



SAR EVALUATION REPORT

Applicant Name:
 LG Electronics MobileComm U.S.A., Inc.
 1000 Sylvan Avenue
 Englewood Cliffs, NJ 07632
 USA

Date of Testing:
 11/26/12 - 12/04/12
Test Site/Location:
 PCTEST Lab, Columbia, MD, USA
Document Serial No.:
 0Y1211261701-R3.ZNF

FCC ID: ZNFVS870

APPLICANT: LG ELECTRONICS MOBILECOMM U.S.A., INC.

DUT Type: Portable Handset
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): LG-VS870, LGVS870, VS870

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)
PCE	Cell. CDMA/EVDO	824.70 - 848.31 MHz	24.69	0.25	0.36	0.42
PCE	PCS CDMA/EVDO	1851.25 - 1908.75 MHz	24.57	0.28	0.69	0.72
PCE	LTE Band 13	782 MHz	23.65	0.35	0.44	0.44
DTS	2.4 GHz WLAN	2412 - 2462 MHz	16.24	0.55	0.15	0.15
DTS	5.8 GHz WLAN	5745 - 5825 MHz	13.19	< 0.1	< 0.1	
UNII	5.2 GHz WLAN	5180 - 5240 MHz	12.99	0.18	0.18	
UNII	5.3 GHz WLAN	5260 - 5320 MHz	13.19	0.15	0.18	
UNII	5.5 GHz WLAN	5500 - 5700 MHz	13.26	< 0.1	< 0.1	
DSS	Bluetooth	2402 - 2480 MHz	11.07	N/A		
Simultaneous SAR per KDB 690783 D01v01r02:				0.97	1.24	1.07

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.

Note: This revised Test Report (S/N: 0Y1211261701-R3.ZNF) supersedes and replaces the previously issued test report on the same subject EUT for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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.

PCTEST certifies that no party to this application has been subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.


 Randy Ortanez
 President



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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
Cell. CDMA/EVDO	Voice/Data	824.70 - 848.31 MHz
PCS CDMA/EVDO	Voice/Data	1851.25 - 1908.75 MHz
LTE Band 13	Data	782 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

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		Modulated Average (dBm)
Cell. CDMA/EVDO	Maximum	24.7
	Nominal	24.2
PCS CDMA/EVDO	Maximum	24.7
	Nominal	24.2

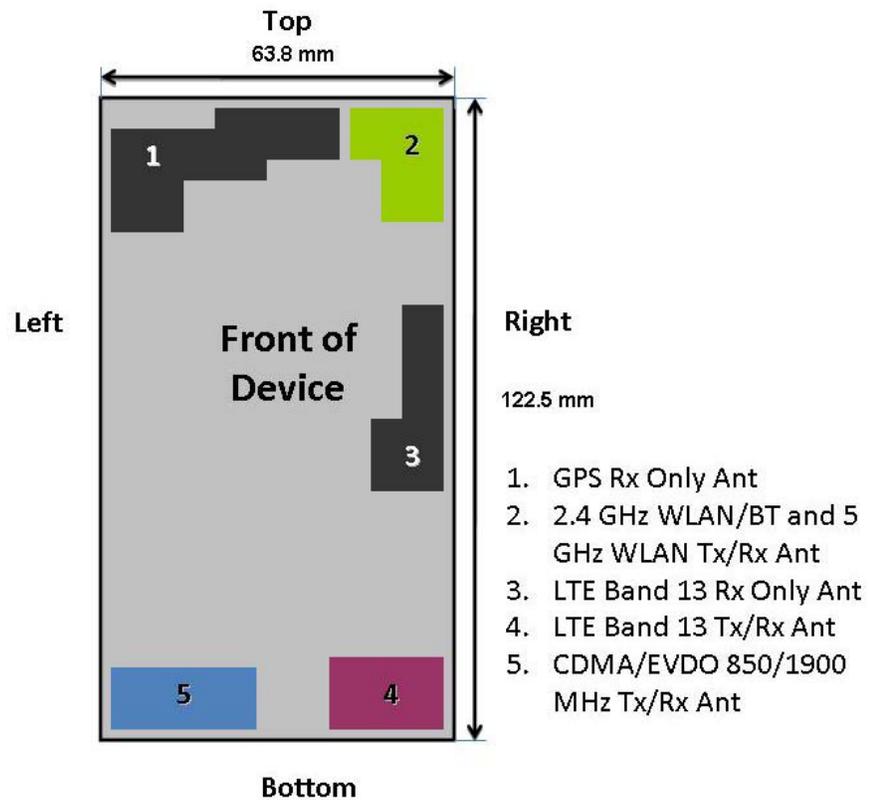
Mode / Band			Modulated Average (dBm)
Cell. CDMA	SVLTE threshold	Maximum	19.2
	LTE is not reducing	Nominal	18.7
PCS CDMA	SVLTE threshold	Maximum	19.2
	LTE is not reducing	Nominal	18.7

Mode / Band	Power Reduction		Modulated Average (dBm)
LTE Band 13	Inactive	Maximum	23.7
		Nominal	23.2
	Active	Maximum	19.7
		Nominal	19.2

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Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	17.0
	Nominal	16.3
IEEE 802.11g (2.4 GHz)	Maximum	14.0
	Nominal	13.3
IEEE 802.11n (2.4 GHz)	Maximum	13.0
	Nominal	12.3
IEEE 802.11a (5 GHz)	Maximum	14.0
	Nominal	13.3
IEEE 802.11n (5 GHz)	Maximum	13.0
	Nominal	12.3
Bluetooth	Maximum	11.7
	Nominal	11.0

1.3 DUT Antenna Locations



Note: Specific antenna dimensions and separation distances are shown in the antenna distance document.

Figure 1-1
DUT Antenna Locations

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**Table 1-1
Mobile Hotspot Sides for SAR Testing**

Mode	Back	Front	Top	Bottom	Right	Left
Cell. EVDO	Yes	Yes	No	Yes	No	Yes
PCS EVDO	Yes	Yes	No	Yes	No	Yes
LTE Band 13	Yes	Yes	No	Yes	Yes	No
2.4 GHz WLAN	Yes	Yes	Yes	No	Yes	No

Note: Particular DUT edges were not required to be evaluated for Wireless Router SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v01 guidance, page 2. The antenna document shows the distances between the transmit antennas and the edges of the device. When the wireless router mode is enabled, all 5 GHz bands are disabled. Therefore 5 GHz WIFI is not considered in this section.

1.4 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. Possible transmission paths for the DUT are shown in Figure 1-2 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.



**Figure 1-2
Simultaneous Transmission Paths**

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 TX Configuration	Head SAR	Body SAR	Hotspot SAR	Power Reduction (LTE)	Note
1	CDMA BC0 Voice + 2.4GHz WiFi data	Yes	Yes	No	No	
2	CDMA BC0 Voice + 5GHz WiFi data	Yes	Yes	No	No	
3	CDMA BC1 Voice + 2.4GHz WiFi data	Yes	Yes	No	No	
4	CDMA BC1 Voice + 5GHz WiFi data	Yes	Yes	No	No	
5	CDMA BC0 1X Data/EVDO + 2.4GHz WiFi data	Yes	Yes	Yes	No	CDMA Hotspot
6	CDMA BC0 1X Data/EVDO + 5GHz WiFi data	Yes	Yes	No	No	WiFi Direct
7	CDMA BC1 1X Data/EVDO + 2.4GHz WiFi data	Yes	Yes	Yes	No	CDMA Hotspot
8	CDMA BC1 1X Data/EVDO + 5GHz WiFi data	Yes	Yes	No	No	WiFi Direct
9	LTE B13 + 2.4GHz WiFi data	Yes	Yes	Yes	No	LTE Hotspot
10	LTE B13 + 5GHz WiFi data	Yes	Yes	No	No	WiFi Direct
11	CDMA BC0 Voice + LTE B13	Yes	Yes	No	Yes	SVLTE
12	CDMA BC1 Voice + LTE B13	Yes	Yes	No	Yes	SVLTE
13	CDMA BC0 Voice + LTE B13 + 2.4GHz WLAN	Yes	Yes	Yes	Yes	WiFi Hotspot (SVLTE)
14	CDMA BC1 Voice + LTE B13 + 2.4GHz WLAN	Yes	Yes	Yes	Yes	WiFi Hotspot (SVLTE)
15	CDMA BC0 Voice + LTE B13 + 5GHz WLAN	Yes	Yes	No	Yes	WiFi Direct (SVLTE)
16	CDMA BC1 Voice + LTE B13 + 5GHz WLAN	Yes	Yes	No	Yes	WiFi Direct (SVLTE)
17	CDMA BC0 Voice + 2.4 GHz Bluetooth	No	Yes	No	No	
18	CDMA BC1 Voice + 2.4 GHz Bluetooth	No	Yes	No	No	
19	LTE B13 + 2.4 GHz Bluetooth	No	Yes	No	No	
20	CDMA BC0 Voice + LTE B13 + 2.4 GHz Bluetooth	No	Yes	No	No	
21	CDMA BC1 Voice + LTE B13 + 2.4 GHz Bluetooth	No	Yes	No	No	

* BT and WLAN are not simultaneous transmission.
 * CDMA EVDO and LTE are not simultaneous transmission.
 * CDMA BC0/BC1 EVDO is supported.
 * VoLTE is supported.
 * SVLTE is supported.
 * Power reduction for SVLTE mode is supported.
 * EVDO VoIP is supported.

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1.5 Power Reduction for SAR

This device uses power reduction mechanisms for LTE during SVLTE operation (1x-RTT CDMA voice + LTE data) for SAR compliance. See Section 10 for more details.

1.6 Wireless Charging Battery Cover

This DUT may be used with a standard battery cover or with an optional wireless charging battery cover. Per FCC KDB Publication 648474 D04, SAR was measured using the standard battery cover and then repeated with the wireless charging battery cover for the highest reported SAR for each wireless technology, frequency band, operating mode, and exposure condition. Since reported SAR did not exceed 1.2 W/kg, additional testing with the wireless charging battery cover was not required.

1.7 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 447498 D01 v05, the SAR exclusion threshold for distances <50mm is defined by the following equation:

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

Based on the maximum conducted power of Bluetooth and the antenna to use separation distance, Bluetooth SAR was not required; $[(15/10) * \sqrt{2.441}] = 2.34 < 3.0$.

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.

(B) Licensed Transmitter(s)

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth; and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02.

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1.8 Guidance Applied

- FCC OET Bulletin 65 Supplement C [June 2001]
- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (2G/3G/4G 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)
- FCC KDB Publication 648474 D04 (Wireless Charging Battery Covers)

1.9 Device Serial Numbers

Several samples were used with identical hardware to support SAR testing.

	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
Cell. CDMA/EVDO Maximum Power	3	3	3
Cell. CDMA/EVDO Reduced Power	6	6	6
PCS CDMA/EVDO Maximum Power	3	3	3
PCS CDMA/EVDO Reduced Power	6	6	6
LTE Band 13 Maximum Power	10	10	10
LTE Band 13 Reduced Power	4	4	4
2.4 GHz WLAN	6	10	10
5 GHz WLAN	3	10	-

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LTE INFORMATION

LTE Information				
	FCC ID	ZNFVS870		
	Form Factor	Portable Handset		
1)	Frequency Range of each LTE transmission band	LTE Band 13 (782 MHz)		
2)	Channel Bandwidths	LTE Band 13: 10 MHz		
3)	Channel Numbers and Frequencies (MHz)	Low	Mid	High
	LTE Band 13: 10 MHz		782 (23230)	
4)(a)	UE Category	3		
(b)	Modulations Supported in UL	QPSK, 16QAM		
	LTE Transmitter and Antenna Implementation	CDMA has one Tx/Rx antenna and LTE has one Tx/ Rx antenna and one Rx only antenna		
5)	Description of LTE Tx and Ant. Implementation	CDMA/LTE operate on separate transmission paths		
6)	LTE Voice available?	YES		
	Hotspot with LTE+WIFI	YES		
	Hotspot with LTE+WIFI active with 1XVoice sessions?	YES		
7)	LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES		
	A-MPR (Additional MPR) disabled for SAR Testing?	YES		
8)	Conducted power Table provided for 1RB (low, mid, and high offset), 50% RB (low, mid, and high offset), 100% RB	YES		

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3 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.

3.1 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 (ρ). 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 3-1
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:

- σ = conductivity of the tissue-simulating material (S/m)
- ρ = mass density of the tissue-simulating material (kg/m³)
- 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]

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4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure:

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 4-1).
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 DASYS 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.

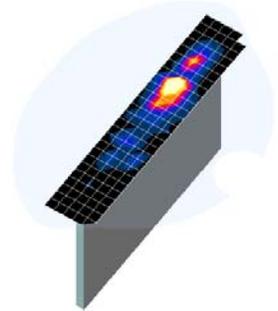


Figure 4-1
Sample SAR Area Scan

Table 4-1
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) $\Delta z_{zoom}(n)$	Minimum Zoom Scan Volume (mm) (x,y,z)
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≥ 22

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DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

Figure 5-2 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 5-1. 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 5-1). 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].

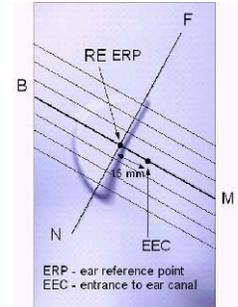


Figure 5-1
Close-Up Side view of ERP

5.2 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 5-3). The “test device reference point” was then 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 5-2
Front, back and side view of SAM Twin Phantom

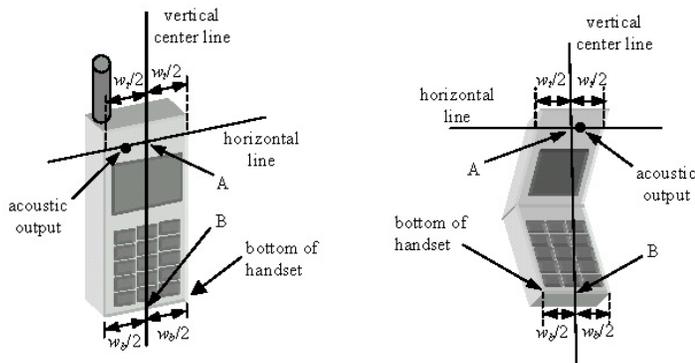


Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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6 TEST CONFIGURATION POSITIONS FOR HANDSETS

6.1 Device Holder

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

6.2 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 6-1), 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.

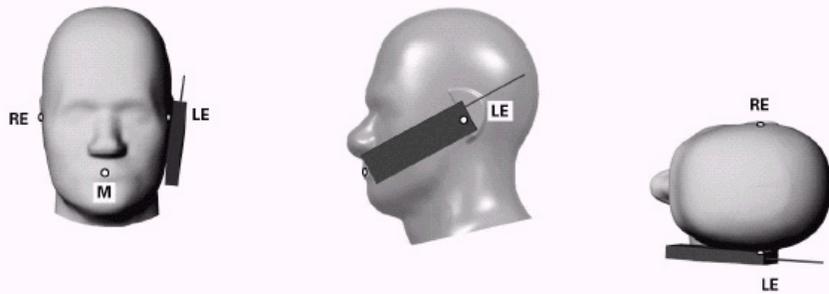


Figure 6-1 Front, Side and Top View of Cheek Position

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 with 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 6-2).

6.3 Positioning for Ear / 15° 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 6-2).

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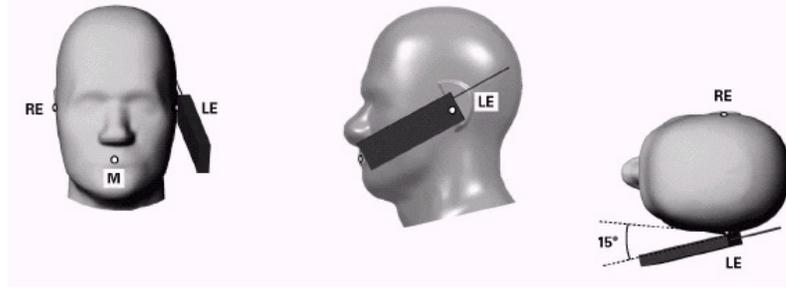


Figure 6-2 Front, Side and Top View of Ear/15° Tilt Position

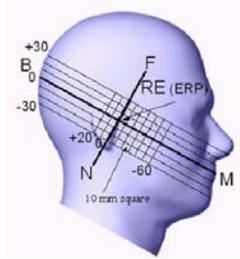


Figure 6-3 Side view w/ relevant markings

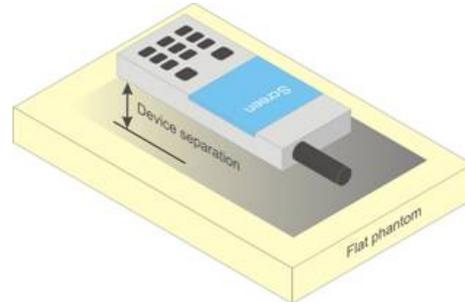


Figure 6-4 Sample Body-Worn Diagram

6.4 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.

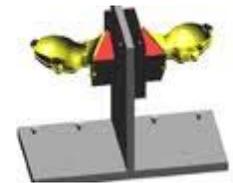


Figure 6-5 Twin SAM Chin20

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6.5 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 6-4). Per FCC KDB Publication 648474 D04_v01, 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 D01_v05 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.

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.

6.6 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 ($L \times W \geq 9$ cm \times 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.

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7 RF EXPOSURE LIMITS

7.1 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.

7.2 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 7-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6**

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT <i>General Population</i> (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT <i>Occupational</i> (W/kg) or (mW/g)
SPATIAL PEAK SAR Brain	1.6	8.0
SPATIAL AVERAGE SAR Whole Body	0.08	0.4
SPATIAL PEAK SAR Hands, Feet, Ankles, Wrists	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.

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8 FCC MEASUREMENT PROCEDURES

Power measurements were performed using a base station simulator under digital average power.

8.1 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.

8.2 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.

8.3 SAR Measurement Conditions for CDMA2000

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

8.3.1 Output Power Verification

See 3GPP2 C.S0011/TIA-98-E as recommended by "SAR Measurement Procedures for 3G Devices" v02, October 2007. Maximum output power is verified on the High, Middle and Low channels according to procedures in section 4.4.5.2 of 3GPP2 C.S0011/TIA-98-E. SO55 tests were measured with power control bits in the "All Up" condition.

1. If the mobile station (MS) supports Reverse TCH RC 1 and Forward TCH RC 1, set up a call using Fundamental Channel Test Mode 1 (RC=1/1) with 9600 bps data rate only.
2. Under RC1, C.S0011 Table 4.4.5.2-1, Table 8-1 parameters were applied.
3. If the MS supports the RC 3 Reverse FCH, RC3 Reverse SCH₀ and demodulation of RC 3,4, or 5, set up a call using Supplemental Channel Test Mode 3 (RC 3/3) with 9600 bps Fundamental Channel and 9600 bps SCH₀ data rate.
4. Under RC3, C.S0011 Table 4.4.5.2-2, Table 8-2 was applied.

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**Table 8-1
Parameters for Max. Power for RC1**

Parameter	Units	Value
I_{or}	dBm/1.23 MHz	-104
$\frac{Pilot E_c}{I_{or}}$	dB	-7
$\frac{Traffic E_c}{I_{or}}$	dB	-7.4

**Table 8-2
Parameters for Max. Power for RC3**

Parameter	Units	Value
I_{or}	dBm/1.23 MHz	-86
$\frac{Pilot E_c}{I_{or}}$	dB	-7
$\frac{Traffic E_c}{I_{or}}$	dB	-7.4

5. FCHs were configured at full rate for maximum SAR with “All Up” power control bits.

8.3.2 Head SAR Measurements

SAR for head exposure configurations is measured in RC3 with the DUT configured to transmit at full rate using Loopback Service Option SO55. SAR for RC1 is not required when the maximum average output of each channel is less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel in RC1 using the exposure configuration that results in the highest SAR for that channel in RC3. Head SAR was additionally evaluated for EVDO Rev. A to determine VoIP compliance. See Section 8.3.4 for EVDO Rev. A configuration parameters.

8.3.3 Body SAR Measurements

SAR for body exposure configurations is measured in RC3 with the DUT configured to transmit at full rate on FCH with all other code channels disabled using TDSO / SO32. SAR for multiple code channels (FCH + SCH_n) is not required when the maximum average output of each RF channel is less than ¼ dB higher than that measured with FCH only. Otherwise, SAR is measured on the maximum output channel (FCH + SCH_n) with FCH at full rate and SCH₀ enabled at 9600 bps using the exposure configuration that results in the highest SAR for that channel with FCH only. When multiple code channels are enabled, the DUT output may shift by more than 0.5 dB and lead to higher SAR drifts and SCH dropouts. Body SAR was measured using TDSO / SO32 with power control bits in the “All Up”

Body SAR in RC1 is not required when the maximum average output of each channel is less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel in RC1; with Loopback Service Option SO55, at full rate, using the body exposure configuration that results in the highest SAR for that channel in RC3.

8.3.4 Handsets with EVDO

For handsets with Ev-Do capabilities, when the maximum average output of each channel in Rev. 0 is less than ¼ dB higher than that measured in RC3 (1x RTT), body SAR for EV-DO is not required. Otherwise, SAR for Rev. 0 is measured on the maximum output channel at 153.6 kbps using the body exposure configuration that results in the highest SAR for that channel in RC3. SAR for Rev. A is not required when the maximum average output of each channel is less than that measured in Rev. 0 or less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel for Rev. A using a Reverse Data Channel payload size of 4096 bits and a Termination Target of 16 slots defined for Subtype 2 Physical Layer configurations. A Forward Traffic Channel data rate corresponding to the 2-slot version of 307.2 kbps with the ACK Channel transmitting in all slots would be configured in the downlink for both Rev. 0 and Rev. A.

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8.3.5 Body SAR Measurements for EVDO Hotspot

Hotspot Body SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0 per KDB Publication 941225 D01 procedures for “1x Ev-Do data Devices”. SAR for Subtype 2 Physical layer configurations is not required for Rev. A when the maximum average output of each RF channels is less than that measured in Subtype 0/1 Physical layer configurations. Otherwise, SAR is measured on the maximum output channel for Rev. A using the exposure configuration that results in the highest SAR for the RF channels in Rev. 0. The AT is tested with a Reverse Data Channel rate of 153.6 kbps in Subtype 0/1 Physical Layer configurations; and a Reverse Data Channel payload size of 4096 bits and Termination Target of 16 slots in Subtype 2 Physical Layer configurations.

SAR is not required for 1x RTT for Ev-Do devices that also support 1x RTT voice and/or data operations, when the maximum average output of each channel is less than 1/4 dB higher than that measured in Subtype 0/1 Physical Layer configurations for Rev. 0. Otherwise, CDMA “Body-SAR Measurement” procedures for “CDMA 2000 1x Handsets” were applied.

8.4 SAR Measurement Conditions for LTE

LTE modes were tested according to FCC KDB 941225 D05v02 publication. Please see notes after the tabulated SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 was used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing.

8.4.1 Spectrum Plots for RB Configurations

A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.

8.4.2 MPR

MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.

8.4.3 A-MPR

MPR (Additional MPR) has been disabled for all SAR tests by setting NS=01 on the base station simulator.

8.4.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02:

- a. Per Section 5.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
 - i. The required channel and offset combination with the highest maximum output power is required for SAR.
 - ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.

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- iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
- b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.
- c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
- d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to ½ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is <1.45 W/kg.

8.5 SAR Testing with 802.11 Transmitters

Normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g/n 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.

8.5.1 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.

8.5.2 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 than 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.

If the maximum extrapolated peak SAR of the zoom scan for the highest output channel was less than 1.6 W/kg or 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.

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9 RF CONDUCTED POWERS

9.1 CDMA Conducted Powers

Band	Channel	Frequency	SO55 [dBm]	SO55 [dBm]	TDSO SO32 [dBm]	TDSO SO32 [dBm]	1x EvDO Rev. 0 [dBm]	1x EvDO Rev. A [dBm]
	F-RC	MHz	RC1	RC3	FCH+SCH	FCH	(RTAP)	(RETAP)
Cellular	1013	824.7	24.43	24.60	24.49	24.39	24.39	24.31
	384	836.52	24.45	24.69	24.59	24.41	24.41	24.38
	777	848.31	24.50	24.65	24.63	24.44	24.49	24.34
PCS	25	1851.25	24.42	24.48	24.54	24.52	24.51	24.49
	600	1880	24.45	24.51	24.53	24.57	24.55	24.50
	1175	1908.75	24.38	24.51	24.48	24.48	24.49	24.47

Note: RC1 is only applicable for IS-95 compatibility.

Per KDB Publication 941225 D01v02:

1. Head SAR was tested with SO55 RC3. SO55 RC1 was not required since the average output power was not more than 0.25 dB than the SO55 RC3 powers.
2. Head SAR was additionally evaluated for EVDO Rev. A to determine SAR compliance for VoIP over EVDO.
3. Body-Worn SAR was tested with 1x RTT with TDSO / SO32 FCH Only. Ev-Do and TDSO / SO32 FCH+SCH SAR tests were not required since the average output power was not more than 0.25 dB higher than the TDSO / SO32 FCH only powers.
4. Hotspot SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0. If the average output power of Subtype 2 for Rev. A is less than the Rev. 0 power levels, then Rev. A SAR is not required. Otherwise, SAR is measured on the maximum output channel for Rev. A using the exposure configuration that results in the highest SAR for that RF channel in Rev. 0.
5. CDMA 1x-RTT SAR was additionally required to be evaluated for Hotspot exposure conditions to support simultaneous transmission capabilities.

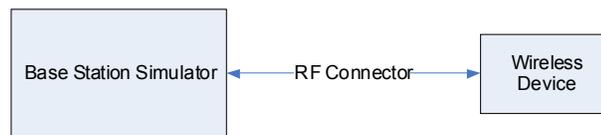


Figure 9-1
Power Measurement Setup

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9.2 LTE Conducted Powers

9.2.1 LTE Band 13

Table 9-1
LTE Band 13 Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	782.0	23230	10	QPSK	1	0	23.65	0	0
	782.0	23230	10	QPSK	1	25	23.59	0	0
	782.0	23230	10	QPSK	1	49	23.58	0	0
	782.0	23230	10	QPSK	25	0	22.57	1	0-1
	782.0	23230	10	QPSK	25	12	22.62	1	0-1
	782.0	23230	10	QPSK	25	25	22.58	1	0-1
	782.0	23230	10	QPSK	50	0	22.50	1	0-1
	782.0	23230	10	16QAM	1	0	22.44	1	0-1
	782.0	23230	10	16QAM	1	25	22.48	1	0-1
	782.0	23230	10	16QAM	1	49	22.35	1	0-1
	782.0	23230	10	16QAM	25	0	21.61	2	0-2
	782.0	23230	10	16QAM	25	12	21.68	2	0-2
	782.0	23230	10	16QAM	25	25	21.62	2	0-2
	782.0	23230	10	16QAM	50	0	21.55	2	0-2

9.3 WLAN Conducted Powers

Table 9-2
IEEE 802.11b Average RF Power

Mode	Freq [MHz]	Channel	802.11b (2.4 GHz) Conducted Power [dBm]			
			Data Rate [Mbps]			
			1	2	5.5	11
802.11b	2412	1	16.24	16.16	16.24	16.18
802.11b	2437	6	15.70	15.75	15.82	15.81
802.11b	2462	11	15.30	15.29	15.47	15.44

Table 9-3
IEEE 802.11g Average RF Power

Mode	Freq [MHz]	Channel	802.11g (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11g	2412	1	13.14	12.87	12.82	12.88	13.37	13.43	13.47	13.44
802.11g	2437	6	13.15	13.04	13.10	12.95	13.09	13.17	13.13	13.07
802.11g	2462	11	12.82	12.66	12.78	12.71	12.75	12.78	12.80	12.20

Table 9-4
IEEE 802.11n Average RF Power

Mode	Freq [MHz]	Channel	802.11n (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	20	26	39	52	58	65
802.11n	2412	1	12.15	12.21	12.17	12.18	12.17	12.22	12.26	12.24
802.11n	2437	6	11.83	11.81	11.80	11.85	11.80	11.74	11.78	11.78
802.11n	2462	11	11.42	11.46	11.41	11.38	11.42	11.42	11.39	11.42

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**Table 9-5
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*	12.84	12.93	12.92	12.86	12.63	12.59	12.60	12.60
802.11a	5200	40	12.95	12.83	12.89	12.85	12.81	12.73	12.78	12.78
802.11a	5220	44	12.99	12.97	12.93	12.96	13.00	12.96	12.93	12.84
802.11a	5240	48*	12.86	13.05	13.07	13.07	12.95	12.99	12.93	12.91
802.11a	5260	52*	13.01	12.63	12.73	12.65	12.57	12.61	12.53	12.52
802.11a	5280	56	13.05	12.71	12.61	12.71	12.69	12.67	12.64	12.55
802.11a	5300	60	13.12	13.17	13.10	13.11	13.08	13.07	13.09	12.99
802.11a	5320	64*	13.19	13.26	13.16	13.08	13.06	13.22	13.26	13.11
802.11a	5500	100	12.81	12.71	12.75	12.74	12.72	12.84	12.64	12.59
802.11a	5520	104*	12.55	12.43	12.40	12.55	12.50	12.55	12.49	12.80
802.11a	5540	108	12.84	12.82	12.86	12.84	12.86	12.75	12.80	12.75
802.11a	5560	112	12.87	12.86	12.81	12.83	12.76	12.78	12.58	12.57
802.11a	5580	116*	12.74	12.67	12.74	12.64	12.62	12.58	12.53	12.54
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	13.21	13.34	13.19	13.16	12.99	13.02	12.98	12.85
802.11a	5680	136*	12.99	13.00	12.93	12.98	12.93	13.05	13.12	13.01
802.11a	5700	140	13.26	13.17	13.34	13.29	13.27	13.37	13.32	13.23
802.11a	5745	149*	12.91	12.93	12.82	12.81	12.77	12.78	12.77	12.64
802.11a	5765	153	12.97	13.00	12.93	12.91	12.92	12.90	12.86	12.95
802.11a	5785	157*	13.02	12.98	12.94	12.88	12.94	12.95	12.92	12.89
802.11a	5805	161*	13.04	13.00	12.97	13.00	12.96	12.91	12.91	12.80
802.11a	5825	165	13.19	13.35	13.29	13.22	13.18	13.12	13.10	13.15

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 than the default channels, these “required channels” are considered for SAR testing instead of the default channels.

**Table 9-6
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	20	26	39	52	58	65	
802.11n	5180	36	11.45	11.39	11.50	11.51	11.28	11.36	11.37	11.34
802.11n	5200	40	11.52	11.46	11.41	11.39	11.36	11.32	11.31	11.35
802.11n	5220	44	11.52	11.56	11.56	11.46	11.45	11.43	11.49	11.45
802.11n	5240	48	11.64	11.64	11.65	11.62	11.73	11.69	11.56	11.75
802.11n	5260	52	11.72	11.62	11.63	11.55	11.58	11.54	11.59	11.58
802.11n	5280	56	11.83	11.80	11.75	11.85	11.72	11.71	11.79	11.85
802.11n	5300	60	11.85	11.86	12.03	11.81	11.80	11.79	11.78	11.76
802.11n	5320	64	11.89	11.74	11.75	11.77	11.66	11.67	11.70	11.63
802.11n	5500	100	11.61	11.65	11.57	11.59	11.57	11.61	11.52	11.53
802.11n	5520	104	11.68	11.55	11.57	11.66	11.53	11.44	11.50	11.35
802.11n	5540	108	11.76	11.79	11.69	11.60	11.61	11.56	11.52	11.46
802.11n	5560	112	11.77	11.72	11.73	11.77	11.64	11.70	11.67	11.71
802.11n	5580	116	11.81	11.70	11.76	11.59	11.55	11.51	11.53	11.51
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
802.11n	5660	132	11.92	11.89	11.83	11.71	11.78	11.75	11.75	11.69
802.11n	5680	136	12.06	12.05	12.01	11.98	11.92	11.94	11.91	11.81
802.11n	5700	140	12.13	12.14	12.14	12.05	12.05	11.99	12.01	11.97
802.11n	5745	149	11.50	11.47	11.57	11.48	11.40	11.41	11.37	11.40
802.11n	5765	153	11.70	11.75	11.74	11.89	11.69	11.89	11.67	11.73
802.11n	5785	157	11.64	11.51	11.42	11.45	11.40	11.36	11.26	11.30
802.11n	5805	161	11.73	11.78	11.70	11.75	11.62	11.66	11.61	11.50
802.11n	5825	165	11.64	11.61	11.50	11.49	11.45	11.43	11.33	11.37

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Table 9-7
IEEE 802.11n Average RF Power – 40 MHz Bandwidth

Mode	Freq [MHz]	Channel	40MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			13.5/15	27/30	40.5/45	54/60	81/90	108/120	121.5/135	135/150
802.11n	5190	38	12.01	11.89	11.90	11.89	11.93	11.88	11.87	11.73
802.11n	5230	46	12.14	12.11	12.01	12.04	11.95	11.94	11.96	11.93
802.11n	5270	54	12.25	12.15	12.07	12.11	12.09	12.01	12.06	11.93
802.11n	5310	62	12.37	12.29	12.30	12.20	12.17	12.14	12.24	12.09
802.11n	5510	102	12.19	12.09	12.03	12.01	12.03	12.00	12.04	11.91
802.11n	5550	110	12.26	12.17	12.18	12.07	12.10	12.04	12.14	12.06
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	12.61	12.50	12.42	12.41	12.34	12.34	12.41	12.25
802.11n	5755	151	12.20	12.18	12.01	12.11	11.95	11.99	11.91	11.92
802.11n	5795	159	12.24	12.24	12.10	12.21	12.05	12.06	12.11	12.04

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and April 2010 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.
- 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.

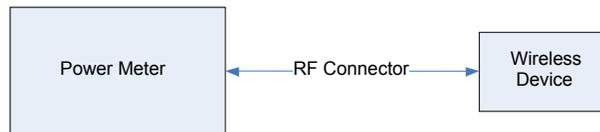


Figure 9-2
Power Measurement Setup

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10 LTE POWER REDUCTION

10.1 Introduction to LTE Power Reduction

This device is capable of Simultaneous Voice and LTE (SVLTE) calls, with the voice call supported by a CDMA 1x-RTT transmitter and the data connection supported by a separate LTE transmitter. A LTE power reduction scheme is applied during a LTE connection operating simultaneously with 1x-RTT voice calls. The maximum transmit power of LTE is limited depending on the CDMA 1x voice transmit power level. When CDMA 1x Voice is operating at a certain range of high power levels, the maximum LTE transmit power is limited. When CDMA 1x Voice transmit power is below a certain threshold transmit power level, LTE can transmit at the maximum power. Target levels of power reduction and CDMA voice threshold levels are provided in Table 10-1.

Table 10-1
SVLTE Power Reduction Scheme

Mode	CDMA Current Voice Power for BC0 & BC1 (in dBm)	LTE Max Power for B13 (in dBm)
SVLTE	$P < 18.7$	23.2
	$P \geq 18.7$	19.2

10.2 Output Power Verification

Per KDB Publication 941225 D05v02 Section 4.4, output powers were measured in SVLTE mode to determine that the power reduction mechanism was operating reliably and consistently. The power reduction was investigated by simultaneously connecting the device to both LTE and CDMA base station simulators. LTE output powers were measured through conducted RF connections by first connecting the device in a LTE data call and subsequently a CDMA 1x-RTT call. CDMA powers were controlled by configuring the CDMA base station simulator to active bits. The LTE output power was monitored while changing the cell output power level.

The power reduction targets and threshold level described in **Table 10-1** were confirmed. Please see results in **Table 10-2**.

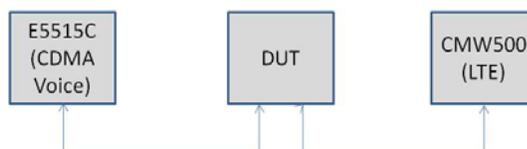


Figure 10-1
SVLTE Conducted Test Setup Diagram

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**Table 10-2
SVLTE Power Reduction Verification Results**

BC0 1x-RTT CDMA Voice Channel	BC0 1x-RTT CDMA Voice Tx(dBm)	LTE Band 13 Conducted Power (dBm)											
		QPSK 1 RB 0 RB Offset	QPSK 1 RB 25 RB Offset	QPSK 1 RB 49 RB Offset	QPSK 25 RB 0 RB Offset	QPSK 25 RB 12 RB Offset	QPSK 50 RB 0 RB Offset	16QAM 1 RB 0 RB Offset	16QAM 1 RB 25 RB Offset	16QAM 1 RB 49 RB Offset	16QAM 25 RB 0 RB Offset	16QAM 25 RB 12 RB Offset	16QAM 50 RB 0 RB Offset
1013 (Low)	24.7	19.50	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	20	19.50	19.60	19.60	19.30	19.30	19.33	19.22	19.50	19.50	19.30	19.30	19.30
	19.5	19.50	19.60	19.60	19.30	19.30	19.33	19.22	19.50	19.50	19.30	19.30	19.30
	18	23.50	23.60	23.60	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
	17	23.50	23.60	23.60	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
	11	23.50	23.60	23.60	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
384 (Mid)	24.7	19.50	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	20	19.50	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	19.5	19.50	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	18	23.50	23.60	23.60	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
	17	23.50	23.60	23.60	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
	11	23.50	23.60	23.60	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
777 (High)	24.7	19.63	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	20	19.60	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	19.5	19.50	19.60	19.60	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	18	23.50	23.60	23.61	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
	17	23.50	23.60	23.61	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
	11	23.50	23.60	23.61	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
25 (Low)	24.7	19.60	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	20	19.60	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	19.5	19.60	19.60	19.60	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	18	23.60	23.60	23.65	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
	17	23.60	23.60	23.65	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
	11	23.60	23.60	23.68	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
600 (Mid)	24.7	19.60	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	20	19.57	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	19.5	19.60	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	18	23.60	23.60	23.66	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
	17	23.60	23.60	23.66	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
	11	23.60	23.60	23.70	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
1175 (High)	24.7	19.60	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	20	19.60	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	19.5	19.60	19.60	19.70	19.30	19.30	19.30	19.22	19.50	19.50	19.30	19.30	19.30
	18	23.65	23.60	23.65	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
	17	23.65	23.60	23.65	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70
	11	23.66	23.60	23.68	22.50	22.50	22.60	22.50	22.50	22.50	21.60	21.70	21.70

10.3 SVLTE SAR Testing Procedures

Per KDB 941225 D05v02 Section 4.4 B), SAR testing was additionally performed at the reduced CDMA and LTE power levels with respect to the simultaneous transmission scenarios. Additional samples were tuned to fixed reduced power levels to represent the SVLTE condition in a standalone environment. While the power reduction mechanism is activated at the CDMA Voice power level of 18.7 dBm, simultaneous SAR summations of maximum power LTE were evaluated at this reduced fixed CDMA voice power level. SAR was additionally evaluated at reduced power LTE levels to perform simultaneous SAR analysis when CDMA voice is at maximum power.

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10.3.1 Reduced LTE Band 13 Conducted Powers

Table 10-3
Reduced LTE Band 13 Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	782.0	23230	10	QPSK	1	0	19.70	0	0
	782.0	23230	10	QPSK	1	25	19.69	0	0
	782.0	23230	10	QPSK	1	49	19.67	0	0
	782.0	23230	10	QPSK	25	0	19.65	0	0-1
	782.0	23230	10	QPSK	25	12	19.49	0	0-1
	782.0	23230	10	QPSK	25	25	19.63	0	0-1
	782.0	23230	10	QPSK	50	0	19.49	0	0-1
	782.0	23230	10	16QAM	1	0	19.62	0	0-1
	782.0	23230	10	16QAM	1	25	19.54	0	0-1
	782.0	23230	10	16QAM	1	49	19.48	0	0-1
	782.0	23230	10	16QAM	25	0	19.69	0	0-2
	782.0	23230	10	16QAM	25	12	19.46	0	0-2
	782.0	23230	10	16QAM	25	25	19.49	0	0-2
	782.0	23230	10	16QAM	50	0	19.50	0	0-2

LTE Notes:

1. Please refer to Section 8.4.4 for LTE testing requirements per FCC KDB 941225 D05.
2. The bolded powers were tested for SAR.



Figure 10-2
Power Measurement Setup

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10.3.2 Fixed CDMA Conducted Powers

**Table 10-4
Fixed CDMA Conducted Powers**

Band	Channel	Rule Part	Frequency	SO55 [dBm]	SO55 [dBm]	TDSO SO32 [dBm]	TDSO SO32 [dBm]	1x EvDO Rev. 0 [dBm]	1x EvDO Rev. A [dBm]
	F-RC		MHz	RC1	RC3	FCH+SCH	FCH	(RTAP)	(RETAP)
Cellular	1013	22H	824.7	18.85	18.99	19.02	18.93	N/A	N/A
	384	22H	836.52	18.95	18.91	18.92	19.01	N/A	N/A
	777	22H	848.31	19.01	18.87	18.99	19.19	N/A	N/A
PCS	25	24E	1851.25	19.19	19.19	19.20	19.18	N/A	N/A
	600	24E	1880	19.10	19.12	19.12	19.08	N/A	N/A
	1175	24E	1908.75	19.15	19.17	19.13	19.11	N/A	N/A

Note: RC1 is only applicable for IS-95 compatibility.

Note: There is no power reduction applied to the CDMA Voice modes, however the device with output powers represented in the table above was tuned down (for SAR Test purposes only) to analyze simultaneous SAR scenarios in the SVLTE condition where LTE is operating at maximum output power in conjunction with a lower CDMA voice level (see Table 10-1).

Per KDB Publication 941225 D01v02:

1. Head SAR was tested with SO55 RC3. SO55 RC1 was not required since the average output power was not more than 0.25 dB than the SO55 RC3 powers.
2. Body-Worn SAR was tested with 1x RTT with TDSO / SO32 FCH Only. TDSO / SO32 FCH+SCH SAR tests were not required since the average output power was not more than 0.25 dB higher than the TDSO / SO32 FCH only powers.
3. CDMA 1x-RTT SAR was required to be evaluated for Hotspot exposure conditions to support simultaneous transmission capabilities.



**Figure 10-3
Power Measurement Setup**

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11 SYSTEM VERIFICATION

11.1 Tissue Verification

**Table 11-1
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
11/30/2012	740H	20.3	725	0.845	41.20	0.888	42.033	-4.84%	-1.98%
			740	0.866	40.80	0.889	41.953	-2.59%	-2.75%
			755	0.871	40.77	0.891	41.876	-2.24%	-2.64%
			770	0.904	40.31	0.892	41.806	1.35%	-3.58%
			785	0.916	39.86	0.894	41.735	2.46%	-4.49%
11/30/2012	835H	22.3	820	0.900	42.35	0.898	41.571	0.22%	1.87%
			835	0.917	42.17	0.900	41.500	1.89%	1.61%
			850	0.933	41.96	0.916	41.500	1.86%	1.11%
12/1/2012	1900H	22.5	1850	1.391	39.42	1.400	40.000	-0.64%	-1.45%
			1880	1.425	39.28	1.400	40.000	1.79%	-1.80%
			1910	1.456	39.15	1.400	40.000	4.00%	-2.13%
11/28/2012	2450H	21.4	2401	1.813	39.41	1.758	39.298	3.13%	0.29%
			2450	1.846	38.93	1.800	39.200	2.56%	-0.69%
			2499	1.912	38.77	1.852	39.135	3.24%	-0.93%
			5200	4.447	35.35	4.660	36.000	-4.57%	-1.81%
12/04/2012	5200H-5800H	24.8	5220	4.449	35.29	4.680	35.980	-4.94%	-1.92%
			5300	4.551	35.22	4.760	35.900	-4.39%	-1.89%
			5320	4.554	35.21	4.780	35.880	-4.73%	-1.87%
			5600	4.819	34.77	5.070	35.500	-4.95%	-2.06%
			5700	4.926	34.64	5.170	35.400	-4.72%	-2.15%
			5800	5.019	34.49	5.270	35.300	-4.76%	-2.29%
			5825	5.037	34.48	5.296	35.275	-4.89%	-2.25%
			725	0.919	54.38	0.961	55.629	-4.37%	-2.25%
11/29/2012	740B	20.3	740	0.924	54.10	0.963	55.570	-4.05%	-2.65%
			755	0.926	54.00	0.964	55.512	-3.94%	-2.72%
			770	0.954	54.17	0.965	55.453	-1.14%	-2.31%
			785	0.972	53.70	0.966	55.395	0.62%	-3.06%
11/29/2012	835B	22.9	820	0.947	53.55	0.969	55.258	-2.27%	-3.09%
			835	0.959	53.32	0.970	55.200	-1.13%	-3.41%
			850	0.973	53.25	0.988	55.154	-1.52%	-3.45%
11/26/2012	1900B	23.0	1850	1.513	52.62	1.520	53.300	-0.46%	-1.28%
			1880	1.525	52.46	1.520	53.300	0.33%	-1.58%
			1910	1.552	52.40	1.520	53.300	2.11%	-1.69%
11/29/2012	1900B	22.0	1850	1.513	51.74	1.520	53.300	-0.46%	-2.93%
			1880	1.548	51.47	1.520	53.300	1.84%	-3.43%
			1910	1.570	51.45	1.520	53.300	3.29%	-3.47%
11/26/2012	2450B	22.1	2401	1.958	51.53	1.903	52.765	2.89%	-2.34%
			2450	2.023	51.37	1.950	52.700	3.74%	-2.52%
			2499	2.090	51.19	2.019	52.638	3.52%	-2.75%
11/29/2012	5200B-5800B	23.0	5200	5.253	49.32	5.299	49.014	-0.87%	0.62%
			5220	5.283	49.30	5.323	48.987	-0.75%	0.64%
			5300	5.406	49.07	5.416	48.851	-0.18%	0.45%
			5320	5.436	49.03	5.439	48.607	-0.06%	0.87%
			5600	5.845	48.34	5.766	48.444	1.37%	-0.21%
			5700	6.013	48.09	5.880	48.275	2.26%	-0.38%
			5800	6.171	47.84	6.000	48.200	2.85%	-0.75%
			5825	6.215	47.75	6.029	48.132	3.09%	-0.79%

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.

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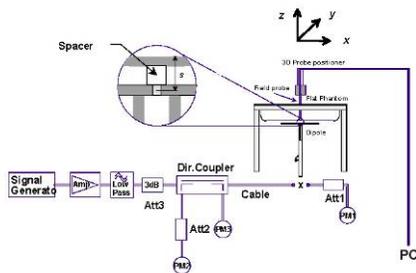
11.2 Test System Verification

Prior to SAR assessment, the system is verified to $\pm 10\%$ of the SAR measurement on the reference dipole at the time of calibration by the calibration facility.

**Table 11-2
System Verification Results**

System Verification TARGET & MEASURED											
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 (%)
750	HEAD	11/30/2012	24.2	21.4	0.100	1054	3263	0.842	8.520	8.420	-1.17%
835	HEAD	11/30/2012	23.0	21.3	0.100	4d119	3022	0.975	9.420	9.750	3.50%
1900	HEAD	12/01/2012	23.7	23.1	0.100	5d080	3022	3.770	39.400	37.700	-4.31%
2450	HEAD	11/28/2012	24.3	23.1	0.100	882	3263	5.470	53.500	54.700	2.24%
5200	HEAD	12/04/2012	23.2	23.1	0.0501	1007	3589	4.030	79.800	80.439	0.80%
5300	HEAD	12/04/2012	23.7	23.4	0.1000	1007	3589	8.220	83.100	82.200	-1.08%
5600	HEAD	12/04/2012	23.2	22.1	0.0473	1007	3589	4.050	84.500	85.623	1.24%
5800	HEAD	12/04/2012	23.6	23.5	0.1000	1007	3589	8.050	79.800	80.500	0.88%
750	BODY	11/29/2012	22.7	22.2	0.100	1054	3263	0.856	8.840	8.560	-3.17%
835	BODY	11/29/2012	24.5	23.5	0.100	4d026	3209	0.992	9.580	9.920	3.55%
1900	BODY	11/26/2012	21.5	21.3	0.100	5d149	3288	4.080	39.300	40.800	3.82%
1900	BODY	11/29/2012	22.8	21.5	0.100	5d149	3288	4.160	39.300	41.600	5.85%
2450	BODY	11/26/2012	23.2	21.3	0.020	797	3022	1.020	50.800	51.000	0.39%
5200	BODY	11/29/2012	21.9	22.3	0.100	1120	3561	7.040	72.200	70.400	-2.49%
5300	BODY	11/29/2012	24.1	22.6	0.100	1007	3561	7.420	75.600	74.200	-1.85%
5600	BODY	11/29/2012	24.2	22.9	0.100	1007	3561	7.770	80.000	77.700	-2.88%
5800	BODY	11/29/2012	23.6	22.5	0.100	1120	3561	7.550	73.800	75.500	2.30%

Note: Full system validation status and results can be found in Appendix E.



**Figure 11-1
System Verification Setup Diagram**



**Figure 11-2
System Verification Setup Photo**

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12 SAR DATA SUMMARY

12.1 Standalone Head SAR Data

**Table 12-1
Cell. CDMA Head SAR**

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift [dB]	Side	Test Position	Cover Type	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.52	384	Cell. CDMA	RC3 / SO55	24.7	24.69	0.13	Right	Cheek	Standard	3	1:1	0.145	1.002	0.145	
836.52	384	Cell. CDMA	RC3 / SO55	24.7	24.69	-0.06	Right	Tilt	Standard	3	1:1	0.091	1.002	0.091	
836.52	384	Cell. CDMA	RC3 / SO55	24.7	24.69	0.06	Left	Cheek	Standard	3	1:1	0.209	1.002	0.209	
836.52	384	Cell. CDMA	RC3 / SO55	24.7	24.69	0.04	Left	Cheek	Wireless Charging	3	1:1	0.202	1.002	0.202	
836.52	384	Cell. CDMA	RC3 / SO55	24.7	24.69	0.01	Left	Tilt	Standard	3	1:1	0.113	1.002	0.113	
836.52	384	Cell. CDMA	RC3 / SO55	19.2	18.91	-0.08	Right	Cheek	Standard	6	1:1	0.064	1.069	0.069	
836.52	384	Cell. CDMA	RC3 / SO55	19.2	18.91	0.02	Right	Tilt	Standard	6	1:1	0.041	1.069	0.044	
836.52	384	Cell. CDMA	RC3 / SO55	19.2	18.91	0.10	Left	Cheek	Standard	6	1:1	0.093	1.069	0.099	
836.52	384	Cell. CDMA	RC3 / SO55	19.2	18.91	-0.07	Left	Cheek	Wireless Charging	6	1:1	0.088	1.069	0.094	
836.52	384	Cell. CDMA	RC3 / SO55	19.2	18.91	0.03	Left	Tilt	Standard	6	1:1	0.047	1.069	0.051	
836.52	384	Cell. CDMA	EVDO Rev. A	24.7	24.38	-0.03	Right	Cheek	Standard	3	1:1	0.183	1.076	0.197	
836.52	384	Cell. CDMA	EVDO Rev. A	24.7	24.38	0.00	Right	Tilt	Standard	3	1:1	0.115	1.076	0.124	
836.52	384	Cell. CDMA	EVDO Rev. A	24.7	24.38	-0.01	Left	Cheek	Standard	3	1:1	0.222	1.076	0.239	
836.52	384	Cell. CDMA	EVDO Rev. A	24.7	24.38	-0.09	Left	Cheek	Wireless Charging	3	1:1	0.235	1.076	0.253	A2
836.52	384	Cell. CDMA	EVDO Rev. A	24.7	24.38	0.11	Left	Tilt	Standard	3	1:1	0.129	1.076	0.139	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram							

**Table 12-2
PCS CDMA Head SAR**

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift [dB]	Side	Test Position	Cover Type	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.51	0.02	Right	Cheek	Standard	3	1:1	0.225	1.045	0.235	
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.51	0.02	Right	Tilt	Standard	3	1:1	0.155	1.045	0.162	
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.51	-0.01	Left	Cheek	Standard	3	1:1	0.269	1.045	0.281	A3
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.51	0.09	Left	Cheek	Wireless Charging	3	1:1	0.252	1.045	0.263	
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.51	0.10	Left	Tilt	Standard	3	1:1	0.195	1.045	0.204	
1880.00	600	PCS CDMA	RC3 / SO55	19.2	19.12	0.03	Right	Cheek	Standard	6	1:1	0.044	1.019	0.045	
1880.00	600	PCS CDMA	RC3 / SO55	19.2	19.12	0.11	Right	Tilt	Standard	6	1:1	0.034	1.019	0.035	
1880.00	600	PCS CDMA	RC3 / SO55	19.2	19.12	-0.04	Left	Cheek	Standard	6	1:1	0.061	1.019	0.062	
1880.00	600	PCS CDMA	RC3 / SO55	19.2	19.12	-0.14	Left	Cheek	Wireless Charging	6	1:1	0.020	1.019	0.020	
1880.00	600	PCS CDMA	RC3 / SO55	19.2	19.12	0.00	Left	Tilt	Standard	6	1:1	0.032	1.019	0.033	
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.50	-0.10	Right	Cheek	Standard	3	1:1	0.178	1.047	0.186	
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.50	-0.07	Right	Tilt	Standard	3	1:1	0.135	1.047	0.141	
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.50	-0.02	Left	Cheek	Standard	3	1:1	0.254	1.047	0.266	
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.50	-0.11	Left	Cheek	Wireless Charging	3	1:1	0.242	1.047	0.253	
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.50	0.03	Left	Tilt	Standard	3	1:1	0.142	1.047	0.149	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram							

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**Table 12-3
LTE Band 13 Head SAR**

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Bandwidth [MHz]	Cover Type	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g) (W/kg)	Scaling Factor	Scaled SAR (1g) (W/kg)	Plot #	
MHz	Ch.																			
782.00	23230	Mid	LTE Band 13	10	Standard	23.7	23.65	0.05	0	Right	Cheek	QPSK	1	0	10	1:1	0.316	1.012	0.320	
782.00	23230	Mid	LTE Band 13	10	Wireless Charging	23.7	23.65	-0.08	0	Right	Cheek	QPSK	1	0	10	1:1	0.344	1.012	0.348	A1
782.00	23230	Mid	LTE Band 13	10	Standard	22.7	22.62	0.11	1	Right	Cheek	QPSK	25	12	10	1:1	0.226	1.019	0.230	
782.00	23230	Mid	LTE Band 13	10	Standard	23.7	23.65	0.06	0	Right	Tilt	QPSK	1	0	10	1:1	0.211	1.012	0.214	
782.00	23230	Mid	LTE Band 13	10	Standard	22.7	22.62	0.08	1	Right	Tilt	QPSK	25	12	10	1:1	0.139	1.019	0.142	
782.00	23230	Mid	LTE Band 13	10	Standard	23.7	23.65	0.16	0	Left	Cheek	QPSK	1	0	10	1:1	0.244	1.012	0.247	
782.00	23230	Mid	LTE Band 13	10	Standard	22.7	22.62	0.04	1	Left	Cheek	QPSK	25	12	10	1:1	0.189	1.019	0.193	
782.00	23230	Mid	LTE Band 13	10	Standard	23.7	23.65	-0.02	0	Left	Tilt	QPSK	1	0	10	1:1	0.168	1.012	0.170	
782.00	23230	Mid	LTE Band 13	10	Standard	22.7	22.62	0.03	1	Left	Tilt	QPSK	25	12	10	1:1	0.131	1.019	0.133	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.70	-0.05	0	Right	Cheek	QPSK	1	0	4	1:1	0.182	1.000	0.182	
782.00	23230	Mid	LTE Band 13	10	Wireless Charging	19.7	19.70	0.05	0	Right	Cheek	QPSK	1	0	4	1:1	0.175	1.000	0.175	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.65	0.02	0	Right	Cheek	QPSK	25	0	4	1:1	0.168	1.012	0.170	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.70	-0.08	0	Right	Tilt	QPSK	1	0	4	1:1	0.113	1.000	0.113	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.65	-0.08	0	Right	Tilt	QPSK	25	0	4	1:1	0.097	1.012	0.098	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.70	-0.07	0	Left	Cheek	QPSK	1	0	4	1:1	0.145	1.000	0.145	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.65	0.00	0	Left	Cheek	QPSK	25	0	4	1:1	0.148	1.012	0.148	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.70	0.02	0	Left	Tilt	QPSK	1	0	4	1:1	0.106	1.000	0.106	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.65	-0.07	0	Left	Tilt	QPSK	25	0	4	1:1	0.111	1.012	0.112	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram										

**Table 12-4
DTS Head SAR**

MEASUREMENT RESULTS																	
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift [dB]	Side	Test Position	Cover Type	Device Serial Number	Data Rate (Mbps)	Duty Cycle	SAR (1g) (W/kg)	Scaling Factor	Scaled SAR (1g) (W/kg)	Plot #	
MHz	Ch.																
2412	1	IEEE 802.11b	DSSS	17.0	16.24	0.09	Right	Cheek	Standard	6	1	1:1	0.241	1.191	0.287		
2412	1	IEEE 802.11b	DSSS	17.0	16.24	0.13	Right	Tilt	Standard	6	1	1:1	0.219	1.191	0.261		
2412	1	IEEE 802.11b	DSSS	17.0	16.24	0.05	Left	Cheek	Standard	6	1	1:1	0.458	1.191	0.545	A4	
2412	1	IEEE 802.11b	DSSS	17.0	16.24	0.03	Left	Cheek	Wireless Charging	6	1	1:1	0.385	1.191	0.459		
2412	1	IEEE 802.11b	DSSS	17.0	16.24	0.08	Left	Tilt	Standard	6	1	1:1	0.318	1.191	0.379		
5825	165	IEEE 802.11a	OFDM	14.0	13.19	0.12	Right	Cheek	Standard	3	6	1:1	0.015	1.205	0.018		
5825	165	IEEE 802.11a	OFDM	14.0	13.19	0.12	Right	Tilt	Standard	3	6	1:1	0.016	1.205	0.019		
5825	165	IEEE 802.11a	OFDM	14.0	13.19	0.20	Left	Cheek	Standard	3	6	1:1	0.000	1.205	0.000		
5825	165	IEEE 802.11a	OFDM	14.0	13.19	0.18	Left	Tilt	Standard	3	6	1:1	0.028	1.205	0.033	A6	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram							

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**Table 12-5
NII Head SAR**

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift [dB]	Side	Test Position	Cover Type	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	14.0	12.99	0.08	Right	Cheek	Standard	3	6	1:1	0.066	1.262	0.083	
5220	44	IEEE 802.11a	OFDM	14.0	12.99	0.14	Right	Tilt	Standard	3	6	1:1	0.063	1.262	0.079	
5220	44	IEEE 802.11a	OFDM	14.0	12.99	0.13	Left	Cheek	Standard	3	6	1:1	0.142	1.262	0.179	A5
5220	44	IEEE 802.11a	OFDM	14.0	12.99	-0.12	Left	Cheek	Wireless Charging	3	6	1:1	0.120	1.262	0.151	
5220	44	IEEE 802.11a	OFDM	14.0	12.99	0.14	Left	Tilt	Standard	3	6	1:1	0.103	1.262	0.130	
5320	64	IEEE 802.11a	OFDM	14.0	13.19	0.08	Right	Cheek	Standard	3	6	1:1	0.062	1.205	0.075	
5320	64	IEEE 802.11a	OFDM	14.0	13.19	0.13	Right	Tilt	Standard	3	6	1:1	0.060	1.205	0.072	
5320	64	IEEE 802.11a	OFDM	14.0	13.19	0.10	Left	Cheek	Standard	3	6	1:1	0.122	1.205	0.147	
5320	64	IEEE 802.11a	OFDM	14.0	13.19	0.17	Left	Tilt	Standard	3	6	1:1	0.099	1.205	0.119	
5700	140	IEEE 802.11a	OFDM	14.0	13.26	0.16	Right	Cheek	Standard	3	6	1:1	0.021	1.186	0.025	
5700	140	IEEE 802.11a	OFDM	14.0	13.26	0.13	Right	Tilt	Standard	3	6	1:1	0.024	1.186	0.029	
5700	140	IEEE 802.11a	OFDM	14.0	13.26	0.17	Left	Cheek	Standard	3	6	1:1	0.038	1.186	0.045	
5700	140	IEEE 802.11a	OFDM	14.0	13.26	0.16	Left	Tilt	Standard	3	6	1:1	0.034	1.186	0.041	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram								

12.2 Standalone Body-Worn SAR Data

**Table 12-6
CDMA Body-Worn SAR Data**

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift [dB]	Spacing	Cover Type	Device Serial Number	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.52	384	Cell. CDMA	TDSO / SO32	24.7	24.41	0.07	10 mm	Standard	3	1:1	back	0.338	1.069	0.361	A8
836.52	384	Cell. CDMA	TDSO / SO32	24.7	24.41	0.00	10 mm	Wireless Charging	3	1:1	back	0.245	1.069	0.262	
836.52	384	Cell. CDMA	TDSO / SO32	19.2	19.01	0.01	10 mm	Standard	6	1:1	back	0.149	1.045	0.156	
836.52	384	Cell. CDMA	TDSO / SO32	19.2	19.01	-0.01	10 mm	Wireless Charging	6	1:1	back	0.110	1.045	0.115	
1880.00	600	PCS CDMA	TDSO / SO32	24.7	24.57	-0.08	10 mm	Standard	3	1:1	back	0.672	1.030	0.692	A10
1880.00	600	PCS CDMA	TDSO / SO32	24.7	24.57	0.00	10 mm	Wireless Charging	3	1:1	back	0.425	1.030	0.438	
1880.00	600	PCS CDMA	TDSO / SO32	19.2	19.08	-0.03	10 mm	Standard	6	1:1	back	0.191	1.028	0.196	
1880.00	600	PCS CDMA	TDSO / SO32	19.2	19.08	-0.02	10 mm	Wireless Charging	6	1:1	back	0.140	1.028	0.144	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram							

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**Table 12-7
LTE Body-Worn SAR**

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Bandwidth [MHz]	Cover Type	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.															(W/kg)		(W/kg)		
782.00	23230	Mid	LTE Band 13	10	Standard	23.7	23.65	0.04	0	10	QPSK	1	0	10 mm	back	1:1	0.436	1.012	0.441	A7
782.00	23230	Mid	LTE Band 13	10	Wireless Charging	23.7	23.65	0.00	0	10	QPSK	1	0	10 mm	back	1:1	0.250	1.012	0.253	
782.00	23230	Mid	LTE Band 13	10	Standard	22.7	22.62	-0.02	1	10	QPSK	25	12	10 mm	back	1:1	0.323	1.019	0.329	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.70	0.13	0	4	QPSK	1	0	10 mm	back	1:1	0.227	1.000	0.227	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.65	0.03	0	4	QPSK	25	0	10 mm	back	1:1	0.230	1.012	0.233	
782.00	23230	Mid	LTE Band 13	10	Wireless Charging	19.7	19.65	-0.18	0	4	QPSK	25	0	10 mm	back	1:1	0.165	1.012	0.167	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Body 1.6 W/kg (mW/g) averaged over 1 gram										

**Table 12-8
DTS Body-Worn SAR**

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Cover Type	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	17.0	16.24	-0.09	10 mm	Standard	10	1	back	1:1	0.123	1.191	0.146	A12
2412	1	IEEE 802.11b	DSSS	17.0	16.24	-0.06	10 mm	Wireless Charging	10	1	back	1:1	0.112	1.191	0.133	
5825	165	IEEE 802.11a	OFDM	14.0	13.19	0.09	10 mm	Standard	10	6	back	1:1	0.040	1.205	0.048	A15
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Body 1.6 W/kg (mW/g) averaged over 1 gram						

**Table 12-9
NII Body-Worn SAR**

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Cover Type	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	14.0	12.99	-0.02	10 mm	Standard	10	6	back	1:1	0.143	1.262	0.180	
5320	64	IEEE 802.11a	OFDM	14.0	13.19	-0.15	10 mm	Standard	10	6	back	1:1	0.152	1.205	0.183	A14
5320	64	IEEE 802.11a	OFDM	14.0	13.19	0.16	10 mm	Wireless Charging	10	6	back	1:1	0.138	1.205	0.166	
5700	140	IEEE 802.11a	OFDM	14.0	13.26	0.05	10 mm	Standard	10	6	back	1:1	0.056	1.186	0.066	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Body 1.6 W/kg (mW/g) averaged over 1 gram						

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12.3 Standalone Wireless Router SAR Data

Table 12-10
CDMA Hotspot SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Cover Type	Device Serial Number	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.52	384	Cell. CDMA	TDSO / SO32	24.7	24.41	0.07	10 mm	Standard	3	1:1	back	0.338	1.069	0.361	
836.52	384	Cell. CDMA	TDSO / SO32	24.7	24.41	0.00	10 mm	Wireless Charging	3	1:1	back	0.245	1.069	0.262	
836.52	384	Cell. CDMA	TDSO / SO32	24.7	24.41	-0.19	10 mm	Standard	3	1:1	front	0.223	1.069	0.238	
836.52	384	Cell. CDMA	TDSO / SO32	24.7	24.41	0.10	10 mm	Standard	3	1:1	bottom	0.079	1.069	0.084	
836.52	384	Cell. CDMA	TDSO / SO32	24.7	24.41	0.20	10 mm	Standard	3	1:1	left	0.312	1.069	0.334	
836.52	384	Cell. CDMA	TDSO / SO32	19.2	19.01	0.01	10 mm	Standard	6	1:1	back	0.149	1.045	0.156	
836.52	384	Cell. CDMA	TDSO / SO32	19.2	19.01	-0.01	10 mm	Wireless Charging	6	1:1	back	0.110	1.045	0.115	
836.52	384	Cell. CDMA	TDSO / SO32	19.2	19.01	-0.08	10 mm	Standard	6	1:1	front	0.104	1.045	0.109	
836.52	384	Cell. CDMA	TDSO / SO32	19.2	19.01	-0.09	10 mm	Standard	6	1:1	bottom	0.035	1.045	0.036	
836.52	384	Cell. CDMA	TDSO / SO32	19.2	19.01	0.03	10 mm	Standard	6	1:1	left	0.123	1.045	0.129	
836.52	384	Cell. CDMA	EVDO Rev. 0	24.7	24.41	0.05	10 mm	Standard	3	1:1	back	0.397	1.069	0.424	A9
836.52	384	Cell. CDMA	EVDO Rev. 0	24.7	24.41	-0.03	10 mm	Wireless Charging	3	1:1	back	0.269	1.069	0.288	
836.52	384	Cell. CDMA	EVDO Rev. 0	24.7	24.41	-0.03	10 mm	Standard	3	1:1	front	0.266	1.069	0.284	
836.52	384	Cell. CDMA	EVDO Rev. 0	24.7	24.41	-0.04	10 mm	Standard	3	1:1	bottom	0.078	1.069	0.083	
836.52	384	Cell. CDMA	EVDO Rev. 0	24.7	24.41	0.10	10 mm	Standard	3	1:1	left	0.294	1.069	0.314	
1880.00	600	PCS CDMA	TDSO / SO32	24.7	24.57	-0.08	10 mm	Standard	3	1:1	back	0.672	1.030	0.692	
1880.00	600	PCS CDMA	TDSO / SO32	24.7	24.57	0.00	10 mm	Wireless Charging	3	1:1	back	0.425	1.030	0.438	
1880.00	600	PCS CDMA	TDSO / SO32	24.7	24.57	0.09	10 mm	Standard	3	1:1	front	0.327	1.030	0.337	
1880.00	600	PCS CDMA	TDSO / SO32	24.7	24.57	0.01	10 mm	Standard	3	1:1	bottom	0.176	1.030	0.181	
1880.00	600	PCS CDMA	TDSO / SO32	24.7	24.57	-0.05	10 mm	Standard	3	1:1	left	0.155	1.030	0.160	
1880.00	600	PCS CDMA	TDSO / SO32	19.2	19.08	-0.05	10 mm	Standard	6	1:1	back	0.191	1.028	0.196	
1880.00	600	PCS CDMA	TDSO / SO32	19.2	19.08	0.00	10 mm	Wireless Charging	6	1:1	back	0.140	1.028	0.144	
1880.00	600	PCS CDMA	TDSO / SO32	19.2	19.08	-0.01	10 mm	Standard	6	1:1	front	0.075	1.028	0.077	
1880.00	600	PCS CDMA	TDSO / SO32	19.2	19.08	-0.06	10 mm	Standard	6	1:1	bottom	0.041	1.028	0.042	
1880.00	600	PCS CDMA	TDSO / SO32	19.2	19.08	0.03	10 mm	Standard	6	1:1	left	0.037	1.028	0.038	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.55	0.01	10 mm	Standard	3	1:1	back	0.693	1.035	0.717	A11
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.55	0.02	10 mm	Wireless Charging	3	1:1	back	0.420	1.035	0.435	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.55	-0.06	10 mm	Standard	3	1:1	front	0.324	1.035	0.335	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.55	0.05	10 mm	Standard	3	1:1	bottom	0.277	1.035	0.287	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.55	0.16	10 mm	Standard	3	1:1	left	0.152	1.035	0.157	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

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**Table 12-11
LTE Band 13 Hotspot SAR**

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Cover Type	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR	Plot #
MHz	Ch.	High															(W/kg)		(W/kg)	
782.00	23230	Mid	LTE Band 13	10	Standard	23.7	23.65	0.04	0	10	QPSK	1	0	10 mm	back	1:1	0.436	1.012	0.441	A7
782.00	23230	Mid	LTE Band 13	10	Wireless Charging	23.7	23.65	0.00	0	10	QPSK	1	0	10 mm	back	1:1	0.250	1.012	0.253	
782.00	23230	Mid	LTE Band 13	10	Standard	22.7	22.62	-0.02	1	10	QPSK	25	12	10 mm	back	1:1	0.323	1.019	0.329	
782.00	23230	Mid	LTE Band 13	10	Standard	23.7	23.65	-0.08	0	10	QPSK	1	0	10 mm	front	1:1	0.336	1.012	0.340	
782.00	23230	Mid	LTE Band 13	10	Standard	23.7	22.62	0.14	1	10	QPSK	25	12	10 mm	front	1:1	0.242	1.282	0.247	
782.00	23230	Mid	LTE Band 13	10	Standard	22.7	23.65	0.00	0	10	QPSK	1	0	10 mm	bottom	1:1	0.120	0.804	0.121	
782.00	23230	Mid	LTE Band 13	10	Standard	23.7	22.62	0.10	1	10	QPSK	25	12	10 mm	bottom	1:1	0.094	1.282	0.096	
782.00	23230	Mid	LTE Band 13	10	Standard	22.7	23.65	-0.03	0	10	QPSK	1	0	10 mm	right	1:1	0.337	0.804	0.341	
782.00	23230	Mid	LTE Band 13	10	Standard	22.7	22.62	0.09	1	10	QPSK	25	12	10 mm	right	1:1	0.251	1.019	0.256	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.70	0.13	0	4	QPSK	1	0	10 mm	back	1:1	0.227	1.000	0.227	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.65	0.03	0	4	QPSK	25	0	10 mm	back	1:1	0.230	1.012	0.233	
782.00	23230	Mid	LTE Band 13	10	Wireless Charging	19.7	19.65	-0.18	0	4	QPSK	25	0	10 mm	back	1:1	0.165	1.012	0.167	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.70	0.00	0	4	QPSK	1	0	10 mm	front	1:1	0.174	1.000	0.174	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.65	0.04	0	4	QPSK	25	0	10 mm	front	1:1	0.171	1.012	0.173	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.70	0.05	0	4	QPSK	1	0	10 mm	bottom	1:1	0.063	1.000	0.063	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.65	0.06	0	4	QPSK	25	0	10 mm	bottom	1:1	0.065	1.012	0.066	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.70	0.05	0	4	QPSK	1	0	10 mm	right	1:1	0.130	1.000	0.130	
782.00	23230	Mid	LTE Band 13	10	Standard	19.7	19.65	-0.01	0	4	QPSK	25	0	10 mm	right	1:1	0.132	1.012	0.134	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Body 1.6 W/kg (mW/g) averaged over 1 gram										

**Table 12-12
WLAN Hotspot SAR**

MEASUREMENT RESULTS																	
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Cover Type	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR	Plot #	
MHz	Ch.												(W/kg)		(W/kg)		
2412	1	IEEE 802.11b	DSSS	17.0	16.24	-0.09	10 mm	Standard	10	1	back	1:1	0.123	1.191	0.146	A12	
2412	1	IEEE 802.11b	DSSS	17.0	16.24	-0.06	10 mm	Wireless Charging	10	1	back	1:1	0.112	1.191	0.133		
2412	1	IEEE 802.11b	DSSS	17.0	16.24	0.01	10 mm	Standard	10	1	front	1:1	0.082	1.191	0.098		
2412	1	IEEE 802.11b	DSSS	17.0	16.24	-0.09	10 mm	Standard	10	1	top	1:1	0.105	1.191	0.125		
2412	1	IEEE 802.11b	DSSS	17.0	16.24	0.10	10 mm	Standard	10	1	right	1:1	0.060	1.191	0.071		
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Body 1.6 W/kg (mW/g) averaged over 1 gram							

12.4 SAR Test Notes

General Notes:

- 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.
- Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all SAR measurements.
- Liquid tissue depth was at least 15.0 cm for all frequencies.
- 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
- SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.

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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 not required since the measured SAR results for each frequency band were less than 0.8 W/kg. Please see Section 14 for more information.
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 6.6 for more details).
10. This DUT may be used with a standard battery cover or with an optional wireless charging battery cover. Per FCC KDB Publication 648474 D04, SAR was measured using the standard battery cover and then repeated with the wireless charging battery cover for the highest reported SAR for each wireless technology, frequency band, operating mode, and exposure condition. Since reported SAR did not exceed 1.2 W/kg, additional testing with the wireless charging battery cover was not required.

CDMA Notes:

1. Head SAR for CDMA2000 mode was tested under RC3/SO55 per FCC KDB Publication 941225 D01v02.
2. Body-Worn SAR was tested with 1x RTT with TDSO / SO32 FCH Only. EVDO and TDSO / SO32 FCH+SCH SAR tests were not required since the average output power was not more than 0.25 dB higher than the TDSO / SO32 FCH only powers, per FCC KDB Publication 941225 D01v02.
3. CDMA Wireless Router SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0 according to KDB 941225 D01 procedures for data devices. If the average output power of Subtype 2 for Rev. A is less than the Rev. 0 power levels, then EVDO Rev. A SAR is not required. Otherwise, SAR is measured on the maximum output channel for Rev. A using the exposure configuration that results in the highest SAR for that RF channel in Rev. 0. 1x-RTT CDMA hotspot was additionally evaluated for SAR to support simultaneous transmission scenarios.
4. Per FCC KDB Publication 447498 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s).
5. CDMA 1x-RTT Hotspot SAR was additionally evaluated for Hotspot exposure to support simultaneous capabilities.
6. EVDO Rev. A was additionally tested for head SAR to show compliance for VoIP.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02. Implementation of the general test procedures can be found in Section 8.4.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator.

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WLAN Notes:

1. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and April 2010 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 April 2010 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. When Hotspot is enabled, all 5 GHz bands are disabled. Therefore no 5 GHz WIFI Wireless Router SAR Data was required.
4. WIFI transmission was verified using an uncalibrated spectrum analyzer.
5. Since 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 default channels was not required.

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13 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

13.1 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 and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

13.2 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 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.

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

**Table 13-1
Estimated SAR**

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2441	11.70	10	0.312

Note: Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission.

13.3 Head SAR Simultaneous Transmission Analysis

**Table 13-2
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Held to Ear)**

Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS CDMA SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.145	0.287	0.432	Head SAR	Right Cheek	0.235	0.287	0.522
	Right Tilt	0.091	0.261	0.352		Right Tilt	0.162	0.261	0.423
	Left Cheek	0.209	0.545	0.754		Left Cheek	0.281	0.545	0.826
	Left Tilt	0.113	0.379	0.492		Left Tilt	0.204	0.379	0.583
	Simult Tx	Configuration	LTE Band 13 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)				
Head SAR	Right Cheek		0.348	0.287	0.635				
	Right Tilt		0.214	0.261	0.475				
	Left Cheek		0.247	0.545	0.792				
	Left Tilt		0.170	0.379	0.549				

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Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.197	0.287	0.484	Head SAR	Right Cheek	0.186	0.287	0.473
	Right Tilt	0.124	0.261	0.385		Right Tilt	0.141	0.261	0.402
	Left Cheek	0.253	0.545	0.798		Left Cheek	0.266	0.545	0.811
	Left Tilt	0.139	0.379	0.518		Left Tilt	0.149	0.379	0.528

**Table 13-3
Simultaneous Transmission Scenario with 5 GHz WLAN (Held to Ear)**

Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS CDMA SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.145	0.083	0.228	Head SAR	Right Cheek	0.235	0.083	0.318
	Right Tilt	0.091	0.079	0.170		Right Tilt	0.162	0.079	0.241
	Left Cheek	0.209	0.179	0.388		Left Cheek	0.281	0.179	0.460
	Left Tilt	0.113	0.130	0.243		Left Tilt	0.204	0.130	0.334

Simult Tx	Configuration	LTE Band 13 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.348	0.083	0.431
	Right Tilt	0.214	0.079	0.293
	Left Cheek	0.247	0.179	0.426
	Left Tilt	0.170	0.130	0.300

Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.197	0.083	0.280	Head SAR	Right Cheek	0.186	0.083	0.269
	Right Tilt	0.124	0.079	0.203		Right Tilt	0.141	0.079	0.220
	Left Cheek	0.253	0.179	0.432		Left Cheek	0.266	0.179	0.445
	Left Tilt	0.139	0.130	0.269		Left Tilt	0.149	0.130	0.279

Note: The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Direct capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

13.4 Body-Worn Simultaneous Transmission Analysis

**Table 13-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 10 mm)**

Configuration	Mode	CDMA/LTE SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	Cell. CDMA	0.361	0.146	0.507
Back Side	PCS CDMA	0.692	0.146	0.838
Back Side	LTE Band 13	0.441	0.146	0.587

Note: Per KDB 941225, when the maximum output power of each channel in EVDO is less than 0.25 dB higher than measured in TDSO, body SAR for EVDO is not required. Therefore, 1x-RTT CDMA body-worn SAR summations additionally show compliance for EVDO Rev. A VoIP body-worn simultaneous transmission scenarios.

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Table 13-5
Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 10 mm)

Configuration	Mode	CDMA/LTE SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	Cell. CDMA	0.361	0.183	0.544
Back Side	PCS CDMA	0.692	0.183	1.075
Back Side	LTE Band 13	0.441	0.183	0.624

Note:

1. The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Direct capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.
2. Per KDB 941225, when the maximum output power of each channel in EVDO is less than 0.25 dB higher than measured in TDSO, body SAR for EVDO is not required. Therefore, 1x-RTT CDMA body-worn SAR summations additionally show compliance for EVDO Rev. A VoIP body-worn simultaneous transmission scenarios.

Table 13-6
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 10 mm)

Configuration	Mode	CDMA/LTE SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back Side	Cell. CDMA	0.361	0.312	0.673
Back Side	PCS CDMA	0.692	0.312	1.004
Back Side	LTE Band 13	0.441	0.312	0.753

Note:

1. 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.
2. Per KDB 941225, when the maximum output power of each channel in EVDO is less than 0.25 dB higher than measured in TDSO, body SAR for EVDO is not required. Therefore, 1x-RTT CDMA body-worn SAR summations additionally show compliance for EVDO Rev. A VoIP body-worn simultaneous transmission scenarios.

13.5 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 13-7
Simultaneous Transmission Scenario (Hotspot at 10 mm)

Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.424	0.146	0.570	Body SAR	Back	0.717	0.146	0.863
	Front	0.284	0.098	0.382		Front	0.335	0.098	0.433
	Top	-	0.125	0.125		Top	-	0.125	0.125
	Bottom	0.083	-	0.083		Bottom	0.287	-	0.287
	Right	-	0.071	0.071		Right	-	0.071	0.071
	Left	0.314	-	0.314		Left	0.157	-	0.157
	Simult Tx	Configuration	LTE Band 13 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)				
Body SAR	Back		0.441	0.146	0.587				
	Front		0.340	0.098	0.438				
	Top		-	0.125	0.125				
	Bottom		0.121	-	0.121				
	Right		0.341	0.071	0.412				
	Left		-	-	0.000				

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13.6 SVLTE Simultaneous Transmission Scenario Analysis

Table 13-8
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Held to Ear)

CDMA Power Level (dBm)	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 13 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
					1+2	1+2+3
P ≥ 18.7	Tx Antenna	1	2	3		
	Maximum Allowed Power (dBm)	24.7	19.7	17.0	1+2	1+2+3
	Right Cheek	0.145	0.182	0.287	0.327	0.614
	Right Tilt	0.091	0.113	0.261	0.204	0.465
	Left Cheek	0.209	0.148	0.545	0.357	0.902
	Left Tilt	0.113	0.112	0.379	0.225	0.604
P < 18.7	Maximum Allowed Power (dBm)	19.2	23.7	17.0		
	Right Cheek	0.069	0.348	0.287	0.417	0.704
	Right Tilt	0.044	0.214	0.261	0.258	0.519
	Left Cheek	0.099	0.247	0.545	0.346	0.891
	Left Tilt	0.051	0.170	0.379	0.221	0.600
CDMA Power Level (dBm)	Configuration	PCS CDMA SAR (W/kg)	LTE Band 13 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
					1+2	1+2+3
P ≥ 18.7	Tx Antenna	1	2	3		
	Maximum Allowed Power (dBm)	24.7	19.7	17.0	1+2	1+2+3
	Right Cheek	0.235	0.182	0.287	0.417	0.704
	Right Tilt	0.162	0.113	0.261	0.275	0.536
	Left Cheek	0.281	0.148	0.545	0.429	0.974
	Left Tilt	0.204	0.112	0.379	0.316	0.695
P < 18.7	Maximum Allowed Power (dBm)	19.2	23.7	17.0		
	Right Cheek	0.045	0.348	0.287	0.393	0.680
	Right Tilt	0.035	0.214	0.261	0.249	0.510
	Left Cheek	0.062	0.247	0.545	0.309	0.854
	Left Tilt	0.033	0.170	0.379	0.203	0.582

Table 13-9
Simultaneous Transmission Scenario with 5 GHz WLAN (Held to Ear)

CDMA Power Level (dBm)	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 13 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
					1+2	1+2+3
P ≥ 18.7	Tx Antenna	1	2	3		
	Maximum Allowed Power (dBm)	24.7	19.7	14.0	1+2	1+2+3
	Right Cheek	0.145	0.182	0.083	0.327	0.410
	Right Tilt	0.091	0.113	0.079	0.204	0.283
	Left Cheek	0.209	0.148	0.179	0.357	0.536
	Left Tilt	0.113	0.112	0.130	0.225	0.355
P < 18.7	Maximum Allowed Power (dBm)	19.2	23.7	14.0		
	Right Cheek	0.069	0.348	0.083	0.417	0.500
	Right Tilt	0.044	0.214	0.079	0.258	0.337
	Left Cheek	0.099	0.247	0.179	0.346	0.525
	Left Tilt	0.051	0.170	0.130	0.221	0.351

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CDMA Power Level (dBm)	Configuration	PCS CDMA SAR (W/kg)	LTE Band 13 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
					1+2	1+2+3
P ≥ 18.7	Tx Antenna	1	2	3		
	Maximum Allowed Power (dBm)	24.7	19.7	14.0		
	Right Cheek	0.235	0.182	0.083	0.417	0.500
	Right Tilt	0.162	0.113	0.079	0.275	0.354
	Left Cheek	0.281	0.148	0.179	0.429	0.608
	Left Tilt	0.204	0.112	0.130	0.316	0.446
P < 18.7	Maximum Allowed Power (dBm)	19.2	23.7	14.0		
	Right Cheek	0.045	0.348	0.083	0.393	0.476
	Right Tilt	0.035	0.214	0.079	0.249	0.328
	Left Cheek	0.062	0.247	0.179	0.309	0.488
	Left Tilt	0.033	0.170	0.130	0.203	0.333

Note: The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Direct capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

Table 13-10
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 10 mm)

CDMA Power Level (dBm)	Mode	Configuration	CDMA SAR (W/kg)	LTE Band 13 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
						1+2	1+2+3
P ≥ 18.7	Cell. CDMA	Tx Antenna	1	2	3		
		Maximum Allowed Power (dBm)	24.7	19.7	17.0		
		Back Side	0.361	0.233	0.146	0.594	0.740
	PCS CDMA	Back Side	0.692	0.233	0.146	0.925	1.071
		Maximum Allowed Power (dBm)	19.2	23.7	17.0		
		Back Side	0.156	0.441	0.146	0.597	0.743
P < 18.7	Cell. CDMA	Back Side	0.196	0.441	0.146	0.637	0.783
	PCS CDMA	Back Side	0.196	0.441	0.146	0.637	0.783

Table 13-11
Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 10 mm)

CDMA Power Level (dBm)	Mode	Configuration	CDMA SAR (W/kg)	LTE Band 13 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
						1+2	1+2+3
P ≥ 18.7	Cell. CDMA	Tx Antenna	1	2	3		
		Maximum Allowed Power (dBm)	24.7	19.7	14.0		
		Back Side	0.361	0.233	0.183	0.594	0.777
	PCS CDMA	Back Side	0.692	0.233	0.183	0.925	1.108
		Maximum Allowed Power (dBm)	19.2	23.7	14.0		
		Back Side	0.156	0.441	0.183	0.597	0.780
P < 18.7	Cell. CDMA	Back Side	0.196	0.441	0.183	0.637	0.820
	PCS CDMA	Back Side	0.196	0.441	0.183	0.637	0.820

Note: The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Direct capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

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Table 13-12
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth (Body-Worn at 10 mm)

CDMA Power Level (dBm)	Mode	Configuration	CDMA SAR (W/kg)	LTE Band 13 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	
			1	2	3	1+2	1+2+3
P ≥ 18.7	Cell. CDMA PCS CDMA	Tx Antenna	1	2	3	1+2	1+2+3
		Maximum Allowed Power (dBm)	24.7	19.7	11.7		
		Back Side	0.361	0.233	0.312	0.594	0.906
P < 18.7	Cell. CDMA PCS CDMA	Maximum Allowed Power (dBm)	19.2	23.7	11.7		
		Back Side	0.156	0.441	0.312	0.597	0.909
		Back Side	0.196	0.441	0.312	0.637	0.949

Table 13-13
Simultaneous Transmission Scenario (Hotspot at 10 mm)

Simult Tx	CDMA Power Level (dBm)	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 13 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
			1	2	3	1+2+3
Body SAR	P ≥ 18.7	Tx Antenna	1	2	3	1+2+3
		Maximum Allowed Power (dBm)	24.7	19.7	17.0	
		Back	0.361	0.233	0.146	0.740
		Front	0.238	0.174	0.098	0.510
		Top	-	-	0.125	0.125
		Bottom	0.084	0.066	-	0.150
		Right	-	0.134	0.071	0.205
	Left	0.334	-	-	0.334	
	Maximum Allowed Power (dBm)	19.2	23.7	17.0		
	P < 18.7	Back	0.156	0.441	0.146	0.743
		Front	0.109	0.340	0.098	0.547
		Top	-	-	0.125	0.125
		Bottom	0.036	0.121	-	0.157
		Right	-	0.341	0.071	0.412
Left		0.129	-	-	0.129	

Simult Tx	CDMA Power Level (dBm)	Configuration	PCS CDMA SAR (W/kg)	LTE Band 13 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
			1	2	3	1+2+3
Body SAR	P ≥ 18.7	Tx Antenna	1	2	3	1+2+3
		Maximum Allowed Power (dBm)	24.7	19.7	17.0	
		Back	0.692	0.233	0.146	1.071
		Front	0.337	0.174	0.098	0.609
		Top	-	-	0.125	0.125
		Bottom	0.181	0.066	-	0.247
		Right	-	0.134	0.071	0.205
	Left	0.160	-	-	0.160	
	Maximum Allowed Power (dBm)	19.2	23.7	17.0		
	P < 18.7	Back	0.196	0.441	0.146	0.783
		Front	0.077	0.340	0.098	0.515
		Top	-	-	0.125	0.125
		Bottom	0.042	0.121	-	0.163
		Right	-	0.341	0.071	0.412
Left		0.038	-	-	0.038	

13.7 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 D01_v05.

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14 SAR MEASUREMENT VARIABILITY

14.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01, SAR measurement variability must be assessed when measured SAR is > 0.80 W/kg. Since highest measured SAR for this device was < 0.8 W/kg, measurement variability was not assessed.

14.2 Measurement Uncertainty

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

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15 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	E5515C	Wireless Communications Test Set	9/24/2012	Annual	9/24/2013	GB43163447
Agilent	E5515C	Wireless Communications Test Set	2/12/2012	Annual	2/12/2013	GB45360986
Agilent	E5515C	Wireless Communications Tester	4/4/2012	Annual	4/4/2013	US41140256
Agilent	E5515C	Wireless Communications Test Set	2/14/2012	Annual	2/14/2013	GB43304447
Agilent	8753E	(30kHz-6GHz) Network Analyzer	4/3/2012	Annual	4/3/2013	US37390350
Agilent	E5515C	Wireless Communications Test Set	2/9/2012	Annual	2/9/2013	GB43460554
Agilent	85070E	Dielectric Probe Kit	3/8/2012	Annual	3/8/2013	NY44300833
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00379
Agilent	E5515C	Wireless Communications Test Set	10/18/2012	Biennial	10/18/2014	GB43193563
Agilent	8648D	Signal Generator	4/3/2012	Annual	4/3/2013	3629U00687
Agilent	E5515C	Wireless Communications Test Set	N/A	N/A	N/A	GB42361078
Agilent	8753E	(30kHz-6GHz) Network Analyzer	4/4/2012	Annual	4/4/2013	JP38020182
Agilent	8648D	(8kHz-4GHz) Signal Generator	10/10/2012	Annual	10/10/2013	3613A00315
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/5/2012	Annual	4/5/2013	MY45470194
Amplifier Research	5S1G4	5W, 800MHz-4.2GHz	CBT	N/A	CBT	21910
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	5821
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	5318
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	2400
Anritsu	MA2481A	Power Sensor	4/5/2012	Annual	4/5/2013	5605
Anritsu	MT8820C	Radio Communication Tester	11/6/2012	Annual	11/6/2013	6200901190
Anritsu	MA2411B	Power Sensor	3/5/2012	Annual	3/5/2013	846215
Anritsu	ML2438A	Power Meter	10/11/2012	Annual	10/11/2013	1070030
Anritsu	ML2438A	Power Meter	2/14/2012	Annual	2/14/2013	1190013
Anritsu	MA2411B	Pulse Sensor	9/19/2012	Annual	9/19/2013	1027293
Anritsu	ML2438A	Power Meter	2/14/2012	Annual	2/14/2013	98150041
Anritsu	MA24106A	USB Power Sensor	8/22/2012	Annual	8/22/2013	1231535
Anritsu	MA24106A	USB Power Sensor	8/22/2012	Annual	8/22/2013	1231538
Anritsu	ML2495A	Power Meter	10/11/2012	Annual	10/11/2013	1039008
COMTECH	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
Control Company	36934-158	Wall-Mounted Thermometer	1/4/2012	Biennial	1/4/2014	122014488
Control Company	61220-416	Long-Stem Thermometer	2/15/2011	Biennial	2/15/2013	111331323
Control Company	61220-416	Long-Stem Thermometer	7/1/2011	Biennial	7/1/2013	111642834
Control Company	36934-158	Wall-Mounted Thermometer	1/4/2012	Biennial	1/4/2014	122014497
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/10/2012	Annual	10/10/2013	1833460
Gigatronics	8651A	Universal Power Meter	10/10/2012	Annual	10/10/2013	8650319
Intelligent Weigh	PD-3000	Electronic Balance	3/27/2012	Annual	3/27/2013	11081534
Intelligent Weighing	PD-3000	Electronic Balance	6/29/2012	Annual	6/29/2013	120405017
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
MiniCircuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
MiniCircuits	BW-N20W6	Power Attenuator	CBT	N/A	CBT	1228
MiniCircuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	9/26/2012	Annual	9/26/2013	106084
Rohde & Schwarz	SME06	Signal Generator	10/11/2012	Annual	10/11/2013	832026
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	3/5/2012	Annual	3/5/2013	102060
Rohde & Schwarz	NRV-Z32	Peak Power Sensor	10/12/2012	Biennial	10/12/2014	836019/013
Rohde & Schwarz	SMI003B	Signal Generator	4/5/2012	Annual	4/5/2013	DE27259
Rohde & Schwarz	NRV0	Dual Channel Power Meter	10/12/2012	Biennial	10/12/2014	101695
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	10/7/2011	Biennial	10/7/2013	103962
Seekonk	NC-100	Torque Wrench (8" lb)	11/29/2011	Triennial	11/29/2014	21053
Seekonk	NC-100	Torque Wrench (8" lb)	3/5/2012	Triennial	3/5/2015	N/A
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/19/2012	Annual	9/19/2013	1323
SPEAG	D2450V2	2450 MHz SAR Dipole	2/7/2012	Annual	2/7/2013	882
SPEAG	D1900V2	1900 MHz SAR Dipole	2/22/2012	Annual	2/22/2013	5d149
SPEAG	D2450V2	2450 MHz SAR Dipole	1/24/2012	Annual	1/24/2013	797
SPEAG	ES3DV3	SAR Probe	9/20/2012	Annual	9/20/2013	3288
SPEAG	D750V3	750 MHz Dipole	2/9/2012	Annual	2/9/2013	1054
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/7/2012	Annual	5/7/2013	1334
SPEAG	D1900V2	1900 MHz SAR Dipole	7/20/2012	Annual	7/20/2013	5d080
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/24/2012	Annual	8/24/2013	1322
SPEAG	D5GHZV2	5 GHz SAR Dipole	2/1/2012	Annual	2/1/2013	1120
SPEAG	D5GHZV2	5 GHz SAR Dipole	10/30/2012	Annual	10/30/2013	1007
SPEAG	D835V2	835 MHz SAR Dipole	4/20/2012	Annual	4/20/2013	4d119
SPEAG	ES3DV3	SAR Probe	3/16/2012	Annual	3/16/2013	3209
SPEAG	ES3DV3	SAR Probe	5/18/2012	Annual	5/18/2013	3263
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/18/2012	Annual	1/18/2013	1272
SPEAG	EX3DV4	SAR Probe	1/27/2012	Annual	1/27/2013	3589
SPEAG	ES3DV2	SAR Probe	8/28/2012	Annual	8/28/2013	3022
SPEAG	EX3DV4	SAR Probe	7/26/2012	Annual	7/26/2013	3561
SPEAG	D835V2	835 MHz SAR Dipole	8/23/2012	Annual	8/23/2013	4d026
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/20/2012	Annual	2/20/2013	649
Tektronix	RSA-6114A	Real Time Spectrum Analyzer	4/5/2012	Annual	4/5/2013	B010177
YWR	23226-658	Long Stem Thermometer	3/30/2012	Biennial	3/30/2014	122179874
YWR	36934-158	Wall-Mounted Thermometer	1/21/2011	Biennial	1/21/2013	111286454
YWR	23226-658	Long Stem Thermometer	7/11/2012	Biennial	7/11/2014	122389334
YWR	36934-158	Wall-Mounted Thermometer	1/21/2011	Biennial	1/21/2013	111286460
YWR	36934-158	Wall-Mounted Thermometer	9/30/2011	Biennial	9/30/2013	111859332
YWR	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.

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16 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

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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

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17 CONCLUSION

17.1 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: ZNFVS870; Type: Portable Handset; Serial: 10

Communication System: LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1

Medium: 770 Head Medium parameters used (interpolated):

$f = 782 \text{ MHz}$; $\sigma = 0.914 \text{ mho/m}$; $\epsilon_r = 39.95$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 11-30-2012; Ambient Temp: 24.2°C; Tissue Temp: 21.4°C

Probe: ES3DV3 - SN3263; ConvF(6.4, 6.4, 6.4); Calibrated: 5/18/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 5/7/2012

Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647

Measurement SW: DASY52, Version 52.8 (3); SEMCAD X Version 14.6.7 (6848)

**Mode: LTE Band 13, Right Head, Cheek, Mid.ch, 10 MHz Bandwidth,
QPSK, 1 RB, 0 RB Offset, Wireless Charging Cover**

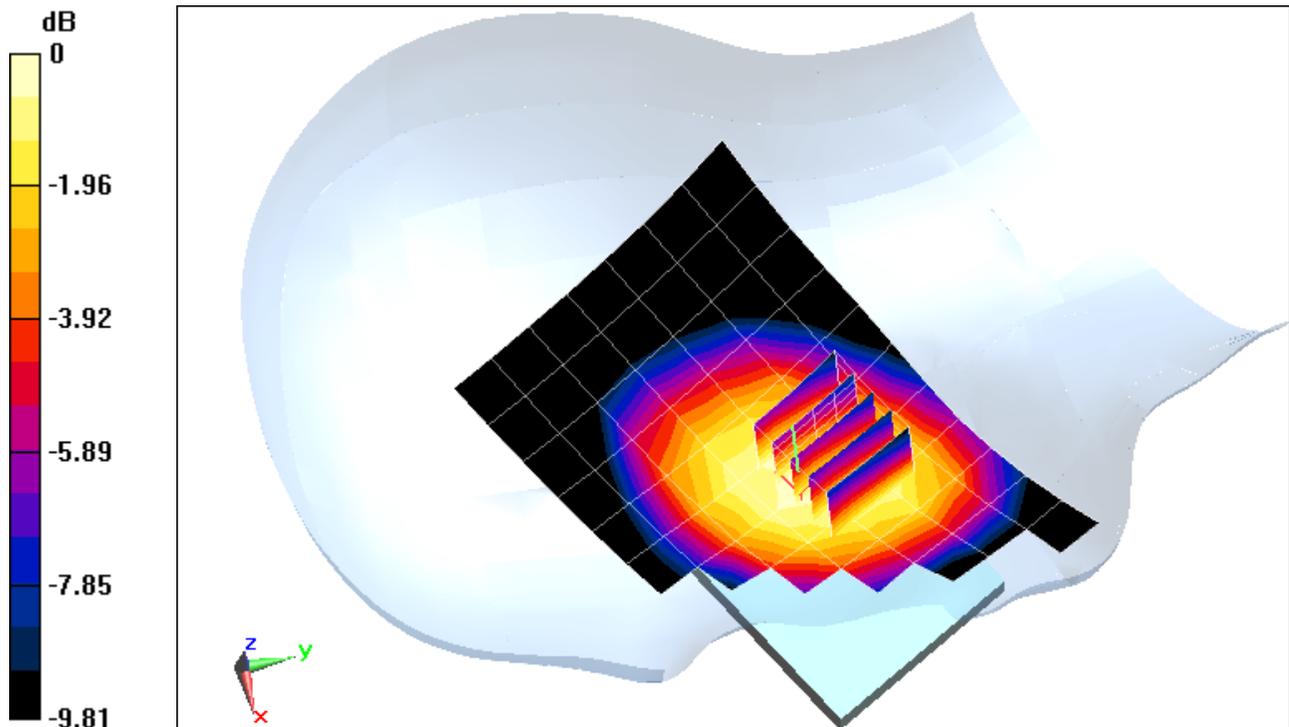
Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 21.020 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 0.427 W/kg

SAR(1 g) = 0.344 W/kg



0 dB = 0.360 W/kg = -4.44 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 3

Communication System: Cellular CDMA; Frequency: 836.52 MHz; Duty Cycle: 1:1

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.52 \text{ MHz}$; $\sigma = 0.919 \text{ mho/m}$; $\epsilon_r = 42.149$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 11-30-2012; Ambient Temp: 23.0°C; Tissue Temp: 21.3°C

Probe: ES3DV2 - SN3022; ConvF(6.03, 6.03, 6.03); Calibrated: 8/28/2012;

Sensor-Surface: 4mm (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 14.6.7 (6848)

**Mode: Cellular EVDO Rev. A, Left Head, Cheek,
Mid.ch, Wireless Charging Cover**

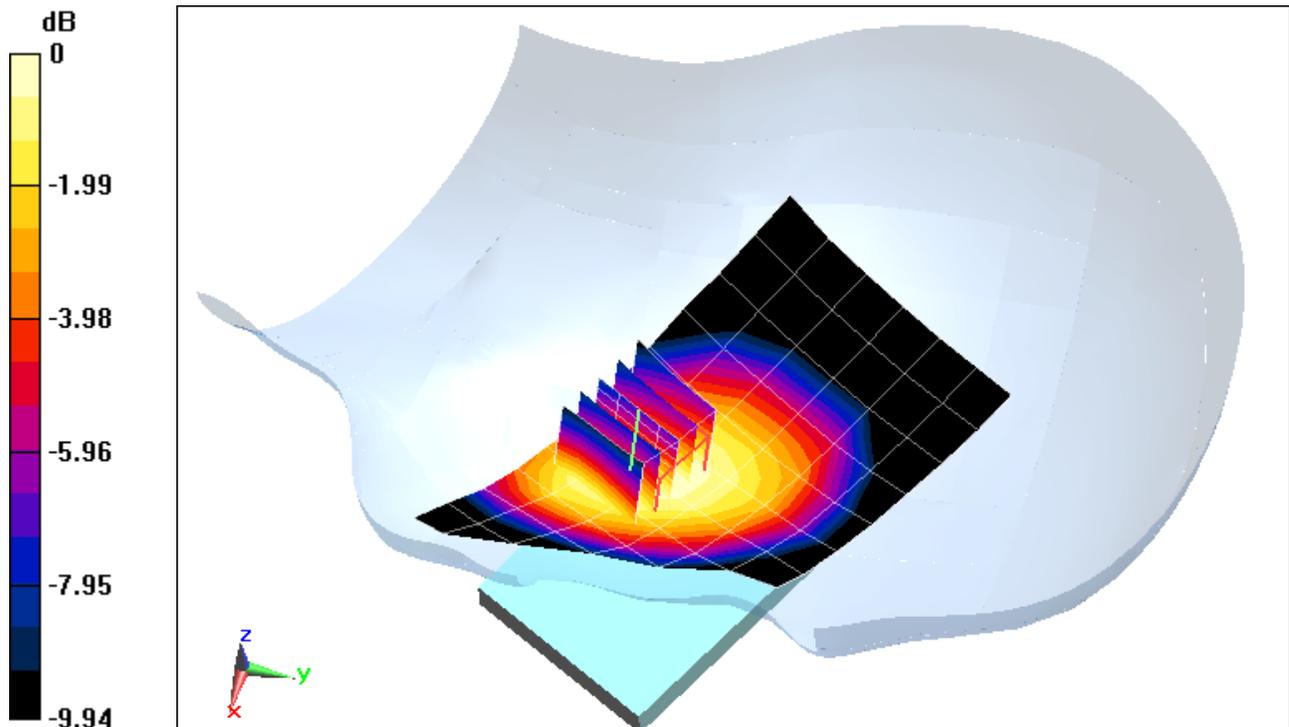
Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 17.376 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 0.308 W/kg

SAR(1 g) = 0.235 W/kg; SAR(10 g) = 0.171 W/kg



0 dB = 0.245 W/kg = -6.11 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 3

Communication System: PCS CDMA; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Head Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.425 \text{ mho/m}$; $\epsilon_r = 39.28$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 12-01-2012; Ambient Temp: 23.7°C; Tissue Temp: 23.1°C

Probe: ES3DV2 - SN3022; ConvF(4.86, 4.86, 4.86); Calibrated: 8/28/2012;

Sensor-Surface: 4mm (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 14.6.7 (6848)

Mode: PCS CDMA, Left Head, Cheek, Mid.ch, Standard Cover

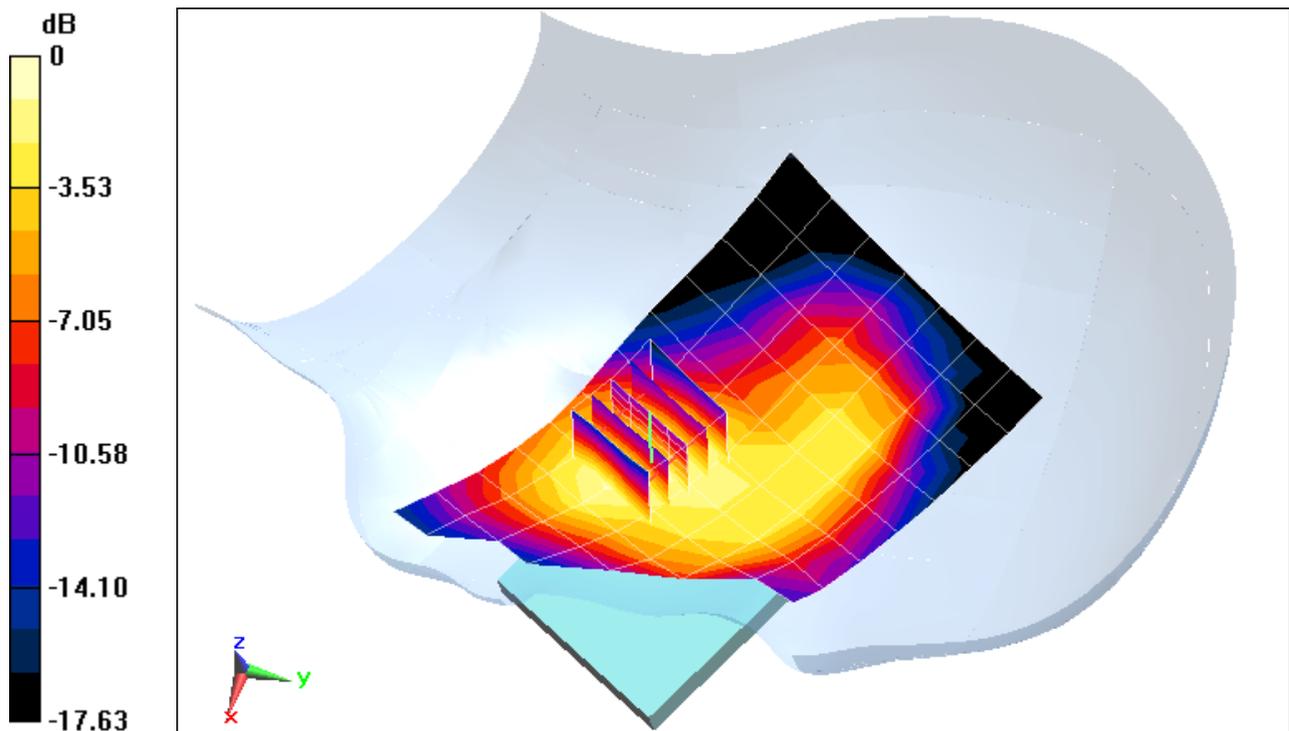
Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 15.242 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.425 W/kg

SAR(1 g) = 0.269 W/kg; SAR(10 g) = 0.163 W/kg



0 dB = 0.290 W/kg = -5.38 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 6

Communication System: IEEE 802.11b; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used (interpolated):

$f = 2412 \text{ MHz}$; $\sigma = 1.82 \text{ mho/m}$; $\epsilon_r = 39.302$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 11-28-2012; Ambient Temp: 24.3°C; Tissue Temp: 23.1°C

Probe: ES3DV3 - SN3263; ConvF(4.45, 4.45, 4.45); Calibrated: 5/18/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 5/7/2012

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (3); SEMCAD X Version 14.6.7 (6848)

Mode: IEEE 802.11b, Left Head, Cheek, Ch 01, 1 Mbps, Standard Cover

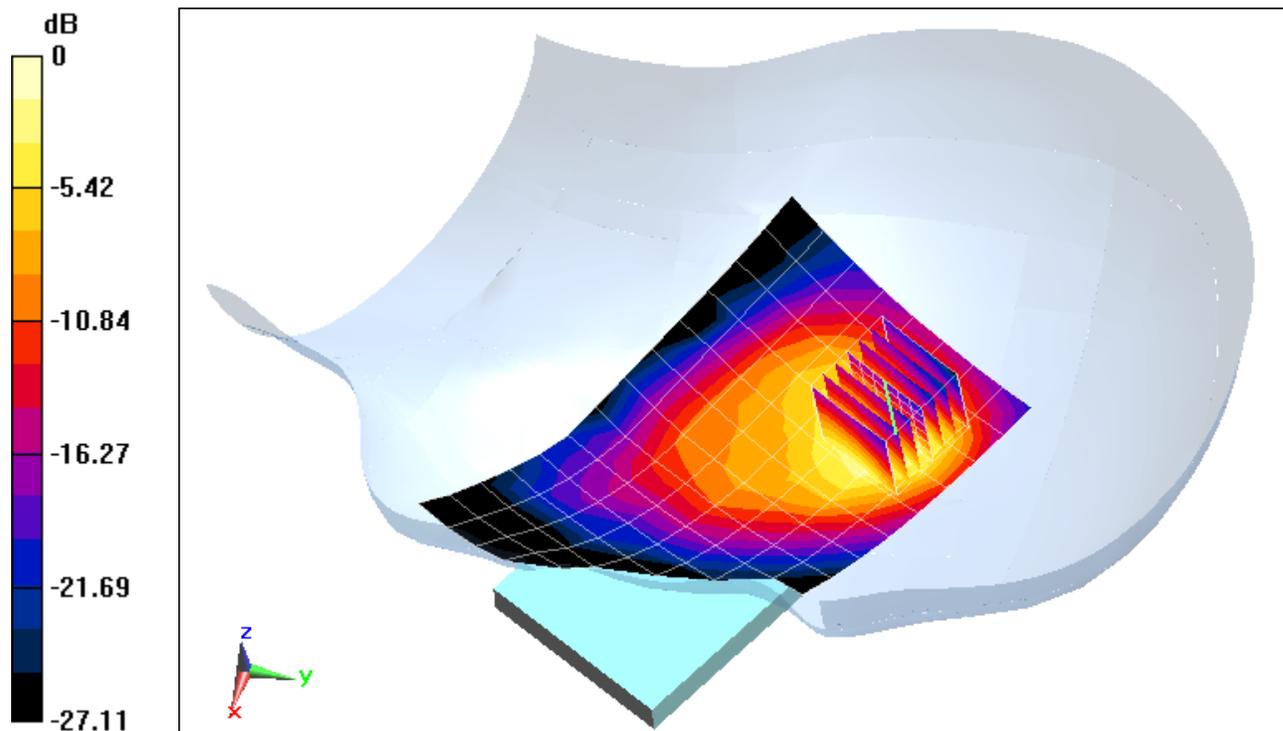
Area Scan (9x16x1): Measurement grid: dx=12mm, dy=12mm

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 16.314 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.943 W/kg

SAR(1 g) = 0.458 W/kg



0 dB = 0.589 W/kg = -2.30 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 3

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5220 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5220 \text{ MHz}$; $\sigma = 4.449 \text{ mho/m}$; $\epsilon_r = 35.29$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 12-04-2012; Ambient Temp: 23.2°C; Tissue Temp: 23.1°C

Probe: EX3DV4 - SN3589; ConvF(4.59, 4.59, 4.59); Calibrated: 1/27/2012;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/18/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.7 (6848)

**Mode: IEEE 802.11a, 5.2 GHz Left Head, Cheek,
Ch 44, 6 Mbps, Standard Cover**

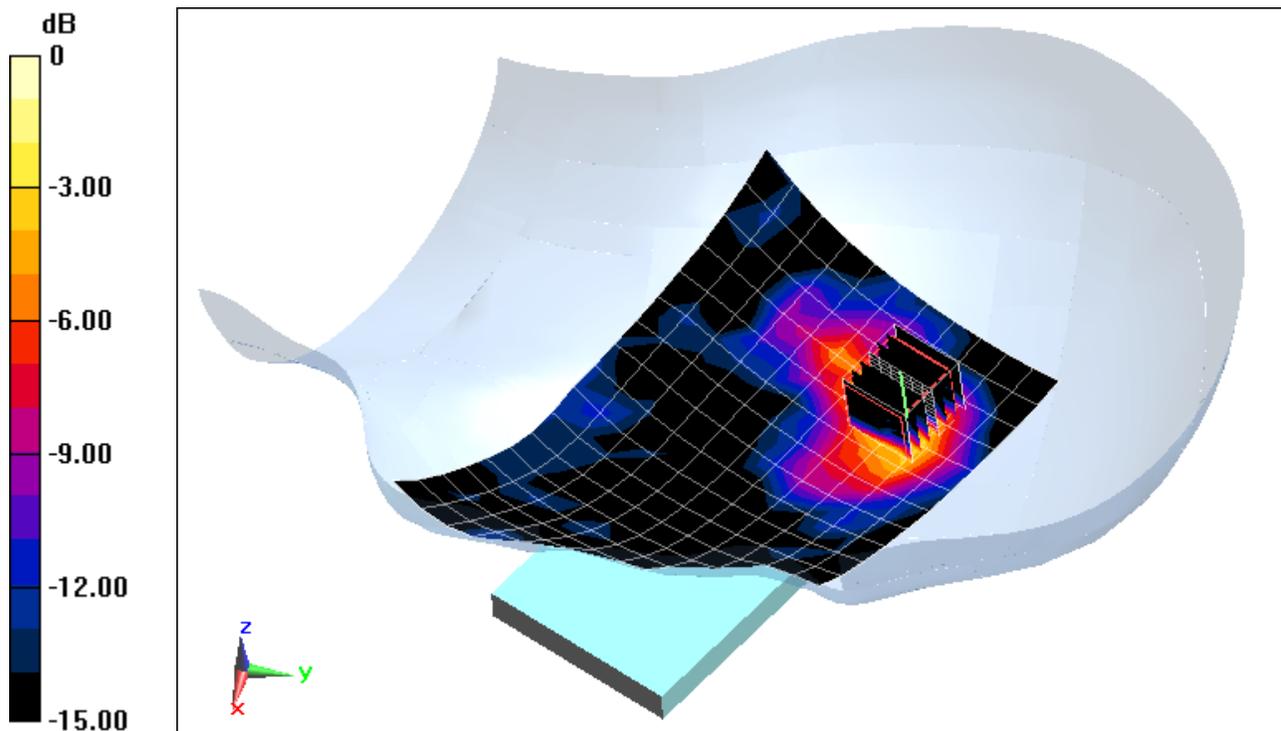
Area Scan (12x18x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 6.009 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 0.622 W/kg

SAR(1 g) = 0.142 W/kg; SAR(10 g) = 0.045 W/kg



0 dB = 0.285 W/kg = -5.45 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 3

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5825 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5825 \text{ MHz}$; $\sigma = 5.037 \text{ mho/m}$; $\epsilon_r = 34.48$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 12-04-2012; Ambient Temp: 23.6°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3589; ConvF(4.05, 4.05, 4.05); Calibrated: 1/27/2012;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/18/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.7 (6848)

**Mode: IEEE 802.11a, 5.8 GHz Left Head, Tilt,
Ch 165, 6 Mbps, Standard Cover**

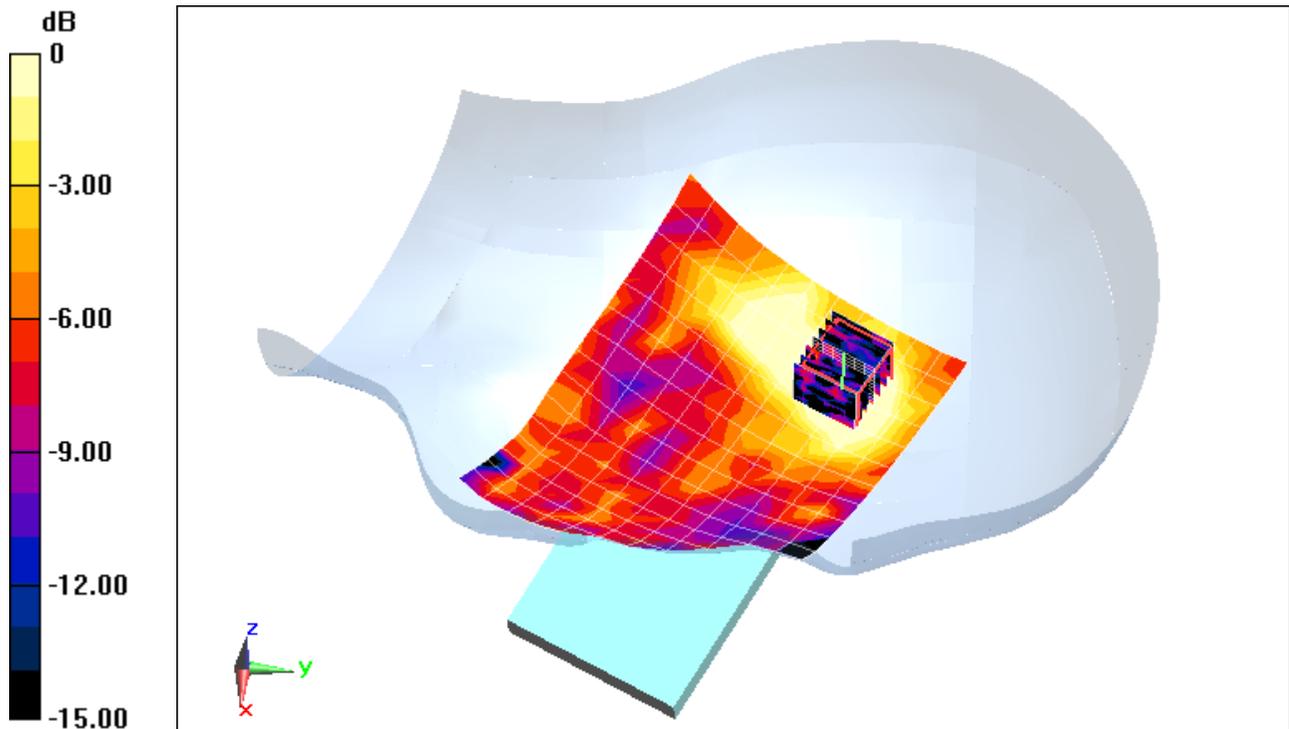
Area Scan (12x16x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.865 V/m; Power Drift = 0.18 dB

Peak SAR (extrapolated) = 0.422 W/kg

SAR(1 g) = 0.028 W/kg; SAR(10 g) = 0.00612 W/kg



0 dB = 0.0501 W/kg = -13.00 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 10

Communication System: LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1

Medium: 770 Body Medium parameters used (interpolated):
 $f = 782 \text{ MHz}$; $\sigma = 0.968 \text{ mho/m}$; $\epsilon_r = 53.794$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-29-2012; Ambient Temp: 22.7°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3263; ConvF(6.26, 6.26, 6.26); Calibrated: 5/18/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 5/7/2012

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (3); SEMCAD X Version 14.6.7 (6848)

**Mode: LTE Band 13, Body SAR, Back side, Mid.ch, 10 MHz Bandwidth,
QPSK, 1 RB, 0 RB Offset, Standard Cover**

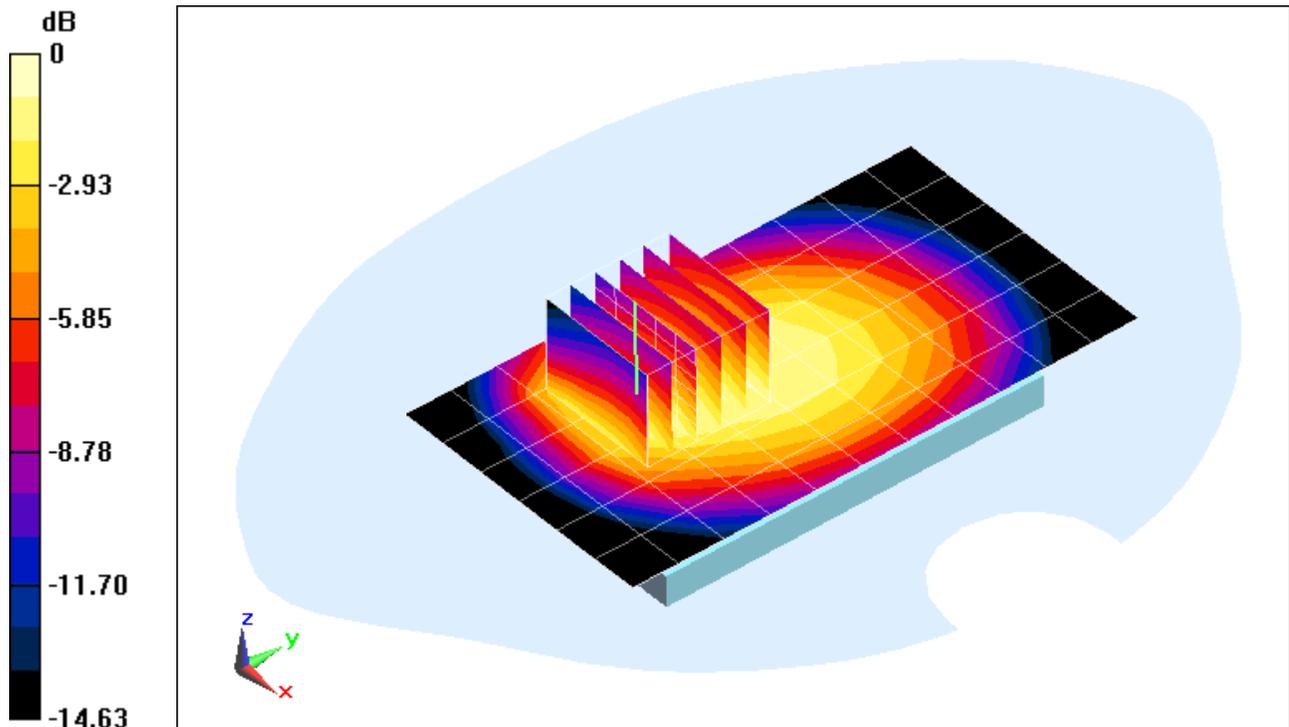
Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 21.825 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.673 W/kg

SAR(1 g) = 0.436 W/kg; SAR(10 g) = 0.301 W/kg



0 dB = 0.465 W/kg = -3.33 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 3

Communication System: Cellular CDMA; Frequency: 836.52 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.52 \text{ MHz}$; $\sigma = 0.96 \text{ mho/m}$; $\epsilon_r = 53.313$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-29-2012; Ambient Temp: 24.5°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3209; ConvF(6.13, 6.13, 6.13); Calibrated: 3/16/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/20/2012

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.7 (6848)

Mode: Cellular CDMA, Body SAR, Back side, Mid.ch, Standard Cover

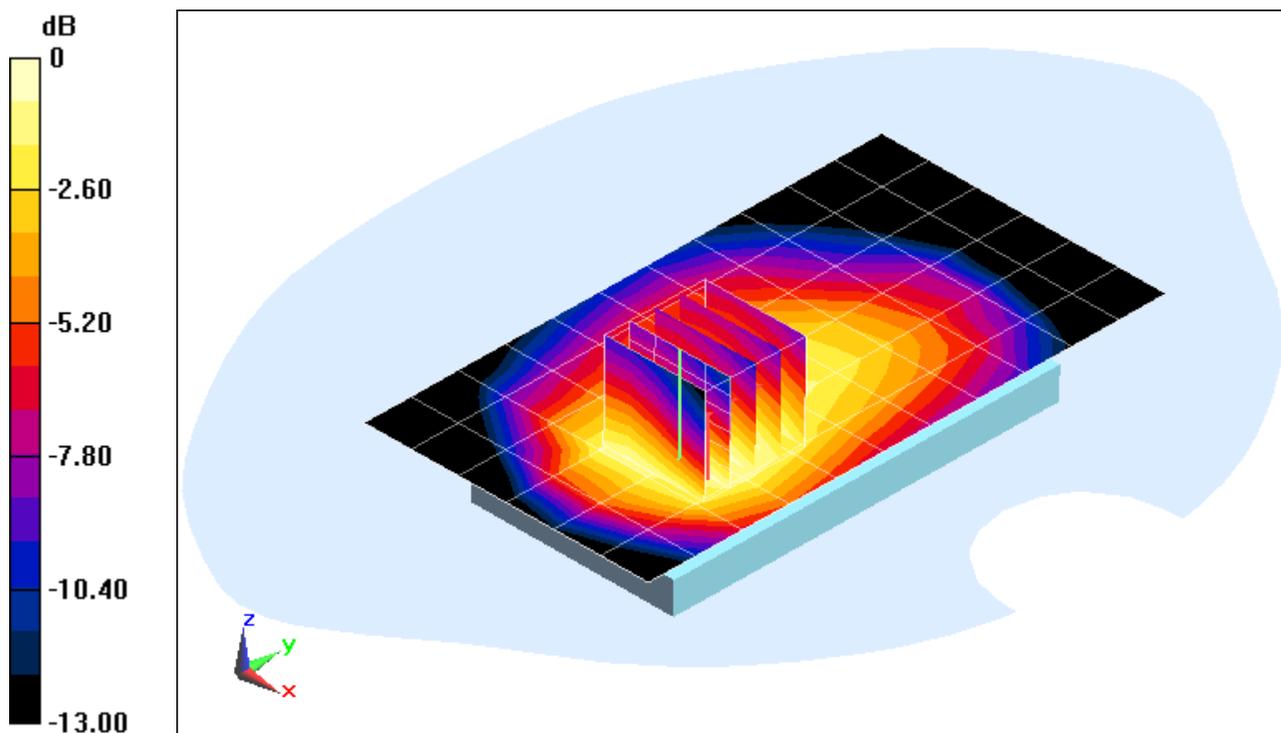
Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 20.640 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 0.492 W/kg

SAR(1 g) = 0.338 W/kg; SAR(10 g) = 0.237 W/kg



0 dB = 0.358 W/kg = -4.46 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 3

Communication System: Cellular CDMA; Frequency: 836.52 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.52 \text{ MHz}$; $\sigma = 0.96 \text{ mho/m}$; $\epsilon_r = 53.313$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-29-2012; Ambient Temp: 24.5°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3209; ConvF(6.13, 6.13, 6.13); Calibrated: 3/16/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/20/2012

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.7 (6848)

Mode: Cellular EVDO Rev. 0, Body SAR, Back side, Mid.ch, Standard Cover

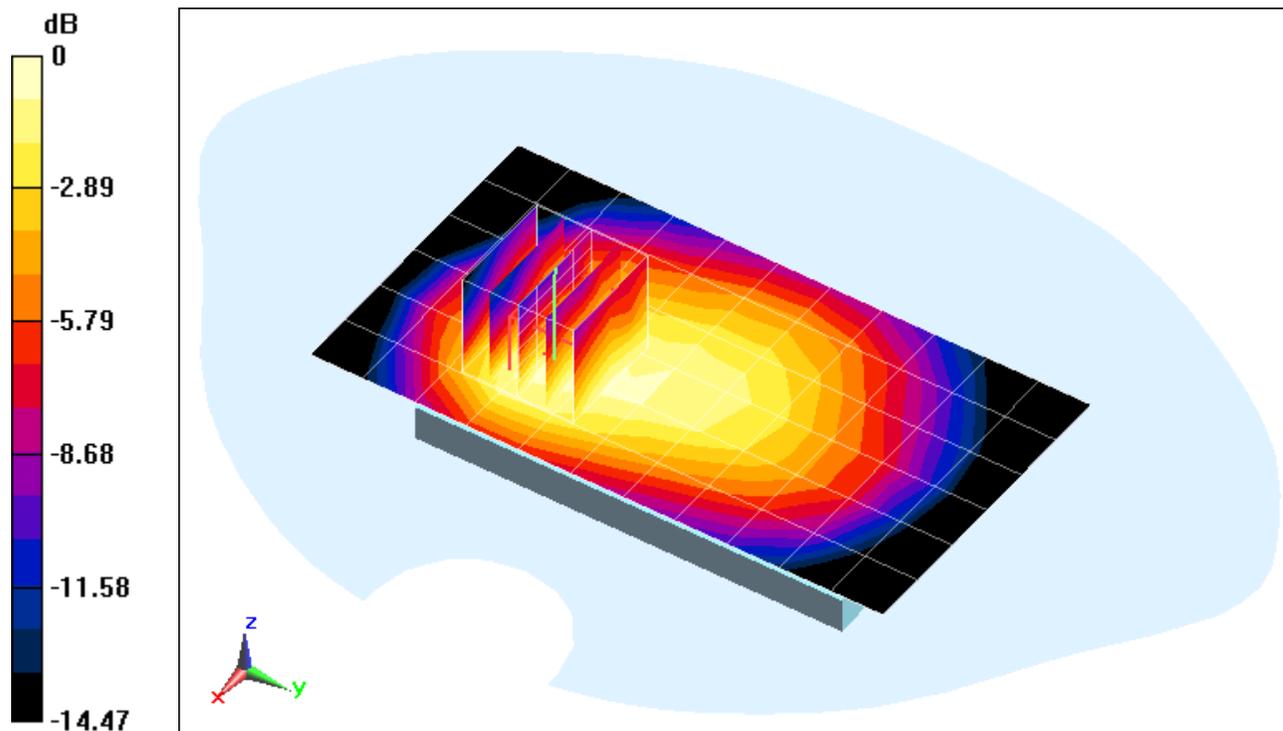
Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 22.773 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.642 W/kg

SAR(1 g) = 0.397 W/kg; SAR(10 g) = 0.271 W/kg



0 dB = 0.422 W/kg = -3.75 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 3

Communication System: CDMA; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.548 \text{ mho/m}$; $\epsilon_r = 51.47$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-29-2012; Ambient Temp: 22.8°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3288; ConvF(4.89, 4.89, 4.89); 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 (3); SEMCAD X Version 14.6.7 (6848)

Mode: PCS CDMA, Body SAR, Back side, Mid.ch, Standard Cover

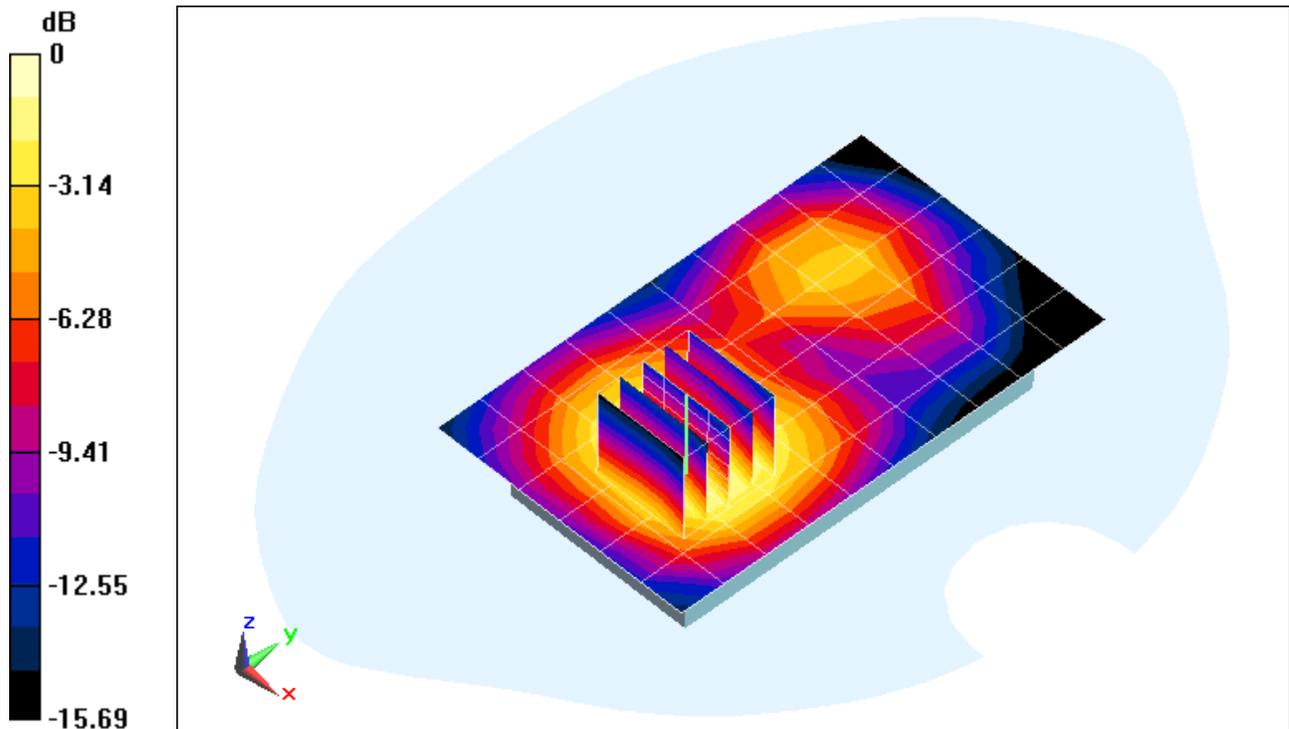
Area Scan (7x11x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 21.304 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 1.07 W/kg

SAR(1 g) = 0.672 W/kg; SAR(10 g) = 0.423 W/kg



0 dB = 0.716 W/kg = -1.45 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 3

Communication System: CDMA; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.525 \text{ mho/m}$; $\epsilon_r = 52.46$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-26-2012; Ambient Temp: 21.5°C; Tissue Temp: 21.3°C

Probe: ES3DV3 - SN3288; ConvF(4.89, 4.89, 4.89); 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 (3); SEMCAD X Version 14.6.7 (6848)

Mode: PCS EVDO Rev. 0, Body SAR, Back side, Mid.ch, Standard Cover

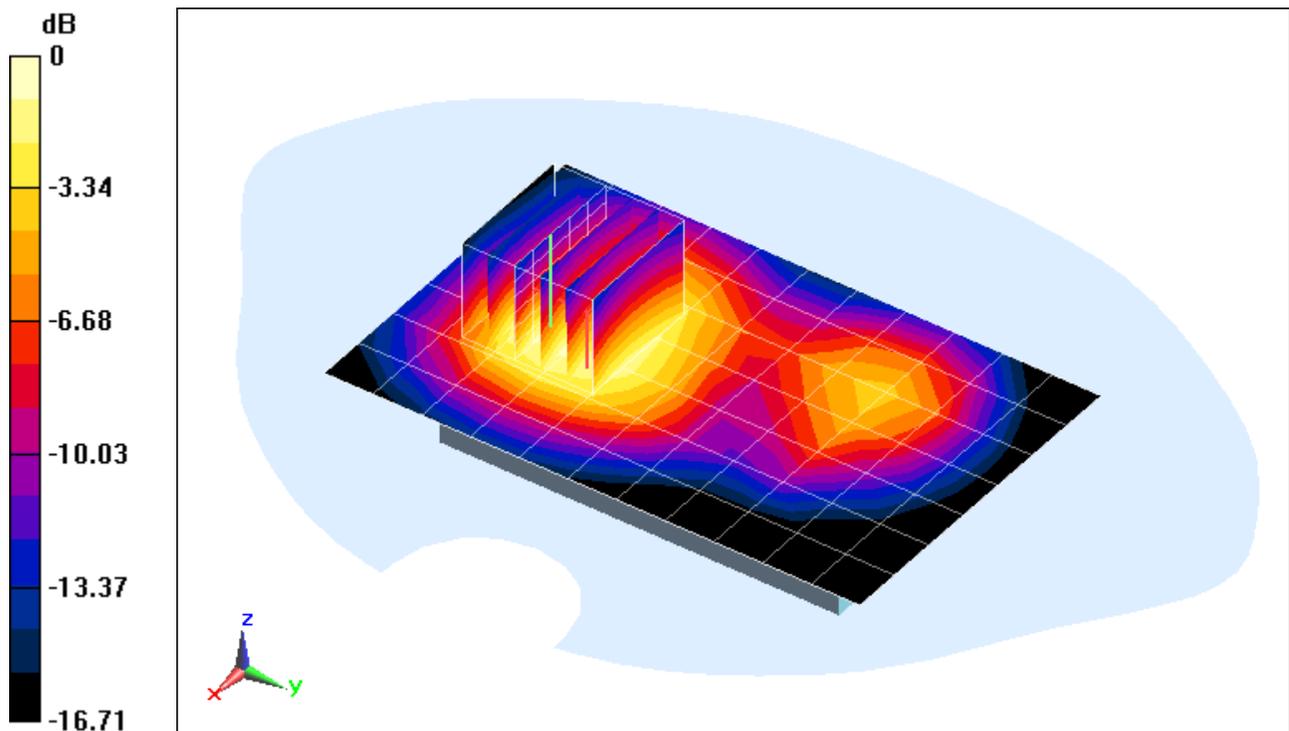
Area Scan (8x12x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 21.424 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.10 W/kg

SAR(1 g) = 0.693 W/kg; SAR(10 g) = 0.434 W/kg



0 dB = 0.763 W/kg = -1.17 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 10

Communication System: IEEE 802.11b; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2412 \text{ MHz}$; $\sigma = 1.973 \text{ mho/m}$; $\epsilon_r = 51.494$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-26-2012; Ambient Temp: 23.2°C; Tissue Temp: 21.3°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 Main; Type: SAM 4.0; Serial: TP-1406

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.7 (6848)

Mode: IEEE 802.11b, Body SAR, Ch 01, 1 Mbps, Back Side, Standard Cover

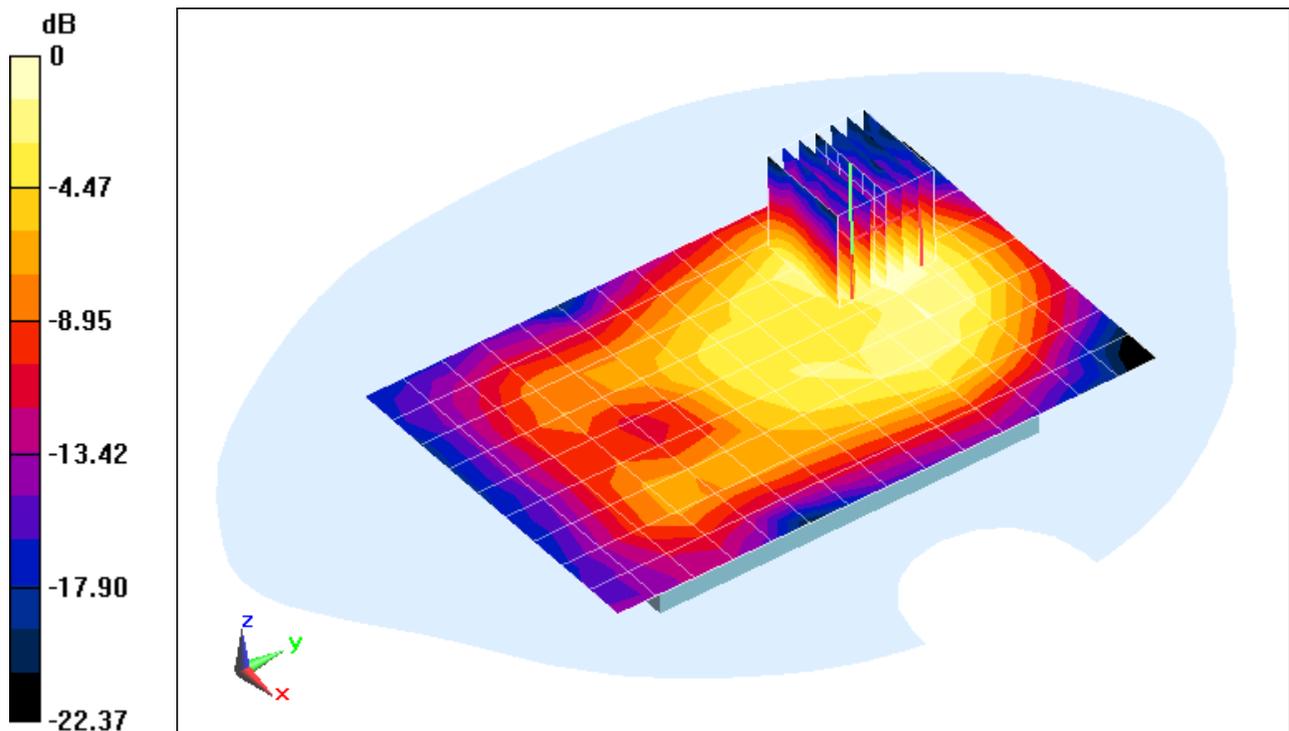
Area Scan (10x15x1): Measurement grid: dx=12mm, dy=12mm

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 8.013 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 0.263 W/kg

SAR(1 g) = 0.123 W/kg; SAR(10 g) = 0.062 W/kg



0 dB = 0.151 W/kg = -8.21 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 10

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5320 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5320$ MHz; $\sigma = 5.436$ mho/m; $\epsilon_r = 49.03$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-29-2012; Ambient Temp: 24.1°C; Tissue Temp: 22.6°C

Probe: EX3DV4 - SN3561; ConvF(3.54, 3.54, 3.54); Calibrated: 7/26/2012;

Sensor-Surface: 2mm (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 14.6.7 (6848)

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

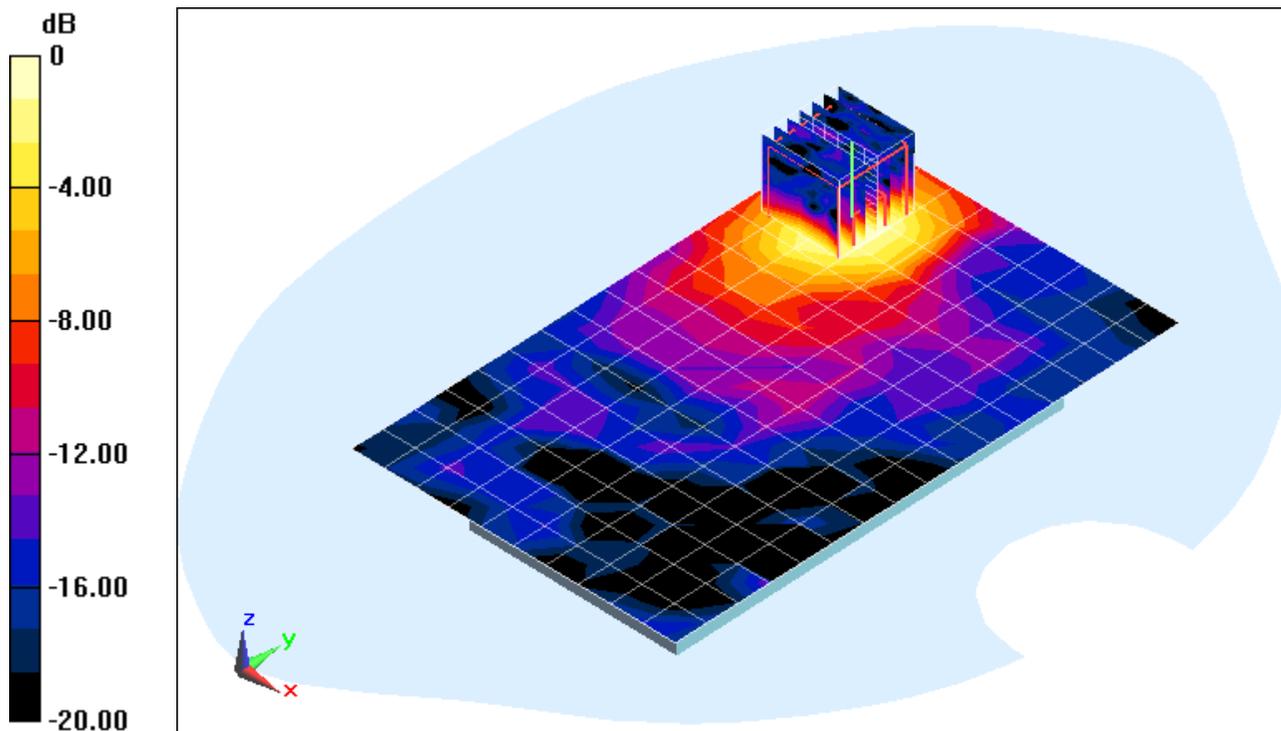
Area Scan (11x17x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 5.193 V/m; Power Drift = -0.15 dB

Peak SAR (extrapolated) = 0.542 W/kg

SAR(1 g) = 0.152 W/kg; SAR(10 g) = 0.055 W/kg



0 dB = 0.288 W/kg = -5.41 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFVS870; Type: Portable Handset; Serial: 10

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5825 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5825 \text{ MHz}$; $\sigma = 6.215 \text{ mho/m}$; $\epsilon_r = 47.75$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-29-2012; Ambient Temp: 23.6°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3561; ConvF(3.42, 3.42, 3.42); Calibrated: 7/26/2012;

Sensor-Surface: 2mm (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 14.6.7 (6848)

**Mode: IEEE 802.11a, 5.8 GHz, Body SAR,
Ch 165, 6 Mbps, Back Side, Standard Cover**

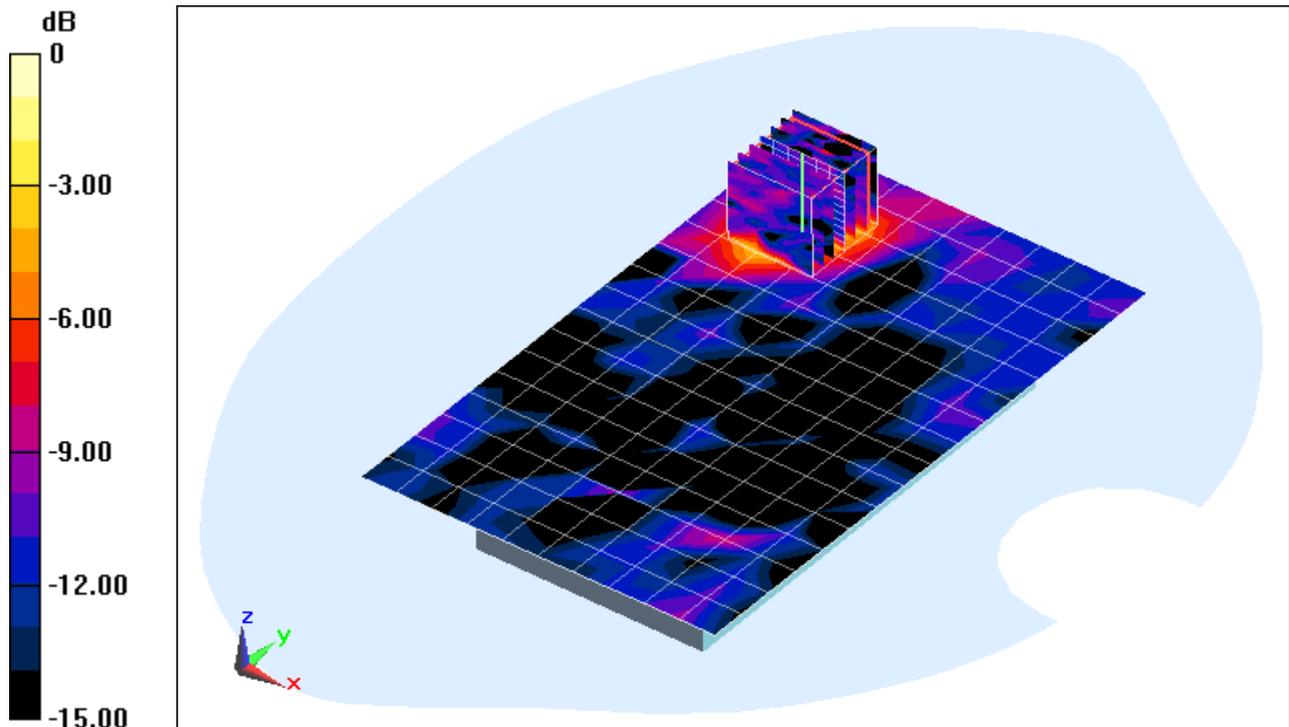
Area Scan (11x17x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.289 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 0.305 W/kg

SAR(1 g) = 0.040 W/kg; SAR(10 g) = 0.014 W/kg



0 dB = 0.100 W/kg = -10.00 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1054

Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: 740 Head Medium parameters used (interpolated):

$f = 750$ MHz; $\sigma = 0.869$ mho/m; $\epsilon_r = 40.78$; $\rho = 1000$ kg/m³

Phantom section: Flat Section ; Space: 1.5 cm

Test Date: 11-30-2012; Ambient Temp: 24.2°C; Tissue Temp: 21.4°C

Probe: ES3DV3 - SN3263; ConvF(6.4, 6.4, 6.4); Calibrated: 5/18/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 5/7/2012

Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647

Measurement SW: DASY52, Version 52.8 (3); SEMCAD X Version 14.6.7 (6848)

750 MHz System Validation

Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm

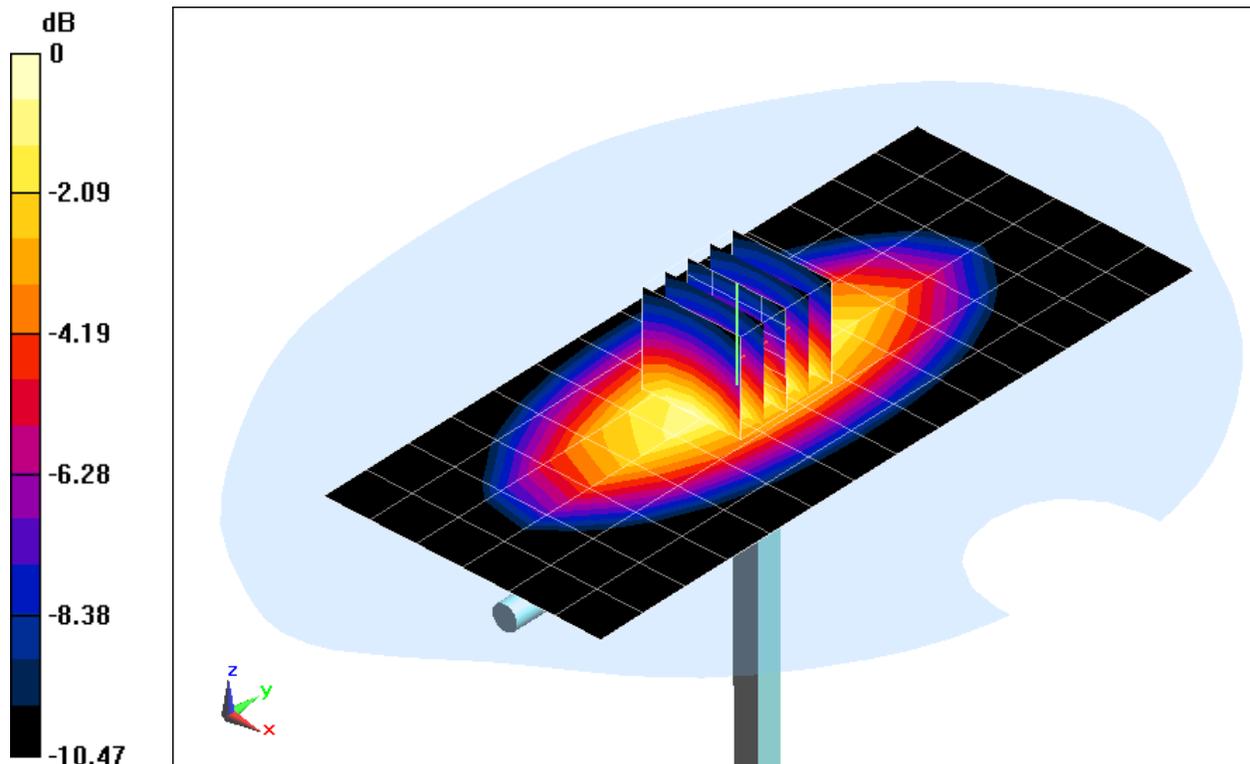
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.24 W/kg

SAR(1 g) = 0.842 W/kg; SAR(10 g) = 0.552 W/kg

Deviation: -1.17%



0 dB = 0.909 W/kg = -0.41 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d119

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Head Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.917 \text{ mho/m}$; $\epsilon_r = 42.17$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-30-2012; Ambient Temp: 23.0°C; Tissue Temp: 21.3°C

Probe: ES3DV2 - SN3022; ConvF(6.03, 6.03, 6.03); Calibrated: 8/28/2012;

Sensor-Surface: 4mm (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 14.6.7 (6848)

835MHz System Verification

Area Scan (7x13x1): Measurement grid: dx=15mm, dy=15mm

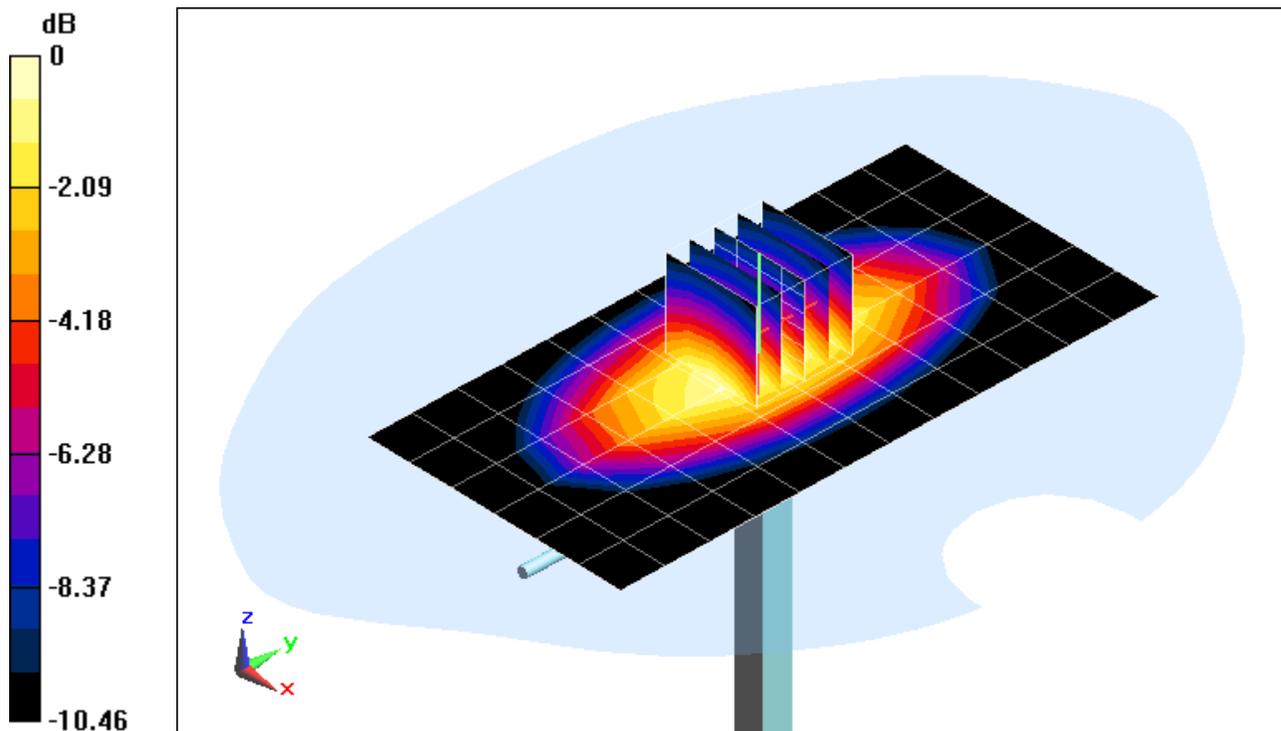
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.42 W/kg

SAR(1 g) = 0.975 W/kg; SAR(10 g) = 0.643 W/kg

Deviation: 3.50%



0 dB = 1.05 W/kg = 0.21 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 1900 MHz; Type: D1900V2; Serial: 5d080

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.446 \text{ mho/m}$; $\epsilon_r = 39.193$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-01-2012; Ambient Temp: 23.7°C; Tissue Temp: 23.1°C

Probe: ES3DV2 - SN3022; ConvF(4.86, 4.86, 4.86); Calibrated: 8/28/2012;

Sensor-Surface: 4mm (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 14.6.7 (6848)

1900MHz System Verification

Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm

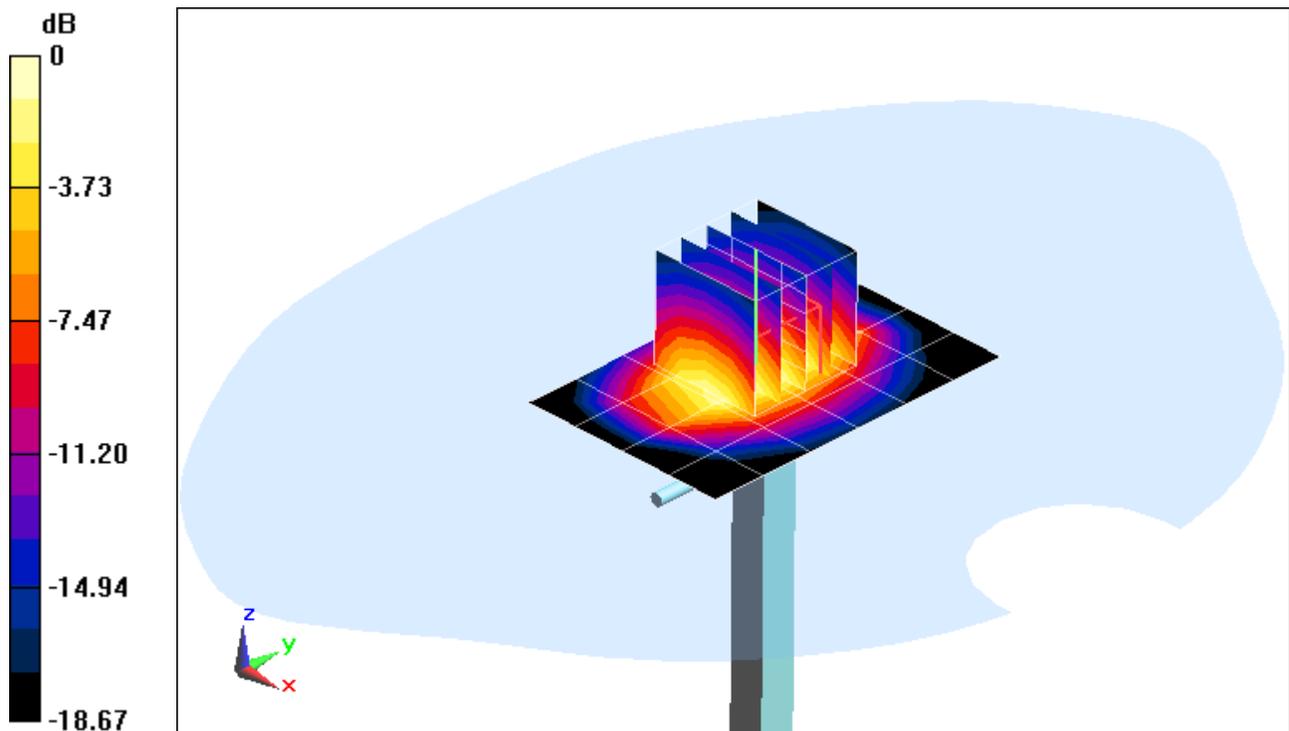
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 6.75 W/kg

SAR(1 g) = 3.77 W/kg; SAR(10 g) = 1.99 W/kg

Deviation: -4.31%



0 dB = 4.13 W/kg = 6.16 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 882

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Head; Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.846 \text{ mho/m}$; $\epsilon_r = 38.93$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-28-2012; Ambient Temp: 24.3°C; Tissue Temp: 23.1°C

Probe: ES3DV3 - SN3263; ConvF(4.45, 4.45, 4.45); Calibrated: 5/18/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 5/7/2012

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (3);SEMCAD X Version 14.6.7 (6848)

2450 MHz System Verification

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm

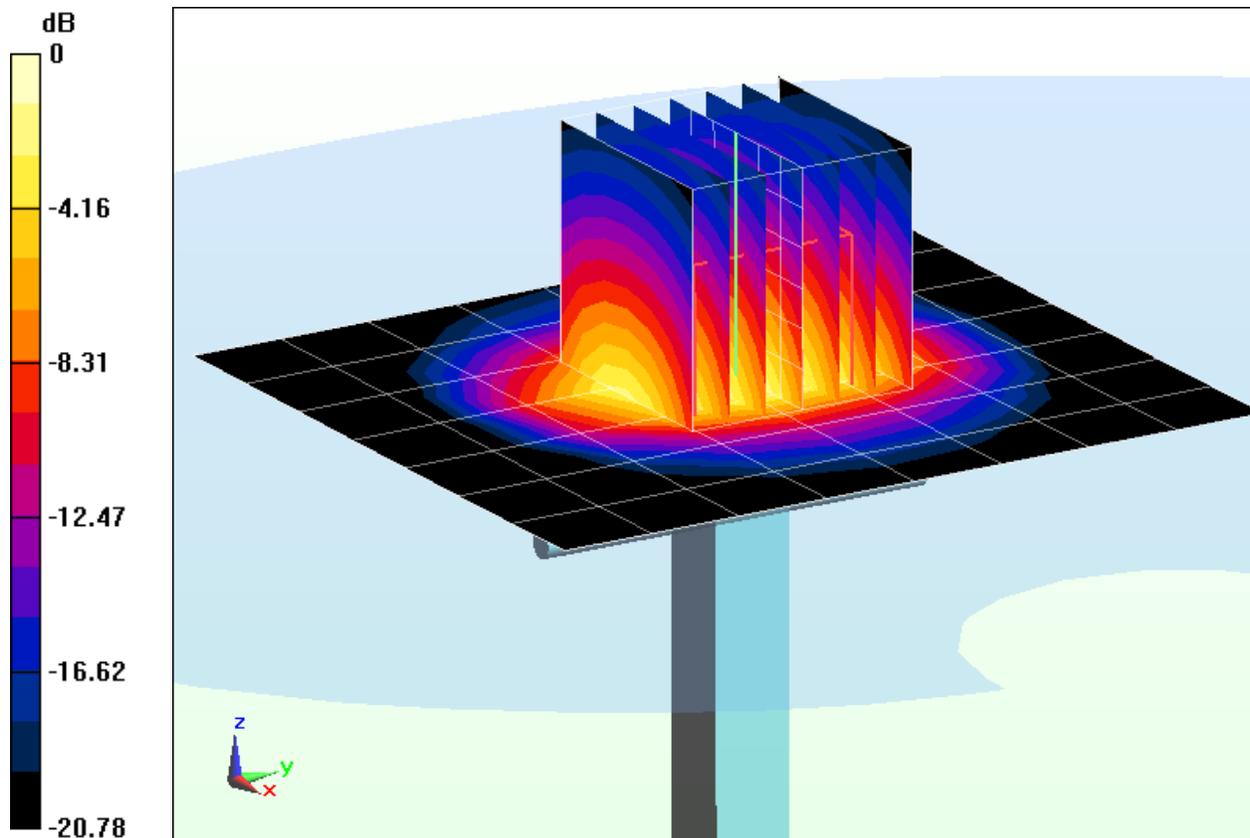
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 10.9 W/kg

SAR(1 g) = 5.47 W/kg; SAR(10 g) = 2.6 W/kg

Deviation = 2.24%



0 dB = 7.11 W/kg = 8.52 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5200 MHz; Type: D5GHzV2; Serial: 1007

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5200 \text{ MHz}$; $\sigma = 4.447 \text{ mho/m}$; $\epsilon_r = 35.35$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-04-2012; Ambient Temp: 23.2°C; Tissue Temp: 23.1°C

Probe: EX3DV4 - SN3589; ConvF(4.59, 4.59, 4.59); Calibrated: 1/27/2012;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/18/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.7 (6848)

5200MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

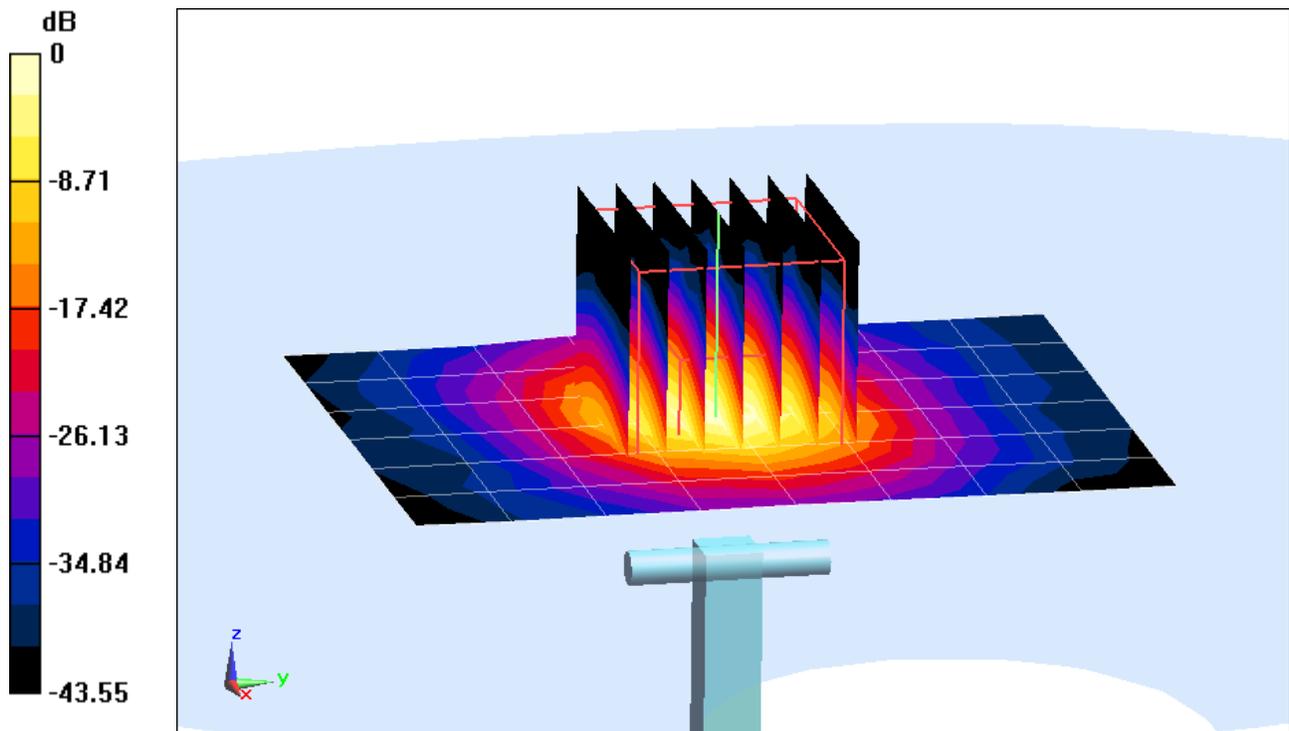
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Input Power = 17.0 dBm (50.1 mW)

Peak SAR (extrapolated) = 16.9 mW/g

SAR(1 g) = 4.03 mW/g; SAR(10 g) = 1.16 mW/g

Deviation = 0.80%



0 dB = 7.54 mW/g = 17.55 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1007

Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 4.551 \text{ mho/m}$; $\epsilon_r = 35.22$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-04-2012; Ambient Temp: 23.7°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(4.36, 4.36, 4.36); Calibrated: 1/27/2012;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/18/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114

Measurement SW: DASYS4, Version 4.7 (80); SEMCAD X Version 14.6.7 (6848)

5300MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

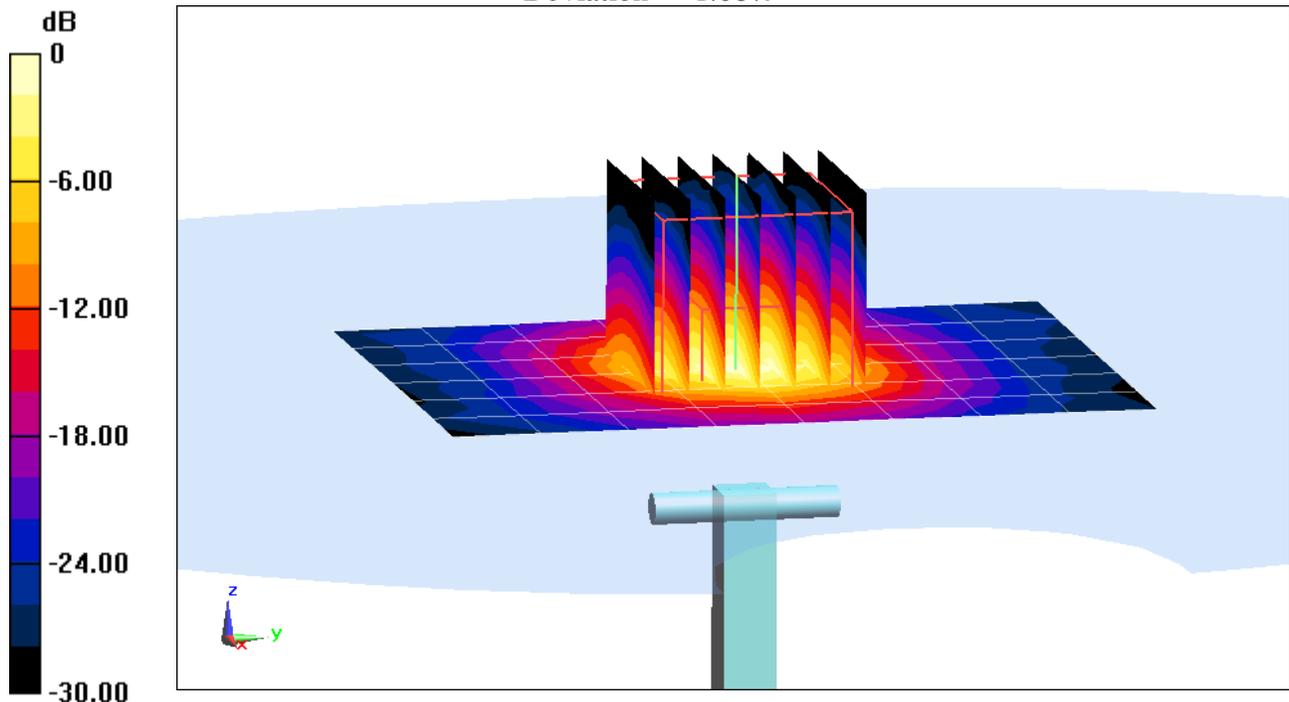
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 34.2 mW/g

SAR(1 g) = 8.22 mW/g; SAR(10 g) = 2.34 mW/g

Deviation = -1.08%



0 dB = 15.8 mW/g = 23.97 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1007

Communication System: CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 4.819 \text{ mho/m}$; $\epsilon_r = 34.77$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-04-2012; Ambient Temp: 23.2°C; Tissue Temp: 22.1°C

Probe: EX3DV4 - SN3589; ConvF(4.04, 4.04, 4.04); Calibrated: 1/27/2012;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/18/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.7 (6848)5

5600 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

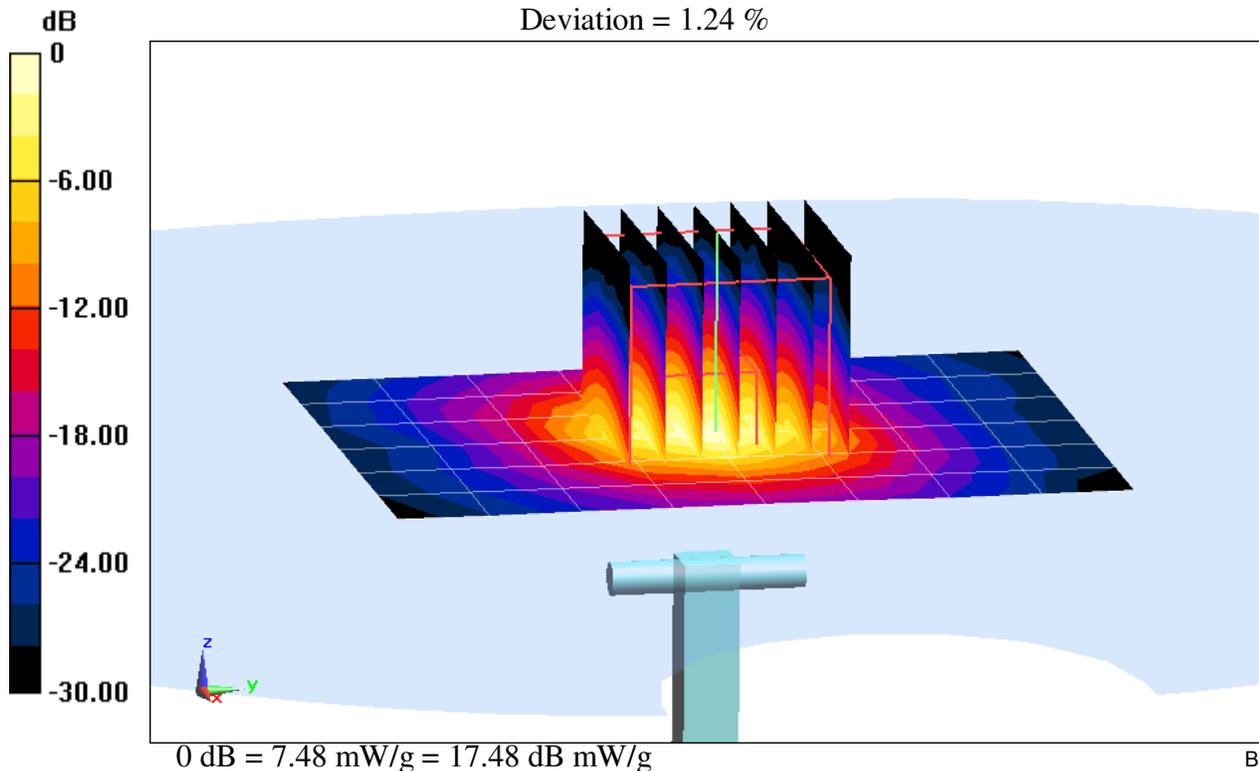
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Input Power = 16.75 dBm (47.3 mW)

Peak SAR (extrapolated) = 18.3 mW/g

SAR(1 g) = 4.05 mW/g; SAR(10 g) = 1.15 mW/g

Deviation = 1.24 %



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5800 MHz; Type: D5GHzV2; Serial: 1007

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 5.019 \text{ mho/m}$; $\epsilon_r = 34.49$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-04-2012; Ambient Temp: 23.6°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3589; ConvF(4.05, 4.05, 4.05); Calibrated: 1/27/2012;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/18/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.7 (6848)

5800MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

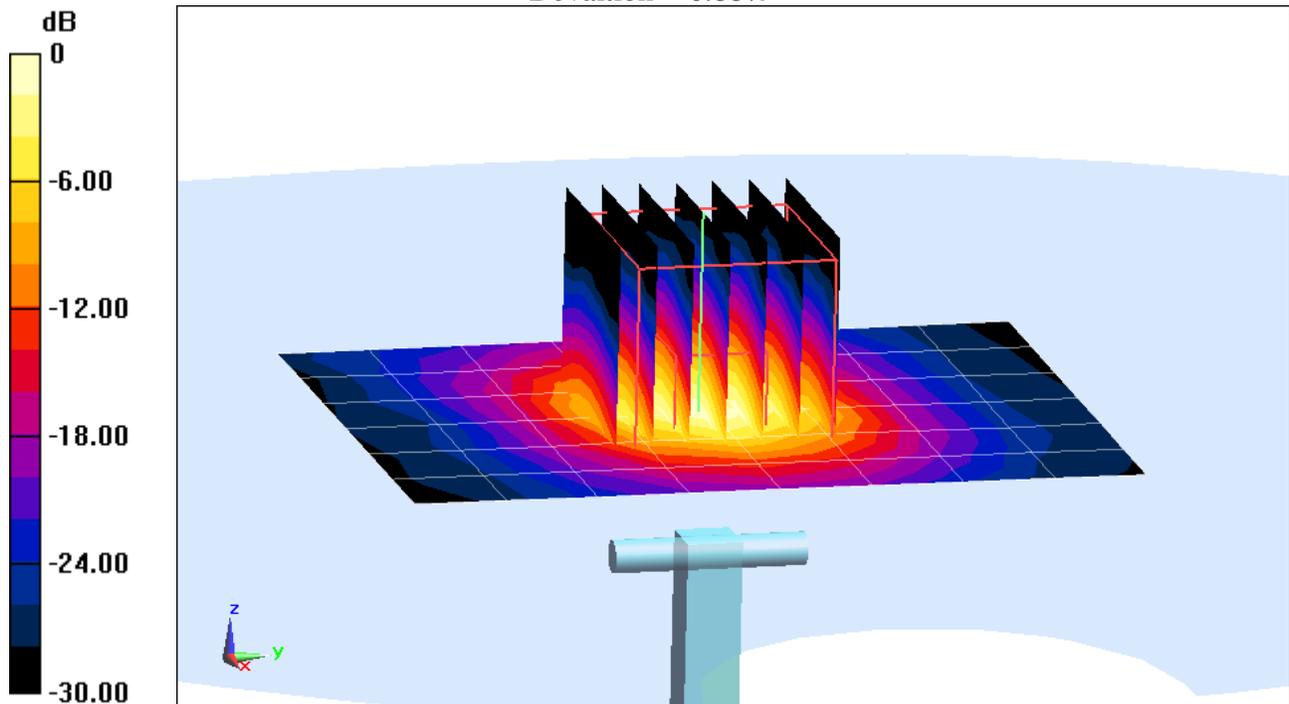
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 37.5 mW/g

SAR(1 g) = 8.05 mW/g; SAR(10 g) = 2.29 mW/g

Deviation = 0.88%



0 dB = 20.0 mW/g = 26.02 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1054

Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: 740 Body Medium parameters used (interpolated):

$f = 750$ MHz; $\sigma = 0.925$ mho/m; $\epsilon_r = 54.033$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-29-2012; Ambient Temp: 22.7°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3263; ConvF(6.26, 6.26, 6.26); Calibrated: 5/18/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 5/7/2012

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (3); SEMCAD X Version 14.6.7 (6848)

750 MHz System Verification

Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm

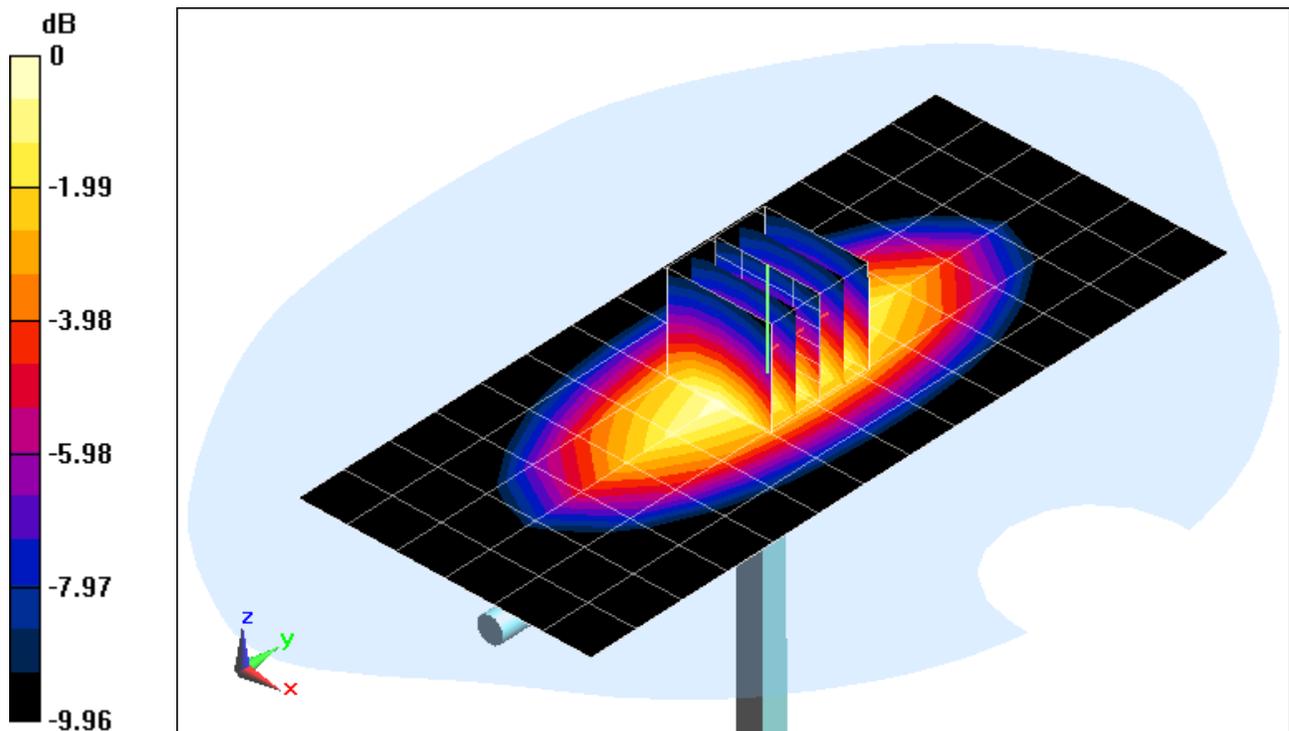
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.25 W/kg

SAR(1 g) = 0.856 W/kg; SAR(10 g) = 0.569 W/kg

Deviation: -3.17%



0 dB = 0.705 W/kg = -1.52 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.959 \text{ mho/m}$; $\epsilon_r = 53.32$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-29-2012; Ambient Temp: 24.5°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3209; ConvF(6.13, 6.13, 6.13); Calibrated: 3/16/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/20/2012

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.7 (6848)

835MHz System Verification

Area Scan (7x13x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

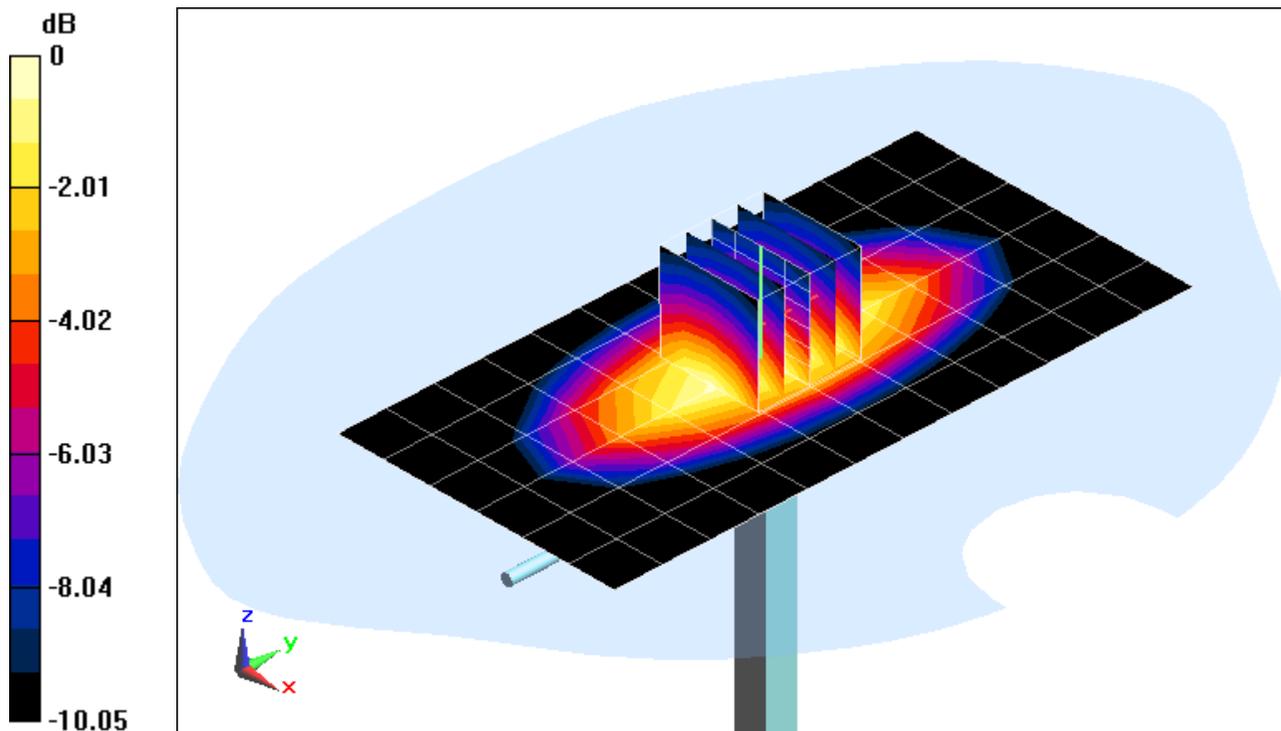
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.41 W/kg

SAR(1 g) = 0.992 W/kg; SAR(10 g) = 0.659 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: 5d149

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.563 \text{ mho/m}$; $\epsilon_r = 51.457$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 11-29-2012; Ambient Temp: 22.8°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3288; ConvF(4.89, 4.89, 4.89); 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 (3); SEMCAD X Version 14.6.7 (6848)

1900 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm

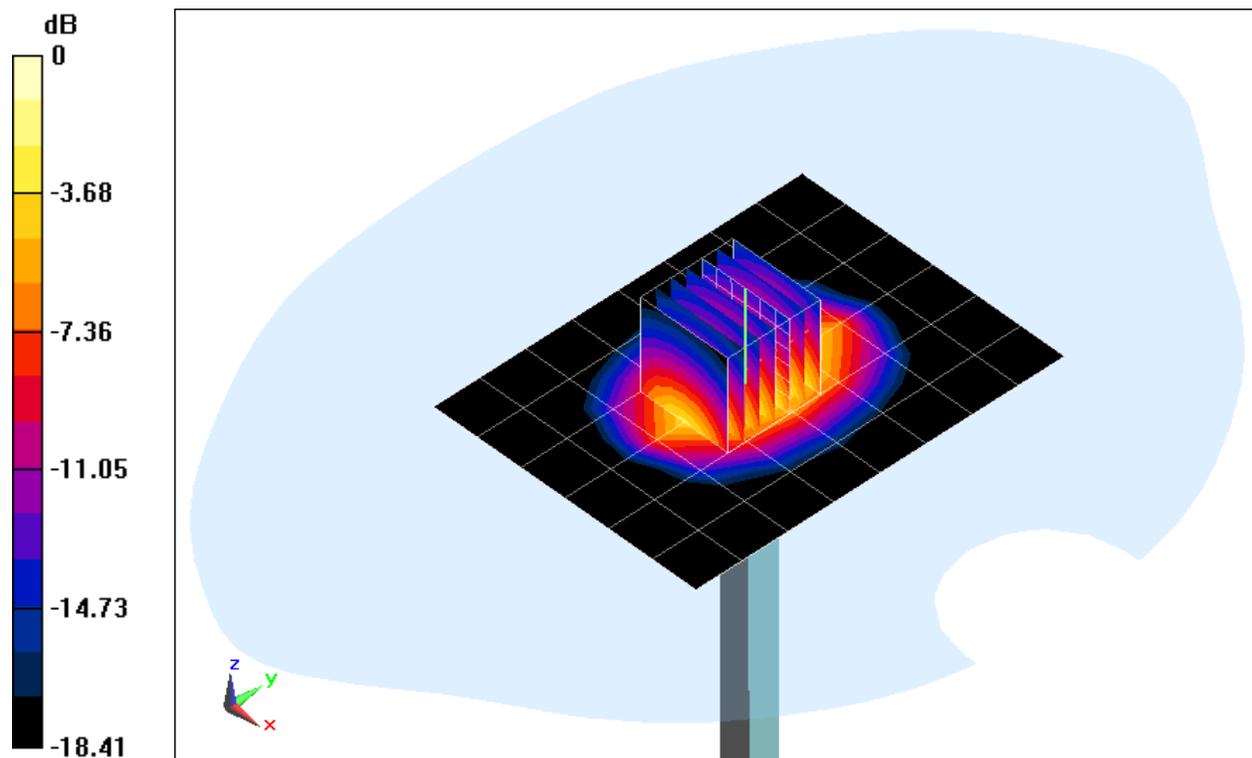
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.56 W/kg

SAR(1 g) = 4.16 W/kg; SAR(10 g) = 2.16 W/kg

Deviation: 5.85%



0 dB = 4.71 W/kg = 6.73 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 2450 MHz; Type: D2450V2; Serial: 797

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used:

$f = 2450$ MHz; $\sigma = 2.023$ mho/m; $\epsilon_r = 51.37$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-26-2012; Ambient Temp: 23.2°C; Tissue Temp: 21.3°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 Main; Type: SAM 4.0; Serial: TP-1406

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.7 (6848)

2450MHz System Verification

Area Scan (6x8x1): Measurement grid: dx=12mm, dy=12mm

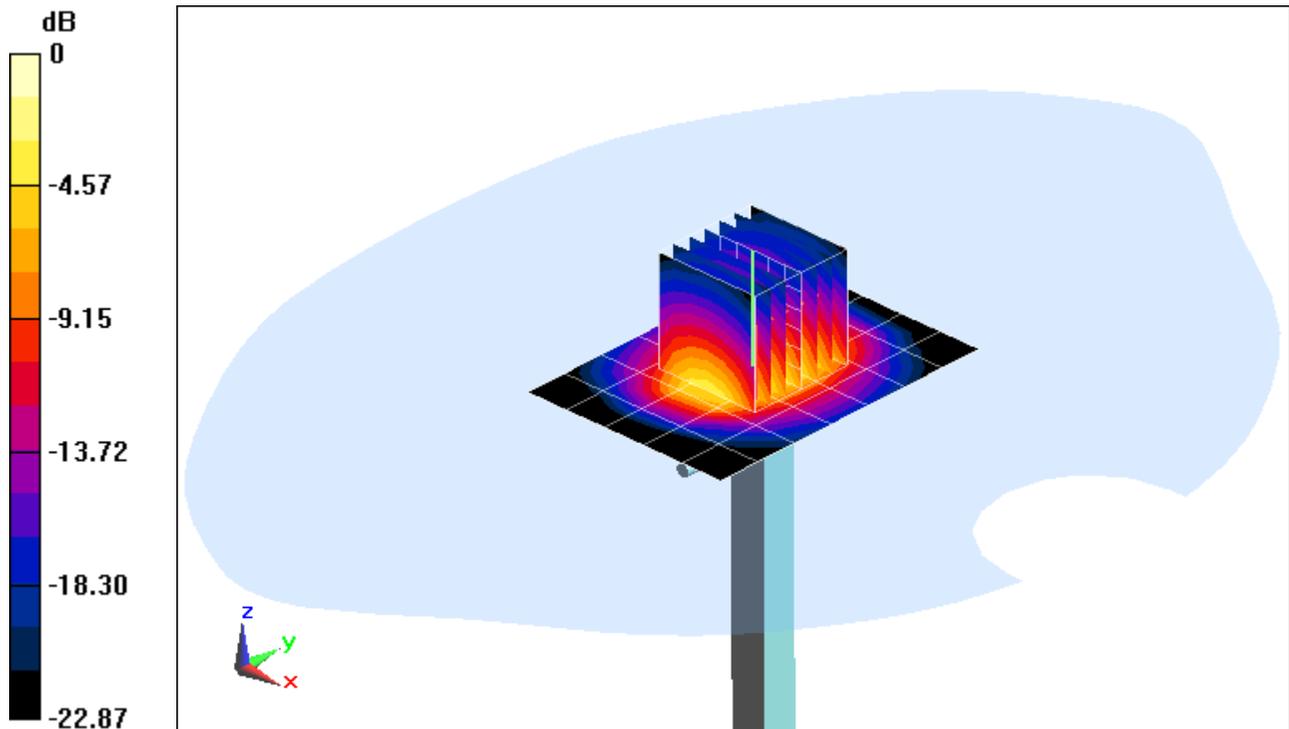
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Input Power: 13.0 dBm (20 mW)

Peak SAR (extrapolated) = 2.24 W/kg

SAR(1 g) = 1.02 W/kg; SAR(10 g) = 0.460 W/kg

Deviation: 0.39%



0 dB = 1.36 W/kg = 1.34 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5200 MHz; Type: D5GHzV2; Serial: 1120

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5200 \text{ MHz}$; $\sigma = 5.253 \text{ mho/m}$; $\epsilon_r = 49.32$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-29-2012; Ambient Temp: 21.9°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN3561; ConvF(3.76, 3.76, 3.76); Calibrated: 7/26/2012;

Sensor-Surface: 2mm (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 14.6.7 (6848)

5200MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

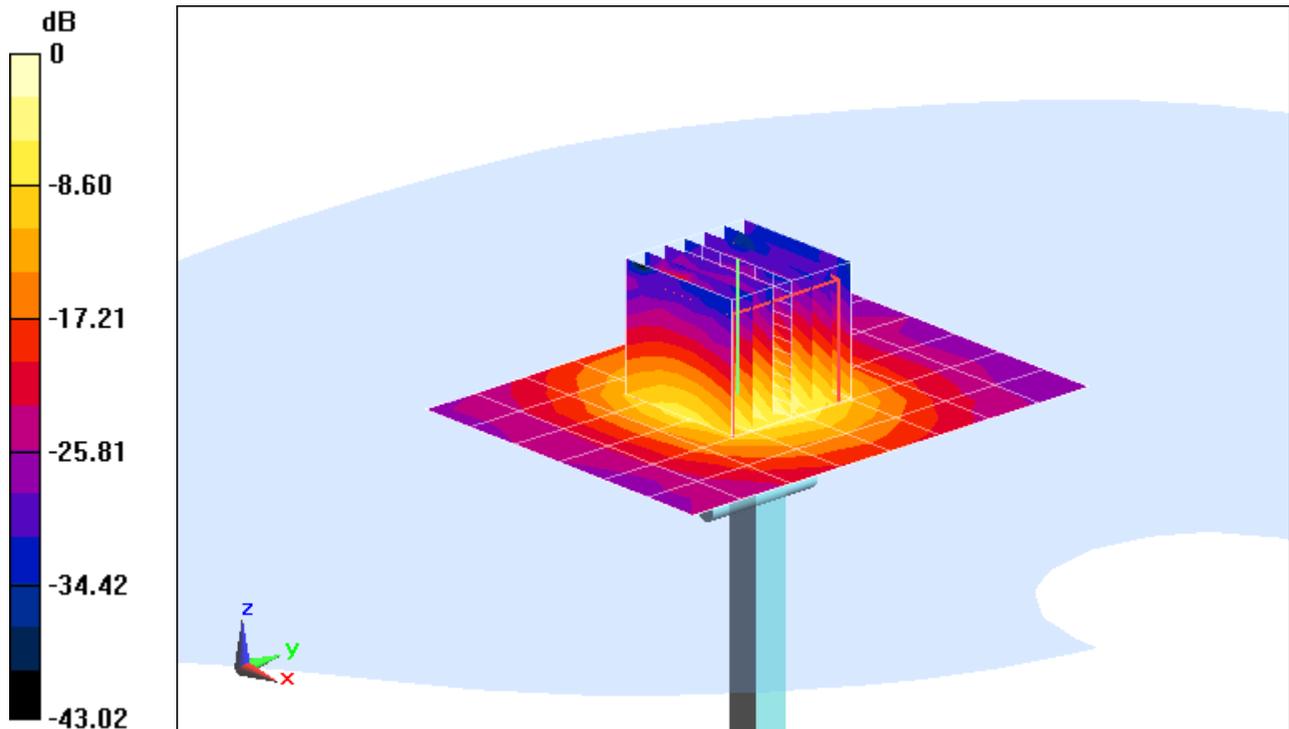
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 27.7 W/kg

SAR(1 g) = 7.04 W/kg; SAR(10 g) = 1.96 W/kg

Deviation: -2.49%



0 dB = 14.4 W/kg = 11.58 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1007

Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 5.406 \text{ mho/m}$; $\epsilon_r = 49.07$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-29-2012; Ambient Temp: 24.1°C; Tissue Temp: 22.6°C

Probe: EX3DV4 - SN3561; ConvF(3.54, 3.54, 3.54); Calibrated: 7/26/2012;

Sensor-Surface: 2mm (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 14.6.7 (6848)

5300MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

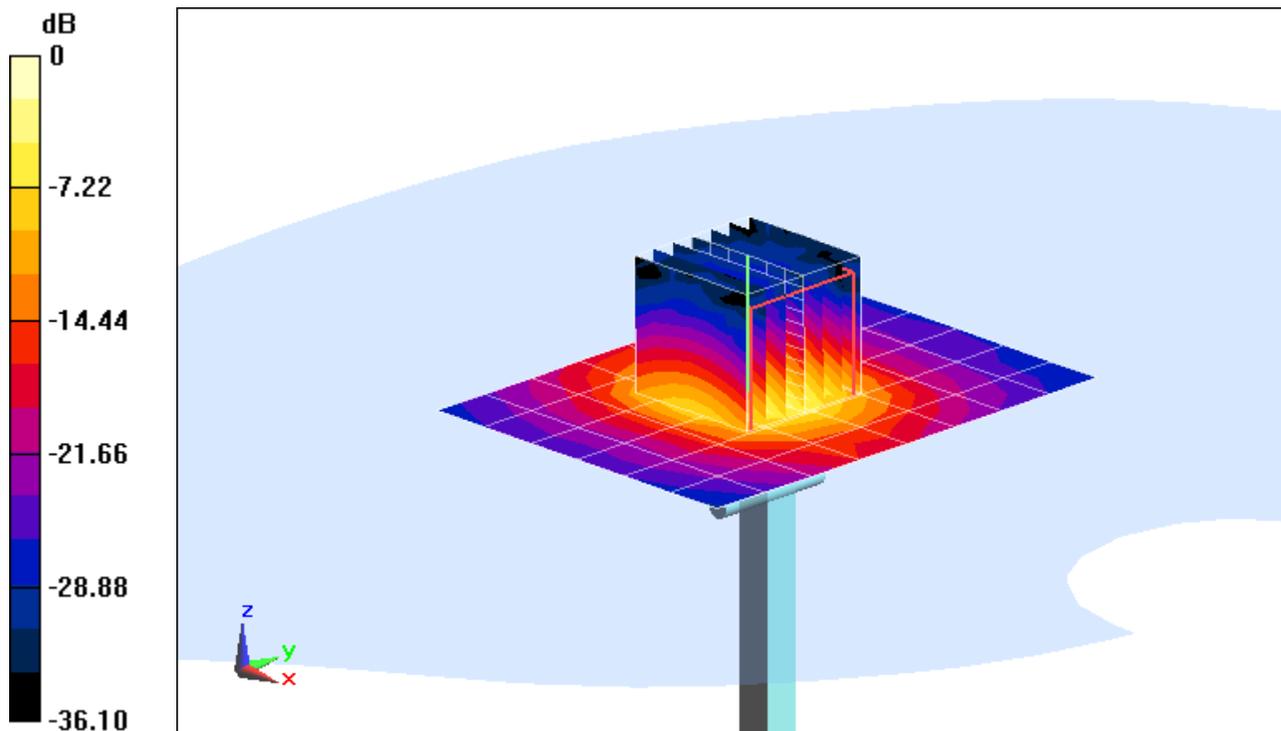
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 29.3 W/kg

SAR(1 g) = 7.42 W/kg; SAR(10 g) = 2.06 W/kg

Deviation: -1.85%



0 dB = 15.5 W/kg = 11.90 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1007

Communication System: CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.845 \text{ mho/m}$; $\epsilon_r = 48.34$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-29-2012; Ambient Temp: 24.2°C; Tissue Temp: 22.9°C

Probe: EX3DV4 - SN3561; ConvF(3.17, 3.17, 3.17); Calibrated: 7/26/2012;

Sensor-Surface: 2mm (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 14.6.7 (6848)

5600MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

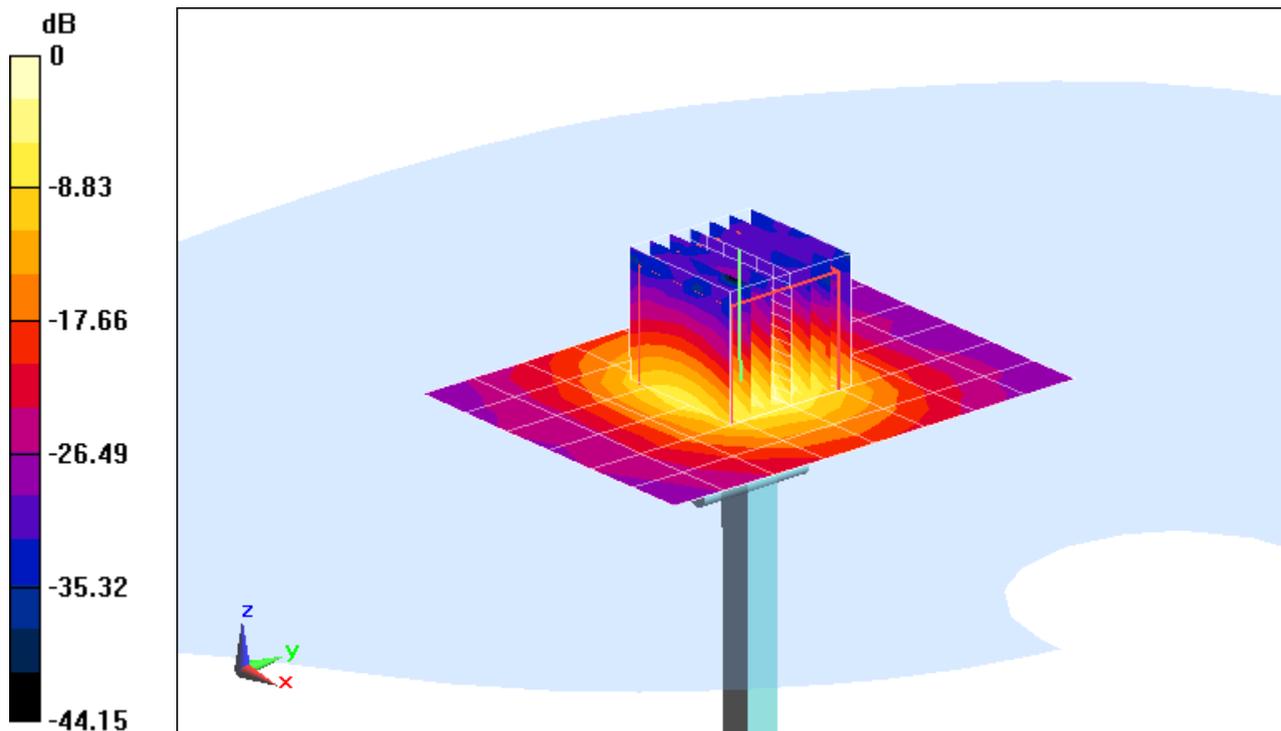
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 33.2 W/kg

SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.13 W/kg

Deviation: -2.88%



0 dB = 16.5 W/kg = 12.17 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5800 MHz; Type: D5GHzV2; Serial: 1120

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 6.171 \text{ mho/m}$; $\epsilon_r = 47.84$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-29-2012; Ambient Temp: 23.6°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3561; ConvF(3.42, 3.42, 3.42); Calibrated: 7/26/2012;

Sensor-Surface: 2mm (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 14.6.7 (6848)

5800MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

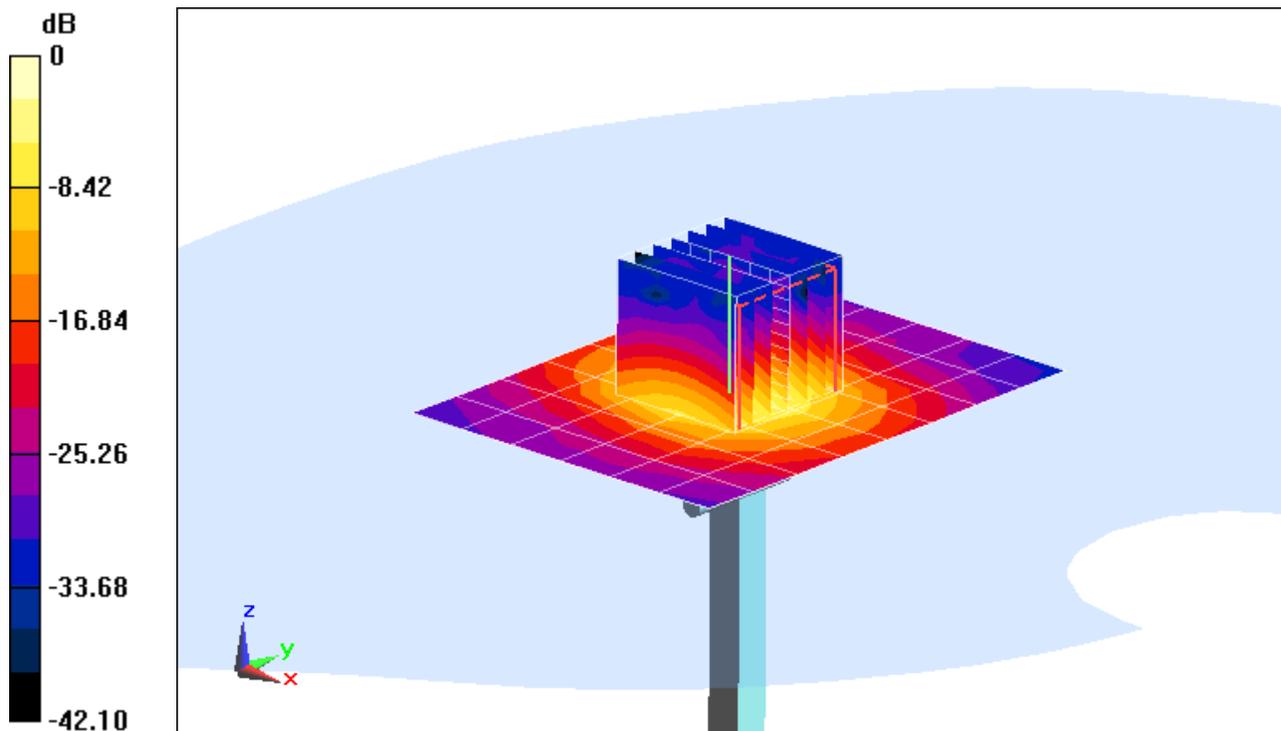
Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 32.5 W/kg

SAR(1 g) = 7.55 W/kg; SAR(10 g) = 2.07 W/kg

Deviation: 2.30%



0 dB = 16.2 W/kg = 12.10 dBW/kg

APPENDIX C: PROBE CALIBRATION



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: **D1900V2-5d149_Feb12**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d149**

Calibration procedure(s) **QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **February 22, 2012**

*✓ KOK
4/11/12*

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: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
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

Calibrated by: **Name** **Function** **Signature**
Israe El-Naouq **Laboratory Technician** *Israe El-Naouq*

Approved by: **Name** **Function**
Katja Pokovic **Technical Manager** *Katja Pokovic*

Issued: February 23, 2012

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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.

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
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 \pm 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 \pm 0.2) °C	40.4 \pm 6 %	1.40 mho/m \pm 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	9.80 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.3 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.18 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.7 mW / g \pm 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 \pm 0.2) °C	53.0 \pm 6 %	1.56 mho/m \pm 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	9.99 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	39.3 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.23 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.7 mW / g \pm 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.4 Ω + 5.5 j Ω
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.0 Ω + 6.7 j Ω
Return Loss	- 23.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
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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: 22.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d149

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.4$ mho/m; $\epsilon_r = 40.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

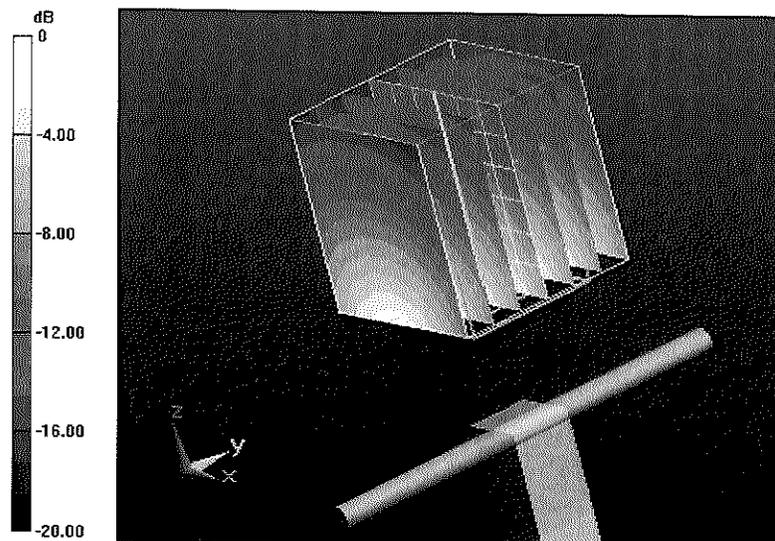
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.685 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 17.4710

SAR(1 g) = 9.8 mW/g; SAR(10 g) = 5.18 mW/g

Maximum value of SAR (measured) = 12.114 mW/g



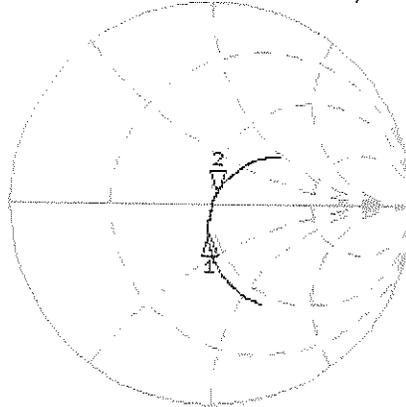
0 dB = 12.110mW/g = 21.66 dB mW/g

Impedance Measurement Plot for Head TSL

22 Feb 2012 09:56:56

CH1 S11 1 U FS 2: 52.387 Ω 5.5859 Ω 461.20 μ H 1 900.000 000 MHz

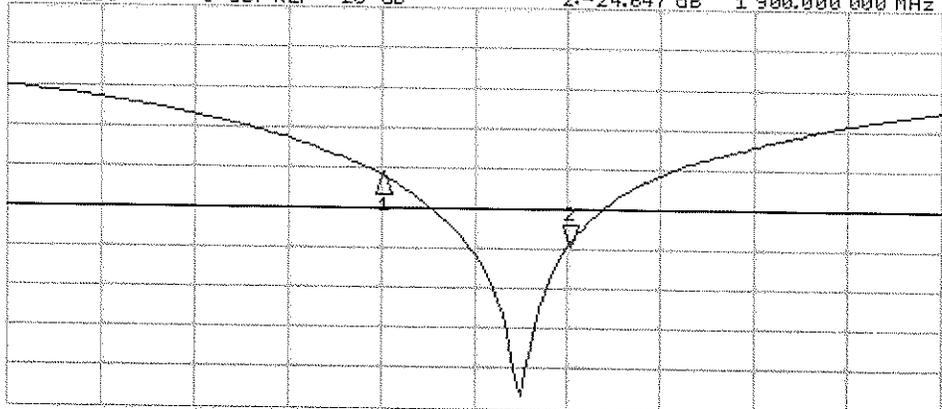
*
Del
Cor
Avg
16
H1 d



CH1 Markers
1: 46.287 Ω
-15.180 Ω
1.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 2: -24.647 dB 1 900.000 000 MHz

Cor
Avg
16
H1 d



CH2 Markers
1: -15.901 dB
1.80000 GHz

DASY5 Validation Report for Body TSL

Date: 06.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d149

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.56$ mho/m; $\epsilon_r = 53$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

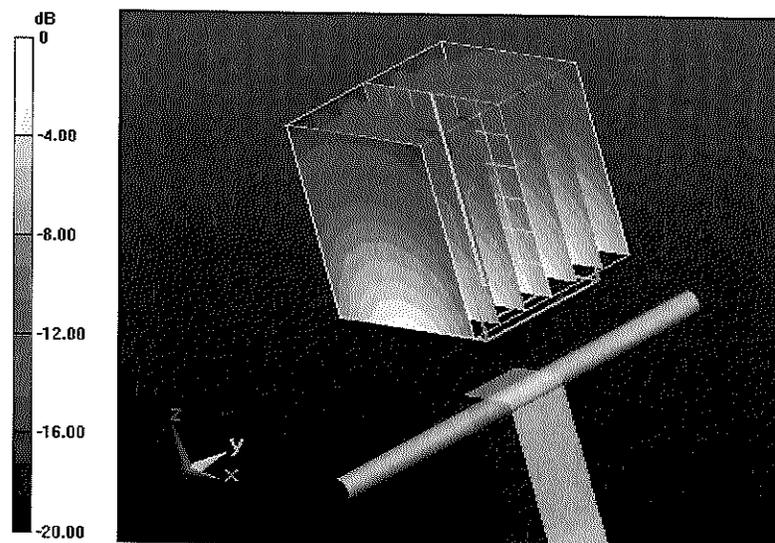
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.047 V/m; Power Drift = 0.0017 dB

Peak SAR (extrapolated) = 18.1310

SAR(1 g) = 9.99 mW/g; SAR(10 g) = 5.23 mW/g

Maximum value of SAR (measured) = 12.672 mW/g



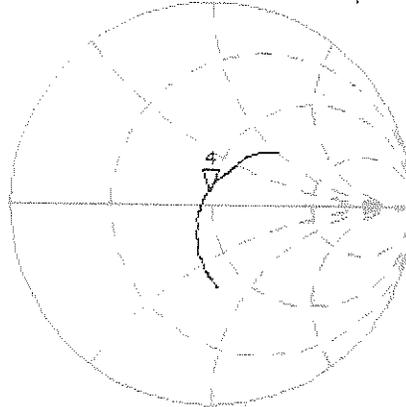
0 dB = 12.670mW/g = 22.06 dB mW/g

Impedance Measurement Plot for Body TSL

6 Feb 2012 12:15:29

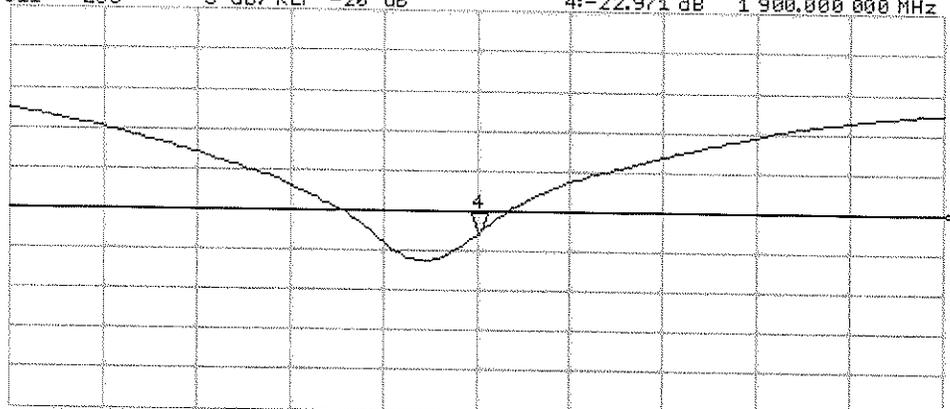
CH1 S11 1 U FS 4: 47.961 Ω 6.8680 Ω 558.55 μ H 1 900.000 000 MHz

*
Del
Ca
Avg
15
H1 d



CH2 S11 LOG 5 dB/REF -20 dB 4:-22.971 dB 1 900.000 000 MHz

Ca
Avg
15
H1 d



START 1 700.000 000 MHz

STOP 2 1 000.000 000 MHz



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d080_Jul12**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d080**

Calibration procedure(s) **QA CAL-05.v8**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **July 20, 2012**

*✓ KOK
8/13/12*

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

Calibrated by: **Dimce Iliev** Name: **Dimce Iliev** Function: **Laboratory Technician**

Signature: *D. Iliev*

Approved by: **Katja Pokovic** Name: **Katja Pokovic** Technical Manager

Signature: *Katja Pokovic*

Issued: July 20, 2012

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



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

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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:

- 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
- 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
- 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:

- 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	V52.8.1
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 \pm 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 \pm 0.2) °C	39.9 \pm 6 %	1.38 mho/m \pm 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	9.78 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.4 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.17 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.8 mW / g \pm 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 \pm 0.2) °C	52.6 \pm 6 %	1.52 mho/m \pm 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	10.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.3 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.35 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.4 mW / g \pm 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$50.9 \Omega + 5.7 j\Omega$
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$46.9 \Omega + 6.0 j\Omega$
Return Loss	- 23.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.191 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	June 28, 2006

DASY5 Validation Report for Head TSL

Date: 20.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d080

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ mho/m; $\epsilon_r = 39.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); 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 52.8.1(838); SEMCAD X 14.6.5(6469)

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

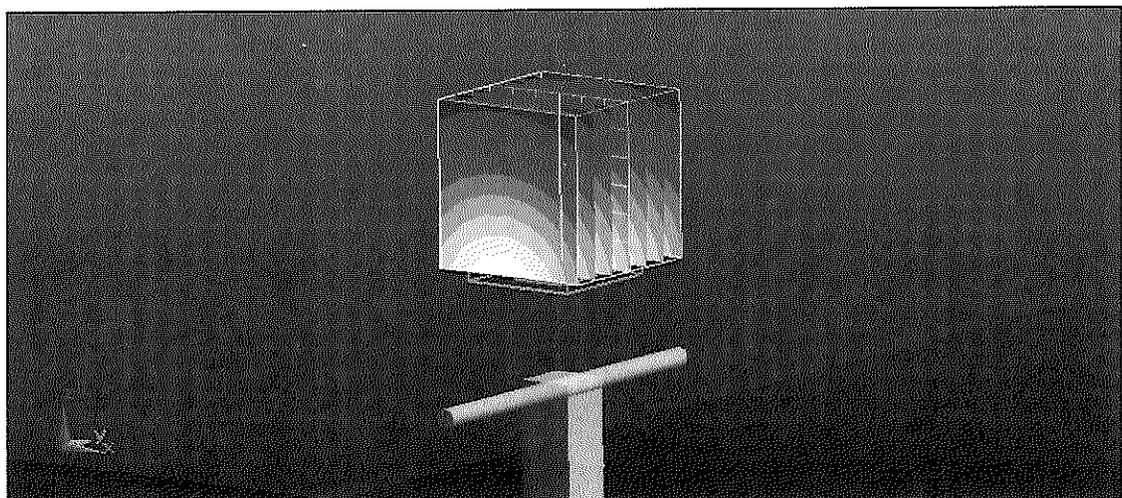
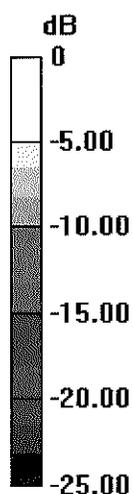
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.586 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 17.454 mW/g

SAR(1 g) = 9.78 mW/g; SAR(10 g) = 5.17 mW/g

Maximum value of SAR (measured) = 12.2 mW/g



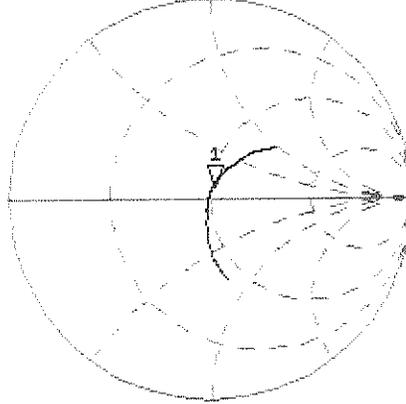
0 dB = 12.2 mW/g = 21.73 dB mW/g

Impedance Measurement Plot for Head TSL

18 Jul 2012 16:15:02

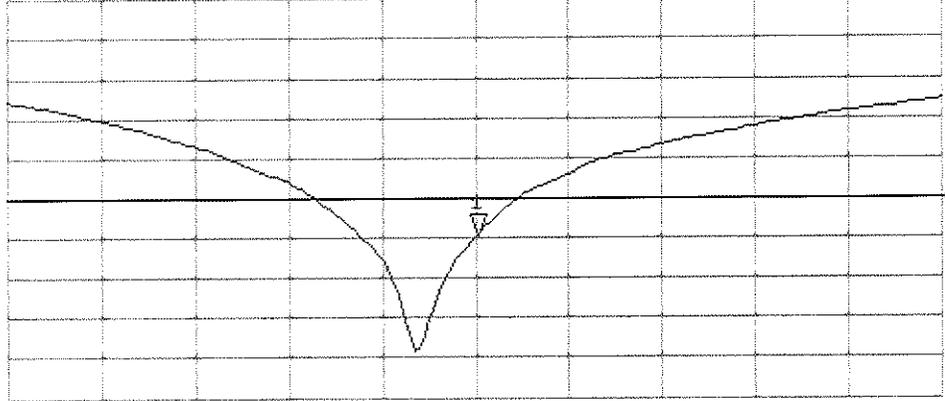
[CH1] S11 1 U FS 1: 50.879 Ω 5.7878 Ω 478.85 pF 1 900.000 000 MHz

*
Del
Cor
Avg
15
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1: -24.851 dB 1 900.000 000 MHz

Del
Cor
Avg
15
H1d



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 20.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d080

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.52$ mho/m; $\epsilon_r = 52.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); 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 52.8.1(838); SEMCAD X 14.6.5(6469)

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

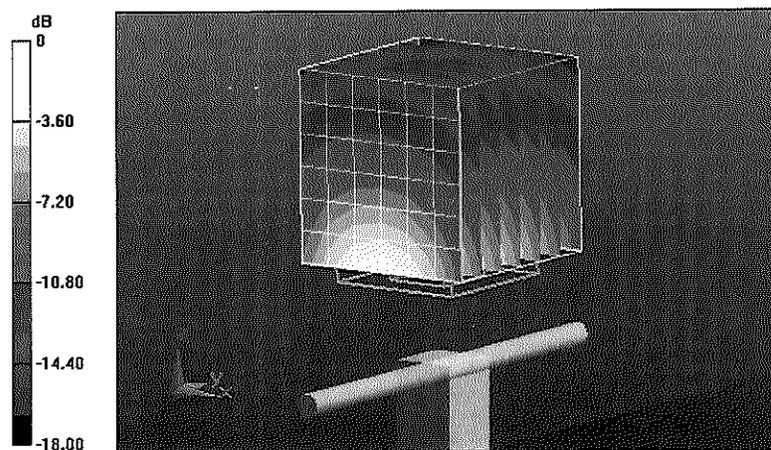
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.688 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 17.552 mW/g

SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.35 mW/g

Maximum value of SAR (measured) = 12.8 mW/g



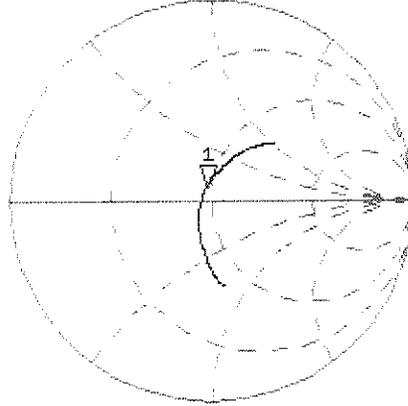
0 dB = 12.8 mW/g = 22.14 dB mW/g

Impedance Measurement Plot for Body TSL

18 Jul 2012 16:16:11

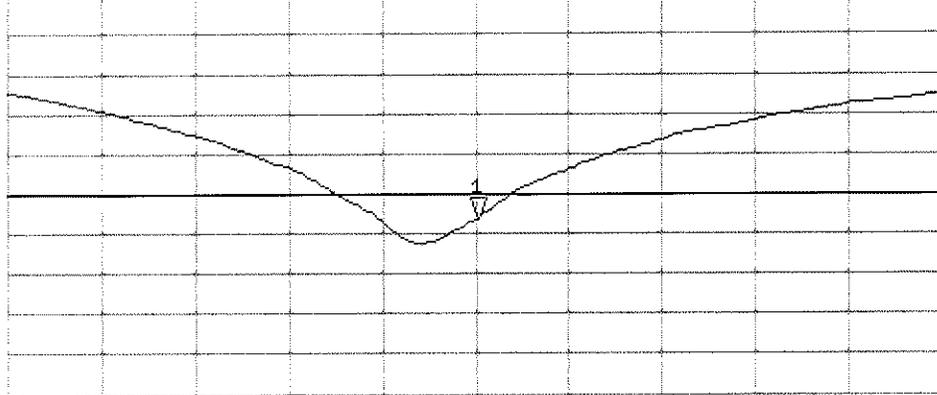
CH1 S11 1 U FS 1: 46.941 Ω 6.0313 Ω 505.21 pF 1 900.000 000 MHz

*
De1
Cor
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-23.145 dB 1 900.000 000 MHz

De1
Cor
Avg
16
H1d



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D2450V2-882_Feb12**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 882**

Calibration procedure(s) **QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **February 07, 2012**

*✓ FOK
4/6/12*

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: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
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

Calibrated by: **Israe El-Naouq** (Name) / **Laboratory Technician** (Function) / *Israe El-Naouq* (Signature)

Approved by: **Katja Pokovic** (Name) / **Technical Manager** (Function) / *Katja Pokovic* (Signature)

Issued: February 15, 2012

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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.

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
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 \pm 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 \pm 0.2) °C	38.9 \pm 6 %	1.86 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.6 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	53.5 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.27 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.8 mW / g \pm 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 \pm 0.2) °C	52.3 \pm 6 %	2.02 mho/m \pm 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	50.3 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.94 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.5 mW / g \pm 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.7 Ω + 1.1 j Ω
Return Loss	- 28.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.0 Ω + 3.2 j Ω
Return Loss	- 29.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.156 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	October 06, 2011

DASY5 Validation Report for Head TSL

Date: 07.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 882

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.86$ mho/m; $\epsilon_r = 38.9$; $\rho = 1000$ kg/m³

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: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

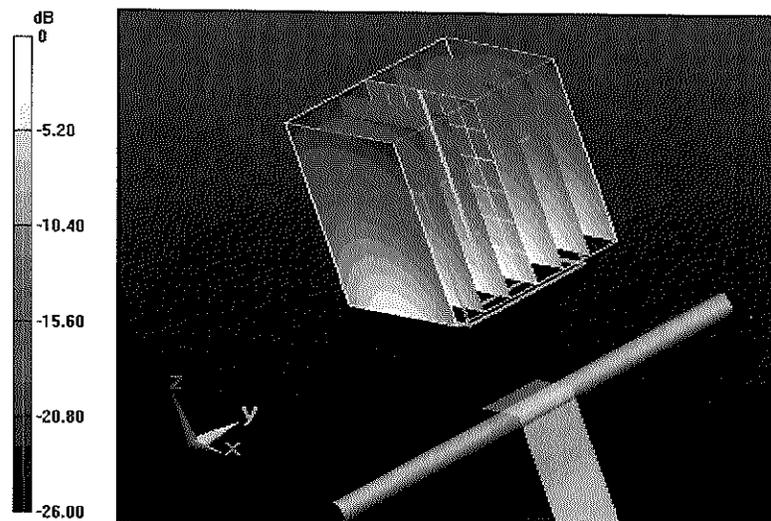
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.8 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 28.3920

SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.27 mW/g

Maximum value of SAR (measured) = 17.598 mW/g



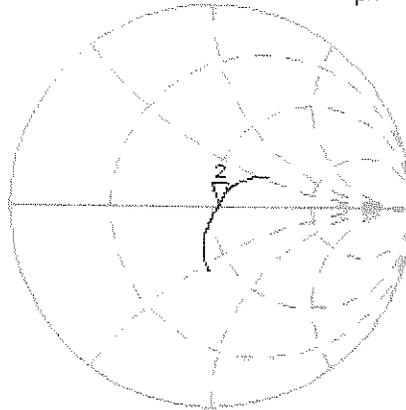
0 dB = 17.600mW/g = 24.91 dB mW/g

Impedance Measurement Plot for Head TSL

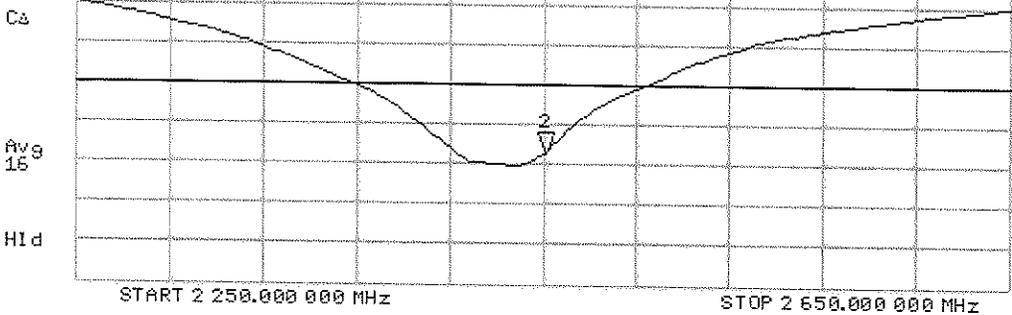
7 Feb 2012 11:30:04

CH1 S11 1 U FS 2: 53.674 Ω 1.0918 Ω 70.924 pF 2 450.000 000 MHz

*
De1
Ca
Avg
15
H1 d



CH2 S11 LOG 5 dB/REF -20 dB 2:-28.637 dB 2 450.000 000 MHz



DASY5 Validation Report for Body TSL

Date: 07.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 882

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.02$ mho/m; $\epsilon_r = 52.3$; $\rho = 1000$ kg/m³

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: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

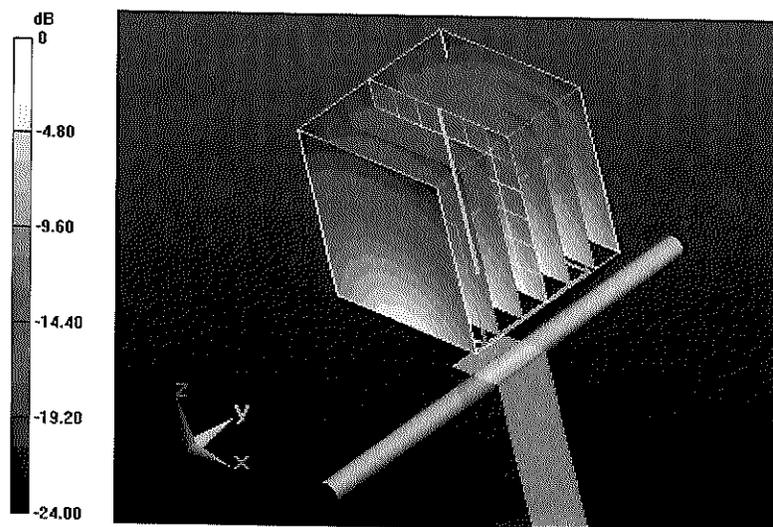
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.959 V/m; Power Drift = 0.0036 dB

Peak SAR (extrapolated) = 26.2610

SAR(1 g) = 12.8 mW/g; SAR(10 g) = 5.94 mW/g

Maximum value of SAR (measured) = 16.899 mW/g



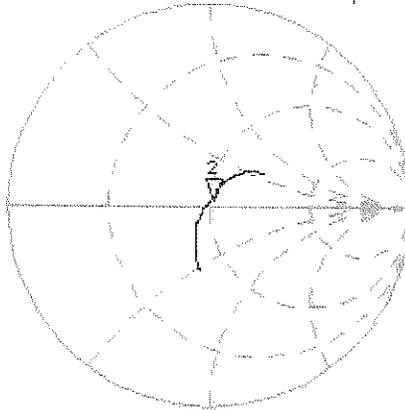
0 dB = 16.900mW/g = 24.56 dB mW/g

Impedance Measurement Plot for Body TSL

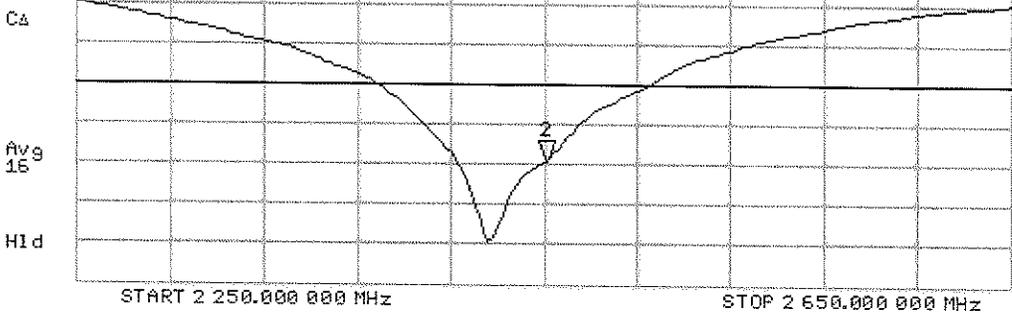
7 Feb 2012 11:28:39

CH1 S11 1 U F3 2: 50.982 Ω 3.1689 Ω 205.79 μ H 2 450.000 000 MHz

*
De1
CA
Avg
15
HI d



CH2 S11 LOG 5 dB/REF -20 dB 2:-29.682 dB 2 450.000 000 MHz





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Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Client **PC Test**

Certificate No: **D2450V2-797_Jan12**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 797**

Calibration procedure(s) **QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **January 24, 2012**

*✓ KOK
2/6/2012*

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: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
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

Calibrated by: **Israe El-Naouq** **Israe El-Naouq** **Signature**
Name: **Israe El-Naouq** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** **Katja Pokovic** **Signature**
Name: **Katja Pokovic** Function: **Technical Manager**

Issued: January 24, 2012

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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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:

- 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
- 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
- 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:

- 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.

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
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 %	1.85 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	52.1 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.12 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.3 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	50.6 ± 6 %	2.01 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	13.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	50.8 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.01 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.7 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.0 Ω + 4.7 j Ω
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.1 Ω + 5.4 j Ω
Return Loss	- 25.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.151 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	January 24, 2006

DASY5 Validation Report for Head TSL

Date: 24.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 797

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.85$ mho/m; $\epsilon_r = 39.2$; $\rho = 1000$ kg/m³

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: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

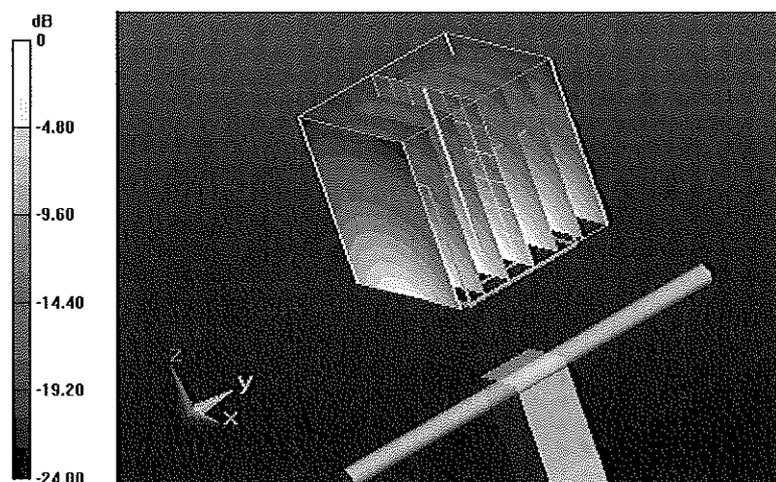
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.248 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 27.3550

SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.12 mW/g

Maximum value of SAR (measured) = 17.017 mW/g



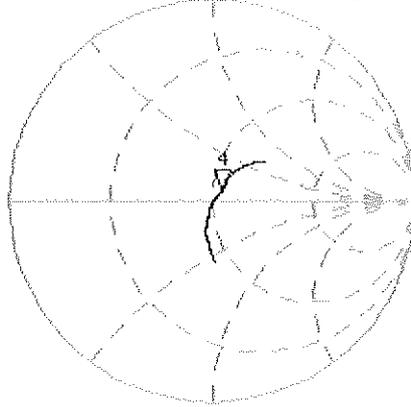
0 dB = 17.020mW/g = 24.62 dB mW/g

Impedance Measurement Plot for Head TSL

24 Jan 2012 11:11:23

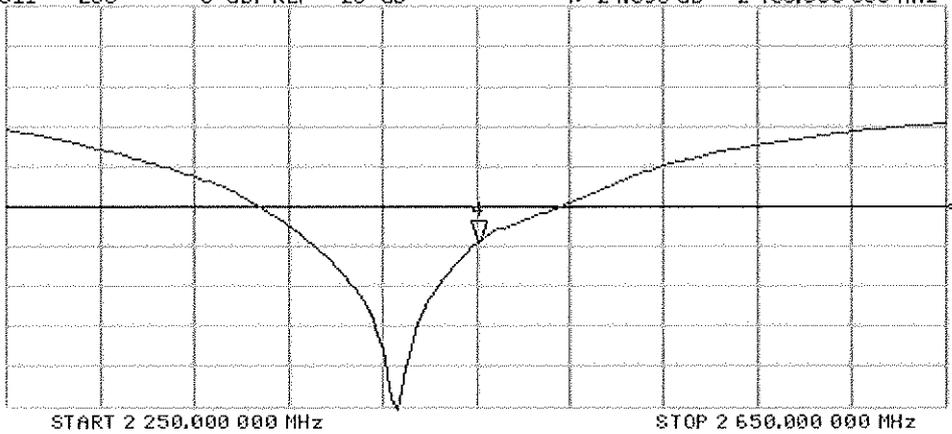
[CH1] S11 1 U FS 4:53.992 n 4:6563 n 382.40 pH 2 450.000 000 MHz

*
De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 4:-24.593 dB 2 450.000 000 MHz

CA
Avg
16
H1d



START 2 250.000 000 MHz

STOP 2 550.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 23.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 797

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.01$ mho/m; $\epsilon_r = 50.6$; $\rho = 1000$ kg/m³

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: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

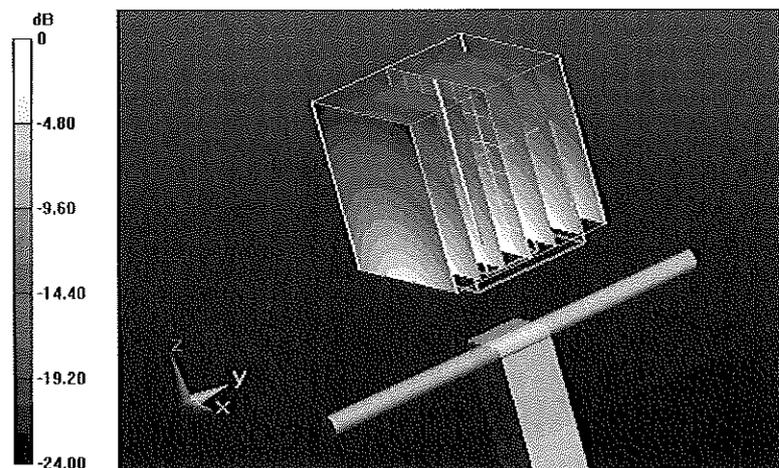
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.727 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 26.9680

SAR(1 g) = 13 mW/g; SAR(10 g) = 6.01 mW/g

Maximum value of SAR (measured) = 17.222 mW/g



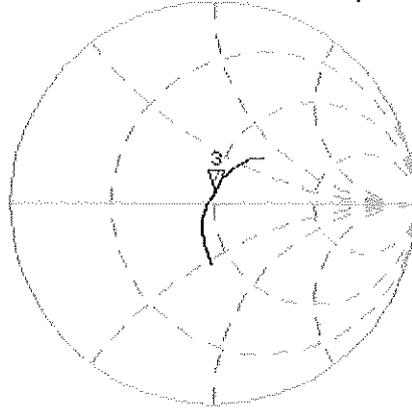
0 dB = 17.220mW/g = 24.72 dB mW/g

Impedance Measurement Plot for Body TSL

23 Jan 2012 11:15:12

[603] 241 1 U FS 3:50.423 A 5.4316 A 352.05 μ H 2 450.000 000 MHz

*
De1
CA



Avg
16

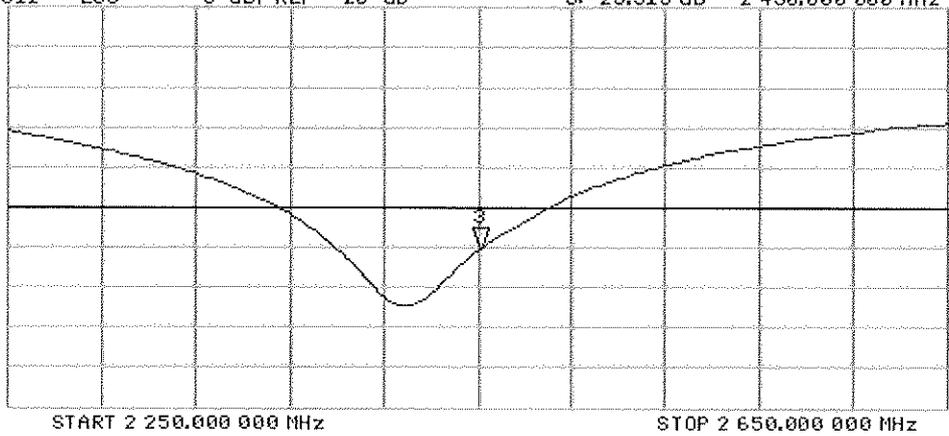
H1d

CH2 S11 LOG 5 dB/REF -20 dB 3:-25.315 dB 2 450.000 000 MHz

CA

Avg
16

H1d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D5GHzV2-1120_Feb12**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1120**

Calibration procedure(s) **QA CAL-22.v1
Calibration procedure for dipole validation kits between 3-6 GHz**

Calibration date: **February 01, 2012**

*KOK
5/14/12*

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: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe EX3DV4	SN: 3503	30-Dec-11 (No. EX3-3503_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
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

Calibrated by: **Jeton Kastrati** **Jeton Kastrati** **Laboratory Technician** *[Signature]*

Approved by: **Katja Pokovic** **Katja Pokovic** **Technical Manager** *[Signature]*

Issued: February 6, 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.

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5500 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.3 ± 6 %	4.60 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.95 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	79.6 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.8 mW / g ± 16.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.8 ± 6 %	4.90 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.49 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	84.9 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.42 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.2 mW / g ± 16.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.3 ± 6 %	5.22 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.88 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	78.8 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.24 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.4 mW / g ± 16.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.2 ± 6 %	5.46 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.21 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	72.2 mW / g ± 18.1 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.03 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.4 mW / g ± 17.6 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.7 ± 6 %	5.86 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.98 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	80.0 mW / g ± 18.1 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.22 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	22.2 mW / g ± 17.6 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.2 ± 6 %	6.28 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.37 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	73.8 mW / g ± 18.1 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.04 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.4 mW / g ± 17.6 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	54.4 Ω - 5.1 j Ω
Return Loss	- 23.8 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.9 Ω - 3.1 j Ω
Return Loss	- 28.9 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	52.9 Ω + 2.3 j Ω
Return Loss	- 28.9 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	53.8 Ω - 2.7 j Ω
Return Loss	- 27.0 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	53.3 Ω + 1.1 j Ω
Return Loss	- 29.4 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	55.2 Ω + 3.9 j Ω
Return Loss	- 24.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.207 ns
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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 08, 2011

DASY5 Validation Report for Head TSL

Date: 01.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1120

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
Medium parameters used: $f = 5200$ MHz; $\sigma = 4.6$ mho/m; $\epsilon_r = 36.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.9$ mho/m; $\epsilon_r = 35.8$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.22$ mho/m; $\epsilon_r = 35.3$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

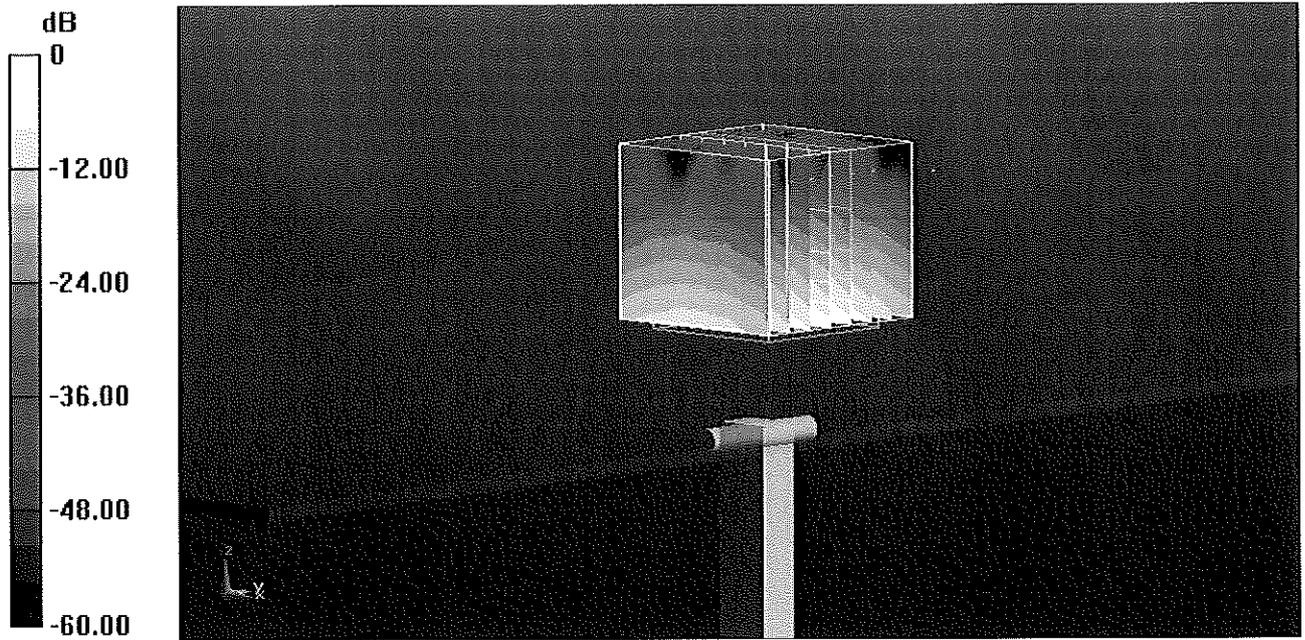
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41), ConvF(4.91, 4.91, 4.91), ConvF(4.81, 4.81, 4.81); Calibrated: 30.12.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.814 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 29.5200
SAR(1 g) = 7.95 mW/g; SAR(10 g) = 2.28 mW/g
Maximum value of SAR (measured) = 17.959 mW/g

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.007 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 33.8120
SAR(1 g) = 8.49 mW/g; SAR(10 g) = 2.42 mW/g
Maximum value of SAR (measured) = 19.722 mW/g

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.595 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 32.9250
SAR(1 g) = 7.88 mW/g; SAR(10 g) = 2.24 mW/g
Maximum value of SAR (measured) = 18.643 mW/g

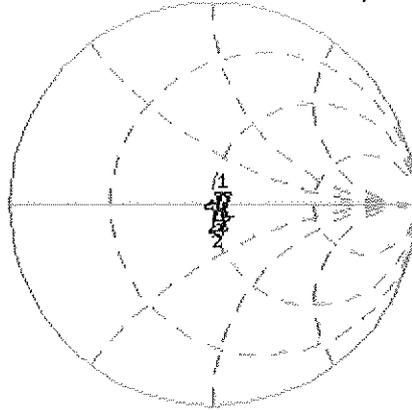


Impedance Measurement Plot for Head TSL

1 Feb 2012 17:16:58

CH1 S11 1 U FS 1: 54.412 Ω -5.1445 Ω 5.9494 pF 5 200.000 000 MHz

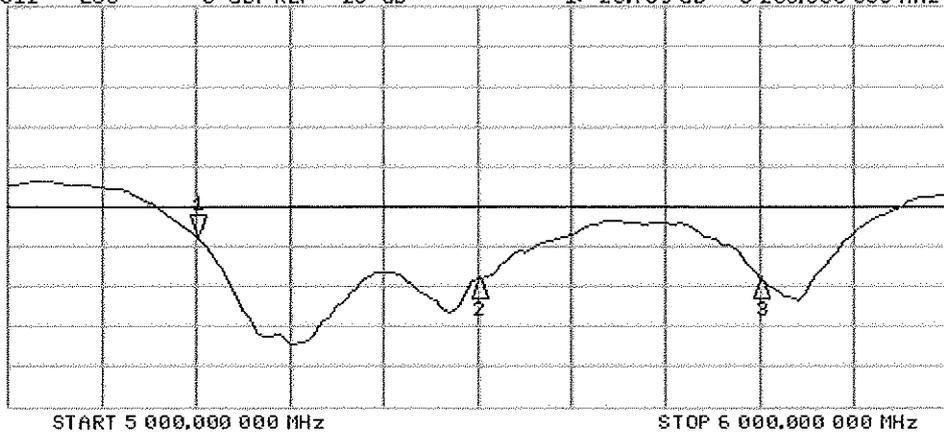
*
Del
Cor
Avg
16
H1d



CH1 Markers
2: 51.904 Ω
-3.1094 Ω
5.50000 GHz
3: 52.885 Ω
2.3047 Ω
5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1:-23.759 dB 5 200.000 000 MHz

Cor
Avg
16
H1d



CH2 Markers
2:-28.921 dB
5.50000 GHz
3:-28.897 dB
5.80000 GHz

DASY5 Validation Report for Body TSL

Date: 31.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1120

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
Medium parameters used: $f = 5200$ MHz; $\sigma = 5.46$ mho/m; $\epsilon_r = 49.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.86$ mho/m; $\epsilon_r = 48.7$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.28$ mho/m; $\epsilon_r = 48.2$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91), ConvF(4.43, 4.43, 4.43), ConvF(4.38, 4.38, 4.38); Calibrated: 30.12.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 57.518 V/m; Power Drift = -0.008 dB

Peak SAR (extrapolated) = 28.3990

SAR(1 g) = 7.21 mW/g; SAR(10 g) = 2.03 mW/g

Maximum value of SAR (measured) = 16.537 mW/g

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.605 V/m; Power Drift = -0.0017 dB

Peak SAR (extrapolated) = 34.4630

SAR(1 g) = 7.98 mW/g; SAR(10 g) = 2.22 mW/g

Maximum value of SAR (measured) = 19.105 mW/g

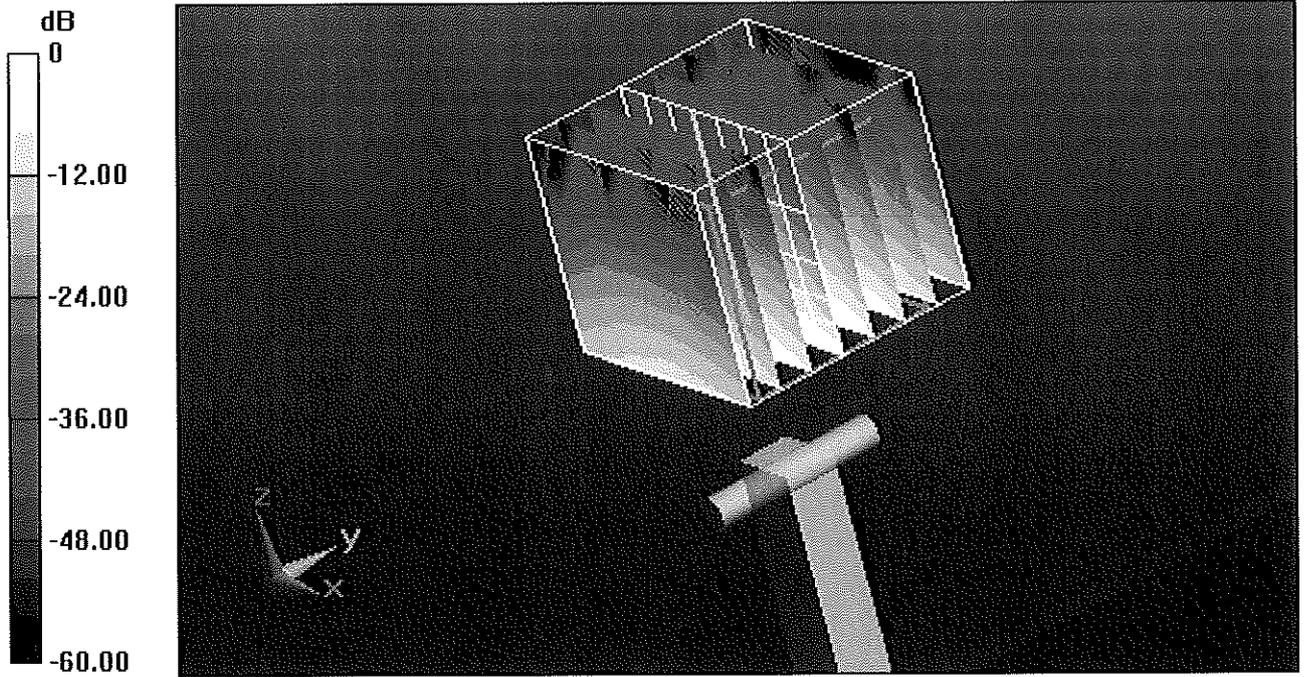
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 54.867 V/m; Power Drift = 0.0057 dB

Peak SAR (extrapolated) = 34.2880

SAR(1 g) = 7.37 mW/g; SAR(10 g) = 2.04 mW/g

Maximum value of SAR (measured) = 17.882 mW/g



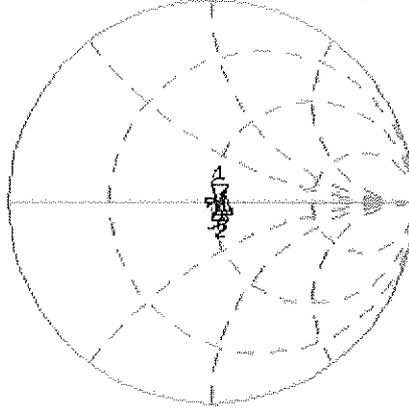
0 dB = 17.880mW/g = 25.05 dB mW/g

Impedance Measurement Plot for Body TSL

31 Jan 2012 17:04:49

[CH1] S11 1 U FS 1: 53.781 Ω -2.6582 Ω 11.514 pF 5 200.000 000 MHz

*
De1
Cor



CH1 Markers
2: 53.338 Ω
1.1406 Ω
5.50000 GHz
3: 55.191 Ω
3.9453 Ω
5.80000 GHz

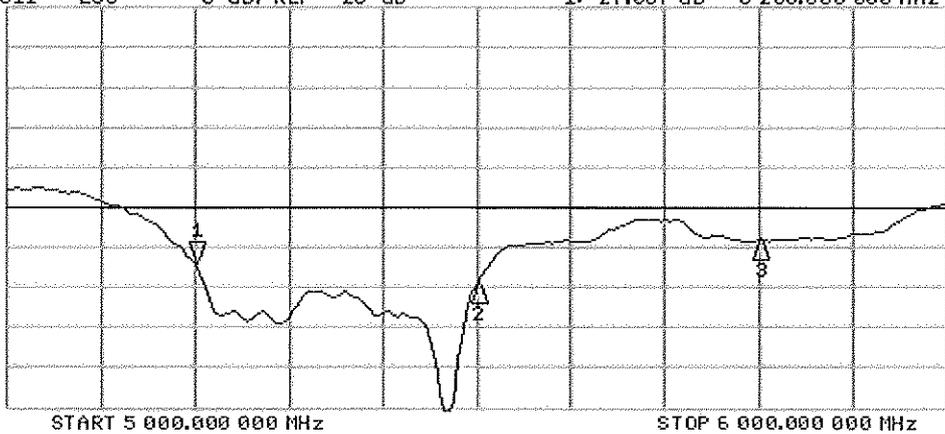
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -27.037 dB 5 200.000 000 MHz

Cor

Avg
16

H1d



CH2 Markers
2: -29.403 dB
5.50000 GHz
3: -24.115 dB
5.80000 GHz

START 5 000.000 000 MHz

STOP 6 000.000 000 MHz



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: **D5GHzV2-1007_Oct12**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1007**

Calibration procedure(s) **QA CAL-22.v1**
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: **October 30, 2012**

KOK
11/15/12

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 EX3DV4	SN: 3503	30-Dec-11 (No. EX3-3503_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-12)	In house check: Oct-13

Calibrated by: **Israe El-Naouq** Name: **Israe El-Naouq** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Name: **Katja Pokovic** Function: **Technical Manager**

Signature
Israe El-Naouq
Katja Pokovic

Issued: October 31, 2012

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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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:

- IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- 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:

- 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	V52.8.3
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.8 ± 6 %	4.53 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.9 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.63 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.9 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	4.83 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.9 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.44 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.1 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	4.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.5 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.0 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.0 ± 6 %	5.15 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.41 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	73.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.6 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.7 ± 6 %	5.52 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.63 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	5.78 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.92 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	78.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.8 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.2 ± 6 %	5.90 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	45.9 ± 6 %	6.18 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.6 W/kg ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	55.1 Ω - 11.2 j Ω
Return Loss	- 18.7 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	56.8 Ω - 1.2 j Ω
Return Loss	- 23.8 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	49.5 Ω - 4.3 j Ω
Return Loss	- 27.3 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	59.3 Ω - 7.4 j Ω
Return Loss	- 19.3 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	57.2 Ω + 5.4 j Ω
Return Loss	- 21.6 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	52.1 Ω - 10.0 j Ω
Return Loss	- 20.1 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	55.6 Ω - 3.0 j Ω
Return Loss	- 24.4 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	50.1 Ω - 3.3 j Ω
Return Loss	- 29.5 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	57.6 Ω - 6.2 j Ω
Return Loss	- 20.8 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	59.7 Ω + 4.5 j Ω
Return Loss	- 20.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 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	August 28, 2003

DASY5 Validation Report for Head TSL

Date: 30.10.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1007

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz,
Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.53$ mho/m; $\epsilon_r = 34.8$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.63$ mho/m; $\epsilon_r = 34.7$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.83$ mho/m; $\epsilon_r = 34.4$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.93$ mho/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.15$ mho/m; $\epsilon_r = 34$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 30.12.2011, ConvF(5.1, 5.1, 5.1); Calibrated: 30.12.2011, ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2011, ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2011, ConvF(4.81, 4.81, 4.81); Calibrated: 30.12.2011;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.518 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 29.8 W/kg

SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.31 W/kg

Maximum value of SAR (measured) = 18.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.964 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 31.8 W/kg

SAR(1 g) = 8.38 W/kg; SAR(10 g) = 2.41 W/kg

Maximum value of SAR (measured) = 19.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.435 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 33.8 W/kg

SAR(1 g) = 8.56 W/kg; SAR(10 g) = 2.44 W/kg

Maximum value of SAR (measured) = 20.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.179 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 33.9 W/kg

SAR(1 g) = 8.53 W/kg; SAR(10 g) = 2.43 W/kg

Maximum value of SAR (measured) = 20.4 W/kg

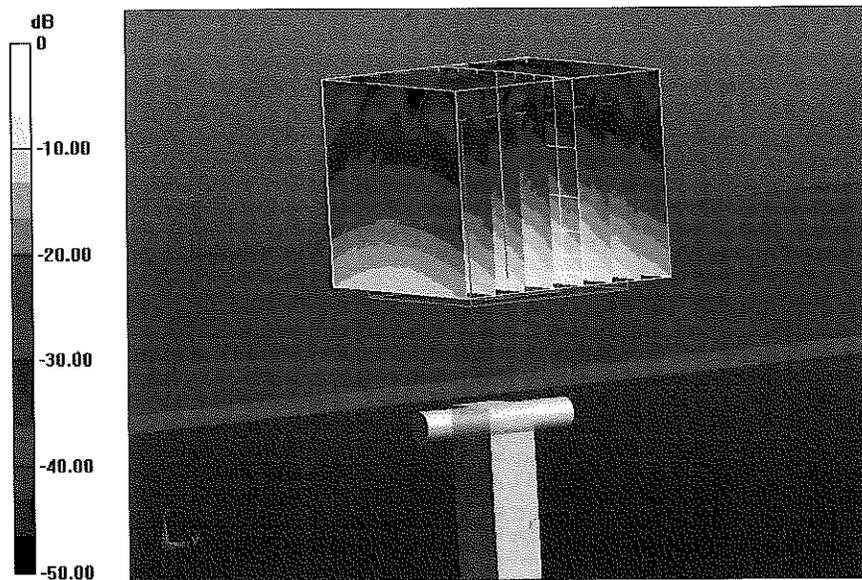
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 61.223 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 33.5 W/kg

SAR(1 g) = 8.05 W/kg; SAR(10 g) = 2.29 W/kg

Maximum value of SAR (measured) = 19.6 W/kg



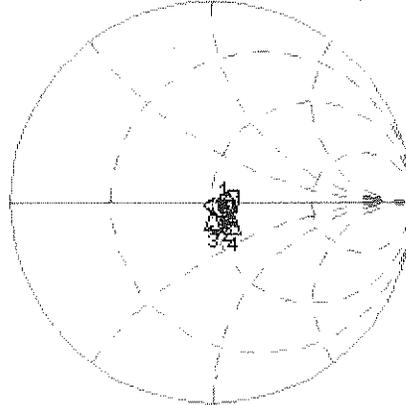
0 dB = 19.6 W/kg = 12.92 dBW/kg

Impedance Measurement Plot for Head TSL

30 Oct 2012 11:43:37

CH1 S11 1 U FS 1: 55.082 Ω -11.236 Ω 2.7239 pF 5 200.000 000 MHz

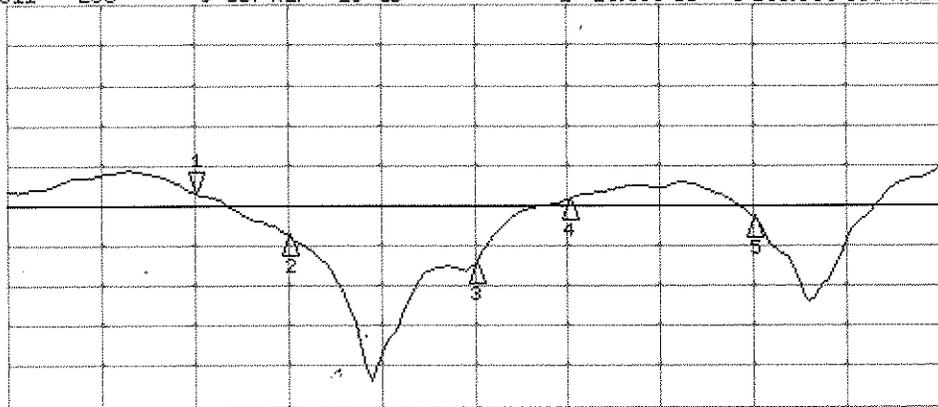
*
Del
Cor
Avg
16
H1d



CH1 Markers
2: 56.760 Ω
-1.2324 Ω
5.30000 GHz
3: 49.537 Ω
-4.2871 Ω
5.50000 GHz
4: 59.338 Ω
-7.4336 Ω
5.60000 GHz
5: 57.160 Ω
5.3867 Ω
5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -18.659 dB 5 200.000 000 MHz

Cor
Avg
16
H1d



CH2 Markers
2: -23.826 dB
5.30000 GHz
3: -27.278 dB
5.50000 GHz
4: -19.256 dB
5.60000 GHz
5: -21.566 dB
5.80000 GHz

START 5 000.000 000 MHz

STOP 6 000.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 30.10.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1007

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: f = 5200 MHz; $\sigma = 5.41$ mho/m; $\epsilon_r = 46.8$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5300 MHz; $\sigma = 5.52$ mho/m; $\epsilon_r = 46.7$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5500 MHz; $\sigma = 5.78$ mho/m; $\epsilon_r = 46.3$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5600 MHz; $\sigma = 5.9$ mho/m; $\epsilon_r = 46.2$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5800 MHz; $\sigma = 6.18$ mho/m; $\epsilon_r = 45.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2011, ConvF(4.67, 4.67, 4.67); Calibrated: 30.12.2011, ConvF(4.43, 4.43, 4.43); Calibrated: 30.12.2011, ConvF(4.22, 4.22, 4.22); Calibrated: 30.12.2011, ConvF(4.38, 4.38, 4.38); Calibrated: 30.12.2011;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.3(988); SEMCAD X.14.6.7(6848)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.536 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 29.4 W/kg

SAR(1 g) = 7.4 W/kg; SAR(10 g) = 2.08 W/kg

Maximum value of SAR (measured) = 17.6 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.637 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 31.3 W/kg

SAR(1 g) = 7.63 W/kg; SAR(10 g) = 2.14 W/kg

Maximum value of SAR (measured) = 18.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.216 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 34.4 W/kg

SAR(1 g) = 7.92 W/kg; SAR(10 g) = 2.21 W/kg

Maximum value of SAR (measured) = 19.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.347 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 35.9 W/kg

SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.25 W/kg

Maximum value of SAR (measured) = 19.9 W/kg

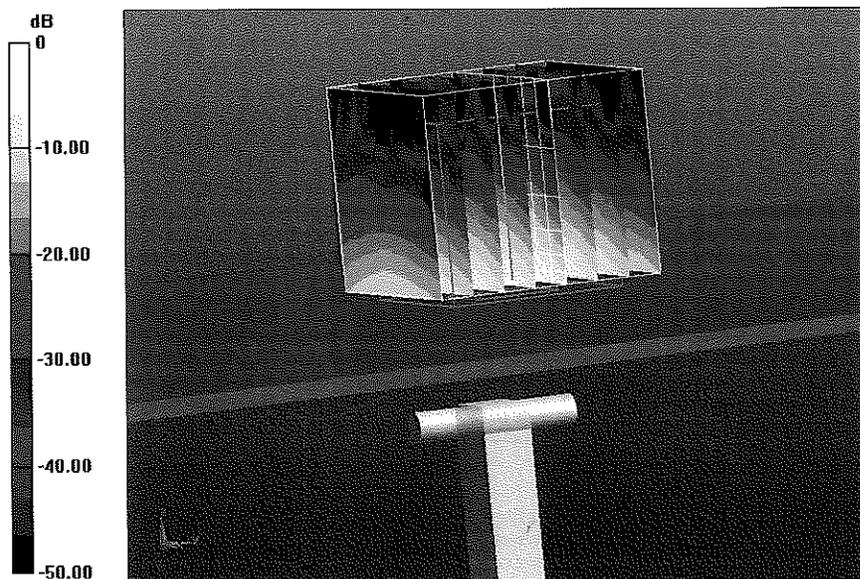
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 55.261 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 35.4 W/kg

SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.08 W/kg

Maximum value of SAR (measured) = 18.9 W/kg



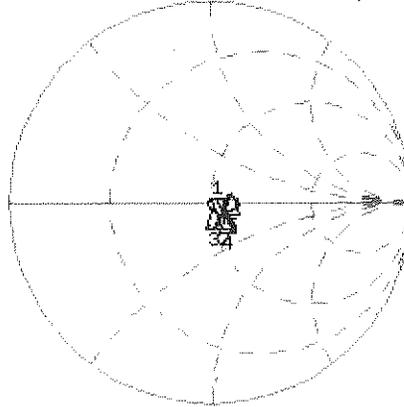
0 dB = 18.9 W/kg = 12.76 dBW/kg

Impedance Measurement Plot for Body TSL

30 Oct 2012 11:02:08

CH1 S11 1 U FS 1: 52.068 Ω -9.9570 Ω 3.0739 pF 5 200.000 000 MHz

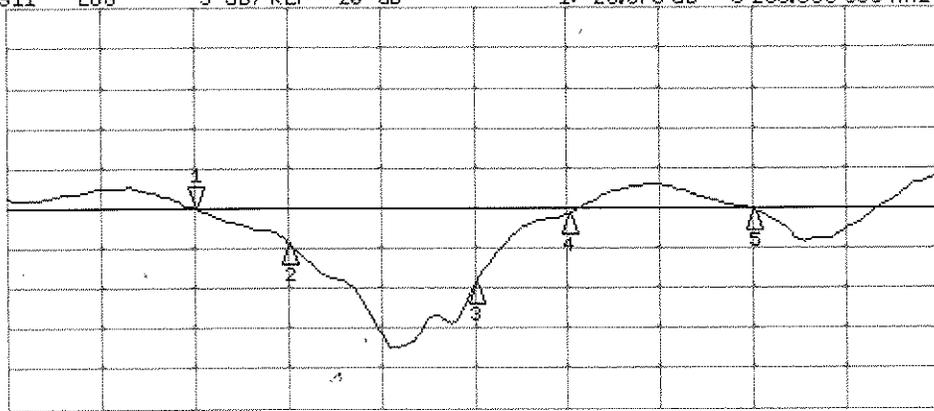
*
De1
Cor
Avg
16
H1d



CH1 Markers
2: 55.563 Ω
-3.0234 Ω
5.30000 GHz
3: 50.104 Ω
-3.3438 Ω
5.50000 GHz
4: 57.613 Ω
-6.1699 Ω
5.60000 GHz
5: 59.734 Ω
4.4648 Ω
5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -20.070 dB 5 200.000 000 MHz

Cor
Avg
16
H1d



CH2 Markers
2: -24.438 dB
5.30000 GHz
3: -29.525 dB
5.50000 GHz
4: -20.822 dB
5.60000 GHz
5: -20.219 dB
5.80000 GHz

START 5 000.000 000 MHz

STOP 6 000.000 000 MHz