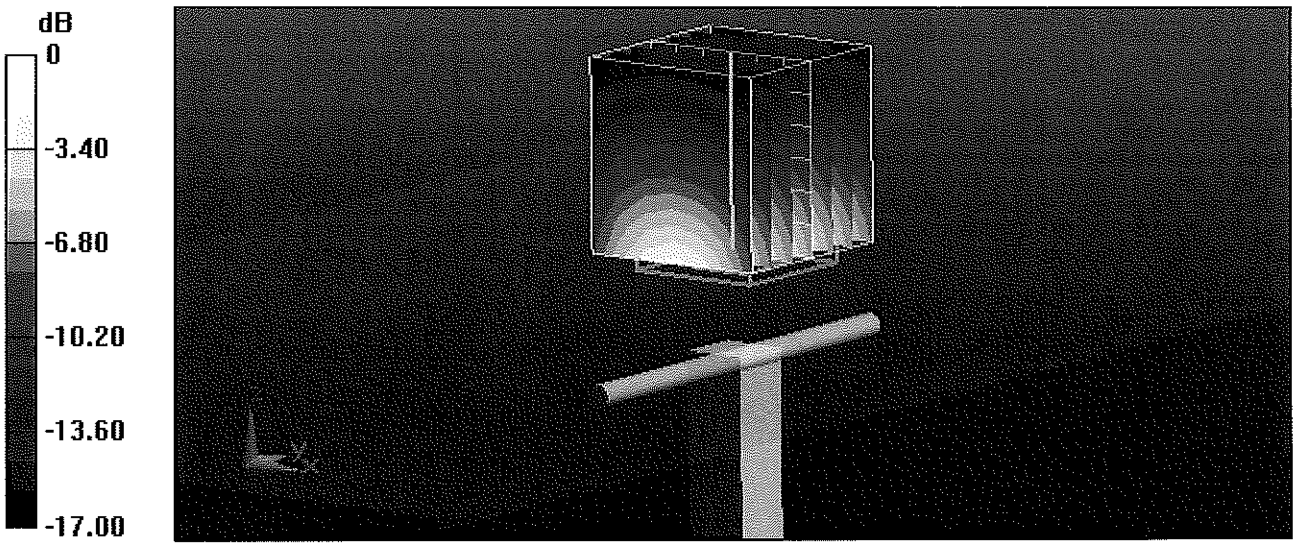
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.53 S/m; $\varepsilon_r$ = 51.9; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

## Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.534 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 17.9 W/kg
**SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.45 W/kg**
Maximum value of SAR (measured) = 13.1 W/kg




0 dB = 13.1 W/kg = 11.17 dBW/kg

## Impedance Measurement Plot for Body TSL