PCTEST ENGINEERING LABORATORY, INC.
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. +1.410.290.6652 / Fax +1.410.290.6654
http://www.pctestlab.com

SAR EVALUATION REPORT

Applicant Name:
Samsung Electronics, Co. Ltd.
129, Samsung-ro, Maetan dong,
Yeongtong-gu, Suwon-si
Gyeonggi-do 443-742, Korea

Date of Testing:
08/11/14 - 08/20/14
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1408081662.A3L

FCC ID: **A3LSMN9109W**

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

DUT Type: Portable Handset
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): SM-N9109W

Equipment Class	Band & Mode	Tx Frequency	SAR			
			1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Hotspot (W/kg)	10 gm Extremity (W/kg)
PCE	GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	< 0.1	0.40	0.40	
PCE	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	0.19	0.30	0.51	
PCE	UMTS 850	826.40 - 846.60 MHz	< 0.1	0.28	0.28	
PCE	UMTS 1900	1852.4 - 1907.6 MHz	0.22	0.35	0.65	
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.17	0.14	0.14	
DTS	5.8 GHz WLAN	5745 - 5825 MHz	< 0.1	0.12		0.21
NII	5.2 GHz WLAN	5180 - 5240 MHz	0.11	0.15		0.33
NII	5.3 GHz WLAN	5260 - 5320 MHz	< 0.1	0.13		0.27
NII	5.5 GHz WLAN	5500 - 5700 MHz	< 0.1	0.10		0.16
DSS/DTS	Bluetooth	2402 - 2480 MHz	N/A			N/A
Simultaneous SAR per KDB 690783 D01v01r03:			0.38	0.61	0.65	0.33

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

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

Randy Ortanez
President

The SAR Tick is an initiative of the Mobile Manufacturers Forum (MMF). While a product may be considered eligible, use of the SAR Tick logo requires an agreement with the MMF. Further details can be obtained by emailing: sartick@mmfai.info.

© 2014 PCTEST Engineering Laboratory, Inc.

TABLE OF CONTENTS

1 DEVICE UNDER TEST 3

2 INTRODUCTION 10

3 DOSIMETRIC ASSESSMENT 11

4 DEFINITION OF REFERENCE POINTS 12

5 TEST CONFIGURATION POSITIONS FOR HANDSETS 13

6 RF EXPOSURE LIMITS 16

7 FCC MEASUREMENT PROCEDURES 17

8 RF CONDUCTED POWERS 21

9 SYSTEM VERIFICATION 33

10 SAR DATA SUMMARY 36

11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS 44

12 SAR MEASUREMENT VARIABILITY 52

13 EQUIPMENT LIST 53

14 MEASUREMENT UNCERTAINTIES 54

15 CONCLUSION 56

16 REFERENCES 57

APPENDIX A: SAR TEST PLOTS

APPENDIX B: SAR DIPOLE VERIFICATION PLOTS

APPENDIX C: PROBE AND DIPOLE CALIBRATION CERTIFICATES

APPENDIX D: SAR TISSUE SPECIFICATIONS

APPENDIX E: SAR SYSTEM VALIDATION

APPENDIX F: SAR TEST SETUP PHOTOGRAPHS

© 2014 PCTEST Engineering Laboratory, Inc.

1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE 850	Voice/Data	824.20 - 848.80 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
5.8 GHz WLAN	Data	5745 - 5825 MHz
5.2 GHz WLAN	Data	5180 - 5240 MHz
5.3 GHz WLAN	Data	5260 - 5320 MHz
5.5 GHz WLAN	Data	5500 - 5700 MHz
Bluetooth	Data	2402 - 2480 MHz
NFC	Data	13.56 MHz
ANT+	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		Voice (dBm)	Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slot	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*
GSM/GPRS/EDGE 850	Maximum	**33.0**	**33.0**	**30.0**	**29.0**	**27.0**	**26.5**	**26.5**	**23.0**	**23.0**
	Nominal	**32.5**	**32.5**	**29.5**	**28.5**	**26.5**	**26.0**	**26.0**	**22.5**	**22.5**
GSM/GPRS/EDGE 1900 Master	Maximum	**30.0**	**30.0**	**27.5**	**25.5**	**24.0**	**26.0**	**26.0**	**22.5**	**22.5**
	Nominal	**29.5**	**29.5**	**27.0**	**25.0**	**23.5**	**25.5**	**25.5**	**22.0**	**22.0**
GSM/GPRS 1900 Slave	Maximum	**30.0**	**30.0**	**27.5**	**26.0**	**24.0**	**-**	**-**	**-**	**-**
	Nominal	**29.5**	**29.5**	**27.0**	**25.5**	**23.5**	**-**	**-**	**-**	**-**

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

© 2014 PCTEST Engineering Laboratory, Inc.

Antenna 1 and Antenna 2:

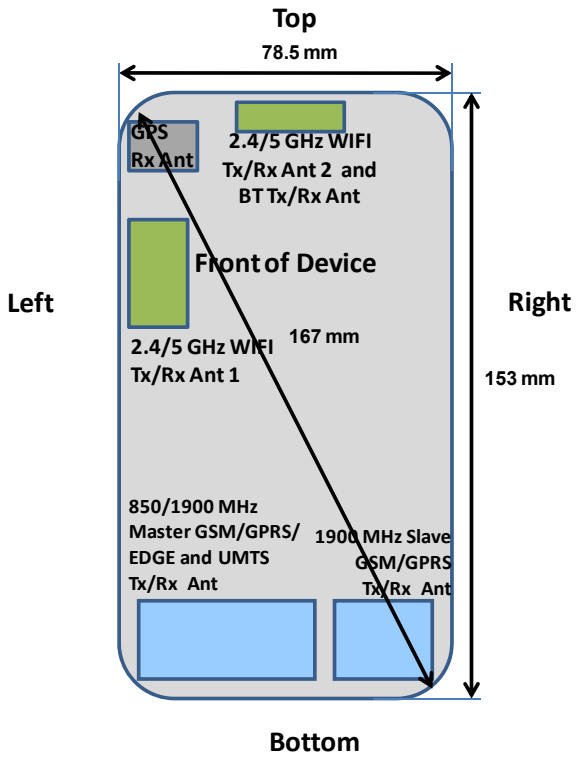
Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	**17.5**
	Nominal	**17.0**
IEEE 802.11g (2.4 GHz)	Maximum	**14.5**
	Nominal	**14.0**
IEEE 802.11n (2.4 GHz)	Maximum	**13.5**
	Nominal	**13.0**
IEEE 802.11a (5 GHz)	Maximum	**12.5**
	Nominal	**12.0**
IEEE 802.11n (5 GHz, 20 MHz BW)	Maximum	**11.5**
	Nominal	**11.0**
IEEE 802.11n (5 GHz, 40 MHz BW)	Maximum	**10.5**
	Nominal	**10.0**
IEEE 802.11ac (5 GHz, 80 MHz BW)	Maximum	**8.5**
	Nominal	**8.0**
Bluetooth	Maximum	**10.0**
	Nominal	**9.5**
Bluetooth LE	Maximum	**6.5**
	Nominal	**6.0**

MIMO:

Mode / Band		Modulated Average (dBm)
IEEE 802.11n (2.4 GHz)	Maximum	**16.0**
	Nominal	**15.5**
IEEE 802.11n (5 GHz, 20 MHz BW)	Maximum	**14.5**
	Nominal	**14.0**
IEEE 802.11n (5 GHz, 40 MHz BW)	Maximum	**13.5**
	Nominal	**13.0**
IEEE 802.11ac (5 GHz, 80 MHz BW)	Maximum	**11.5**
	Nominal	**11.0**

© 2014 PCTEST Engineering Laboratory, Inc.

1.3 DUT Antenna Locations



Note: Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC Filing. Since the diagonal dimension of this device is > 160 mm and <200 mm, it is considered a "phablet.".

Figure 1-1
DUT Antenna Locations

Table 1-1
Sides for SAR Testing

Mode	Configuration	Back	Front	Top	Bottom	Right	Left
GPRS 850	Hotspot	Yes	Yes	No	Yes	No	Yes
GPRS 1900 Master	Hotspot	Yes	Yes	No	Yes	No	Yes
GPRS 1900 Slave	Hotspot	Yes	Yes	No	Yes	Yes	No
UMTS 850	Hotspot	Yes	Yes	No	Yes	No	Yes
UMTS 1900	Hotspot	Yes	Yes	No	Yes	No	Yes
2.4 GHz WLAN Ant 1	Hotspot	Yes	Yes	Yes	No	No	Yes
2.4 GHz WLAN Ant 2	Hotspot	Yes	Yes	Yes	No	No	Yes
2.4 GHz WLAN MIMO	Hotspot	Yes	Yes	Yes	No	No	Yes
5 GHz WLAN Ant 1	Extremity	Yes	Yes	Yes	No	No	Yes
5 GHz WLAN Ant 2	Extremity	Yes	Yes	Yes	No	No	Yes
5 GHz WLAN MIMO	Extremity	Yes	Yes	Yes	No	No	Yes

Note: Particular DUT edges were not required to be evaluated for Wireless Router SAR or Extremity SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v01 guidance, page 2 and FCC KDB 648474 D04v01r01. The distances between the transmit antennas and the edges of the device are included in the filing.

© 2014 PCTEST Engineering Laboratory, Inc.

1.4 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the specialized battery. The SAR tests were performed with the specialized battery (model: EB-BN916BBC).

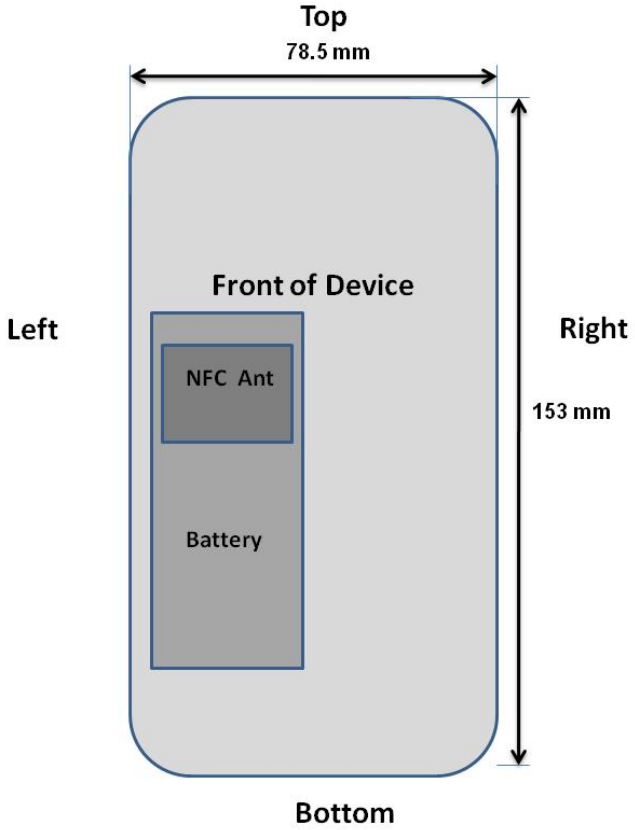


Figure 1-2
NFC Antenna Locations

© 2014 PCTEST Engineering Laboratory, Inc.

1.5 Simultaneous Transmission Capabilities

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

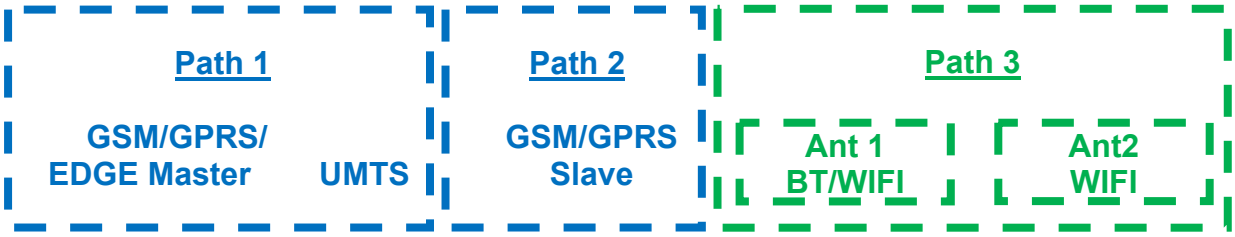


Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body-Worn Accessory	Wireless Router	Extremity
1	GSM voice + 2.4 GHz WI-FI	Yes	Yes	N/A	Yes
2	GSM voice + 5 GHz WI-FI	Yes	Yes	N/A	Yes
3	GSM voice + 2.4 GHz Bluetooth	N/A	Yes	N/A	Yes
4	UMTS + 2.4 GHz WI-FI	Yes	Yes	Yes	Yes
5	UMTS + 5 GHz WI-FI	Yes	Yes	N/A	Yes
6	UMTS + 2.4 GHz Bluetooth	N/A	Yes	N/A	Yes
7	GPRS/EDGE + 2.4 GHz WI-FI	N/A	N/A	Yes	Yes
8	GPRS/EDGE + 5 GHz WI-FI	N/A	N/A	N/A	Yes

1. 2.4 GHz WLAN, 5 GHz WLAN, and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously.
2. This model does not support DSDA (Master and Slave Antenna cannot transmit simultaneously).
3. When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.
4. Per the manufacturer, WIFI Direct is not expected to be used in conjunction with a held-to-ear or body-worn accessory voice call. Therefore, there are no simultaneous transmission scenarios involving WIFI direct beyond that listed in the above table.
5. When wireless router mode is enabled, all 5GHz bands are disabled.
6. This device supports 2x2 MIMO Tx for WLAN 802.11n/ac. Each WLAN antenna can transmit independently or together when operating with MIMO.

© 2014 PCTEST Engineering Laboratory, Inc.

1.6 SAR Test Exclusions Applied

(A) WIFI/BT

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

Per FCC KDB 447498 D01v05, the 1g SAR exclusion threshold for distances <50mm is defined by the following equation:

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

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, body-worn Bluetooth SAR was not required; [(10/10)* √2.480] = 1.6< 3.0. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

Per FCC KDB 447498 D01v05, the 10g SAR exclusion threshold for distances <50mm is defined by the following equation:

$$\frac{Max\ Power\ of\ Channel\ (mW)}{Test\ Separation\ Dist\ (mm)} * \sqrt{Frequency(GHz)} \leq 7.5$$

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, extremity Bluetooth SAR was not required; [(10/ 5)* √2.480] = 3.1< 7.5. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

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

This device supports IEEE 802.11ac with the following features:

a) Up to 80 MHz Bandwidth only
b) No aggregate channel configurations
c) 2 Tx antenna output
d) 256 QAM is supported
e) No new 5 GHz channels

Per FCC KDB Publication 648474 D04v01r01, this device is considered a "phablet" since the diagonal dimension is greater than 160mm and less than 200mm. Extremity SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg. Because wireless router operations are not supported for 5 GHz WLAN, extremity SAR tests were performed. Extremity SAR was not evaluated for 2.4 GHz WLAN operations since wireless router 1g SAR was < 1.2 W/kg.

© 2014 PCTEST Engineering Laboratory, Inc.

(B) Licensed Transmitter(s)

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

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

Per FCC KDB Publication 648474 D04v01r01, this device is considered a "phablet" since the diagonal dimension is greater than 160mm and less than 200mm. Therefore, extremity SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg. Extremity SAR was not evaluated for licensed technologies since wireless router 1g SAR was < 1.2 W/kg for these modes.

1.7 Power Reduction for SAR

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

1.8 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D01v02, D03v01, D06v01r01 (2G/3G and Hotspot)
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r03, D02v01r01 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 648474 D03-D04 (Phablet Procedures)
- April 2013 TCB Workshop Notes (IEEE 802.11ac)
- October 2013 TCB Workshop Notes (GPRS Testing Considerations)

1.9 Device Serial Numbers

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

.

	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number	Extremity Serial Number
GSM/GPRS/EDGE 850	707A1	707A1	707A1	-
GSM/GPRS/EDGE 1900	707A1	707A1	707A1	-
UMTS 850	707AC	707AC	707AC	-
UMTS 1900	707AC	707AC	707AC	-
2.4 GHz WLAN	707A1	707A1	707A1	-
5 GHz WLAN	707A1	707AF	-	707A1

© 2014 PCTEST Engineering Laboratory, Inc.

2 INTRODUCTION

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

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [22]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

2.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 2-1).

Equation 2-1
SAR Mathematical Equation

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

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

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

where:

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

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

© 2014 PCTEST Engineering Laboratory, Inc.

3 DOSIMETRIC ASSESSMENT

3.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01 and IEEE 1528-2013:

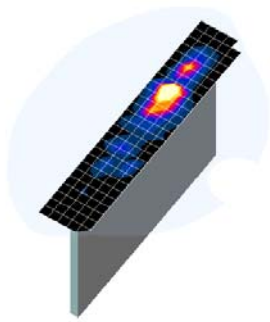


Figure 3-1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01 (See Table 3-1) and IEEE 1528-2013.
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 3-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):
   a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 3-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

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

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

*Also compliant to IEEE 1528-2013 Table 6

© 2014 PCTEST Engineering Laboratory, Inc.

4 DEFINITION OF REFERENCE POINTS

4.1 EAR REFERENCE POINT

Figure 4-2 shows the front, back and side views of the SAM Twin Phantom. The point "M" is the reference point for the center of the mouth, "LE" is the left ear reference point (ERP), and "RE" is the right ERP. The ERP is 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 4-1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front), also called the Reference Pivoting Line, is not perpendicular to the reference plane (see Figure 4-1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].

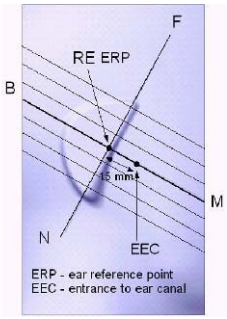


Figure 4-1
Close-Up Side view of ERP

4.2 HANDSET REFERENCE POINTS

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

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

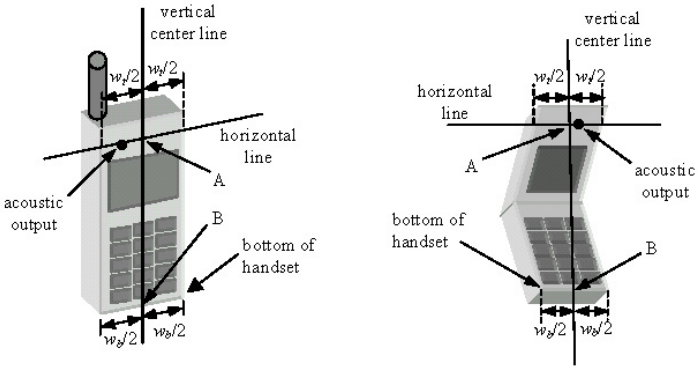


Figure 4-3
Handset Vertical Center & Horizontal Line Reference Points

© 2014 PCTEST Engineering Laboratory, Inc.

5 TEST CONFIGURATION POSITIONS FOR HANDSETS

5.1 Device Holder

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

5.2 Positioning for Cheek

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

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

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

5.3 Positioning for Ear / 15º Tilt

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

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15degrees.
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. In this situation, the tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 5-2).

© 2014 PCTEST Engineering Laboratory, Inc.

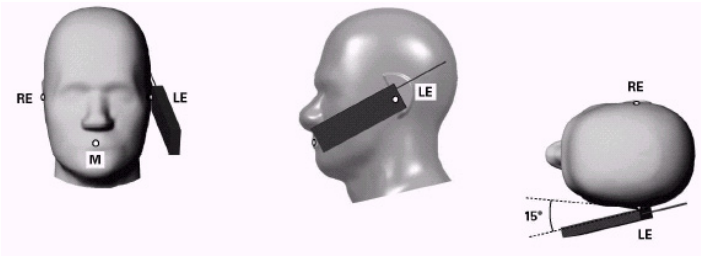


Figure 5-2 Front, Side and Top View of Ear/15º Tilt Position

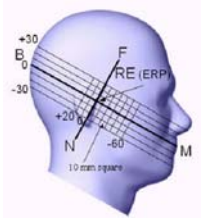


Figure 5-3
Side view w/ relevant markings

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

Antennas located near the bottom of a phone may require SAR measurements around the mouth and jaw regions of the SAM head phantom. This typically applies to clam-shell style phones that are generally longer in the unfolded normal use positions or to certain older style long rectangular phones. Per IEEE 1528-2013, a rotated SAM phantom is necessary to allow probe access to such regions. Both SAM heads of the TwinSAM-Chin20 are rotated 20 degrees around the NF line. Each head can be removed from the table for emptying and cleaning.

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.

5.5 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 5-4). Per FCC KDB Publication 648474 D04v01, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v05 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

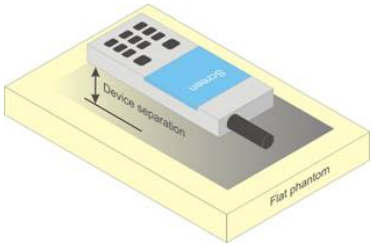


Figure 5-4
Sample Body-Worn Diagram

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories

© 2014 PCTEST Engineering Laboratory, Inc.

that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

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

5.6 Extremity Exposure Configurations

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

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

5.7 Wireless Router Configurations

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

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

© 2014 PCTEST Engineering Laboratory, Inc.

6 RF EXPOSURE LIMITS

6.1 Uncontrolled Environment

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

6.2 Controlled Environment

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

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

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

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

© 2014 PCTEST Engineering Laboratory, Inc.

7 FCC MEASUREMENT PROCEDURES

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

7.1 Measured and Reported SAR

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

7.2 Procedures Used to Establish RF Signal for SAR

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

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

7.3 SAR Measurement Conditions for UMTS

7.3.1 Output Power Verification

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

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

7.3.2 Head SAR Measurements for Handsets

SAR for head exposure configurations is measured using the 12.2 kbps RMC with TPC bits configured to all “1s”. SAR in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than 0.25 dB higher than that measured in 12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a

© 2014 PCTEST Engineering Laboratory, Inc.

3.4 kbps SRB (signaling radio bearer) using the exposure configuration that resulted in the highest SAR for that RF channel in the 12.2 kbps RMC mode.

7.3.3 Body SAR Measurements

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

7.3.4 SAR Measurements for Handsets with Rel 5 HSDPA

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

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

Sub-Test	β_c	β_d	β_d *(SF)*	β_c/β_d	β_{HS} *(Note1, Note 2)*	CM (dB) *(Note 3)*	MPR (dB) *(Note 3)*
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 *(Note 4)*	15/15 *(Note 4)*	64	12/15 *(Note 4)*	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

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

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

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

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

7.3.5 SAR Measurements for Handsets with Rel 6 HSUPA

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

© 2014 PCTEST Engineering Laboratory, Inc.

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

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs}(1)	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM(2) (dB)	MPR (dB)	AG(4) Index	E-TFCI
1	11/15(3)	15/15(3)	64	11/15(3)	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}: 47/15 β_{ed2}: 47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15(4)	15/15(4)	64	15/15(4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

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

7.4 SAR Testing with 802.11 Transmitters

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

7.4.1 General Device Setup

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

7.4.2 Frequency Channel Configurations [24]

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.

© 2014 PCTEST Engineering Laboratory, Inc.

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

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

7.4.3 MIMO SAR considerations

Per KDB 248227, SAR for MIMO was measured with both transmitting simultaneously and was evaluated independently of SISO operation. For 2.4 and 5 GHz MIMO, 802.11n 20 MHz was evaluated. Other IEEE 802.11 modes and bandwidths were not investigated for MIMO operations since the maximum allowed output power (including tolerance) was not higher for these modes.

© 2014 PCTEST Engineering Laboratory, Inc.

8 RF CONDUCTED POWERS

8.1 GSM Conducted Powers

		Maximum Burst-Averaged Output Power								
		Voice	*GPRS/EDGE Data (GMSK)*				*EDGE Data (8-PSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**	**EDGE [dBm] 1 Tx Slot**	**EDGE [dBm] 2 Tx Slot**	**EDGE [dBm] 3 Tx Slot**	**EDGE [dBm] 4 Tx Slot**
GSM 850	128	32.34	32.37	29.90	**28.58**	26.50	26.03	25.95	22.83	22.40
	190	32.54	32.58	29.87	**28.45**	26.44	25.90	25.84	22.60	22.30
	251	32.52	32.55	30.00	**28.34**	26.60	26.00	25.97	22.73	22.50
GSM 1900 Master	512	29.02	29.20	27.04	**25.00**	23.77	25.50	25.28	22.33	22.10
	661	29.34	29.50	27.06	**24.99**	23.70	25.50	25.29	22.20	22.07
	810	29.60	29.77	27.20	**25.04**	23.66	25.64	25.45	22.29	22.22

		Calculated Maximum Frame-Averaged Output Power								
		Voice	*GPRS/EDGE Data (GMSK)*				*EDGE Data (8-PSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**	**EDGE [dBm] 1 Tx Slot**	**EDGE [dBm] 2 Tx Slot**	**EDGE [dBm] 3 Tx Slot**	**EDGE [dBm] 4 Tx Slot**
GSM 850	128	23.31	23.34	23.88	**24.32**	23.49	17.00	19.93	18.57	19.39
	190	23.51	23.55	23.85	**24.19**	23.43	16.87	19.82	18.34	19.29
	251	23.49	23.52	23.98	**24.08**	23.59	16.97	19.95	18.47	19.49
GSM 1900 Master	512	19.99	20.17	21.02	**20.74**	20.76	16.47	19.26	18.07	19.09
	661	20.31	20.47	21.04	**20.73**	20.69	16.47	19.27	17.94	19.06
	810	20.57	20.74	21.18	**20.78**	20.65	16.61	19.43	18.03	19.21

GSM 850	**Frame Avg.Targets:**	23.47	23.47	23.48	**24.24**	23.49	16.97	19.98	18.24	19.49
GSM 1900 Master		20.47	20.47	20.98	**20.74**	20.49	16.47	19.48	17.74	18.99

© 2014 PCTEST Engineering Laboratory, Inc.

		Maximum Burst-Averaged Output Power				
		Voice	*GPRS Data (GMSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**
GSM 1900 Slave	512	29.30	29.30	27.28	**25.75**	23.45
	661	29.20	29.24	27.19	**25.65**	23.37
	810	29.37	29.41	27.35	**25.80**	23.47
Calculated Maximum Frame-Averaged Output Power						
		Voice	*GPRS Data (GMSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**
GSM 1900 Slave	512	20.27	20.27	21.26	**21.49**	20.44
	661	20.17	20.21	21.17	**21.39**	20.36
	810	20.34	20.38	21.33	**21.54**	20.46
GSM 1900 Slave	**Frame Avg.Targets:**	20.47	20.47	20.98	**21.24**	20.49

Note:

1. Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
2. The source-based frame-averaged output power was evaluated for all GPRS/EDGE slot configurations. The configuration with the highest target frame averaged output power was evaluated for hotspot SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
3. GPRS/EDGE (GMSK) output powers were measured with coding scheme setting of 1 (CS1) on the base station simulator. CS1 was configured to measure GPRS output power measurements and SAR to ensure GMSK modulation in the signal. Our Investigation has shown that CS1 - CS4 settings do not have any impact on the output levels or modulation in the GPRS modes.
4. EDGE (8-PSK) output powers were measured with MCS7 on the base station simulator. MCS7 coding scheme was used to measure the output powers for EDGE since investigation has shown that choosing MCS7 coding scheme will ensure 8-PSK modulation. It has been shown that MCS levels that produce 8PSK modulation do not have an impact on output power.

Master and Slave GSM Class: B
Master GPRS Multislot class: 33 (Max 4 Tx uplink slots)
Slave GPRS Multislot class: 12 (Max 4 Tx uplink slots)
Master EDGE Multislot class: 33 (Max 4 Tx uplink slots)
Slave EDGE Multislot class: N/A
Master and Slave DTM Multislot Class: N/A

Figure 8-1
Power Measurement Setup

© 2014 PCTEST Engineering Laboratory, Inc.

8.2 UMTS Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	22.75	22.72	22.70	22.92	22.92	22.95	-
99		12.2 kbps AMR	22.70	22.69	22.75	22.98	22.96	22.97	-
6	HSDPA	Subtest 1	22.19	22.33	22.45	22.57	22.66	22.74	0
6		Subtest 2	22.18	22.31	22.61	22.61	22.59	22.85	0
6		Subtest 3	21.72	21.78	22.07	21.99	22.05	22.28	0.5
6		Subtest 4	21.69	21.71	21.93	21.88	21.97	22.21	0.5
6	HSUPA	Subtest 1	21.85	22.00	22.31	22.04	22.06	22.13	0
6		Subtest 2	21.00	21.17	21.34	21.51	21.62	21.49	2
6		Subtest 3	21.01	21.10	21.35	21.60	21.66	21.74	1
6		Subtest 4	21.22	21.26	21.51	21.73	21.69	21.72	2
6		Subtest 5	22.14	22.22	22.39	22.52	22.58	22.63	0

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

This device does not support DC-HSDPA.

It is expected by the manufacturer that MPR for some HSPA subtests may as low as 0 dB according to the chipset implementation in this model.

Figure 8-2
Power Measurement Setup

© 2014 PCTEST Engineering Laboratory, Inc.

8.3 WLAN Conducted Powers

Table 8-1
IEEE 802.11b Average RF Power – Antenna 1

Mode	Freq [MHz]	Channel	802.11b Conducted Power [dBm]			
			Data Rate [Mbps]			
			1	2	5.5	11
802.11b	2412	1*	16.45	16.65	16.52	16.60
802.11b	2437	6*	16.24	16.41	16.38	16.43
802.11b	2462	11*	**17.08**	17.22	17.24	17.26

Table 8-2
IEEE 802.11b Average RF Power – Antenna 2

Mode	Freq [MHz]	Channel	802.11b Conducted Power [dBm]			
			Data Rate [Mbps]			
			1	2	5.5	11
802.11b	2412	1*	16.26	16.49	16.48	16.42
802.11b	2437	6*	**16.99**	17.20	17.22	17.12
802.11b	2462	11*	16.17	16.32	16.25	16.34

Table 8-3
IEEE 802.11g Average RF Power – Antenna 1

Mode	Freq [MHz]	Channel	802.11g Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11g	2412	1	13.69	13.67	13.72	13.73	14.09	13.92	13.99	13.72
802.11g	2437	6	12.79	12.83	12.82	12.85	13.16	12.99	13.04	12.81
802.11g	2462	11	13.59	13.57	13.57	13.55	13.89	13.78	13.95	13.60

Table 8-4
IEEE 802.11g Average RF Power – Antenna 2

Mode	Freq [MHz]	Channel	802.11g Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11g	2412	1	14.02	13.92	13.93	13.91	14.16	14.07	14.18	14.14
802.11g	2437	6	13.61	13.47	13.53	13.36	13.54	13.63	13.64	13.71
802.11g	2462	11	14.01	14.00	14.07	13.90	14.06	14.16	14.16	14.26

© 2014 PCTEST Engineering Laboratory, Inc.

Table 8-5
IEEE 802.11n Average RF Power – Antenna 1

Mode	Freq [MHz]	Channel	802.11n (2.4GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	19.5	26	39	52	58.5	65
802.11n	2412	1	12.48	12.49	12.49	12.72	12.69	12.78	12.71	12.82
802.11n	2437	6	11.72	11.69	11.69	11.96	11.88	12.02	11.96	12.01
802.11n	2462	11	12.55	12.49	12.48	12.77	12.77	12.88	12.73	12.88

Table 8-6
IEEE 802.11n Average RF Power – Antenna 2

Mode	Freq [MHz]	Channel	802.11n (2.4GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	19.5	26	39	52	58.5	65
802.11n	2412	1	12.91	12.86	12.97	12.95	12.98	13.25	13.30	13.24
802.11n	2437	6	12.28	12.32	12.37	12.60	12.56	12.61	12.75	12.76
802.11n	2462	11	12.76	12.81	12.83	13.06	13.15	13.19	13.32	13.28

Table 8-7
IEEE 802.11n Average RF Power – MIMO

Mode	Freq [MHz]	Channel	Data Rate (Mbps)
			13
802.11n	2412	1	**15.71**
802.11n	2437	6	15.02
802.11n	2462	11	15.67

© 2014 PCTEST Engineering Laboratory, Inc.

Table 8-8
IEEE 802.11a Average RF Power – Antenna 1

Mode	Freq [MHz]	Channel	802.11a Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11a	5180	36*	**12.18**	12.25	12.23	12.18	12.42	12.41	12.33	12.26
802.11a	5200	40	12.14	12.19	12.13	12.16	12.42	12.37	12.29	12.21
802.11a	5220	44	12.06	12.20	12.11	11.99	12.30	12.31	12.16	12.17
802.11a	5240	48*	12.11	12.18	12.16	12.02	12.37	12.32	12.26	12.22
802.11a	5260	52*	**12.29**	12.39	12.39	12.33	12.44	12.48	12.45	12.33
802.11a	5280	56	12.27	12.35	12.37	12.24	12.37	12.46	12.47	12.22
802.11a	5300	60	12.24	12.32	12.41	12.27	12.46	12.42	12.37	12.30
802.11a	5320	64*	12.24	12.35	12.33	12.25	12.43	12.41	12.39	12.22
802.11a	5500	100	**12.25**	12.23	12.19	12.07	12.28	12.12	12.18	12.02
802.11a	5520	104*	11.87	11.81	11.79	11.69	11.89	11.77	11.86	11.69
802.11a	5540	108	11.87	11.87	11.82	11.61	11.92	11.69	11.73	11.66
802.11a	5560	112	11.78	11.74	11.67	11.65	11.80	11.69	11.73	11.55
802.11a	5580	116*	11.67	11.67	11.64	11.52	11.70	11.56	11.53	11.40
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	11.01	10.99	10.93	10.88	11.03	10.88	10.89	10.76
802.11a	5680	136*	10.99	10.98	10.91	10.83	11.05	10.88	10.92	10.81
802.11a	5700	140	10.88	10.85	10.82	10.74	10.94	10.71	10.77	10.70
802.11a	5745	149*	11.94	11.58	11.63	11.62	11.78	11.67	11.84	11.53
802.11a	5765	153	11.66	11.26	11.38	11.30	11.54	11.33	11.60	11.23
802.11a	5785	157*	11.93	11.54	11.59	11.59	11.78	11.63	11.84	11.52
802.11a	5805	161	11.87	11.52	11.58	11.54	11.71	11.67	11.72	11.41
802.11a	5825	165*	**11.96**	11.58	11.64	11.60	11.76	11.71	11.91	11.47

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

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

© 2014 PCTEST Engineering Laboratory, Inc.

Table 8-9
IEEE 802.11a Average RF Power – Antenna 2

Mode	Freq [MHz]	Channel	802.11a Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11a	5180	36*	**12.21**	12.01	11.95	11.91	12.15	12.18	12.17	12.19
802.11a	5200	40	12.20	11.93	11.93	11.85	12.22	12.15	12.13	12.20
802.11a	5220	44	11.92	11.71	11.65	11.65	11.89	11.92	11.83	11.88
802.11a	5240	48*	11.83	11.59	11.56	11.56	11.85	11.76	11.71	11.84
802.11a	5260	52*	**11.81**	11.81	11.81	11.79	11.85	11.94	12.02	11.98
802.11a	5280	56	11.53	11.48	11.52	11.54	11.59	11.67	11.76	11.69
802.11a	5300	60	11.34	11.29	11.32	11.37	11.41	11.46	11.53	11.57
802.11a	5320	64*	11.35	11.41	11.28	11.32	11.48	11.47	11.56	11.54
802.11a	5500	100	11.70	11.57	11.64	11.57	11.85	11.91	11.73	11.79
802.11a	5520	104*	11.72	11.63	11.64	11.60	11.84	11.88	11.76	11.83
802.11a	5540	108	11.89	11.77	11.90	11.78	12.05	12.16	11.92	11.97
802.11a	5560	112	11.87	11.76	11.81	11.73	12.03	12.05	11.90	11.89
802.11a	5580	116*	**12.17**	12.04	12.12	12.02	12.36	12.38	12.19	12.29
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	11.45	11.29	11.39	11.31	11.62	11.61	11.49	11.53
802.11a	5680	136*	11.63	11.55	11.61	11.51	11.70	11.77	11.60	11.77
802.11a	5700	140	11.78	11.60	11.75	11.63	11.90	11.99	11.81	11.95
802.11a	5745	149*	11.91	12.11	12.09	12.08	12.11	12.12	12.06	12.01
802.11a	5765	153	11.99	12.18	12.16	12.19	12.16	12.26	12.11	12.11
802.11a	5785	157*	**12.11**	12.21	12.30	12.30	12.28	12.31	12.25	12.28
802.11a	5805	161	11.43	11.62	11.65	11.59	11.58	11.68	11.61	11.58
802.11a	5825	165*	11.70	11.93	11.94	11.96	11.90	11.88	11.80	11.81

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

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

© 2014 PCTEST Engineering Laboratory, Inc.

Table 8-10
IEEE 802.11n Average RF Power – 20 MHz Bandwidth – Antenna 1

Mode	Freq [MHz]	Channel	20MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	19.5	26	39	52	58.5	65
802.11n	5180	36	11.07	11.13	11.08	11.18	11.33	11.33	11.40	11.44
802.11n	5200	40	11.09	11.18	11.04	11.23	11.26	11.41	11.42	11.46
802.11n	5220	44	11.16	11.21	11.09	11.36	11.38	11.41	11.45	11.43
802.11n	5240	48	11.13	11.21	11.14	11.26	11.40	11.37	11.49	11.42
802.11n	5260	52	11.28	11.38	11.21	11.25	10.98	10.97	11.03	10.92
802.11n	5280	56	10.60	10.73	10.51	10.58	10.34	10.29	10.34	10.19
802.11n	5300	60	11.02	11.19	11.04	10.99	10.64	10.73	10.79	10.62
802.11n	5320	64	11.13	11.18	11.16	11.16	10.83	10.79	10.82	10.74
802.11n	5500	100	11.25	11.29	11.18	11.24	11.29	11.24	11.02	10.96
802.11n	5520	104	10.76	10.78	10.66	10.70	10.79	10.75	10.58	10.48
802.11n	5540	108	10.85	10.87	10.78	10.79	10.96	10.87	10.68	10.59
802.11n	5560	112	10.88	10.85	10.78	10.83	10.96	10.89	10.62	10.57
802.11n	5580	116	10.85	10.84	10.76	10.84	10.84	10.87	10.62	10.58
802.11n	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5660	132	11.05	11.14	10.96	10.99	11.14	11.02	10.82	10.74
802.11n	5680	136	11.03	11.08	11.00	11.00	11.03	11.10	10.79	10.74
802.11n	5700	140	11.19	11.29	11.15	11.14	11.22	11.09	11.01	10.90
802.11n	5745	149	11.08	11.16	11.02	11.34	11.26	11.38	11.30	11.39
802.11n	5765	153	11.13	11.19	11.04	11.46	11.31	11.39	11.40	11.47
802.11n	5785	157	11.21	11.37	11.14	11.40	11.39	11.45	11.46	11.41
802.11n	5805	161	11.18	11.33	11.18	11.46	11.44	11.44	11.37	11.48
802.11n	5825	165	11.22	11.26	11.09	11.49	11.35	11.40	11.42	11.49

© 2014 PCTEST Engineering Laboratory, Inc.

Table 8-11
IEEE 802.11n Average RF Power – 20 MHz Bandwidth – Antenna 2

Mode	Freq [MHz]	Channel	20MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	19.5	26	39	52	58.5	65
802.11n	5180	36	10.92	10.73	10.79	11.07	11.07	11.05	10.97	10.99
802.11n	5200	40	10.61	10.41	10.54	10.69	10.79	10.71	10.69	10.74
802.11n	5220	44	10.34	10.19	10.17	10.46	10.45	10.45	10.40	10.46
802.11n	5240	48	10.08	9.94	10.01	10.14	10.26	10.24	10.06	10.10
802.11n	5260	52	10.50	10.45	10.55	10.68	10.66	10.66	10.71	10.76
802.11n	5280	56	10.23	10.15	10.34	10.35	10.38	10.37	10.45	10.52
802.11n	5300	60	9.93	9.89	9.97	10.09	10.08	10.11	10.20	10.17
802.11n	5320	64	9.66	9.61	9.63	9.85	9.87	9.79	9.91	9.92
802.11n	5500	100	10.68	10.77	10.74	11.03	10.90	10.85	10.98	10.89
802.11n	5520	104	10.83	10.84	10.97	11.20	11.08	11.03	11.18	11.04
802.11n	5540	108	10.95	11.08	11.06	11.31	11.12	11.06	11.28	11.20
802.11n	5560	112	11.02	11.17	11.09	11.41	11.24	11.23	11.37	11.25
802.11n	5580	116	11.19	11.28	11.18	11.30	11.42	11.33	11.26	11.47
802.11n	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5660	132	11.21	11.37	11.28	11.37	11.42	11.44	11.30	11.42
802.11n	5680	136	11.32	11.45	11.44	11.46	11.39	11.44	11.34	11.30
802.11n	5700	140	11.25	11.33	11.23	11.48	11.44	11.42	11.28	11.33
802.11n	5745	149	11.04	11.44	11.43	11.46	11.42	11.46	11.41	11.49
802.11n	5765	153	11.11	11.29	11.18	11.21	11.26	11.18	11.19	11.30
802.11n	5785	157	11.16	11.23	11.26	11.34	11.20	11.29	11.17	11.34
802.11n	5805	161	11.37	11.27	11.33	11.30	11.31	11.36	11.27	11.34
802.11n	5825	165	11.47	11.41	11.44	11.42	11.40	11.46	11.31	11.46

© 2014 PCTEST Engineering Laboratory, Inc.

Table 8-12
IEEE 802.11n Average RF Power – 20 MHz Bandwidth – MIMO

Mode	Freq [MHz]	Channel	Data Rate (Mbps)
			13
802.11n	5180	36	**14.01**
802.11n	5200	40	13.86
802.11n	5220	44	13.78
802.11n	5240	48	13.64
802.11n	5260	52	**13.92**
802.11n	5280	56	13.43
802.11n	5300	60	13.52
802.11n	5320	64	13.47
802.11n	5500	100	13.98
802.11n	5520	104	13.80
802.11n	5540	108	13.91
802.11n	5560	112	13.96
802.11n	5580	116	14.03
802.11n	5600	120	N/A
802.11n	5620	124	N/A
802.11n	5640	128	N/A
802.11n	5660	132	14.14
802.11n	5680	136	14.19
802.11n	5700	140	**14.23**
802.11n	5745	149	14.07
802.11n	5765	153	14.13
802.11n	5785	157	14.20
802.11n	5805	161	14.29
802.11n	5825	165	**14.36**

Table 8-13
IEEE 802.11n Average RF Power – 40 MHz Bandwidth – Antenna 1

Mode	Freq [MHz]	Channel	40MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			13.5	27	40.5	54	81	108	121.5	135
802.11n	5190	38	10.21	10.21	10.19	10.40	10.39	10.43	10.35	10.27
802.11n	5230	46	10.03	10.05	10.04	10.25	10.22	10.28	10.18	10.12
802.11n	5270	54	9.82	9.94	10.04	10.17	10.09	10.19	10.13	10.13
802.11n	5310	62	9.83	10.03	10.00	10.23	10.15	10.25	10.20	10.10
802.11n	5510	102	10.33	10.49	10.42	10.45	10.43	10.40	10.49	10.44
802.11n	5550	110	10.42	10.49	10.42	10.46	10.47	10.42	10.43	10.39
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	10.16	10.40	10.22	10.29	10.32	10.27	10.35	10.28
802.11n	5755	151	9.86	9.86	9.80	10.02	10.04	10.05	10.01	10.08
802.11n	5795	159	9.94	9.86	9.89	10.13	10.11	10.13	10.11	10.13

© 2014 PCTEST Engineering Laboratory, Inc.

Table 8-14
IEEE 802.11n Average RF Power – 40 MHz Bandwidth – Antenna 2

Mode	Freq [MHz]	Channel	40MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			13.5	27	40.5	54	81	108	121.5	135
802.11n	5190	38	9.93	9.85	9.85	10.09	10.09	10.00	10.08	10.06
802.11n	5230	46	9.49	9.47	9.43	9.68	9.69	9.57	9.61	9.60
802.11n	5270	54	9.57	9.75	9.65	9.77	9.79	9.74	9.83	9.74
802.11n	5310	62	9.56	9.68	9.57	9.78	9.80	9.66	9.81	9.66
802.11n	5510	102	9.84	9.98	9.97	9.95	9.95	9.95	9.94	10.16
802.11n	5550	110	10.01	10.16	10.12	10.13	10.14	10.20	10.11	10.33
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	10.08	10.19	10.27	10.16	10.23	10.13	10.25	10.32
802.11n	5755	151	9.64	9.61	9.64	9.89	9.64	9.66	9.70	9.64
802.11n	5795	159	9.74	9.71	9.73	9.98	9.76	9.72	9.79	9.70

Table 8-15
IEEE 802.11n Average RF Power – 40 MHz Bandwidth – MIMO

Mode	Freq [MHz]	Channel	Data Rate (Mbps)
			27
802.11n	5190	38	13.08
802.11n	5230	46	12.78
802.11n	5270	54	12.71
802.11n	5310	62	12.71
802.11n	5510	102	13.10
802.11n	5550	110	13.23
802.11n	5590	118	N/A
802.11n	5630	126	N/A
802.11n	5670	134	13.13
802.11n	5755	151	12.76
802.11n	5795	159	12.85

Table 8-16
IEEE 802.11ac Average RF Power – 80 MHz Bandwidth – Antenna 1

Mode	Freq [MHz]	Channel	80MHz BW 802.11ac (5GHz) Conducted Power [dBm]									
			Data Rate [Mbps]									
			29.3	58.5	87.8	117	175.5	234	263.3	292.5	351	390
802.11ac	5210	42	**8.10**	7.82	7.92	8.23	8.27	8.32	8.27	8.23	8.16	8.31
802.11ac	5290	58	**8.34**	8.19	8.19	8.05	7.94	7.81	8.03	7.87	7.78	7.93
802.11ac	5530	106	**7.98**	8.00	7.90	8.22	8.22	8.13	8.17	8.14	8.19	8.09
802.11ac	5775	155	**7.72**	7.53	7.54	7.91	7.76	7.72	7.86	7.80	7.79	7.70

Table 8-17
IEEE 802.11ac Average RF Power – 80 MHz Bandwidth – Antenna 2

Mode	Freq [MHz]	Channel	80MHz BW 802.11ac (5GHz) Conducted Power [dBm]									
			Data Rate [Mbps]									
			29.3	58.5	87.8	117	175.5	234	263.3	292.5	351	390
802.11ac	5210	42	**7.46**	7.38	7.33	7.61	7.61	7.68	7.66	7.62	7.61	7.58
802.11ac	5290	58	**7.83**	7.84	7.75	7.93	7.99	8.06	7.98	7.97	7.98	7.99
802.11ac	5530	106	**8.27**	8.28	8.13	8.39	8.49	8.48	8.48	8.23	8.27	8.31
802.11ac	5775	155	**7.40**	7.54	7.38	7.64	7.61	7.61	7.62	7.52	7.49	7.39

© 2014 PCTEST Engineering Laboratory, Inc.

Table 8-18
IEEE 802.11ac Average RF Power – 80 MHz Bandwidth – MIMO

Mode	Freq [MHz]	Channel	Data Rate (Mbps)
			58.5
802.11ac	5210	42	10.80
802.11ac	5290	58	11.10
802.11ac	5530	106	11.14
802.11ac	5775	155	10.57

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

- For 2.4 GHz SISO operations, highest average RF output power channel for the lowest data rate for IEEE 802.11b were selected for SAR evaluation. Other IEEE 802.11 SISO 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 SISO operations, highest average RF output power channel for the lowest data rate for IEEE 802.11a were selected for SAR evaluation. Other IEEE 802.11 SISO modes (including 802.11n 20 MHz and 40 MHz) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
- Full SAR tests for all SISO IEEE 802.11ac configurations were not required because the average output power was not more than 0.25 dB higher than IEEE 802.11a mode. IEEE 802.11ac in SISO mode was evaluated for the highest IEEE 802.11a position in each 5 GHz band and exposure condition.
- For MIMO 2.4 GHz and 5 GHz operations, the highest average RF output power channel for the lowest data rate for IEEE 802.11n (20 MHz bandwidth) was selected for SAR evaluation. Other IEEE 802.11 modes and bandwidths were not investigated for MIMO operations since the maximum allowed output power (including tolerance) was not higher for these modes.
- The individual spectra for each 2x2 MIMO WIFI Antenna were summed mathematically in linear power units for the MIMO output power measurements.
- 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.

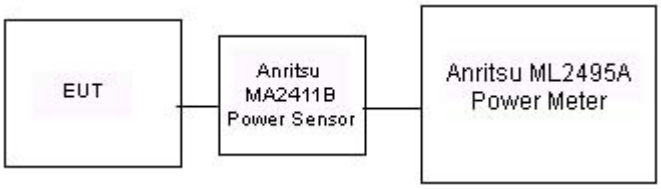


Figure 8-3
Power Measurement Setup for Bandwidths < 50 MHz

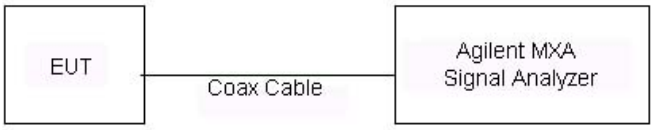


Figure 8-4
Power Measurement Setup for Bandwidths > 50 MHz

© 2014 PCTEST Engineering Laboratory, Inc.

9 SYSTEM VERIFICATION

9.1 Tissue Verification

Table 9-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C˚)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
8/11/2014	835H	21.1	820	0.920	43.326	0.899	41.578	2.34%	4.20%
			835	0.935	43.129	0.900	41.500	3.89%	3.93%
			850	0.951	42.942	0.916	41.500	3.82%	3.47%
8/11/2014	1900H	20.0	1850	1.403	40.855	1.400	40.000	0.21%	2.14%
			1880	1.437	40.738	1.400	40.000	2.64%	1.85%
			1910	1.467	40.608	1.400	40.000	4.79%	1.52%
8/11/2014	2450H	22.8	2401	1.807	39.822	1.756	39.287	2.90%	1.36%
			2450	1.866	39.666	1.800	39.200	3.67%	1.19%
			2499	1.923	39.488	1.853	39.138	3.78%	0.89%
08/18/2014	5200H-5800H	24.0	5180	4.468	35.795	4.635	36.009	-3.60%	-0.59%
			5200	4.490	35.730	4.655	35.986	-3.54%	-0.71%
			5220	4.526	35.694	4.676	35.963	-3.21%	-0.75%
			5260	4.577	35.705	4.717	35.917	-2.97%	-0.59%
			5280	4.579	35.688	4.737	35.894	-3.34%	-0.57%
			5300	4.587	35.645	4.758	35.871	-3.59%	-0.63%
			5500	4.803	35.376	4.963	35.643	-3.22%	-0.75%
			5520	4.829	35.402	4.983	35.620	-3.09%	-0.61%
			5540	4.829	35.392	5.004	35.597	-3.50%	-0.58%
			5580	4.848	35.269	5.045	35.551	-3.90%	-0.79%
			5600	4.878	35.236	5.065	35.529	-3.69%	-0.82%
			5700	4.962	35.123	5.168	35.414	-3.99%	-0.82%
			5765	5.072	35.116	5.234	35.340	-3.10%	-0.63%
			5785	5.064	35.096	5.255	35.317	-3.63%	-0.63%
			5800	5.077	35.056	5.270	35.300	-3.66%	-0.69%
			5825	5.097	34.983	5.296	35.271	-3.76%	-0.82%
8/14/2014	835B	23.1	820	0.983	53.141	0.969	55.258	1.44%	-3.83%
			835	0.997	53.013	0.970	55.200	2.78%	-3.96%
			850	1.011	52.849	0.988	55.154	2.33%	-4.18%
8/11/2014	1900B	22.3	1850	1.492	52.104	1.520	53.300	-1.84%	-2.24%
			1880	1.528	52.005	1.520	53.300	0.53%	-2.43%
			1910	1.559	51.859	1.520	53.300	2.57%	-2.70%
8/11/2014	2450B	22.5	2401	1.880	52.108	1.903	52.765	-1.21%	-1.25%
			2450	1.943	51.913	1.950	52.700	-0.36%	-1.49%
			2499	2.011	51.733	2.019	52.638	-0.40%	-1.72%
08/18/2014	5200B-5800B	20.5	5180	5.086	47.247	5.276	49.041	-3.60%	-3.66%
			5200	5.106	47.285	5.299	49.014	-3.64%	-3.53%
			5220	5.119	47.231	5.323	48.987	-3.83%	-3.58%
			5260	5.168	47.140	5.369	48.933	-3.74%	-3.66%
			5280	5.210	47.109	5.393	48.906	-3.39%	-3.67%
			5300	5.228	47.061	5.416	48.879	-3.47%	-3.72%
			5500	5.509	46.844	5.650	48.607	-2.50%	-3.63%
			5520	5.544	46.831	5.673	48.580	-2.27%	-3.60%
			5540	5.560	46.766	5.696	48.553	-2.39%	-3.68%
			5580	5.626	46.738	5.743	48.499	-2.04%	-3.63%
			5600	5.653	46.714	5.766	48.471	-1.96%	-3.62%
			5700	5.780	46.550	5.883	48.336	-1.75%	-3.69%
			5765	5.845	46.465	5.959	48.248	-1.91%	-3.70%
			5785	5.834	46.393	5.982	48.220	-2.47%	-3.79%
			5800	5.842	46.461	6.000	48.200	-2.63%	-3.61%
			5825	5.890	46.409	6.029	48.166	-2.31%	-3.65%
08/20/2014	5200B-5800B	23.5	5180	5.221	47.880	5.276	49.041	-1.04%	-2.37%
			5200	5.257	47.753	5.299	49.014	-0.79%	-2.57%
			5220	5.292	47.750	5.323	48.987	-0.58%	-2.53%
			5260	5.366	47.716	5.369	48.933	-0.06%	-2.49%
			5280	5.398	47.645	5.393	48.906	0.09%	-2.58%
			5300	5.394	47.602	5.416	48.879	-0.41%	-2.61%
			5500	5.736	47.095	5.650	48.607	1.52%	-3.11%
			5520	5.755	47.042	5.673	48.580	1.45%	-3.17%
			5540	5.781	46.997	5.696	48.553	1.49%	-3.20%
			5580	5.845	46.860	5.743	48.499	1.78%	-3.38%
			5600	5.873	46.807	5.766	48.471	1.86%	-3.43%
			5700	6.025	46.591	5.883	48.336	2.41%	-3.61%
			5765	6.143	46.504	5.959	48.248	3.09%	-3.61%
			5785	6.152	46.461	5.982	48.220	2.84%	-3.65%
			5800	6.167	46.375	6.000	48.200	2.78%	-3.79%
			5825	6.212	46.297	6.029	48.166	3.04%	-3.88%

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 KDB Publication 865664 and IEEE 1528-2013 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.

© 2014 PCTEST Engineering Laboratory, Inc.

9.2 Test System Verification

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

Table 9-2
1g System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	$Deviation_{1g}$ (%)
C	835	HEAD	08/11/2014	22.6	21.1	0.100	4d132	3213	0.958	9.270	9.580	3.34%
C	1900	HEAD	08/11/2014	22.8	20.0	0.100	5d148	3213	4.080	40.700	40.800	0.25%
H	2450	HEAD	08/11/2014	22.2	22.8	0.100	797	3319	5.310	51.800	53.100	2.51%
E	5200	HEAD	08/18/2014	24.6	24.0	0.100	1057	3914	7.380	78.000	73.800	-5.38%
E	5300	HEAD	08/18/2014	24.6	24.1	0.100	1057	3914	7.940	83.000	79.400	-4.34%
E	5500	HEAD	08/18/2014	24.5	24.1	0.100	1057	3914	7.830	84.300	78.300	-7.12%
E	5600	HEAD	08/18/2014	24.5	24.1	0.100	1057	3914	8.070	83.500	80.700	-3.35%
E	5800	HEAD	08/18/2014	24.5	24.1	0.100	1057	3914	7.550	79.300	75.500	-4.79%
D	835	BODY	08/14/2014	23.9	23.1	0.100	4d119	3263	0.912	9.340	9.120	-2.36%
B	1900	BODY	08/11/2014	23.1	22.3	0.100	5d148	3288	4.110	39.300	41.100	4.58%
H	2450	BODY	08/11/2014	23.2	22.5	0.100	797	3319	4.860	49.400	48.600	-1.62%
A	5200	BODY	08/18/2014	23.4	21.8	0.100	1007	3920	7.490	72.600	74.900	3.17%
A	5300	BODY	08/18/2014	23.4	21.8	0.100	1007	3920	7.620	74.700	76.200	2.01%
A	5500	BODY	08/18/2014	23.4	21.8	0.100	1007	3920	7.670	75.900	76.700	1.05%
A	5600	BODY	08/18/2014	23.4	21.8	0.100	1007	3920	7.740	77.300	77.400	0.13%
A	5800	BODY	08/18/2014	23.4	21.8	0.100	1007	3920	7.120	72.900	71.200	-2.33%

© 2014 PCTEST Engineering Laboratory, Inc.

Table 9-3
10g System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR_{10g} (W/kg)	1 W Target SAR_{10g} (W/kg)	1 W Normalized SAR_{10g} (W/kg)	$Deviation_{10g}$ (%)
I	5200	BODY	08/20/2014	24.2	23.5	0.100	1057	3589	2.130	21.000	21.300	1.43%
I	5300	BODY	08/20/2014	24.2	23.5	0.100	1057	3589	2.300	21.500	23.000	6.98%
I	5500	BODY	08/20/2014	24.2	23.5	0.100	1057	3589	2.330	22.000	23.300	5.91%
I	5600	BODY	08/20/2014	24.2	23.5	0.100	1057	3589	2.150	22.200	21.500	-3.15%
I	5800	BODY	08/20/2014	24.2	23.5	0.100	1057	3589	2.140	20.400	21.400	4.90%

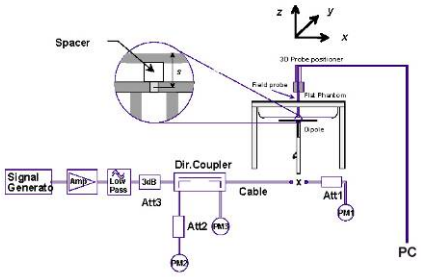


Figure 9-1
System Verification Setup Diagram

Figure 9-2
System Verification Setup Photo

© 2014 PCTEST Engineering Laboratory, Inc.

10 SAR DATA SUMMARY

10.1 Standalone Head SAR Data

Table 10-1
GSM 850 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	190	GSM850	GSM	33.0	32.54	0.14	Right	Cheek	707A1	1:8.3	0.052	1.112	0.058	
836.60	190	GSM850	GSM	33.0	32.54	0.14	Right	Tilt	707A1	1:8.3	0.041	1.112	0.046	
836.60	190	GSM850	GSM	33.0	32.54	0.03	Left	Cheek	707A1	1:8.3	0.067	1.112	0.075	A1
836.60	190	GSM850	GSM	33.0	32.54	0.05	Left	Tilt	707A1	1:8.3	0.039	1.112	0.043	
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 10-2
GSM 1900 Master Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1909.80	810	GSM 1900 Master	GSM	30.0	29.60	0.07	Right	Cheek	707A1	1:8.3	0.176	1.096	0.193	A2
1909.80	810	GSM 1900 Master	GSM	30.0	29.60	0.02	Right	Tilt	707A1	1:8.3	0.116	1.096	0.127	
1909.80	810	GSM 1900 Master	GSM	30.0	29.60	-0.01	Left	Cheek	707A1	1:8.3	0.074	1.096	0.081	
1909.80	810	GSM 1900 Master	GSM	30.0	29.60	0.01	Left	Tilt	707A1	1:8.3	0.102	1.096	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 10-3
GSM 1900 Slave Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	661	GSM 1900 Slave	GSM	30.0	29.20	0.14	Right	Cheek	707A1	1:8.3	0.019	1.202	0.023	
1880.00	661	GSM 1900 Slave	GSM	30.0	29.20	0.13	Right	Tilt	707A1	1:8.3	0.013	1.202	0.016	
1880.00	661	GSM 1900 Slave	GSM	30.0	29.20	0.09	Left	Cheek	707A1	1:8.3	0.033	1.202	0.040	
1880.00	661	GSM 1900 Slave	GSM	30.0	29.20	0.03	Left	Tilt	707A1	1:8.3	0.013	1.202	0.016	
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 10-4
UMTS 850 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	23.0	22.72	-0.19	Right	Cheek	707AC	1:1	0.031	1.067	0.033	
836.60	4183	UMTS 850	RMC	23.0	22.72	0.07	Right	Tilt	707AC	1:1	0.018	1.067	0.019	
836.60	4183	UMTS 850	RMC	23.0	22.72	0.04	Left	Cheek	707AC	1:1	0.034	1.067	0.036	A3
836.60	4183	UMTS 850	RMC	23.0	22.72	0.07	Left	Tilt	707AC	1:1	0.015	1.067	0.016	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

© 2014 PCTEST Engineering Laboratory, Inc.

Table 10-5
UMTS 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	23.0	22.92	-0.11	Right	Cheek	707AC	1:1	0.211	1.019	**0.215**	A4
1880.00	9400	UMTS 1900	RMC	23.0	22.92	-0.06	Right	Tilt	707AC	1:1	0.152	1.019	0.155	
1880.00	9400	UMTS 1900	RMC	23.0	22.92	0.07	Left	Cheek	707AC	1:1	0.086	1.019	0.088	
1880.00	9400	UMTS 1900	RMC	23.0	22.92	-0.04	Left	Tilt	707AC	1:1	0.113	1.019	0.115	

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 10-6
DTS Head SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
2462	11	IEEE 802.11b	DSSS	17.5	17.08	0.06	Right	Cheek	1	707A1	1	1:1	0.153	1.102	**0.169**	A5
2462	11	IEEE 802.11b	DSSS	17.5	17.08	0.18	Right	Tilt	1	707A1	1	1:1	0.053	1.102	0.058	
2462	11	IEEE 802.11b	DSSS	17.5	17.08	-0.19	Left	Cheek	1	707A1	1	1:1	0.142	1.102	0.156	
2462	11	IEEE 802.11b	DSSS	17.5	17.08	0.12	Left	Tilt	1	707A1	1	1:1	0.021	1.102	0.023	
2437	6	IEEE 802.11b	DSSS	17.5	16.99	0.11	Right	Cheek	2	707A1	1	1:1	0.070	1.125	0.079	
2437	6	IEEE 802.11b	DSSS	17.5	16.99	0.11	Right	Tilt	2	707A1	1	1:1	0.071	1.125	0.080	
2437	6	IEEE 802.11b	DSSS	17.5	16.99	0.11	Left	Cheek	2	707A1	1	1:1	0.037	1.125	0.042	
2437	6	IEEE 802.11b	DSSS	17.5	16.99	0.13	Left	Tilt	2	707A1	1	1:1	0.027	1.125	0.030	
2412	1	IEEE 802.11n	OFDM	16.0	15.71	0.21	Right	Cheek	MIMO	707A1	13	1:1	0.050	1.069	0.053	
2412	1	IEEE 802.11n	OFDM	16.0	15.71	0.16	Right	Tilt	MIMO	707A1	13	1:1	0.033	1.069	0.035	
2412	1	IEEE 802.11n	OFDM	16.0	15.71	0.14	Left	Cheek	MIMO	707A1	13	1:1	0.033	1.069	0.035	
2412	1	IEEE 802.11n	OFDM	16.0	15.71	0.12	Left	Tilt	MIMO	707A1	13	1:1	0.009	1.069	0.010	
5825	165	IEEE 802.11a	OFDM	12.5	11.96	0.12	Right	Cheek	1	707A1	6	1:1	0.011	1.132	0.012	A6
5775	155	IEEE 802.11ac	OFDM	8.5	7.72	0.20	Right	Cheek	1	707A1	29.3	1:1	0.000	1.197	0.000	
5825	165	IEEE 802.11a	OFDM	12.5	11.96	0.00	Right	Tilt	1	707A1	6	1:1	0.000	1.132	0.000	
5825	165	IEEE 802.11a	OFDM	12.5	11.96	-0.17	Left	Cheek	1	707A1	6	1:1	0.000	1.132	0.000	
5825	165	IEEE 802.11a	OFDM	12.5	11.96	0.00	Left	Tilt	1	707A1	6	1:1	0.000	1.132	0.000	
5785	157	IEEE 802.11a	OFDM	12.5	12.11	-0.20	Right	Cheek	2	707A1	6	1:1	0.000	1.094	0.000	
5785	157	IEEE 802.11a	OFDM	12.5	12.11	0.00	Right	Tilt	2	707A1	6	1:1	0.000	1.094	0.000	
5785	157	IEEE 802.11a	OFDM	12.5	12.11	0.00	Left	Cheek	2	707A1	6	1:1	0.000	1.094	0.000	
5775	155	IEEE 802.11ac	OFDM	8.5	7.40	0.00	Left	Cheek	2	707A1	29.3	1:1	0.000	1.288	0.000	
5785	157	IEEE 802.11a	OFDM	12.5	12.11	0.00	Left	Tilt	2	707A1	6	1:1	0.000	1.094	0.000	
5825	165	IEEE 802.11n	OFDM	14.5	14.36	0.00	Right	Cheek	MIMO	707A1	13	1:1	0.000	1.033	0.000	
5825	165	IEEE 802.11n	OFDM	14.5	14.36	0.00	Right	Tilt	MIMO	707A1	13	1:1	0.000	1.033	0.000	
5825	165	IEEE 802.11n	OFDM	14.5	14.36	0.20	Left	Cheek	MIMO	707A1	13	1:1	0.000	1.033	0.000	
5825	165	IEEE 802.11n	OFDM	14.5	14.36	0.00	Left	Tilt	MIMO	707A1	13	1:1	0.000	1.033	0.000	

ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population	Head 1.6 W/kg (mW/g) averaged over 1 gram

© 2014 PCTEST Engineering Laboratory, Inc.

Table 10-7
NII Head SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
5180	36	IEEE 802.11a	OFDM	12.5	12.18	0.21	Right	Cheek	1	707A1	6	1:1	0.102	1.076	**0.110**	A7
5210	42	IEEE 802.11ac	OFDM	8.5	8.10	0.18	Right	Cheek	1	707A1	29.3	1:1	0.053	1.096	0.058	
5180	36	IEEE 802.11a	OFDM	12.5	12.18	0.19	Right	Tilt	1	707A1	6	1:1	0.031	1.076	0.033	
5180	36	IEEE 802.11a	OFDM	12.5	12.18	0.16	Left	Cheek	1	707A1	6	1:1	0.026	1.076	0.028	
5180	36	IEEE 802.11a	OFDM	12.5	12.18	0.19	Left	Tilt	1	707A1	6	1:1	0.009	1.076	0.010	
5260	52	IEEE 802.11a	OFDM	12.5	12.29	0.17	Right	Cheek	1	707A1	6	1:1	0.056	1.050	0.059	
5290	58	IEEE 802.11ac	OFDM	8.5	8.34	0.19	Right	Cheek	1	707A1	29.3	1:1	0.029	1.038	0.030	
5260	52	IEEE 802.11a	OFDM	12.5	12.29	-0.20	Right	Tilt	1	707A1	6	1:1	0.014	1.050	0.015	
5260	52	IEEE 802.11a	OFDM	12.5	12.29	0.20	Left	Cheek	1	707A1	6	1:1	0.016	1.050	0.017	
5260	52	IEEE 802.11a	OFDM	12.5	12.29	-0.03	Left	Tilt	1	707A1	6	1:1	0.004	1.050	0.004	
5500	100	IEEE 802.11a	OFDM	12.5	12.25	0.14	Right	Cheek	1	707A1	6	1:1	0.046	1.059	0.049	
5530	106	IEEE 802.11ac	OFDM	8.5	7.98	0.19	Right	Cheek	1	707A1	29.3	1:1	0.015	1.127	0.017	
5500	100	IEEE 802.11a	OFDM	12.5	12.25	0.00	Right	Tilt	1	707A1	6	1:1	0.000	1.059	0.000	
5500	100	IEEE 802.11a	OFDM	12.5	12.25	0.20	Left	Cheek	1	707A1	6	1:1	0.011	1.059	0.012	
5500	100	IEEE 802.11a	OFDM	12.5	12.25	0.00	Left	Tilt	1	707A1	6	1:1	0.000	1.059	0.000	
5180	36	IEEE 802.11a	OFDM	12.5	12.21	0.00	Right	Cheek	2	707A1	6	1:1	0.000	1.069	0.000	
5180	36	IEEE 802.11a	OFDM	12.5	12.21	0.00	Right	Tilt	2	707A1	6	1:1	0.000	1.069	0.000	
5180	36	IEEE 802.11a	OFDM	12.5	12.21	0.00	Left	Cheek	2	707A1	6	1:1	0.000	1.069	0.000	
5210	42	IEEE 802.11ac	OFDM	8.5	7.46	0.00	Left	Cheek	2	707A1	29.3	1:1	0.000	1.271	0.000	
5180	36	IEEE 802.11a	OFDM	12.5	12.21	0.17	Left	Tilt	2	707A1	6	1:1	0.000	1.069	0.000	
5260	52	IEEE 802.11a	OFDM	12.5	11.81	0.00	Right	Cheek	2	707A1	6	1:1	0.000	1.172	0.000	
5260	52	IEEE 802.11a	OFDM	12.5	11.81	0.00	Right	Tilt	2	707A1	6	1:1	0.000	1.172	0.000	
5260	52	IEEE 802.11a	OFDM	12.5	11.81	0.20	Left	Cheek	2	707A1	6	1:1	0.000	1.172	0.000	
5290	58	IEEE 802.11ac	OFDM	8.5	7.83	0.00	Left	Cheek	2	707A1	29.3	1:1	0.000	1.167	0.000	
5260	52	IEEE 802.11a	OFDM	12.5	11.81	-0.14	Left	Tilt	2	707A1	6	1:1	0.000	1.172	0.000	
5580	116	IEEE 802.11a	OFDM	12.5	12.17	0.00	Right	Cheek	2	707A1	6	1:1	0.000	1.079	0.000	
5580	116	IEEE 802.11a	OFDM	12.5	12.17	0.00	Right	Tilt	2	707A1	6	1:1	0.000	1.079	0.000	
5580	116	IEEE 802.11a	OFDM	12.5	12.17	0.00	Left	Cheek	2	707A1	6	1:1	0.000	1.079	0.000	
5530	106	IEEE 802.11ac	OFDM	8.5	8.27	0.00	Left	Cheek	2	707A1	29.3	1:1	0.000	1.054	0.000	
5580	116	IEEE 802.11a	OFDM	12.5	12.17	0.00	Left	Tilt	2	707A1	6	1:1	0.000	1.079	0.000	
5180	36	IEEE 802.11n	OFDM	14.5	14.01	0.17	Right	Cheek	MIMO	707A1	13	1:1	0.083	1.119	0.093	
5180	36	IEEE 802.11n	OFDM	14.5	14.01	0.15	Right	Tilt	MIMO	707A1	13	1:1	0.015	1.119	0.017	
5180	36	IEEE 802.11n	OFDM	14.5	14.01	0.20	Left	Cheek	MIMO	707A1	13	1:1	0.018	1.119	0.020	
5180	36	IEEE 802.11n	OFDM	14.5	14.01	0.00	Left	Tilt	MIMO	707A1	13	1:1	0.000	1.119	0.000	
5260	52	IEEE 802.11n	OFDM	14.5	13.92	-0.10	Right	Cheek	MIMO	707A1	13	1:1	0.054	1.143	0.062	
5260	52	IEEE 802.11n	OFDM	14.5	13.92	0.19	Right	Tilt	MIMO	707A1	13	1:1	0.000	1.143	0.000	
5260	52	IEEE 802.11n	OFDM	14.5	13.92	-0.21	Left	Cheek	MIMO	707A1	13	1:1	0.012	1.143	0.014	
5260	52	IEEE 802.11n	OFDM	14.5	13.92	0.20	Left	Tilt	MIMO	707A1	13	1:1	0.000	1.143	0.000	
5700	140	IEEE 802.11n	OFDM	14.5	14.23	-0.13	Right	Cheek	MIMO	707A1	13	1:1	0.025	1.064	0.027	
5700	140	IEEE 802.11n	OFDM	14.5	14.23	0.00	Right	Tilt	MIMO	707A1	13	1:1	0.000	1.064	0.000	
5700	140	IEEE 802.11n	OFDM	14.5	14.23	0.20	Left	Cheek	MIMO	707A1	13	1:1	0.000	1.064	0.000	
5700	140	IEEE 802.11n	OFDM	14.5	14.23	0.00	Left	Tilt	MIMO	707A1	13	1:1	0.000	1.064	0.000	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram									

© 2014 PCTEST Engineering Laboratory, Inc.

10.2 Standalone Body-Worn SAR Data

Table 10-8
GSM/UMTS Body-Worn SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of Time Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.0	32.54	-0.08	10 mm	707A1	1	1:8.3	back	0.355	1.112	**0.395**	A8
1909.80	810	GSM 1900 Master	GSM	30.0	29.60	0.01	10 mm	707A1	1	1:8.3	back	0.215	1.096	0.236	
1880.00	661	GSM 1900 Slave	GSM	30.0	29.20	-0.02	10 mm	707A1	1	1:8.3	back	0.250	1.202	0.301	A10
836.60	4183	UMTS 850	RMC	23.0	22.72	-0.05	10 mm	707AC	N/A	1:1	back	0.258	1.067	0.275	A12
1880.00	9400	UMTS 1900	RMC	23.0	22.92	0.04	10 mm	707AC	N/A	1:1	back	0.345	1.019	0.352	A13
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 10-9
DTS Body-Worn SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
2462	11	IEEE 802.11b	DSSS	17.5	17.08	0.03	10 mm	1	707A1	1	back	1:1	0.126	1.102	**0.139**	A15
2437	6	IEEE 802.11b	DSSS	17.5	16.99	0.20	10 mm	2	707A1	1	back	1:1	0.022	1.125	0.025	
2412	1	IEEE 802.11n	OFDM	16.0	15.71	0.16	10 mm	MIMO	707A1	13	back	1:1	0.040	1.069	0.043	
5825	165	IEEE 802.11a	OFDM	12.5	11.96	0.06	10 mm	1	707AF	6	back	1:1	0.106	1.132	0.120	A16
5775	155	IEEE 802.11ac	OFDM	8.5	7.72	0.09	10 mm	1	707AF	29.3	back	1:1	0.057	1.197	0.068	
5785	157	IEEE 802.11a	OFDM	12.5	12.11	-0.02	10 mm	2	707AF	6	back	1:1	0.012	1.094	0.013	
5775	155	IEEE 802.11ac	OFDM	8.5	7.40	-0.16	10 mm	2	707AF	29.3	back	1:1	0.017	1.288	0.022	
5825	165	IEEE 802.11n	OFDM	14.5	14.36	0.10	10 mm	MIMO	707AF	13	back	1:1	0.076	1.033	0.079	
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 10-10
NII Body-Worn SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
5180	36	IEEE 802.11a	OFDM	12.5	12.18	0.03	10 mm	1	707AF	6	back	1:1	0.143	1.076	**0.154**	A17
5210	42	IEEE 802.11ac	OFDM	8.5	8.10	0.04	10 mm	1	707AF	29.3	back	1:1	0.051	1.096	0.056	
5260	52	IEEE 802.11a	OFDM	12.5	12.29	0.04	10 mm	1	707AF	6	back	1:1	0.119	1.050	0.125	
5290	58	IEEE 802.11ac	OFDM	8.5	8.34	0.14	10 mm	1	707AF	29.3	back	1:1	0.043	1.038	0.045	
5500	100	IEEE 802.11a	OFDM	12.5	12.25	0.03	10 mm	1	707AF	6	back	1:1	0.097	1.059	0.103	
5530	106	IEEE 802.11ac	OFDM	8.5	7.98	0.12	10 mm	1	707AF	29.3	back	1:1	0.044	1.127	0.050	
5180	36	IEEE 802.11a	OFDM	12.5	12.21	0.03	10 mm	2	707AF	6	back	1:1	0.019	1.069	0.020	
5210	42	IEEE 802.11ac	OFDM	8.5	7.46	0.04	10 mm	2	707AF	29.3	back	1:1	0.009	1.271	0.011	
5260	52	IEEE 802.11a	OFDM	12.5	11.81	0.06	10 mm	2	707AF	6	back	1:1	0.016	1.172	0.019	
5290	58	IEEE 802.11ac	OFDM	8.5	7.83	-0.07	10 mm	2	707AF	29.3	back	1:1	0.010	1.167	0.012	
5580	116	IEEE 802.11a	OFDM	12.5	12.17	0.10	10 mm	2	707AF	6	back	1:1	0.013	1.079	0.014	
5530	106	IEEE 802.11ac	OFDM	8.5	8.27	0.03	10 mm	2	707AF	29.3	back	1:1	0.014	1.054	0.015	
5180	36	IEEE 802.11n	OFDM	14.5	14.01	0.04	10 mm	MIMO	707AF	13	back	1:1	0.101	1.119	0.113	
5260	52	IEEE 802.11n	OFDM	14.5	13.92	0.04	10 mm	MIMO	707AF	13	back	1:1	0.083	1.143	0.095	
5700	140	IEEE 802.11n	OFDM	14.5	14.23	0.06	10 mm	MIMO	707AF	13	back	1:1	0.100	1.064	0.106	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

© 2014 PCTEST Engineering Laboratory, Inc.

10.3 Standalone Wireless Router SAR Data

Table 10-11
GPRS/UMTS Hotspot SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of GPRS Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GPRS	29.0	28.45	0.03	10 mm	707A1	3	1:2.76	back	0.294	1.135	0.334	
836.60	190	GSM 850	GPRS	29.0	28.45	-0.07	10 mm	707A1	3	1:2.76	front	0.351	1.135	0.398	A9
836.60	190	GSM 850	GPRS	29.0	28.45	-0.17	10 mm	707A1	3	1:2.76	bottom	0.207	1.135	0.235	
836.60	190	GSM 850	GPRS	29.0	28.45	0.17	10 mm	707A1	3	1:2.76	left	0.071	1.135	0.081	
1880.00	661	GSM 1900 Master	GPRS	25.5	24.99	-0.09	10 mm	707A1	3	1:2.76	back	0.218	1.125	0.245	
1880.00	661	GSM 1900 Master	GPRS	25.5	24.99	0.05	10 mm	707A1	3	1:2.76	front	0.232	1.125	0.261	
1880.00	661	GSM 1900 Master	GPRS	25.5	24.99	-0.05	10 mm	707A1	3	1:2.76	bottom	0.405	1.125	0.456	
1880.00	661	GSM 1900 Master	GPRS	25.5	24.99	0.01	10 mm	707A1	3	1:2.76	left	0.072	1.125	0.081	
1880.00	661	GSM 1900 Slave	GPRS	26.0	25.65	-0.03	10 mm	707A1	3	1:2.76	back	0.372	1.084	0.403	
1880.00	661	GSM 1900 Slave	GPRS	26.0	25.65	0.03	10 mm	707A1	3	1:2.76	front	0.385	1.084	0.417	
1880.00	661	GSM 1900 Slave	GPRS	26.0	25.65	-0.02	10 mm	707A1	3	1:2.76	bottom	0.469	1.084	0.508	A11
1880.00	661	GSM 1900 Slave	GPRS	26.0	25.65	-0.04	10 mm	707A1	3	1:2.76	right	0.071	1.084	0.077	
836.60	4183	UMTS 850	RMC	23.0	22.72	-0.05	10 mm	707AC	N/A	1:1	back	0.258	1.067	0.275	A12
836.60	4183	UMTS 850	RMC	23.0	22.72	-0.02	10 mm	707AC	N/A	1:1	front	0.239	1.067	0.255	
836.60	4183	UMTS 850	RMC	23.0	22.72	-0.09	10 mm	707AC	N/A	1:1	bottom	0.178	1.067	0.190	
836.60	4183	UMTS 850	RMC	23.0	22.72	0.08	10 mm	707AC	N/A	1:1	left	0.039	1.067	0.042	
1880.00	9400	UMTS 1900	RMC	23.0	22.92	0.04	10 mm	707AC	N/A	1:1	back	0.345	1.019	0.352	
1880.00	9400	UMTS 1900	RMC	23.0	22.92	-0.01	10 mm	707AC	N/A	1:1	front	0.475	1.019	0.484	
1880.00	9400	UMTS 1900	RMC	23.0	22.92	-0.02	10 mm	707AC	N/A	1:1	bottom	0.635	1.019	**0.647**	A14
1880.00	9400	UMTS 1900	RMC	23.0	22.92	-0.02	10 mm	707AC	N/A	1:1	left	0.077	1.019	0.078	
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 10-12
WLAN Hotspot SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
2462	11	IEEE 802.11b	DSSS	17.5	17.08	0.03	10 mm	1	707A1	1	back	1:1	0.126	1.102	**0.139**	A15
2462	11	IEEE 802.11b	DSSS	17.5	17.08	0.17	10 mm	1	707A1	1	front	1:1	0.031	1.102	0.034	
2462	11	IEEE 802.11b	DSSS	17.5	17.08	0.17	10 mm	1	707A1	1	top	1:1	0.001	1.102	0.001	
2462	11	IEEE 802.11b	DSSS	17.5	17.08	0.20	10 mm	1	707A1	1	left	1:1	0.024	1.102	0.026	
2437	6	IEEE 802.11b	DSSS	17.5	16.99	0.20	10 mm	2	707A1	1	back	1:1	0.022	1.125	0.025	
2437	6	IEEE 802.11b	DSSS	17.5	16.99	0.17	10 mm	2	707A1	1	front	1:1	0.008	1.125	0.009	
2437	6	IEEE 802.11b	DSSS	17.5	16.99	0.11	10 mm	2	707A1	1	top	1:1	0.006	1.125	0.007	
2437	6	IEEE 802.11b	DSSS	17.5	16.99	0.11	10 mm	2	707A1	1	left	1:1	0.000	1.125	0.000	
2412	1	IEEE 802.11n	OFDM	16.0	15.71	0.16	10 mm	MIMO	707A1	13	back	1:1	0.040	1.069	0.043	
2412	1	IEEE 802.11n	OFDM	16.0	15.71	0.17	10 mm	MIMO	707A1	13	front	1:1	0.008	1.069	0.009	
2412	1	IEEE 802.11n	OFDM	16.0	15.71	0.12	10 mm	MIMO	707A1	13	top	1:1	0.005	1.069	0.005	
2412	1	IEEE 802.11n	OFDM	16.0	15.71	0.11	10 mm	MIMO	707A1	13	left	1:1	0.009	1.069	0.010	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram							

© 2014 PCTEST Engineering Laboratory, Inc.

10.4 Standalone Hand SAR Data

Table 10-13
WLAN Hand SAR Data

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (10g) (W/kg)	Scaling Factor	Scaled SAR (10g) (W/kg)	Plot #
MHz	Ch.															
5825	165	IEEE 802.11a	OFDM	12.5	11.96	-0.21	0 mm	1	707A1	6	back	1:1	0.186	1.132	0.211	A18
5775	155	IEEE 802.11ac	OFDM	8.5	7.72	-0.01	0 mm	1	707A1	29.3	back	1:1	0.104	1.197	0.124	
5825	165	IEEE 802.11a	OFDM	12.5	11.96	0.13	0 mm	1	707A1	6	front	1:1	0.035	1.132	0.040	
5825	165	IEEE 802.11a	OFDM	12.5	11.96	0.20	0 mm	1	707A1	6	top	1:1	0.005	1.132	0.006	
5825	165	IEEE 802.11a	OFDM	12.5	11.96	-0.08	0 mm	1	707A1	6	left	1:1	0.052	1.132	0.059	
5180	36	IEEE 802.11a	OFDM	12.5	12.18	0.02	0 mm	1	707A1	6	back	1:1	0.307	1.076	0.330	A19
5210	42	IEEE 802.11ac	OFDM	8.5	8.10	0.09	0 mm	1	707A1	29.3	back	1:1	0.100	1.096	0.110	
5180	36	IEEE 802.11a	OFDM	12.5	12.18	0.03	0 mm	1	707A1	6	front	1:1	0.077	1.076	0.083	
5180	36	IEEE 802.11a	OFDM	12.5	12.18	0.08	0 mm	1	707A1	6	top	1:1	0.012	1.076	0.013	
5180	36	IEEE 802.11a	OFDM	12.5	12.18	0.05	0 mm	1	707A1	6	left	1:1	0.093	1.076	0.100	
5260	52	IEEE 802.11a	OFDM	12.5	12.29	0.12	0 mm	1	707A1	6	back	1:1	0.253	1.050	0.266	
5290	58	IEEE 802.11ac	OFDM	8.5	8.34	0.14	0 mm	1	707A1	29.3	back	1:1	0.086	1.038	0.089	
5260	52	IEEE 802.11a	OFDM	12.5	12.29	0.04	0 mm	1	707A1	6	front	1:1	0.066	1.050	0.069	
5260	52	IEEE 802.11a	OFDM	12.5	12.29	0.04	0 mm	1	707A1	6	top	1:1	0.011	1.050	0.012	
5260	52	IEEE 802.11a	OFDM	12.5	12.29	0.16	0 mm	1	707A1	6	left	1:1	0.068	1.050	0.071	
5500	100	IEEE 802.11a	OFDM	12.5	12.25	0.17	0 mm	1	707A1	6	back	1:1	0.155	1.059	0.164	
5530	106	IEEE 802.11ac	OFDM	8.5	7.98	0.15	0 mm	1	707A1	29.3	back	1:1	0.077	1.127	0.087	
5500	100	IEEE 802.11a	OFDM	12.5	12.25	-0.03	0 mm	1	707A1	6	front	1:1	0.061	1.059	0.065	
5500	100	IEEE 802.11a	OFDM	12.5	12.25	0.05	0 mm	1	707A1	6	top	1:1	0.005	1.059	0.005	
5500	100	IEEE 802.11a	OFDM	12.5	12.25	0.04	0 mm	1	707A1	6	left	1:1	0.041	1.059	0.043	
5785	157	IEEE 802.11a	OFDM	12.5	12.11	-0.04	0 mm	2	707A1	6	back	1:1	0.035	1.094	0.038	
5775	155	IEEE 802.11ac	OFDM	8.5	7.40	0.03	0 mm	2	707A1	29.3	back	1:1	0.004	1.288	0.005	
5785	157	IEEE 802.11a	OFDM	12.5	12.11	0.06	0 mm	2	707A1	6	front	1:1	0.035	1.094	0.038	
5785	157	IEEE 802.11a	OFDM	12.5	12.11	0.04	0 mm	2	707A1	6	top	1:1	0.000	1.094	0.000	
5785	157	IEEE 802.11a	OFDM	12.5	12.11	0.02	0 mm	2	707A1	6	left	1:1	0.000	1.094	0.000	
5180	36	IEEE 802.11a	OFDM	12.5	12.21	-0.15	0 mm	2	707A1	6	back	1:1	0.083	1.069	0.089	
5210	42	IEEE 802.11ac	OFDM	8.5	7.46	0.05	0 mm	2	707A1	29.3	back	1:1	0.019	1.271	0.024	
5180	36	IEEE 802.11a	OFDM	12.5	12.21	0.21	0 mm	2	707A1	6	front	1:1	0.029	1.069	0.031	
5180	36	IEEE 802.11a	OFDM	12.5	12.21	0.08	0 mm	2	707A1	6	top	1:1	0.008	1.069	0.009	
5180	36	IEEE 802.11a	OFDM	12.5	12.21	0.05	0 mm	2	707A1	6	left	1:1	0.001	1.069	0.001	
5260	52	IEEE 802.11a	OFDM	12.5	11.81	-0.07	0 mm	2	707A1	6	back	1:1	0.069	1.172	0.081	
5290	58	IEEE 802.11ac	OFDM	8.5	7.83	0.15	0 mm	2	707A1	29.3	back	1:1	0.019	1.167	0.022	
5260	52	IEEE 802.11a	OFDM	12.5	11.81	0.11	0 mm	2	707A1	6	front	1:1	0.038	1.172	0.045	
5260	52	IEEE 802.11a	OFDM	12.5	11.81	0.13	0 mm	2	707A1	6	top	1:1	0.006	1.172	0.007	
5260	52	IEEE 802.11a	OFDM	12.5	11.81	0.05	0 mm	2	707A1	6	left	1:1	0.001	1.172	0.001	
5580	116	IEEE 802.11a	OFDM	12.5	12.17	0.12	0 mm	2	707A1	6	back	1:1	0.037	1.079	0.040	
5580	116	IEEE 802.11a	OFDM	12.5	12.17	0.19	0 mm	2	707A1	6	front	1:1	0.037	1.079	0.040	
5530	106	IEEE 802.11ac	OFDM	8.5	8.27	0.04	0 mm	2	707A1	29.3	front	1:1	0.021	1.054	0.022	
5580	116	IEEE 802.11a	OFDM	12.5	12.17	0.14	0 mm	2	707A1	6	top	1:1	0.001	1.079	0.001	
5580	116	IEEE 802.11a	OFDM	12.5	12.17	0.04	0 mm	2	707A1	6	left	1:1	0.000	1.079	0.000	
5825	165	IEEE 802.11n	OFDM	14.5	14.36	0.02	0 mm	MIMO	707A1	13	back	1:1	0.130	1.033	0.134	
5825	165	IEEE 802.11n	OFDM	14.5	14.36	0.16	0 mm	MIMO	707A1	13	front	1:1	0.014	1.033	0.014	
5825	165	IEEE 802.11n	OFDM	14.5	14.36	-0.04	0 mm	MIMO	707A1	13	top	1:1	0.007	1.033	0.007	
5825	165	IEEE 802.11n	OFDM	14.5	14.36	0.19	0 mm	MIMO	707A1	13	left	1:1	0.037	1.033	0.038	
5180	36	IEEE 802.11n	OFDM	14.5	14.01	0.15	0 mm	MIMO	707A1	13	back	1:1	0.230	1.119	0.257	
5180	36	IEEE 802.11n	OFDM	14.5	14.01	0.12	0 mm	MIMO	707A1	13	front	1:1	0.026	1.119	0.029	
5180	36	IEEE 802.11n	OFDM	14.5	14.01	0.09	0 mm	MIMO	707A1	13	top	1:1	0.006	1.119	0.007	
5180	36	IEEE 802.11n	OFDM	14.5	14.01	0.04	0 mm	MIMO	707A1	13	left	1:1	0.080	1.119	0.090	
5260	52	IEEE 802.11n	OFDM	14.5	13.92	0.06	0 mm	MIMO	707A1	13	back	1:1	0.184	1.143	0.210	
5260	52	IEEE 802.11n	OFDM	14.5	13.92	0.07	0 mm	MIMO	707A1	13	front	1:1	0.024	1.143	0.027	
5260	52	IEEE 802.11n	OFDM	14.5	13.92	0.03	0 mm	MIMO	707A1	13	top	1:1	0.004	1.143	0.005	
5260	52	IEEE 802.11n	OFDM	14.5	13.92	0.08	0 mm	MIMO	707A1	13	left	1:1	0.057	1.143	0.065	
5700	140	IEEE 802.11n	OFDM	14.5	14.23	0.14	0 mm	MIMO	707A1	13	back	1:1	0.175	1.064	0.186	
5700	140	IEEE 802.11n	OFDM	14.5	14.23	0.15	0 mm	MIMO	707A1	13	front	1:1	0.018	1.064	0.019	
5700	140	IEEE 802.11n	OFDM	14.5	14.23	0.09	0 mm	MIMO	707A1	13	top	1:1	0.001	1.064	0.001	
5700	140	IEEE 802.11n	OFDM	14.5	14.23	0.17	0 mm	MIMO	707A1	13	left	1:1	0.057	1.064	0.061	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Hand 4.0 W/kg (mW/g) averaged over 10 grams								

© 2014 PCTEST Engineering Laboratory, Inc.

10.5 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01, body-worn SAR was evaluated without a headset connected to the device. Since the standalone reported body-worn SAR was ≤ 1.2 W/kg, no additional body-worn SAR evaluations using a headset cable were required.
8. Per FCC KDB 865664 D01 v01, variability SAR tests were not performed since the measured SAR results for a frequency band were greater than 0.8 W/kg for 1g SAR and 2.0 W/kg for 10g SAR. Please see Section 12 for variability analysis.
9. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 5.7 for more details).
10. Per FCC KDB Publication 648474 D04v01r01, this device is considered a "phablet" since the diagonal dimension is > 160 mm and < 200 mm. Therefore, hand SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg.

GSM Test Notes:

1. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
2. Justification for reduced test configurations per KDB Publication 941225 D03v01 and October 2013 TCB Workshop Notes: The source-based frame-averaged output power was evaluated for all GPRS/EDGE slot configurations. The configuration with the highest target frame averaged output power was evaluated for hotspot SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
3. 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). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

UMTS Notes:

1. UMTS mode in was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v02. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.
2. Per FCC KDB Publication 447498 D01v05, 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). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

© 2014 PCTEST Engineering Laboratory, Inc.

WLAN Notes:

1. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 2.4 GHz WIFI SISO operations: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11b. Other SISO IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
2. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for SISO 5 GHz WIFI operations: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11a. Other IEEE SISO 802.11 modes (including 802.11n 20 MHz and 40 MHz bandwidths) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
3. Per April 2013 TCB Workshop notes, full SISO SAR tests for all IEEE 802.11ac configurations were not required because the average output power was not more than 0.25 dB higher than IEEE 802.11a mode. IEEE 802.11ac SISO was evaluated for the highest IEEE 802.11a position in each 5 GHz band and exposure condition.
4. When Hotspot is enabled, all 5 GHz bands are disabled. Therefore no 5 GHz WIFI Wireless Router SAR Data was required.
5. Per KDB 248227, SAR for MIMO was measured with both transmitting simultaneously and was evaluated in dependently of SISO operation. For 2.4 GHz MIMO, 802.11n was evaluated. For 5 GHz MIMO, 802.11n 20 MHz was evaluated.
6. WIFI transmission was verified using an uncalibrated spectrum analyzer.
7. Since the maximum extrapolated peak SAR of the zoom scan for the maximum output channel for 1g SAR 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. Since the reported 10g averaged SAR is <2.0 W/kg, SAR testing on other default channels was not required.

© 2014 PCTEST Engineering Laboratory, Inc.

11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

11.1 Introduction

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

11.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05 IV.C.1.iii and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05 4.3.2 2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

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

Table 11-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2480	10.00	10	0.210

Note: Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

Main antenna SAR testing was not required for extremity exposure conditions per FCC KDB 648474. Therefore, no further analysis was required to determine that possible simultaneous scenarios would not exceed the SAR limit.

© 2014 PCTEST Engineering Laboratory, Inc.

11.3 Head SAR Simultaneous Transmission Analysis

Table 11-2
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant 1 (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.058	0.169	0.227
	Right Tilt	0.046	0.058	0.104
	Left Cheek	0.075	0.156	**0.231**
	Left Tilt	0.043	0.023	0.066

Simult Tx	Configuration	GSM 1900 Master SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.193	0.169	**0.362**
	Right Tilt	0.127	0.058	0.185
	Left Cheek	0.081	0.156	0.237
	Left Tilt	0.112	0.023	0.135

Simult Tx	Configuration	GSM 1900 Slave SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.023	0.169	0.192
	Right Tilt	0.016	0.058	0.074
	Left Cheek	0.040	0.156	**0.196**
	Left Tilt	0.016	0.023	0.039

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.033	0.169	**0.202**
	Right Tilt	0.019	0.058	0.077
	Left Cheek	0.036	0.156	0.192
	Left Tilt	0.016	0.023	0.039

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.215	0.169	**0.384**
	Right Tilt	0.155	0.058	0.213
	Left Cheek	0.088	0.156	0.244
	Left Tilt	0.115	0.023	0.138

Table 11-3
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant 2 (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.058	0.079	**0.137**
	Right Tilt	0.046	0.080	0.126
	Left Cheek	0.075	0.042	0.117
	Left Tilt	0.043	0.030	0.073

Simult Tx	Configuration	GSM 1900 Master SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.193	0.079	**0.272**
	Right Tilt	0.127	0.080	0.207
	Left Cheek	0.081	0.042	0.123
	Left Tilt	0.112	0.030	0.142

Simult Tx	Configuration	GSM 1900 Slave SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.023	0.079	**0.102**
	Right Tilt	0.016	0.080	0.096
	Left Cheek	0.040	0.042	0.082
	Left Tilt	0.016	0.030	0.046

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.033	0.079	**0.112**
	Right Tilt	0.019	0.080	0.099
	Left Cheek	0.036	0.042	0.078
	Left Tilt	0.016	0.030	0.046

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.215	0.079	**0.294**
	Right Tilt	0.155	0.080	0.235
	Left Cheek	0.088	0.042	0.130
	Left Tilt	0.115	0.030	0.145

© 2014 PCTEST Engineering Laboratory, Inc.

Table 11-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN MIMO (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.058	0.053	**0.111**
	Right Tilt	0.046	0.035	0.081
	Left Cheek	0.075	0.035	0.110
	Left Tilt	0.043	0.010	0.053

Simult Tx	Configuration	GSM 1900 Master SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.193	0.053	**0.246**
	Right Tilt	0.127	0.035	0.162
	Left Cheek	0.081	0.035	0.116
	Left Tilt	0.112	0.010	0.122

Simult Tx	Configuration	GSM 1900 Slave SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.023	0.053	**0.076**
	Right Tilt	0.016	0.035	0.051
	Left Cheek	0.040	0.035	0.075
	Left Tilt	0.016	0.010	0.026

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.033	0.053	**0.086**
	Right Tilt	0.019	0.035	0.054
	Left Cheek	0.036	0.035	0.071
	Left Tilt	0.016	0.010	0.026

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.215	0.053	**0.268**
	Right Tilt	0.155	0.035	0.190
	Left Cheek	0.088	0.035	0.123
	Left Tilt	0.115	0.010	0.125

Table 11-5
Simultaneous Transmission Scenario with 5 GHz WLAN Ant 1 (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.058	0.110	**0.168**
	Right Tilt	0.046	0.033	0.079
	Left Cheek	0.075	0.028	0.103
	Left Tilt	0.043	0.010	0.053

Simult Tx	Configuration	GSM 1900 Master SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.193	0.110	**0.303**
	Right Tilt	0.127	0.033	0.160
	Left Cheek	0.081	0.028	0.109
	Left Tilt	0.112	0.010	0.122

Simult Tx	Configuration	GSM 1900 Slave SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.023	0.110	**0.133**
	Right Tilt	0.016	0.033	0.049
	Left Cheek	0.040	0.028	0.068
	Left Tilt	0.016	0.010	0.026

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.033	0.110	**0.143**
	Right Tilt	0.019	0.033	0.052
	Left Cheek	0.036	0.028	0.064
	Left Tilt	0.016	0.010	0.026

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.215	0.110	**0.325**
	Right Tilt	0.155	0.033	0.188
	Left Cheek	0.088	0.028	0.116
	Left Tilt	0.115	0.010	0.125

© 2014 PCTEST Engineering Laboratory, Inc.

Table 11-6
Simultaneous Transmission Scenario with 5 GHz WLAN Ant 2 (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.058	0.000	0.058
	Right Tilt	0.046	0.000	0.046
	Left Cheek	0.075	0.000	**0.075**
	Left Tilt	0.043	0.000	0.043

Simult Tx	Configuration	GSM 1900 Master SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.193	0.000	**0.193**
	Right Tilt	0.127	0.000	0.127
	Left Cheek	0.081	0.000	0.081
	Left Tilt	0.112	0.000	0.112

Simult Tx	Configuration	GSM 1900 Slave SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.023	0.000	0.023
	Right Tilt	0.016	0.000	0.016
	Left Cheek	0.040	0.000	**0.040**
	Left Tilt	0.016	0.000	0.016

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.033	0.000	0.033
	Right Tilt	0.019	0.000	0.019
	Left Cheek	0.036	0.000	**0.036**
	Left Tilt	0.016	0.000	0.016

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.215	0.000	**0.215**
	Right Tilt	0.155	0.000	0.155
	Left Cheek	0.088	0.000	0.088
	Left Tilt	0.115	0.000	0.115

Table 11-7
Simultaneous Transmission Scenario with 5 GHz WLAN MIMO (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.058	0.093	**0.151**
	Right Tilt	0.046	0.017	0.063
	Left Cheek	0.075	0.020	0.095
	Left Tilt	0.043	0.000	0.043

Simult Tx	Configuration	GSM 1900 Master SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.193	0.093	**0.286**
	Right Tilt	0.127	0.017	0.144
	Left Cheek	0.081	0.020	0.101
	Left Tilt	0.112	0.000	0.112

Simult Tx	Configuration	GSM 1900 Slave SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.023	0.093	**0.116**
	Right Tilt	0.016	0.017	0.033
	Left Cheek	0.040	0.020	0.060
	Left Tilt	0.016	0.000	0.016

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.033	0.093	**0.126**
	Right Tilt	0.019	0.017	0.036
	Left Cheek	0.036	0.020	0.056
	Left Tilt	0.016	0.000	0.016

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.215	0.093	**0.308**
	Right Tilt	0.155	0.017	0.172
	Left Cheek	0.088	0.020	0.108
	Left Tilt	0.115	0.000	0.115

© 2014 PCTEST Engineering Laboratory, Inc.

11.4 Body-Worn Simultaneous Transmission Analysis

Table 11-8
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant 1 (Body-Worn at 1.0 cm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.395	0.139	**0.534**
Back Side	GSM 1900 Master	0.236	0.139	0.375
Back Side	GSM 1900 Slave	0.301	0.139	0.440
Back Side	UMTS 850	0.275	0.139	0.414
Back Side	UMTS 1900	0.352	0.139	0.491

Table 11-9
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant 2 (Body-Worn at 1.0 cm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.395	0.025	**0.420**
Back Side	GSM 1900 Master	0.236	0.025	0.261
Back Side	GSM 1900 Slave	0.301	0.025	0.326
Back Side	UMTS 850	0.275	0.025	0.300
Back Side	UMTS 1900	0.352	0.025	0.377

Table 11-10
Simultaneous Transmission Scenario with 2.4 GHz WLAN MIMO (Body-Worn at 1.0 cm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.395	0.043	**0.438**
Back Side	GSM 1900 Master	0.236	0.043	0.279
Back Side	GSM 1900 Slave	0.301	0.043	0.344
Back Side	UMTS 850	0.275	0.043	0.318
Back Side	UMTS 1900	0.352	0.043	0.395

Table 11-11
Simultaneous Transmission Scenario with 5 GHz WLAN Ant 1 (Body-Worn at 1.0 cm)

Configuration	Mode	2G/3G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.395	0.154	**0.549**
Back Side	GSM 1900 Master	0.236	0.154	0.390
Back Side	GSM 1900 Slave	0.301	0.154	0.455
Back Side	UMTS 850	0.275	0.154	0.429
Back Side	UMTS 1900	0.352	0.154	0.506

© 2014 PCTEST Engineering Laboratory, Inc.

Table 11-12
Simultaneous Transmission Scenario with 5 GHz WLAN Ant 2 (Body-Worn at 1.0 cm)

Configuration	Mode	2G/3G SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.395	0.022	**0.417**
Back Side	GSM 1900 Master	0.236	0.022	0.258
Back Side	GSM 1900 Slave	0.301	0.022	0.323
Back Side	UMTS 850	0.275	0.022	0.297
Back Side	UMTS 1900	0.352	0.022	0.374

Table 11-13
Simultaneous Transmission Scenario with 5 GHz WLAN MIMO (Body-Worn at 1.0 cm)

Configuration	Mode	2G/3G SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.395	0.113	**0.508**
Back Side	GSM 1900 Master	0.236	0.113	0.349
Back Side	GSM 1900 Slave	0.301	0.113	0.414
Back Side	UMTS 850	0.275	0.113	0.388
Back Side	UMTS 1900	0.352	0.113	0.465

Table 11-14
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 1.0 cm)

Configuration	Mode	2G/3G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.395	0.210	**0.605**
Back Side	GSM 1900 Master	0.236	0.210	0.446
Back Side	GSM 1900 Slave	0.301	0.210	0.511
Back Side	UMTS 850	0.275	0.210	0.485
Back Side	UMTS 1900	0.352	0.210	0.562

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

© 2014 PCTEST Engineering Laboratory, Inc.

11.5 Hotspot SAR Simultaneous Transmission Analysis

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

Table 11-15
Simultaneous Transmission Scenario (2.4 GHz WLAN Ant 1 Hotspot at 1.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.334	0.139	**0.473**
	Front	0.398	0.034	0.432
	Top	-	0.001	0.001
	Bottom	0.235	-	0.235
	Right	-	-	0.000
	Left	0.081	0.026	0.107

Simult Tx	Configuration	GPRS 1900 Master SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.245	0.139	0.384
	Front	0.261	0.034	0.295
	Top	-	0.001	0.001
	Bottom	0.456	-	**0.456**
	Right	-	-	0.000
	Left	0.081	0.026	0.107

Simult Tx	Configuration	GPRS 1900 Slave SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.403	0.139	**0.542**
	Front	0.417	0.034	0.451
	Top	-	0.001	0.001
	Bottom	0.508	-	0.508
	Right	0.077	-	0.077
	Left	-	0.026	0.026

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.275	0.139	**0.414**
	Front	0.255	0.034	0.289
	Top	-	0.001	0.001
	Bottom	0.190	-	0.190
	Right	-	-	0.000
	Left	0.042	0.026	0.068

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.352	0.139	0.491
	Front	0.484	0.034	0.518
	Top	-	0.001	0.001
	Bottom	0.647	-	**0.647**
	Right	-	-	0.000
	Left	0.078	0.026	0.104

Table 11-16
Simultaneous Transmission Scenario (2.4 GHz WLAN Ant 2 Hotspot at 1.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.334	0.025	0.359
	Front	0.398	0.009	**0.407**
	Top	-	0.007	0.007
	Bottom	0.235	-	0.235
	Right	-	-	0.000
	Left	0.081	0.000	0.081

Simult Tx	Configuration	GPRS 1900 Master SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.245	0.025	0.270
	Front	0.261	0.009	0.270
	Top	-	0.007	0.007
	Bottom	0.456	-	**0.456**
	Right	-	-	0.000
	Left	0.081	0.000	0.081

Simult Tx	Configuration	GPRS 1900 Slave SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.403	0.025	0.428
	Front	0.417	0.009	0.426
	Top	-	0.007	0.007
	Bottom	0.508	-	**0.508**
	Right	0.077	-	0.077
	Left	-	0.000	0.000

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.275	0.025	**0.300**
	Front	0.255	0.009	0.264
	Top	-	0.007	0.007
	Bottom	0.190	-	0.190
	Right	-	-	0.000
	Left	0.042	0.000	0.042

© 2014 PCTEST Engineering Laboratory, Inc.

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.352	0.025	0.377
	Front	0.484	0.009	0.493
	Top	-	0.007	0.007
	Bottom	0.647	-	**0.647**
	Right	-	-	0.000
	Left	0.078	0.000	0.078

Table 11-17
Simultaneous Transmission Scenario (2.4 GHz WLAN MIMO Hotspot at 1.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.334	0.043	0.377
	Front	0.398	0.009	**0.407**
	Top	-	0.005	0.005
	Bottom	0.235	-	0.235
	Right	-	-	0.000
	Left	0.081	0.010	0.091

Simult Tx	Configuration	GPRS 1900 Master SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.245	0.043	0.288
	Front	0.261	0.009	0.270
	Top	-	0.005	0.005
	Bottom	0.456	-	**0.456**
	Right	-	-	0.000
	Left	0.081	0.010	0.091

Simult Tx	Configuration	GPRS 1900 Slave SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.403	0.043	0.446
	Front	0.417	0.009	0.426
	Top	-	0.005	0.005
	Bottom	0.508	-	**0.508**
	Right	0.077	-	0.077
	Left	-	0.010	0.010

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.275	0.043	**0.318**
	Front	0.255	0.009	0.264
	Top	-	0.005	0.005
	Bottom	0.190	-	0.190
	Right	-	-	0.000
	Left	0.042	0.010	0.052

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.352	0.043	0.395
	Front	0.484	0.009	0.493
	Top	-	0.005	0.005
	Bottom	0.647	-	**0.647**
	Right	-	-	0.000
	Left	0.078	0.010	0.088

11.6 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v05 and IEEE 1528-2013 Section 6.3.4.1.2.

© 2014 PCTEST Engineering Laboratory, Inc.

12 SAR MEASUREMENT VARIABILITY

12.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01, SAR measurement variability was not assessed since measured 1g SAR each frequency band was below 0.8 W/kg and measured 10g SAR for each frequency band was below 2.0 W/kg.

12.2 Measurement Uncertainty

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

© 2014 PCTEST Engineering Laboratory, Inc.

13 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	8648D	(9kHz-4GHz) Signal Generator	4/15/2014	Annual	4/15/2015	3629U00687
Agilent	8753ES	S-Parameter Network Analyzer	5/22/2014	Annual	5/22/2015	US39170118
Agilent	8753ES	S-Parameter Network Analyzer	10/29/2013	Annual	10/29/2014	US39170122
Agilent	E4438C	ESG Vector Signal Generator	3/31/2014	Annual	3/31/2015	MY42082659
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/15/2014	Annual	4/15/2015	MY45470194
Agilent	N5182A	MXG Vector Signal Generator	4/15/2014	Annual	4/15/2015	MY47420800
Agilent	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433972
Anritsu	MA24106A	USB Power Sensor	1/3/2014	Annual	1/3/2015	1349501
Anritsu	MA24106A	USB Power Sensor	1/3/2014	Annual	1/3/2015	1349503
Anritsu	MA24106A	USB Power Sensor	1/3/2014	Annual	1/3/2015	1349509
Anritsu	MA24106A	USB Power Sensor	1/3/2014	Annual	1/3/2015	1349514
Anritsu	MA2411B	Pulse Power Sensor	11/14/2013	Annual	11/14/2014	1126066
Anritsu	MA2411B	Pulse Power Sensor	3/25/2014	Annual	3/25/2015	1207470
Anritsu	ML2495A	Power Meter	10/31/2013	Annual	10/31/2014	1039008
Anritsu	MT8820C	Radio Communication Analyzer	12/12/2013	Annual	12/12/2014	6200901190
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
Control Company	36934-158	Wall-Mounted Thermometer	4/29/2014	Biennial	4/29/2016	122014488
Control Company	61220-416	Long-Stem Thermometer	4/29/2014	Biennial	4/29/2016	111331323
Fisher Scientific	15-077-960	Digital Thermometer	11/6/2012	Biennial	11/6/2014	122640025
Fisher Scientific	15-078J	Long Stem Thermometer	10/30/2012	Biennial	10/30/2014	122626059
Fisher Scientific	S97611	Thermometer	4/12/2013	Biennial	4/12/2015	130219303
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
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264162
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	CMU200	Base Station Simulator	6/6/2014	Annual	6/6/2015	109892
Rohde & Schwarz	CMW500	Radio Communication Tester	7/22/2014	Annual	7/22/2015	116743
Rohde & Schwarz	CMW500	Radio Communication Tester	2/20/2014	Annual	2/20/2015	128633
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	22313
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
SPEAG	D1900V2	1900 MHz SAR Dipole	2/27/2014	Annual	2/27/2015	5d148
SPEAG	D2450V2	2450 MHz SAR Dipole	1/21/2014	Annual	1/21/2015	797
SPEAG	D5GHzV2	5 GHz SAR Dipole	9/23/2013	Annual	9/23/2014	1007
SPEAG	D5GHzV2	5 GHz SAR Dipole	1/27/2014	Annual	1/27/2015	1057
SPEAG	D835V2	835 MHz SAR Dipole	4/7/2014	Annual	4/7/2015	4d119
SPEAG	D835V2	835 MHz SAR Dipole	7/10/2014	Annual	7/10/2015	4d132
SPEAG	DAE4	Dasy Data Acquisition Electronics	12/12/2013	Annual	12/12/2014	649
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/14/2014	Annual	5/14/2015	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/17/2013	Annual	9/17/2014	1323
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/19/2013	Annual	11/19/2014	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/17/2014	Annual	3/17/2015	1334
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/17/2014	Annual	3/17/2015	1364
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/11/2014	Annual	4/11/2015	1368
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/6/2014	Annual	5/6/2015	1070
SPEAG	DAK-3.5	Dielectric Assessment Kit	11/13/2013	Annual	11/13/2014	1091
SPEAG	ES3DV3	SAR Probe	4/11/2014	Annual	4/11/2015	3213
SPEAG	ES3DV3	SAR Probe	5/15/2014	Annual	5/15/2016	3263
SPEAG	ES3DV3	SAR Probe	9/23/2013	Annual	9/23/2014	3288
SPEAG	ES3DV3	SAR Probe	4/17/2014	Annual	4/17/2015	3319
SPEAG	EX3DV4	SAR Probe	1/29/2014	Annual	1/29/2015	3589
SPEAG	EX3DV4	SAR Probe	10/23/2013	Annual	10/23/2014	3914
SPEAG	EX3DV4	SAR Probe	12/18/2013	Annual	12/18/2014	3920
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/16/2014	Annual	4/16/2015	B010177
VWR	36934-158	Wall-Mounted Thermometer	4/29/2014	Biennial	4/29/2016	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.

© 2014 PCTEST Engineering Laboratory, Inc.

14 MEASUREMENT UNCERTAINTIES

Applicable for frequencies less than 3000 MHz.

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

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

© 2014 PCTEST Engineering Laboratory, Inc.

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

© 2014 PCTEST Engineering Laboratory, Inc.

15 CONCLUSION

15.1 Measurement Conclusion

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

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

© 2014 PCTEST Engineering Laboratory, Inc.

16 REFERENCES

[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, Aug. 1996.

[2] ANSI/IEEE C95.1-2005, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, 2006.

[3] ANSI/IEEE C95.1-1992, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, Sept. 1992.

[4] ANSI/IEEE C95.3-2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave, New York: IEEE, December 2002.

[5] IEEE Standards Coordinating Committee 39 –Standards Coordinating Committee 34 – IEEE Std. 1528-2003, Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head Due to Wireless Communications Devices: Measurement Techniques.

[6] NCRP, National Council on Radiation Protection and Measurements, Biological Effects and Exposure Criteria for RadioFrequency Electromagnetic Fields, NCRP Report No. 86, 1986. Reprinted Feb. 1995.

[7] T. Schmid, O. Egger, N. Kuster, Automated E-field scanning system for dosimetric assessments, IEEE Transaction on Microwave Theory and Techniques, vol. 44, Jan. 1996, pp. 105-113.

[8] K. Pokovic, T. Schmid, N. Kuster, Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies, ICECOM97, Oct. 1997, pp. -124.

[9] K. Pokovic, T. Schmid, and N. Kuster, E-field Probe with improved isotropy in brain simulating liquids, Proceedings of the ELMAR, Zadar, Croatia, June 23-25, 1996, pp. 172-175.

[10] Schmid & Partner Engineering AG, Application Note: Data Storage and Evaluation, June 1998, p2.

[11] V. Hombach, K. Meier, M. Burkhardt, E. Kuhn, N. Kuster, The Dependence of EM Energy Absorption upon Human Modeling at 900 MHz, IEEE Transaction on Microwave Theory and Techniques, vol. 44 no. 10, Oct. 1996, pp. 1865-1873.

[12] N. Kuster and Q. Balzano, Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz, IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.

[13] G. Hartsgrove, A. Kraszewski, A. Surowiec, Simulated Biological Materials for Electromagnetic Radiation Absorption Studies, University of Ottawa, Bioelectromagnetics, Canada: 1987, pp. 29-36.

[14] Q. Balzano, O. Garay, T. Manning Jr., Electromagnetic Energy Exposure of Simulated Users of Portable Cellular Telephones, IEEE Transactions on Vehicular Technology, vol. 44, no.3, Aug. 1995.

[15] W. Gander, Computermathematick, Birkhaeuser, Basel, 1992.

[16] W.H. Press, S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery, Numerical Recipes in C, The Art of Scientific Computing, Second edition, Cambridge University Press, 1992.

[17] N. Kuster, R. Kastle, T. Schmid, Dosimetric evaluation of mobile communications equipment with known precision, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.

© 2014 PCTEST Engineering Laboratory, Inc.

[18] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10kHz-300GHz, Jan. 1995.

[19] Prof. Dr. Niels Kuster, ETH, Eidgenössische Technische Hoschschule Zürich, Dosimetric Evaluation of the Cellular Phone.

[20] IEC 62209-1, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz), Feb. 2005.

[21] Industry Canada RSS-102 Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) Issue 4, March 2010.

[22] Health Canada Safety Code 6 Limits of Human Exposure to Radio Frequency Electromagnetic Fields in the Frequency Range from 3 kHz – 300 GHz, 2009

[23] FCC SAR Test Procedures for 2G-3G Devices, Mobile Hotspot and UMPC Devices KDB Publications 941225, D01-D07

[24] SAR Measurement procedures for IEEE 802.11a/b/g KDB Publication 248227 D01v01r02

[25] FCC SAR Considerations for Handsets with Multiple Transmitters and Antennas, KDB Publications 648474 D02-D04

[26] FCC SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers, FCC KDB Publication 616217 D04

[27] FCC SAR Measurement and Reporting Requirements for 100MHz – 6 GHz, KDB Publications 865664 D01-D02

[28] FCC General RF Exposure Guidance and SAR Procedures for Dongles, KDB Publication 447498, D01-D02

[29] Anexo à Resolução No. 533, de 10 de Septembro de 2009.

[30] IEC 62209-2, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz), Mar. 2010.

© 2014 PCTEST Engineering Laboratory, Inc.

APPENDIX A: SAR TEST DATA

© 2014 PCTEST Engineering Laboratory, Inc.

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707A1

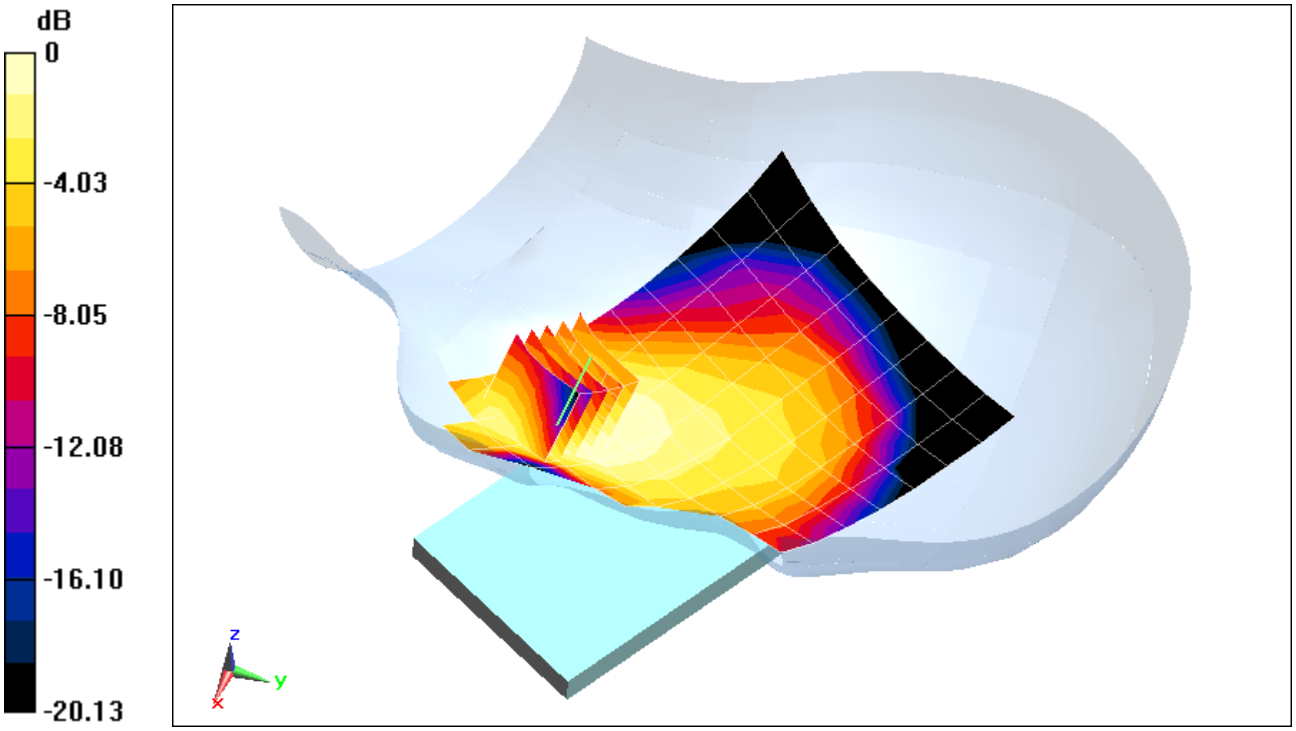
Communication System: UID 0, GSM850; Frequency: 836.6 MHz;Duty Cycle: 1:8.3
Medium: 835 Head Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.937 S/m; ε_r = 43.109; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-11-2014; Ambient Temp: 22.6°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3213; ConvF(6.37, 6.37, 6.37); Calibrated: 4/11/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 3/17/2014
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.550 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.0880 W/kg
SAR(1 g) = 0.067 W/kg



0 dB = 0.0743 W/kg = -11.29 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707A1

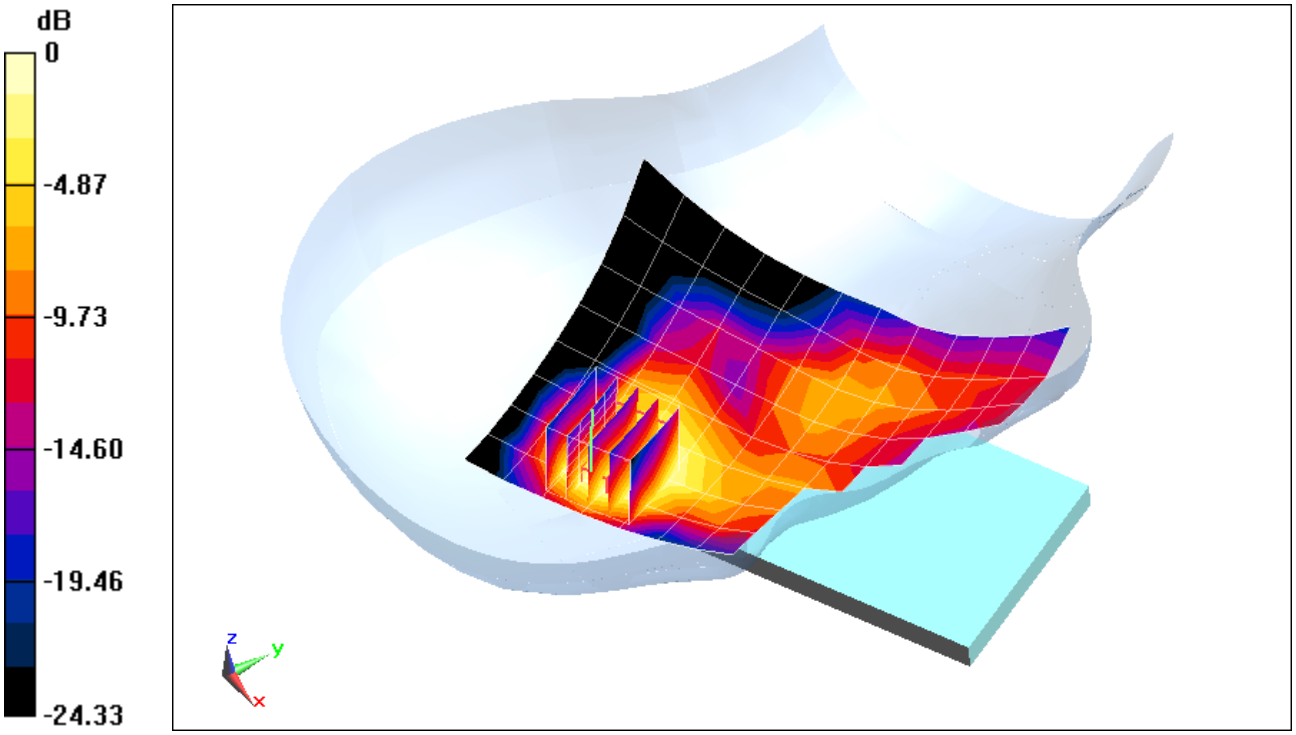
Communication System: UID 0, GSM1900; Frequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium: 1900 Head Medium parameters used:
f = 1910 MHz; σ = 1.467 S/m; ε_r = 40.608; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 08-11-2014; Ambient Temp: 22.8°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3213; ConvF(4.99, 4.99, 4.99); Calibrated: 4/11/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 3/17/2014
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

Mode: GSM 1900, Master, Right Head, Cheek, High.ch

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.24 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.381 W/kg
SAR(1 g) = 0.176 W/kg



0 dB = 0.224 W/kg = -6.50 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707AC

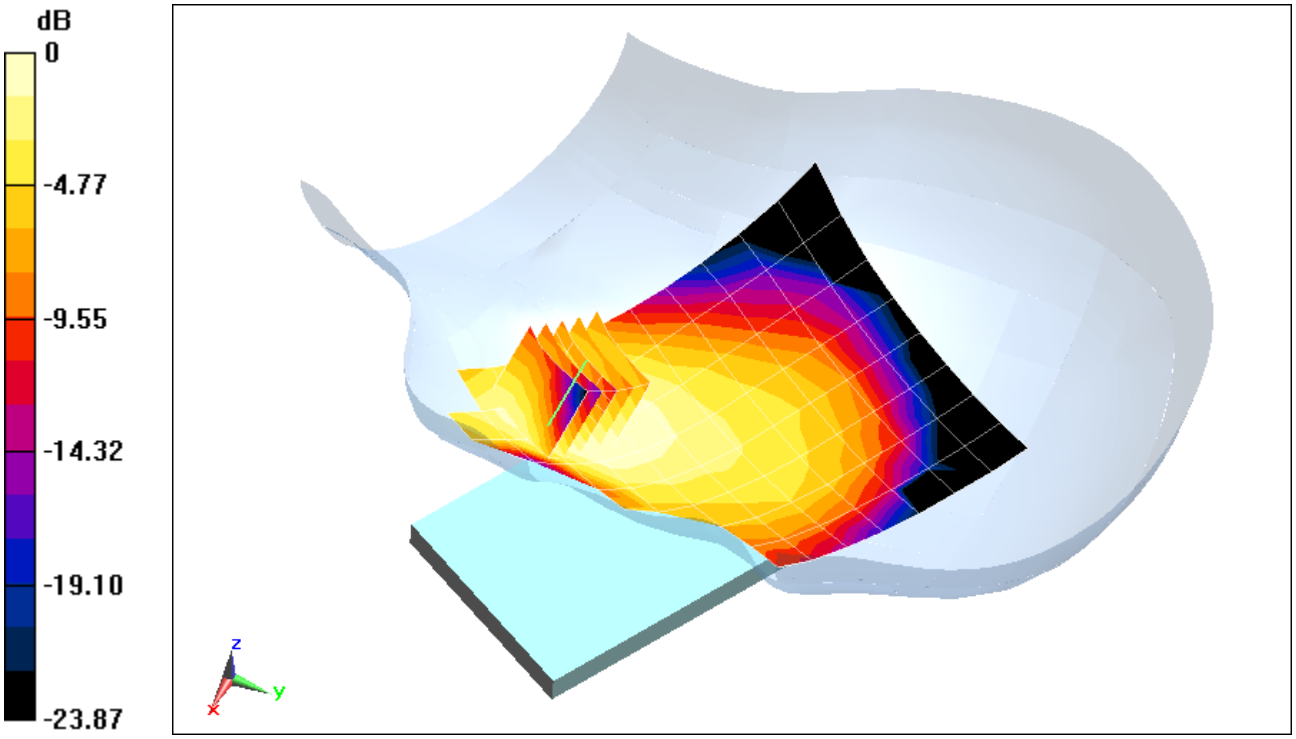
Communication System: UID 0, WCDMA850; Frequency: 836.6 MHz;Duty Cycle: 1:1
Medium: 835 Head Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.937 S/m; ε_r = 43.109; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-11-2014; Ambient Temp: 22.6°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3213; ConvF(6.37, 6.37, 6.37); Calibrated: 4/11/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 3/17/2014
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 6.192 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.0460 W/kg
SAR(1 g) = 0.034 W/kg



0 dB = 0.0376 W/kg = -14.25 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707AC

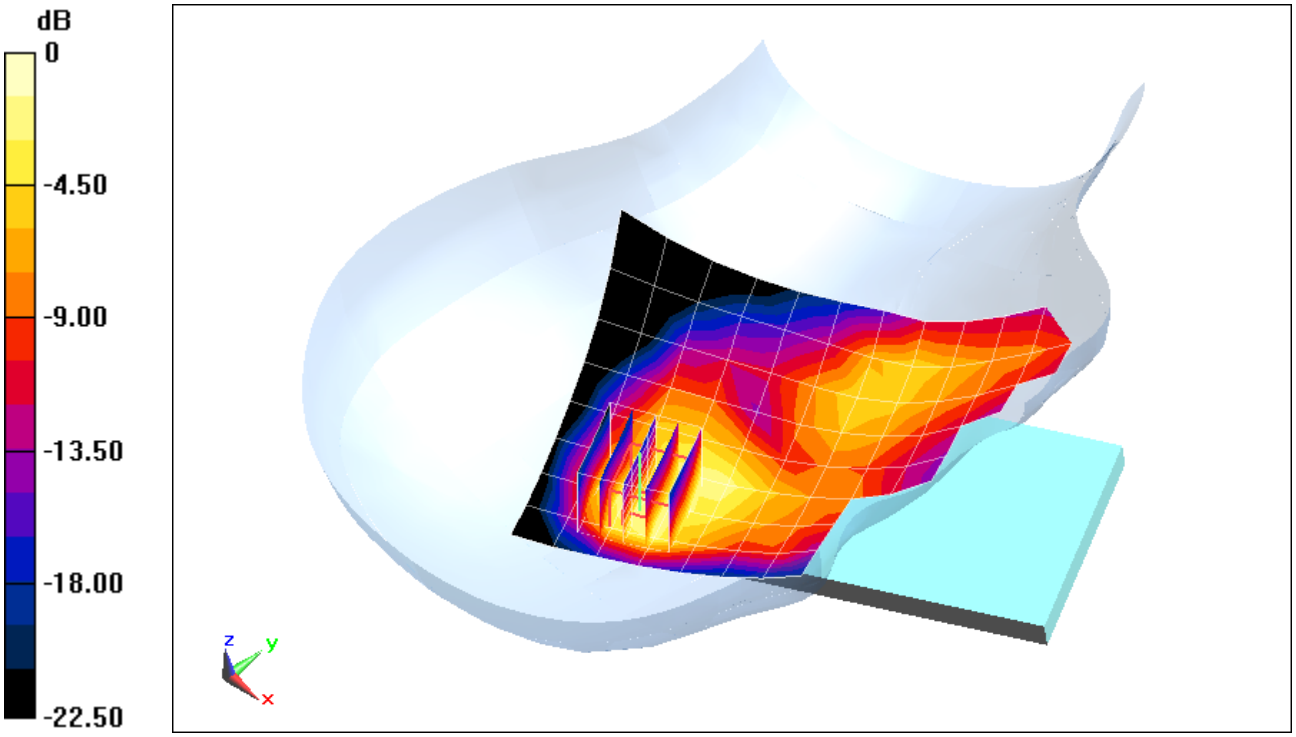
Communication System: UID 0, WCDMA1900; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.437 S/m; ε_r = 40.738; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 08-11-2014; Ambient Temp: 22.8°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3213; ConvF(4.99, 4.99, 4.99); Calibrated: 4/11/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 3/17/2014
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

Mode: UMTS 1900, Right Head, Cheek, Mid.ch

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.50 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 0.457 W/kg
SAR(1 g) = 0.211 W/kg



0 dB = 0.270 W/kg = -5.69 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707A1

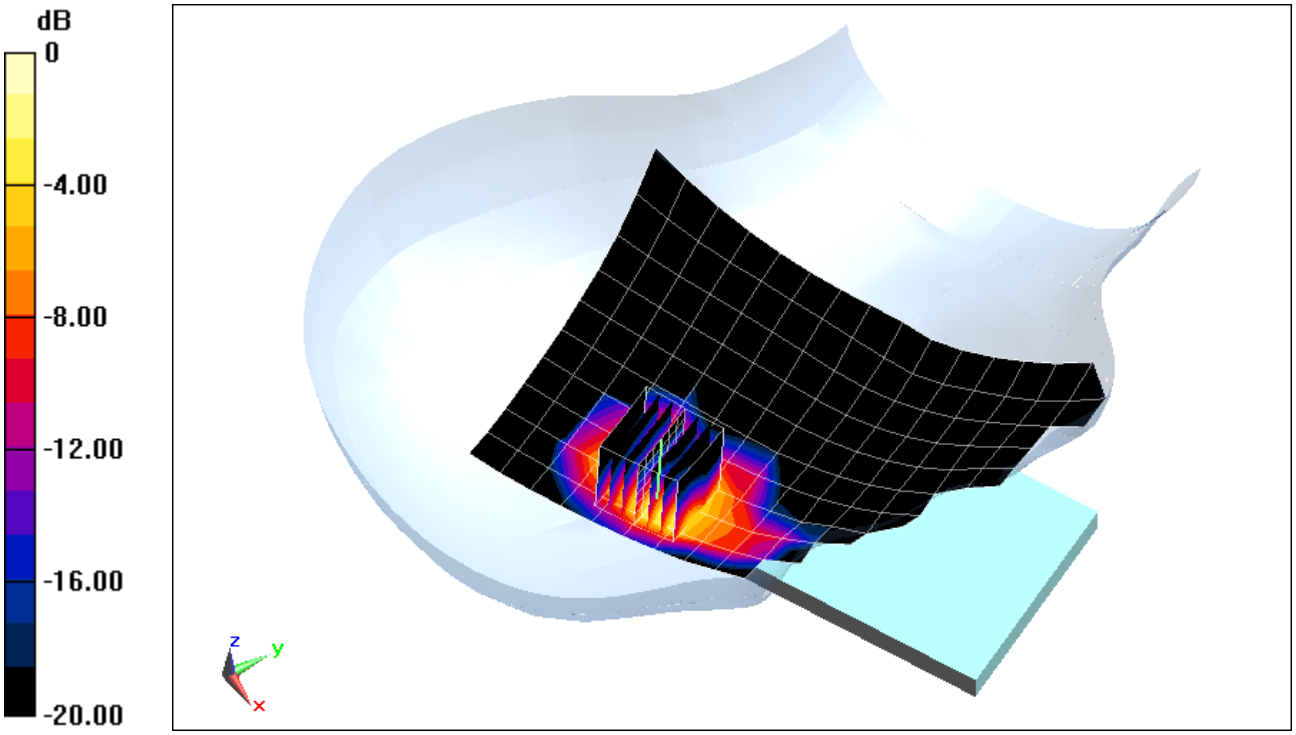
Communication System: UID 0, IEEE 802.11b; Frequency: 2462 MHz;Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used (interpolated):
f = 2462 MHz; σ = 1.88 S/m; ε_r = 39.622; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 08-11-2014; Ambient Temp: 22.2°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3319; ConvF(4.45, 4.45, 4.45); Calibrated: 4/17/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 4/11/2014
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11b, Antenna 1, Right Head, Cheek, Ch 11, 1 Mbps

Area Scan (11x18x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.967 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.392 W/kg
SAR(1 g) = 0.153 W/kg



0 dB = 0.210 W/kg = -6.78 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707A1

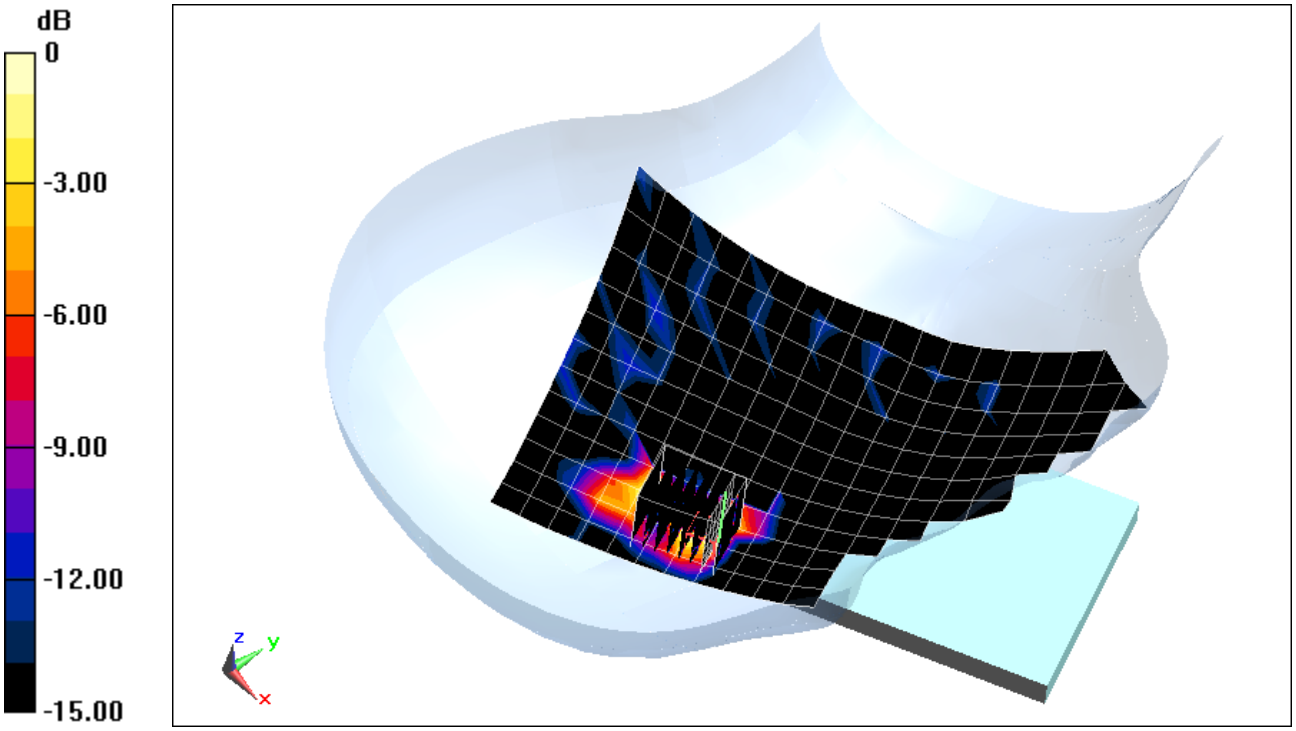
Communication System: UID 0, IEEE 802.11a (0); Frequency: 5825 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5825 MHz; σ = 5.097 S/m; ε_r = 34.983; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 08-18-2014; Ambient Temp: 24.5°C; Tissue Temp: 24.1°C

Probe: EX3DV4 - SN3914; ConvF(4.52, 4.52, 4.52); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11a, Antenna 1, 5.8 GHz, Right Head, Cheek, Ch 165, 6 Mbps

Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 0.5140 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 0.214 W/kg
SAR(1 g) = 0.011 W/kg



0 dB = 0.172 W/kg = -7.64 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707A1

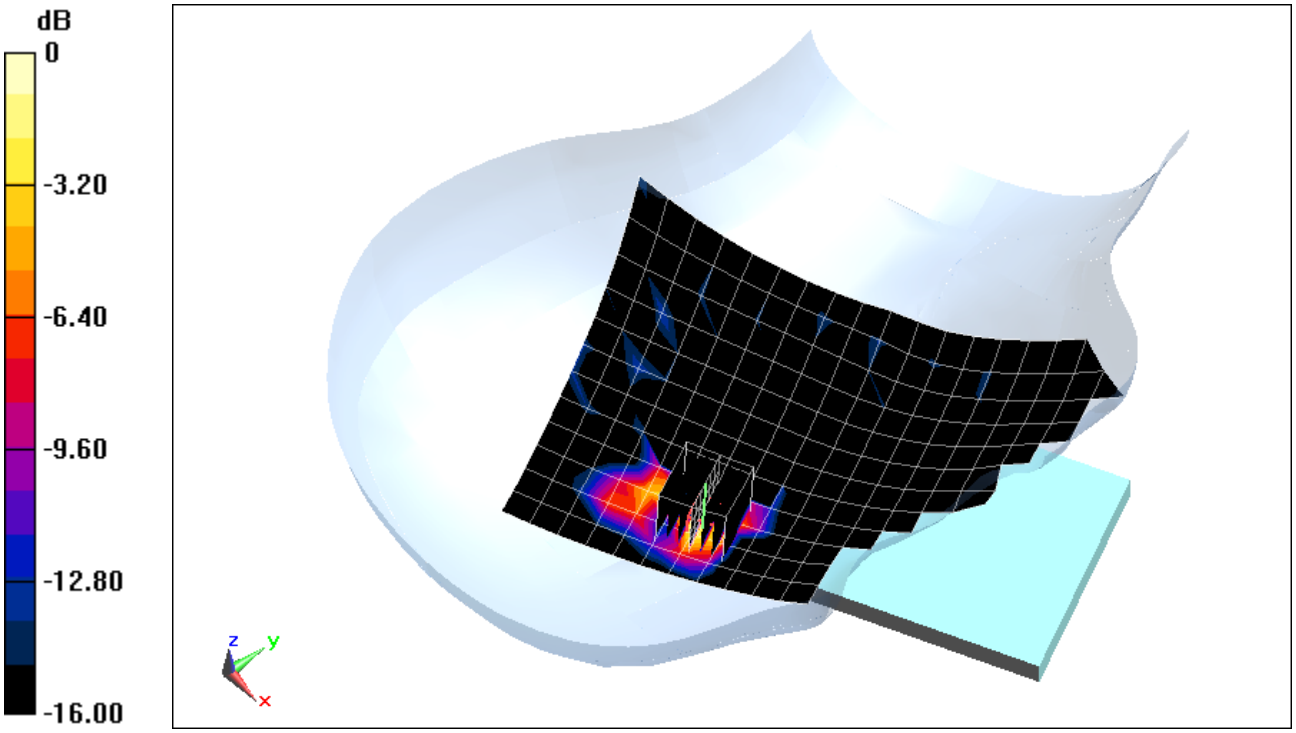
Communication System: UID 0, IEEE 802.11a (0); Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5180 MHz; σ = 4.468 S/m; ε_r = 35.795; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 08-18-2014; Ambient Temp: 24.6°C; Tissue Temp: 24.0°C

Probe: EX3DV4 - SN3914; ConvF(4.99, 4.99, 4.99); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11a, Antenna 1, 5.2 GHz, Right Head, Cheek, Ch 36, 6 Mbps

Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 4.504 V/m; Power Drift = 0.21 dB
Peak SAR (extrapolated) = 0.414 W/kg
SAR(1 g) = 0.102 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707A1

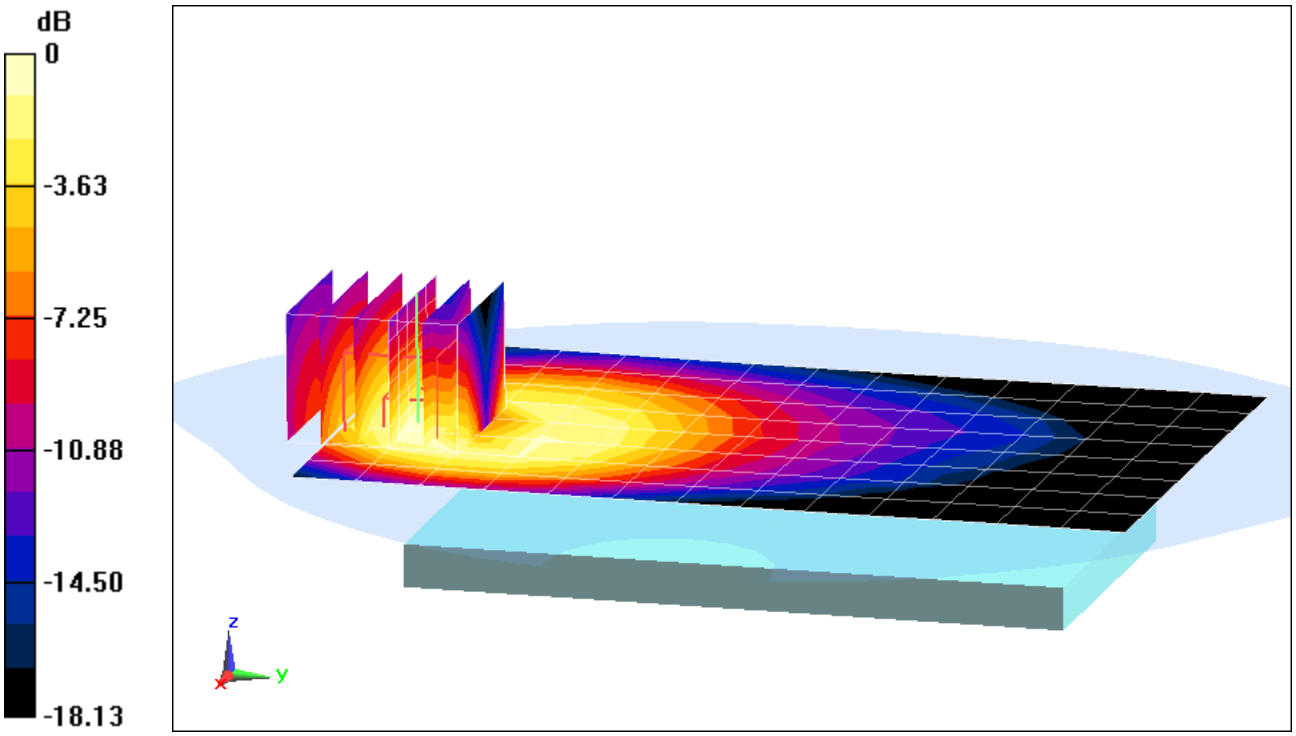
Communication System: UID 0, GSM (0); Frequency: 836.6 MHz;Duty Cycle: 1:8.3
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.998 S/m; ε_r = 52.996; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-14-2014; Ambient Temp: 23.9°C; Tissue Temp: 23.1°C

Probe: ES3DV3 - SN3263; ConvF(6.16, 6.16, 6.16); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.02 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.594 W/kg
SAR(1 g) = 0.355 W/kg



0 dB = 0.429 W/kg = -3.68 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707A1

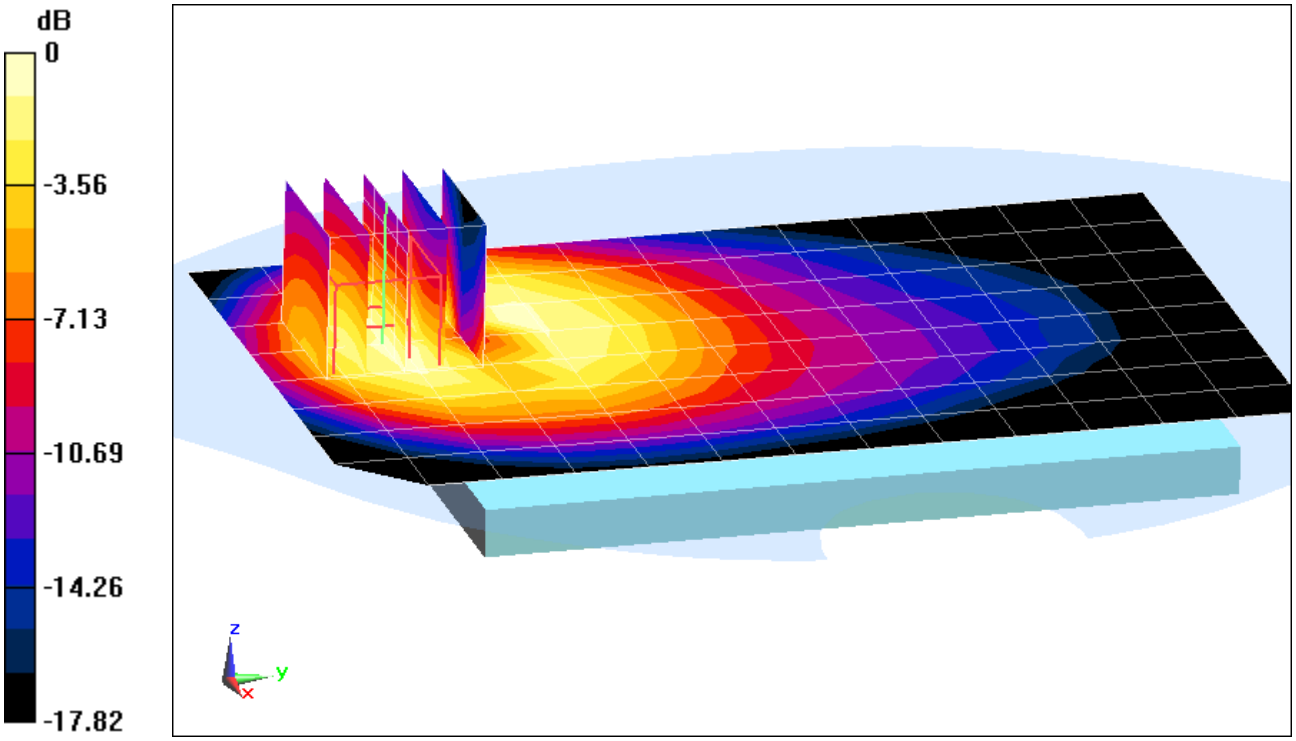
Communication System: UID 0, GSM GPRS; 3 Tx slots (0); Frequency: 836.6 MHz;Duty Cycle: 1:2.76
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.998 S/m; ε_r = 52.996; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-14-2014; Ambient Temp: 23.9°C; Tissue Temp: 23.1°C

Probe: ES3DV3 - SN3263; ConvF(6.16, 6.16, 6.16); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: GPRS 850, Body SAR, Front side, Mid.ch, 3 Tx Slots

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.14 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 0.599 W/kg
SAR(1 g) = 0.351 W/kg



0 dB = 0.430 W/kg = -3.67 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707A1

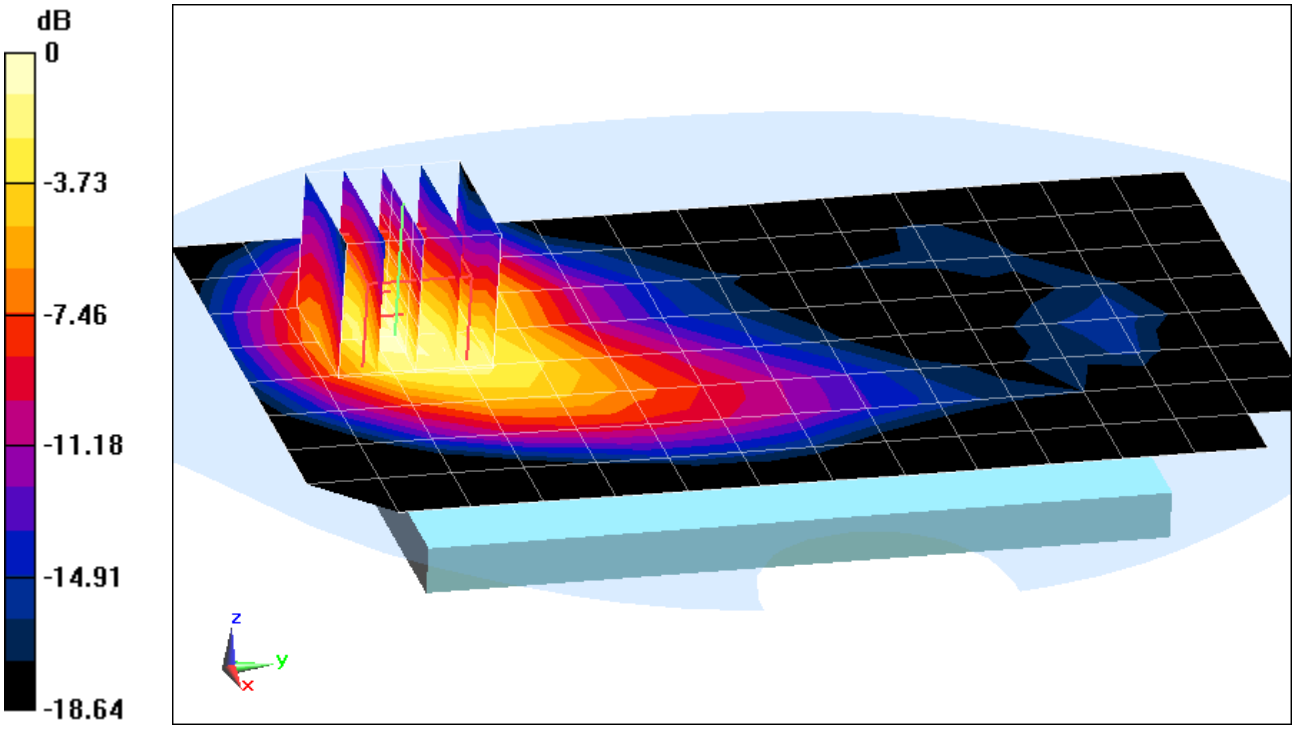
Communication System: UID 0, GSM1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.528 S/m; ε_r = 52.005; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-11-2014; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3288; ConvF(4.82, 4.82, 4.82); Calibrated: 9/23/2013;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2013
Phantom: SAM with CRP; Type: SAM; Serial: TP1375
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.39 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.411 W/kg
SAR(1 g) = 0.250 W/kg



0 dB = 0.311 W/kg = -5.07 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707A1

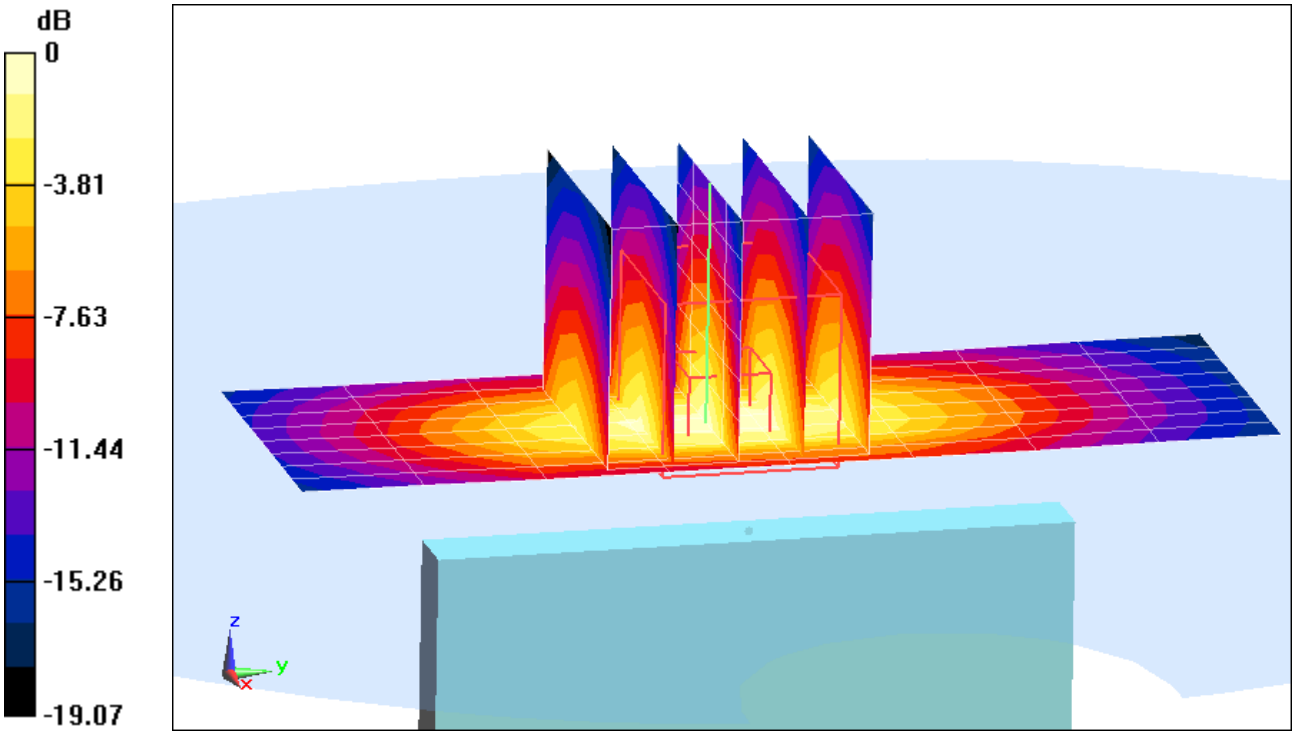
Communication System: UID 0, GSM1900 GPRS; 3 Tx slots; Frequency: 1880 MHz;Duty Cycle: 1:2.76
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.528 S/m; ε_r = 52.005; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-11-2014; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3288; ConvF(4.82, 4.82, 4.82); Calibrated: 9/23/2013;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2013
Phantom: SAM with CRP; Type: SAM; Serial: TP1375
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

Mode: GPRS 1900, Slave, Body SAR, Bottom Edge, Mid.ch, 3 Tx Slots

Area Scan (9x9x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.64 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.807 W/kg
SAR(1 g) = 0.469 W/kg



0 dB = 0.605 W/kg = -2.18 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707AC

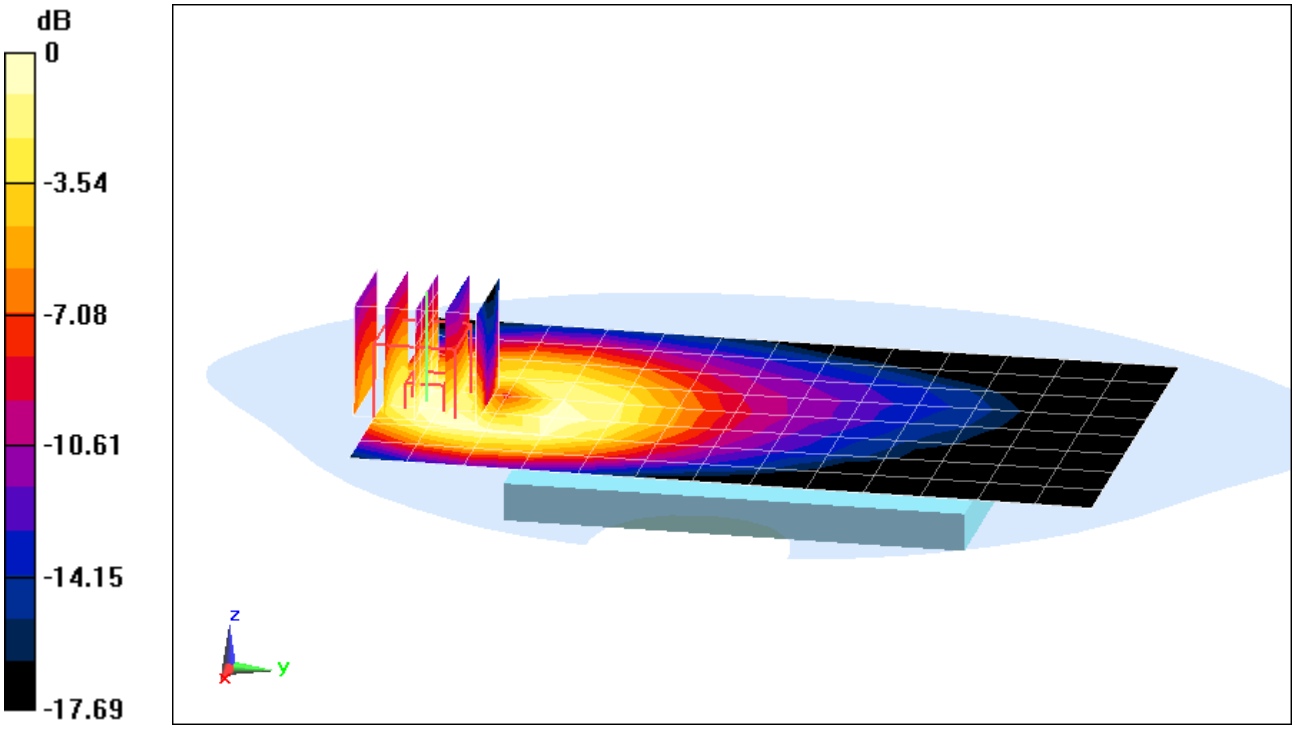
Communication System: UID 0, UMTS; Frequency: 836.6 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.998 S/m; ε_r = 52.996; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-14-2014; Ambient Temp: 23.9°C; Tissue Temp: 23.1°C

Probe: ES3DV3 - SN3263; ConvF(6.16, 6.16, 6.16); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.45 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.436 W/kg
SAR(1 g) = 0.258 W/kg



0 dB = 0.307 W/kg = -5.13 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707AC

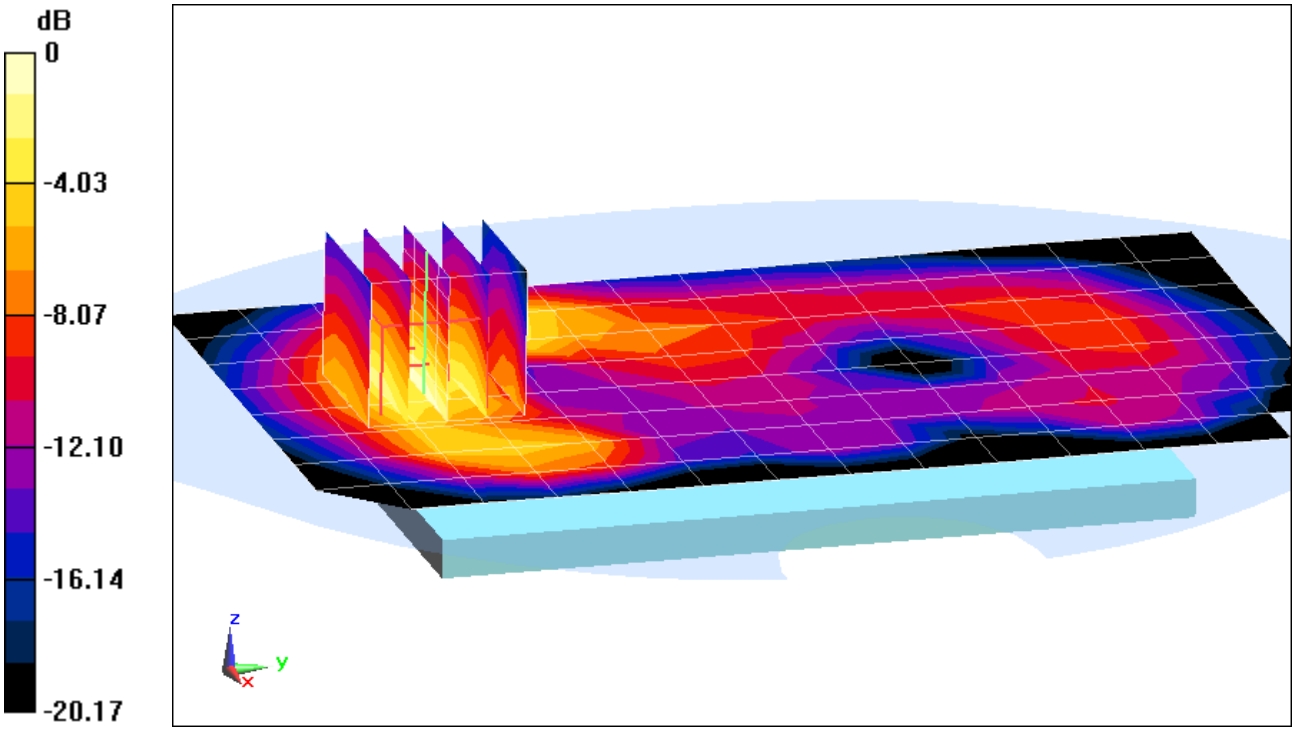
Communication System: UID 0, WCDMA1900; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.528 S/m; ε_r = 52.005; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-11-2014; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3288; ConvF(4.82, 4.82, 4.82); Calibrated: 9/23/2013;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2013
Phantom: SAM with CRP; Type: SAM; Serial: TP1375
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.862 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.584 W/kg
SAR(1 g) = 0.345 W/kg



0 dB = 0.423 W/kg = -3.74 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707AC

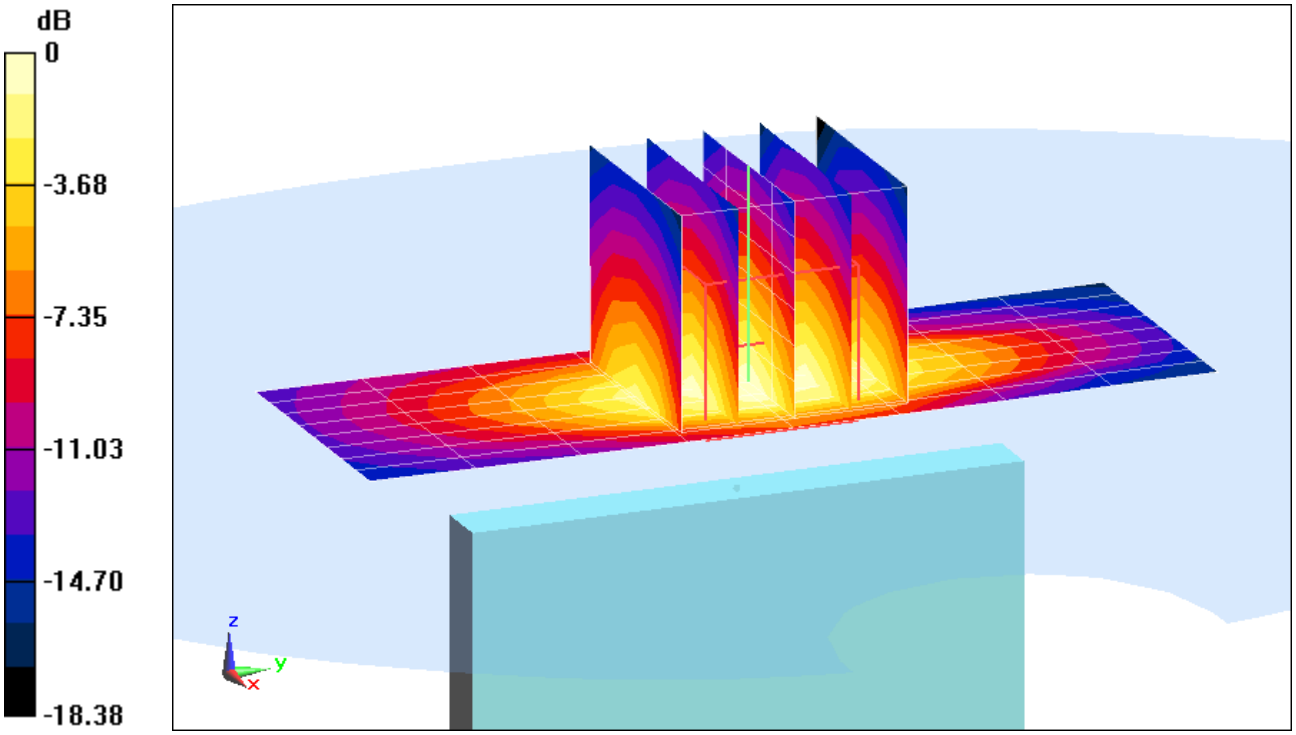
Communication System: UID 0, WCDMA1900; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.528 S/m; ε_r = 52.005; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-11-2014; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3288; ConvF(4.82, 4.82, 4.82); Calibrated: 9/23/2013;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2013
Phantom: SAM with CRP; Type: SAM; Serial: TP1375
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

Mode: UMTS 1900, Body SAR, Bottom Edge, Mid.ch

Area Scan (9x9x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.29 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 1.06 W/kg
SAR(1 g) = 0.635 W/kg



0 dB = 0.784 W/kg = -1.06 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707A1

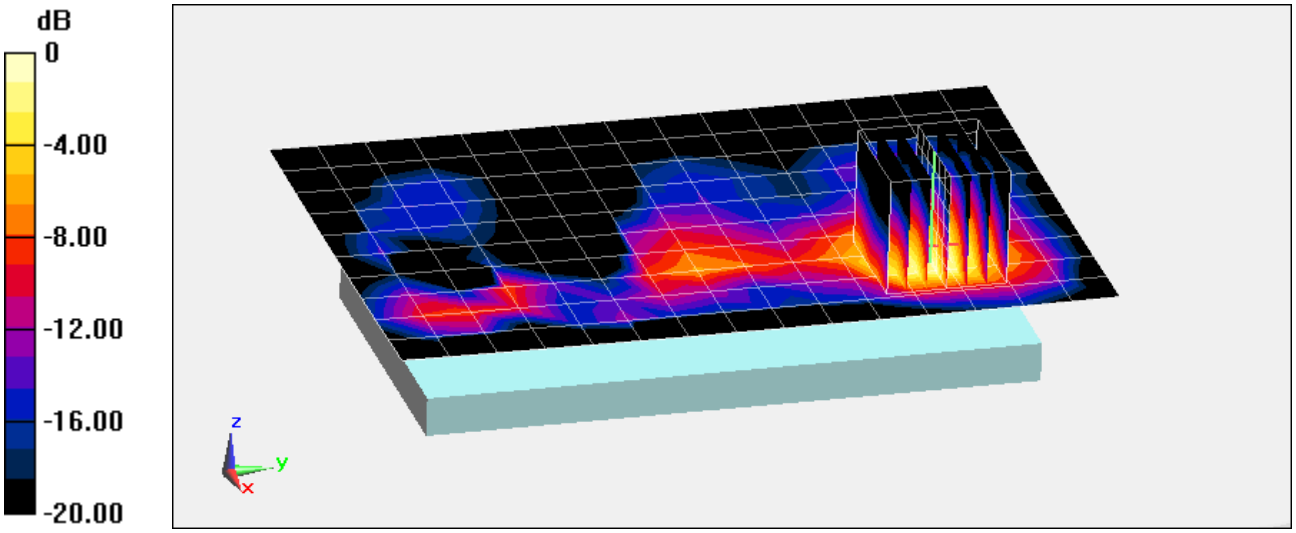
Communication System: UID 0, IEEE 802.11b; Frequency: 2462 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2462 MHz; σ = 1.96 S/m; ε_r = 51.869; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-11-2014; Ambient Temp: 23.2°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3319; ConvF(4.24, 4.24, 4.24); Calibrated: 4/17/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 4/11/2014
Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11b, Antenna 1, Body SAR, Ch 11, 1 Mbps, Back Side

Area Scan (11x16x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.652 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.280 W/kg
SAR(1 g) = 0.126 W/kg



0 dB = 0.171 W/kg = -7.67 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707AF

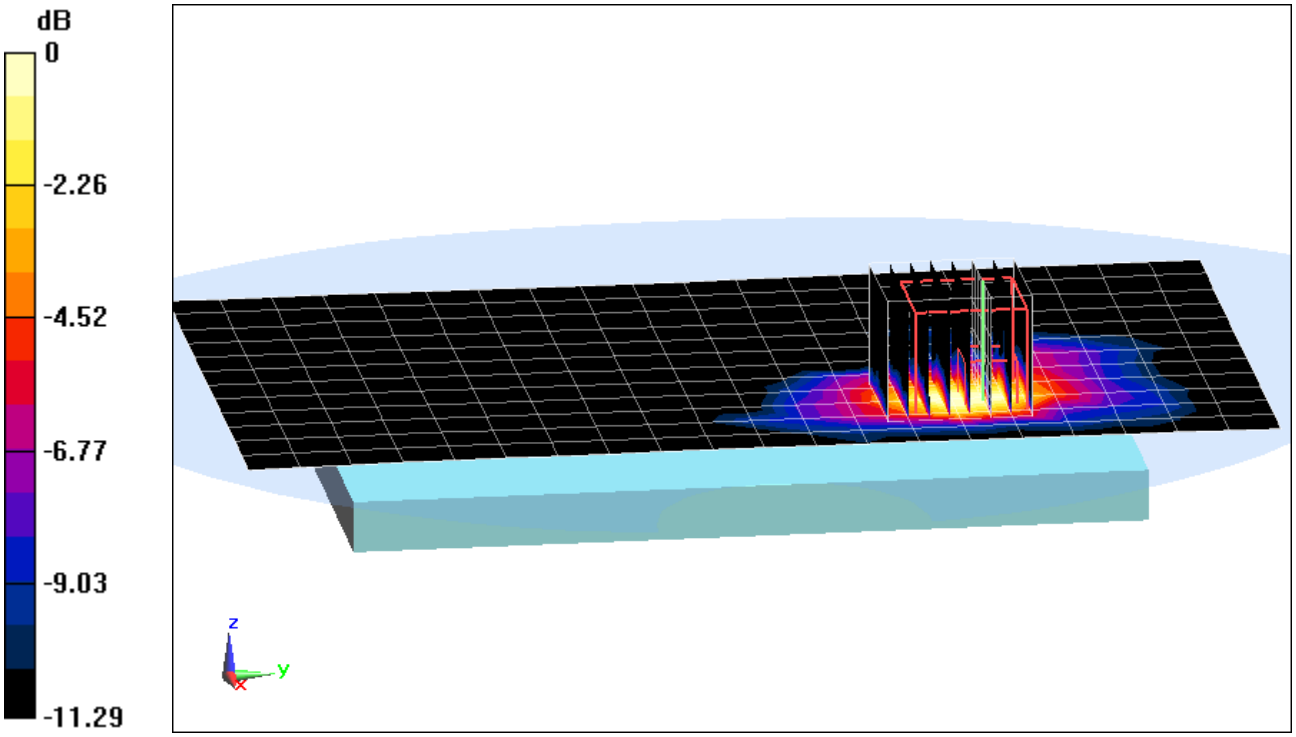
Communication System: UID 0, IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5825 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5825 MHz; σ = 5.89 S/m; ε_r = 46.409; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-18-2014; Ambient Temp: 23.4°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN3920; ConvF(4, 4, 4); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11a, Antenna 1, 5.8 GHz, Body SAR, Ch 165, 6 Mbps, Back Side

Area Scan (13x21x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 4.017 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.557 W/kg
SAR(1 g) = 0.106 W/kg



0 dB = 0.226 W/kg = -6.46 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707AF

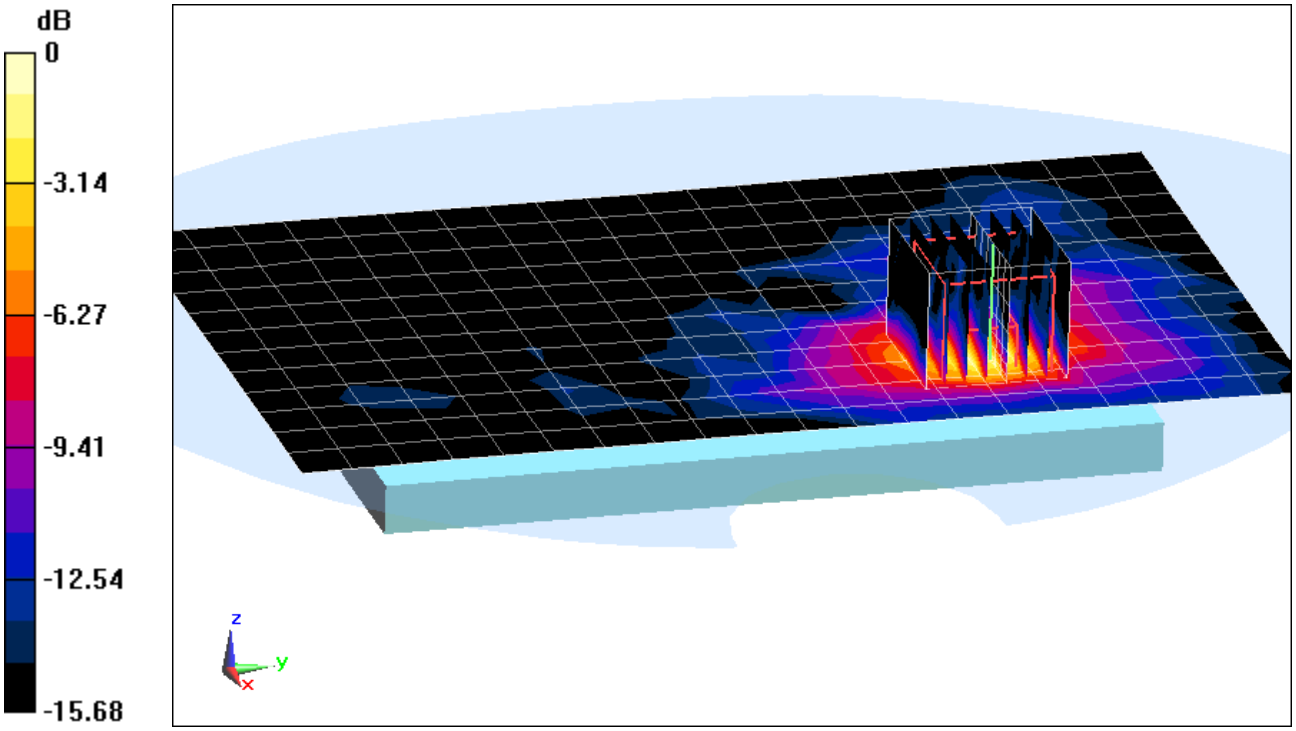
Communication System: UID 0, IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5180 MHz; σ = 5.086 S/m; ε_r = 47.247; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-18-2014; Ambient Temp: 23.4°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN3920; ConvF(4.23, 4.23, 4.23); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11a, Antenna 1, 5.2 GHz, Body SAR, Ch 36, 6 Mbps, Back Side

Area Scan (13x21x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 5.653 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.641 W/kg
SAR(1 g) = 0.143 W/kg



0 dB = 0.326 W/kg = -4.87 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707A1

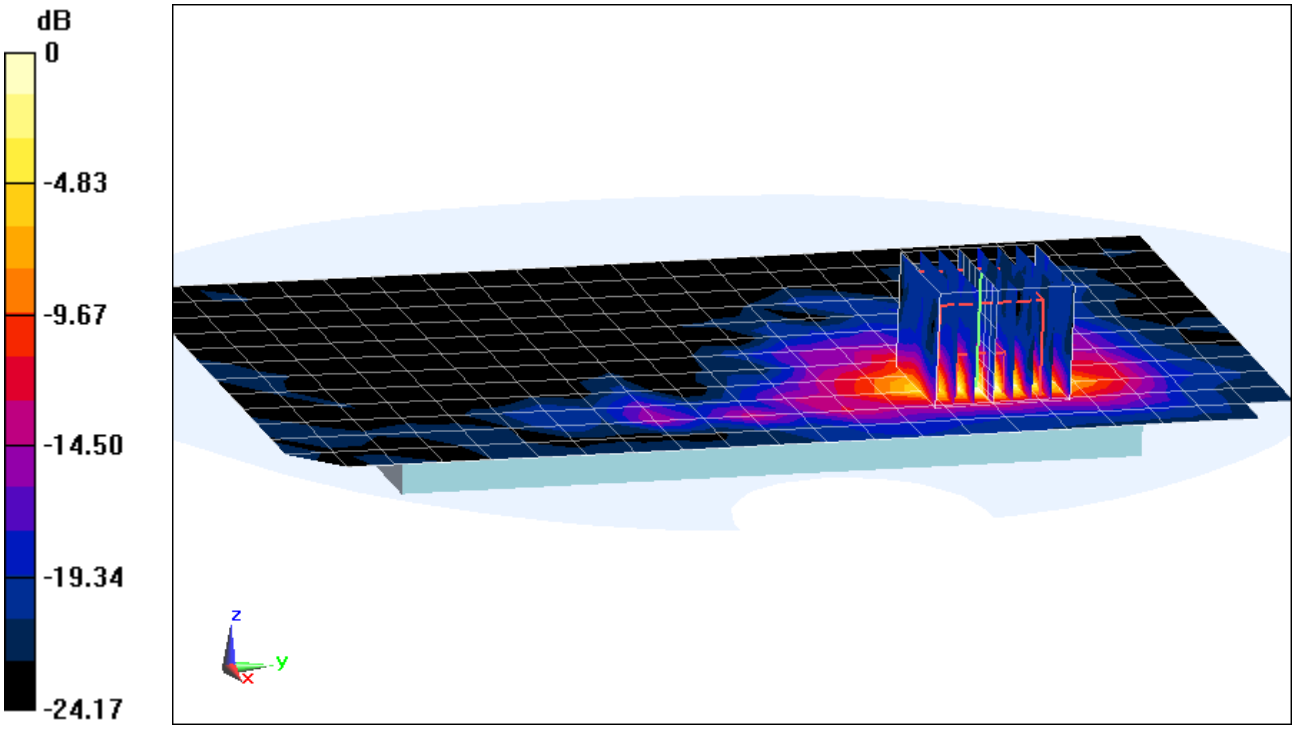
Communication System: UID 0, IEEE 802.11a (0); Frequency: 5825 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5825 MHz; σ = 6.212 S/m; ε_r = 46.297; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 08-20-2014; Ambient Temp: 24.2°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3589; ConvF(3.97, 3.97, 3.97); Calibrated: 1/29/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/17/2014
Phantom: SAM front; Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11a, Antenna 1, 5.8 GHz, Hand SAR, Ch 165, 6 Mbps, Back Side

Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 12.51 V/m; Power Drift = -0.21 dB
Peak SAR (extrapolated) = 5.30 W/kg
SAR(10 g) = 0.186 W/kg



0 dB = 2.53 W/kg = 4.03 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN9109W Type: Portable Handset; Serial: 707A1

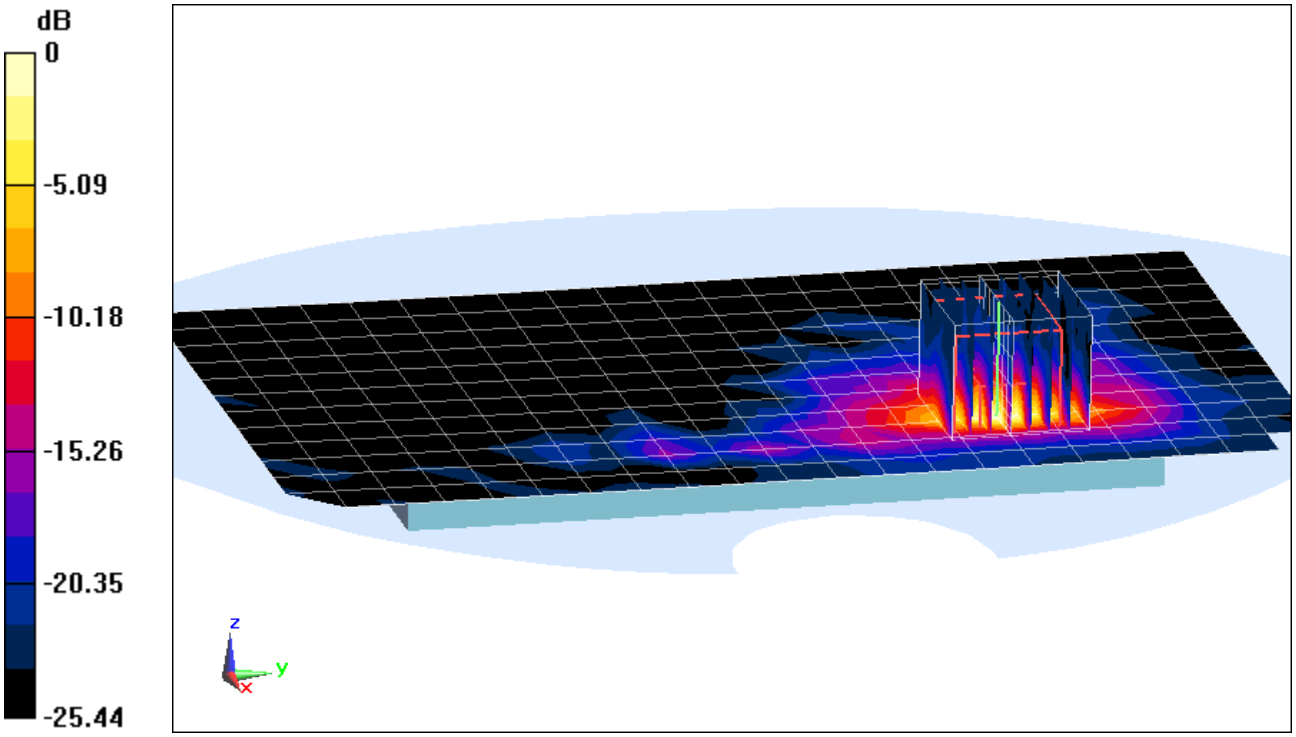
Communication System: UID 0, IEEE 802.11a (0); Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5180 MHz; σ = 5.221 S/m; ε_r = 47.88; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 08-20-2014; Ambient Temp: 24.2°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3589; ConvF(4.19, 4.19, 4.19); Calibrated: 1/29/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/17/2014
Phantom: SAM front; Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11a, Antenna 1, 5.2 GHz, Hand SAR, Ch 36, 6 Mbps, Back Side

Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 18.66 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 7.74 W/kg
SAR(10 g) = 0.307 W/kg



0 dB = 3.78 W/kg = 5.77 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

© 2014 PCTEST Engineering Laboratory, Inc.

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d132

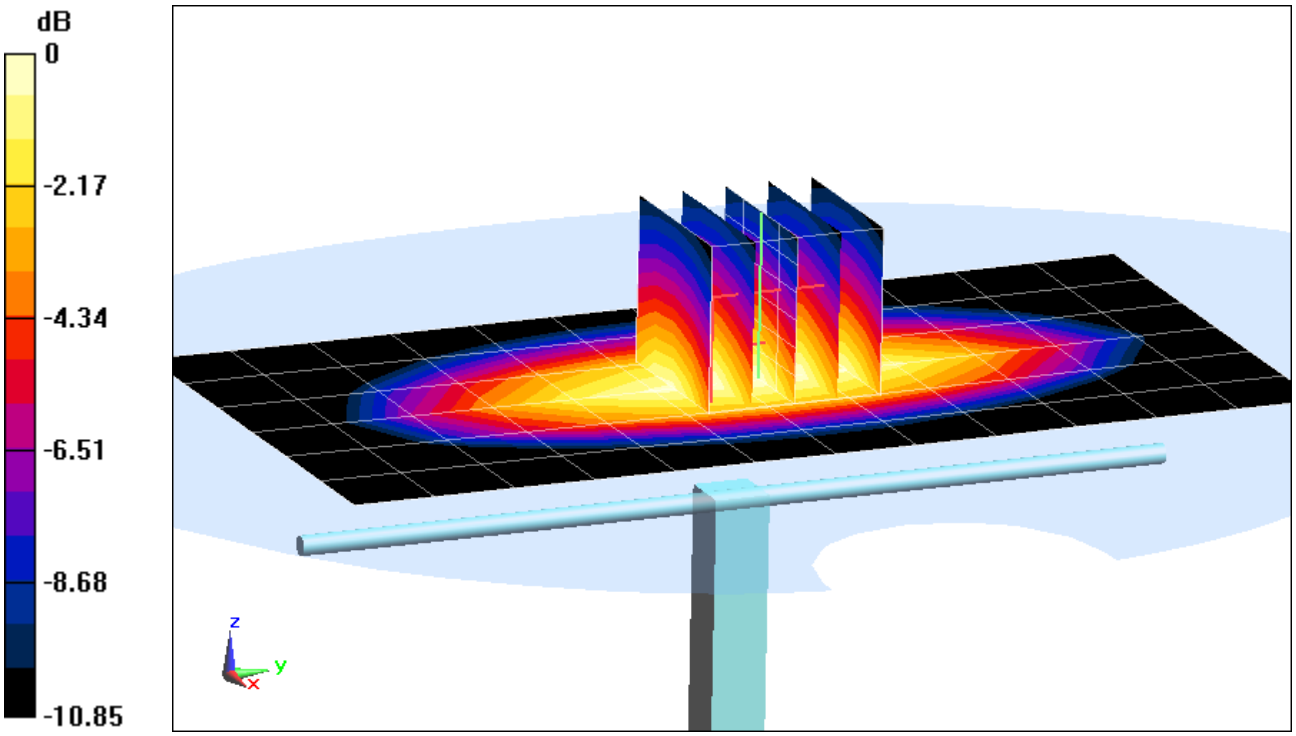
Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: 835 Head Medium parameters used:
f = 835 MHz; σ = 0.935 S/m; ε_r = 43.129; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 08-11-2014; Ambient Temp: 22.6°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3213; ConvF(6.37, 6.37, 6.37); Calibrated: 4/11/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 3/17/2014
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

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 dBm (100 mW)
Peak SAR (extrapolated) = 1.44 W/kg
SAR(1 g) = 0.958 W/kg
Deviation = 3.34%



0 dB = 1.11 W/kg = 0.45 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

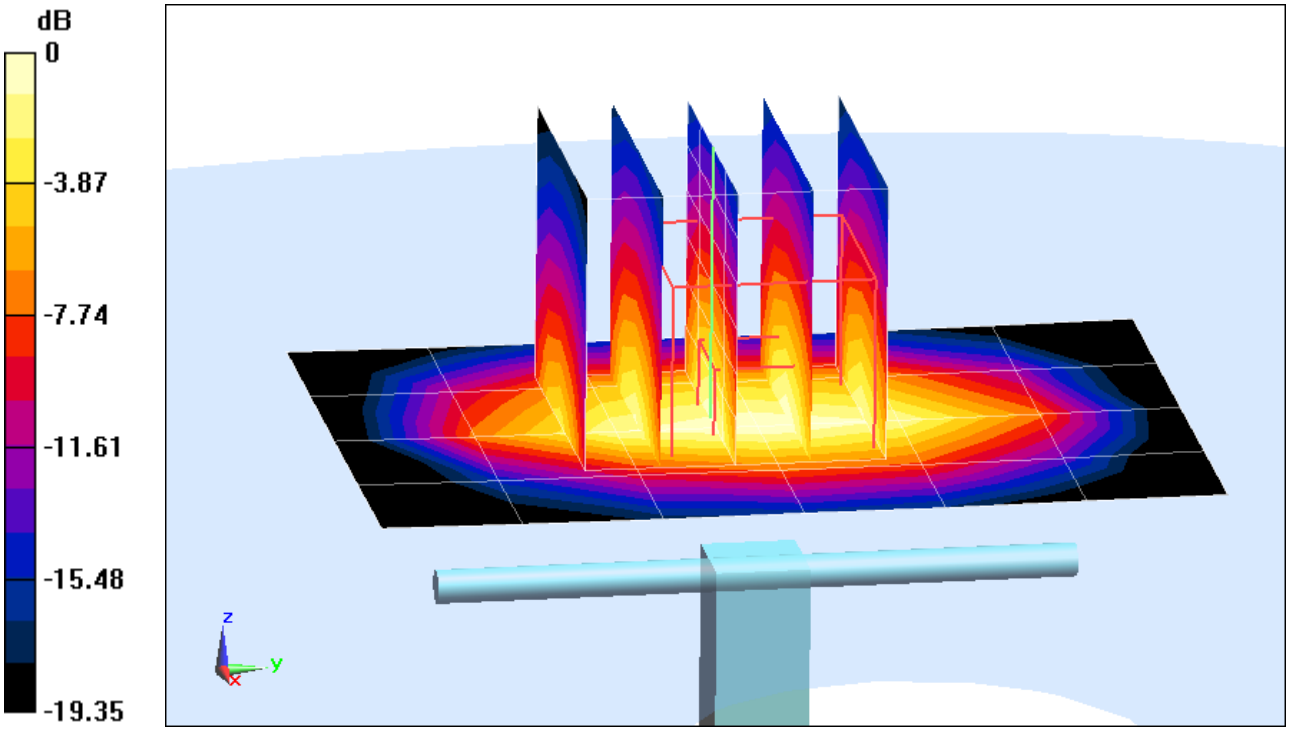
Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.457 S/m; ε_r = 40.651; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-11-2014; Ambient Temp: 22.8°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3213; ConvF(4.99, 4.99, 4.99); Calibrated: 4/11/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 3/17/2014
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

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 dBm (100 mW)
Peak SAR (extrapolated) = 7.56 W/kg
SAR(1 g) = 4.08 W/kg
Deviation = 0.25%



0 dB = 5.10 W/kg = 7.08 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

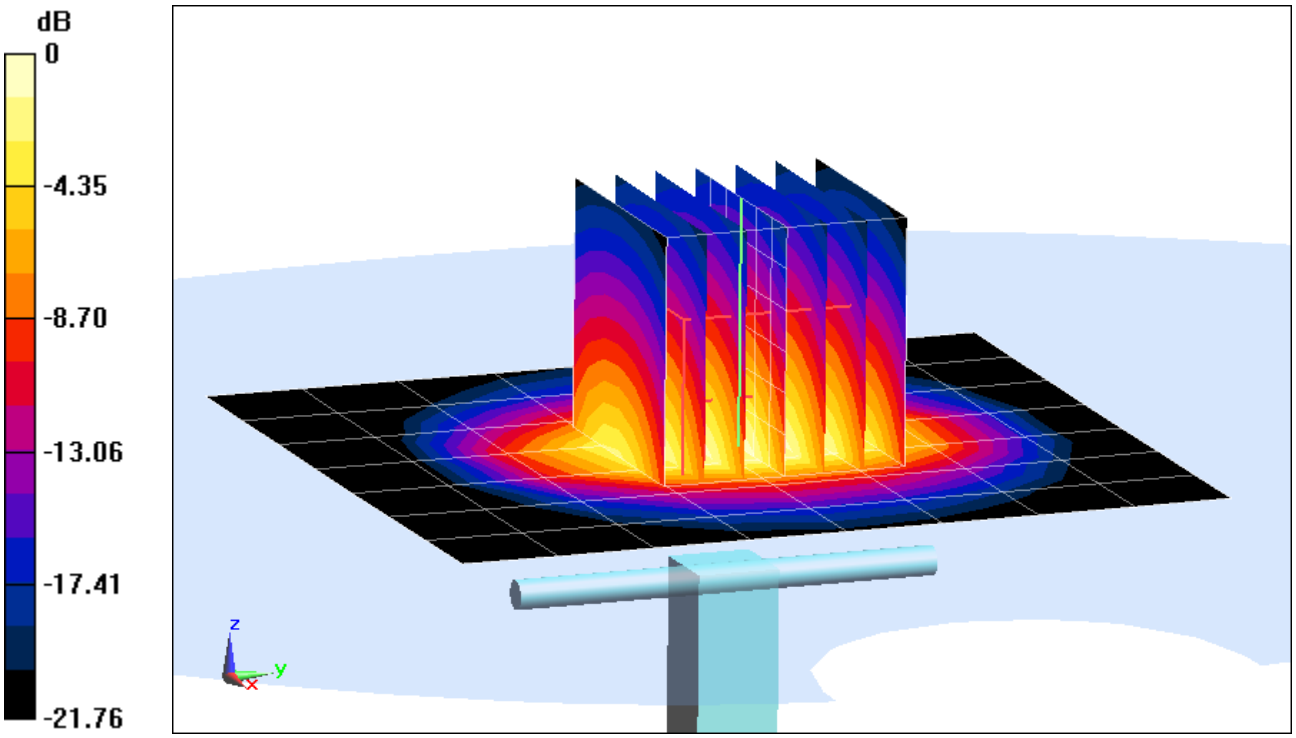
Communication System: UID 0, CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used:
f = 2450 MHz; σ = 1.866 S/m; ε_r = 39.666; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-11-2014; Ambient Temp: 22.2°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3319; ConvF(4.45, 4.45, 4.45); Calibrated: 4/17/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 4/11/2014
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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 dBm (100 mW)
Peak SAR (extrapolated) = 10.8 W/kg
SAR(1 g) = 5.31 W/kg
Deviation = 2.51%



0 dB = 6.93 W/kg = 8.41 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

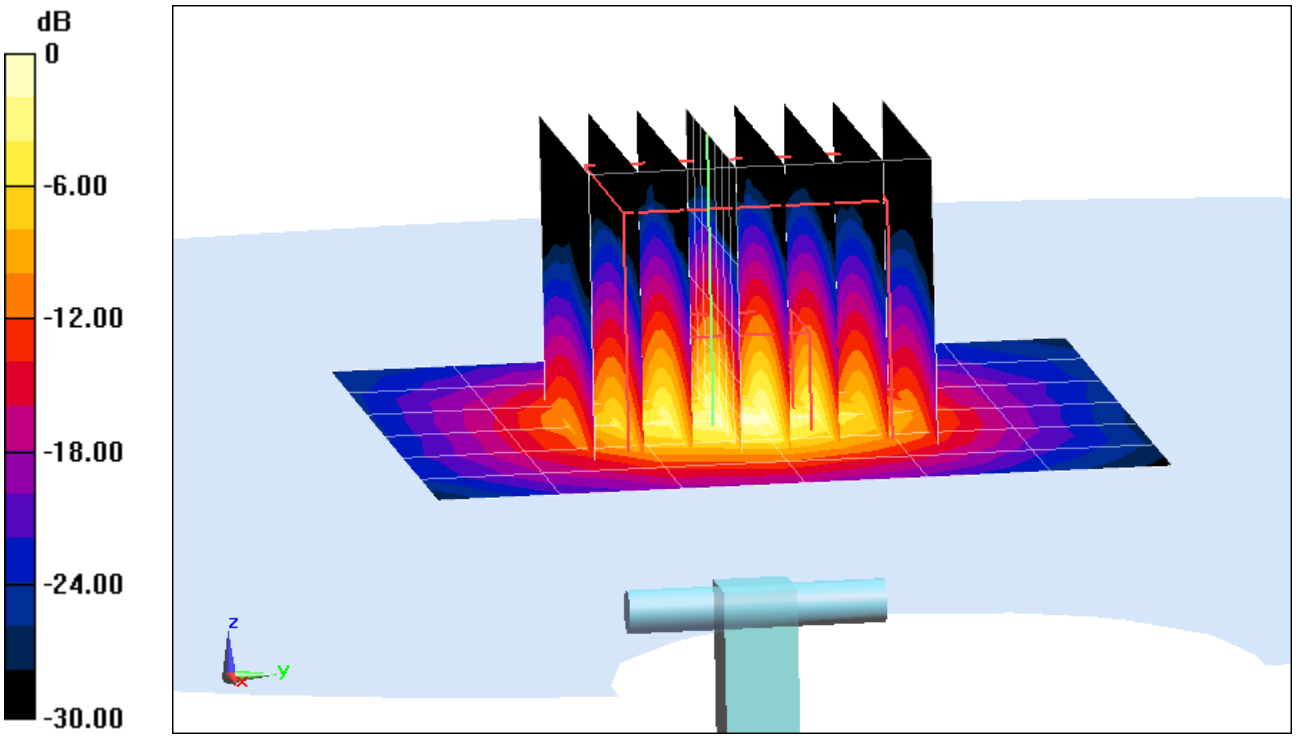
Communication System: UID 0, CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5200 MHz; σ = 4.49 S/m; ε_r = 35.73; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-18-2014; Ambient Temp: 24.6°C; Tissue Temp: 24.0°C

Probe: EX3DV4 - SN3914; ConvF(4.99, 4.99, 4.99); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5200 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 31.1 W/kg
SAR(1 g) = 7.38 W/kg
Deviation = -5.38%



0 dB = 17.2 W/kg = 12.36 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

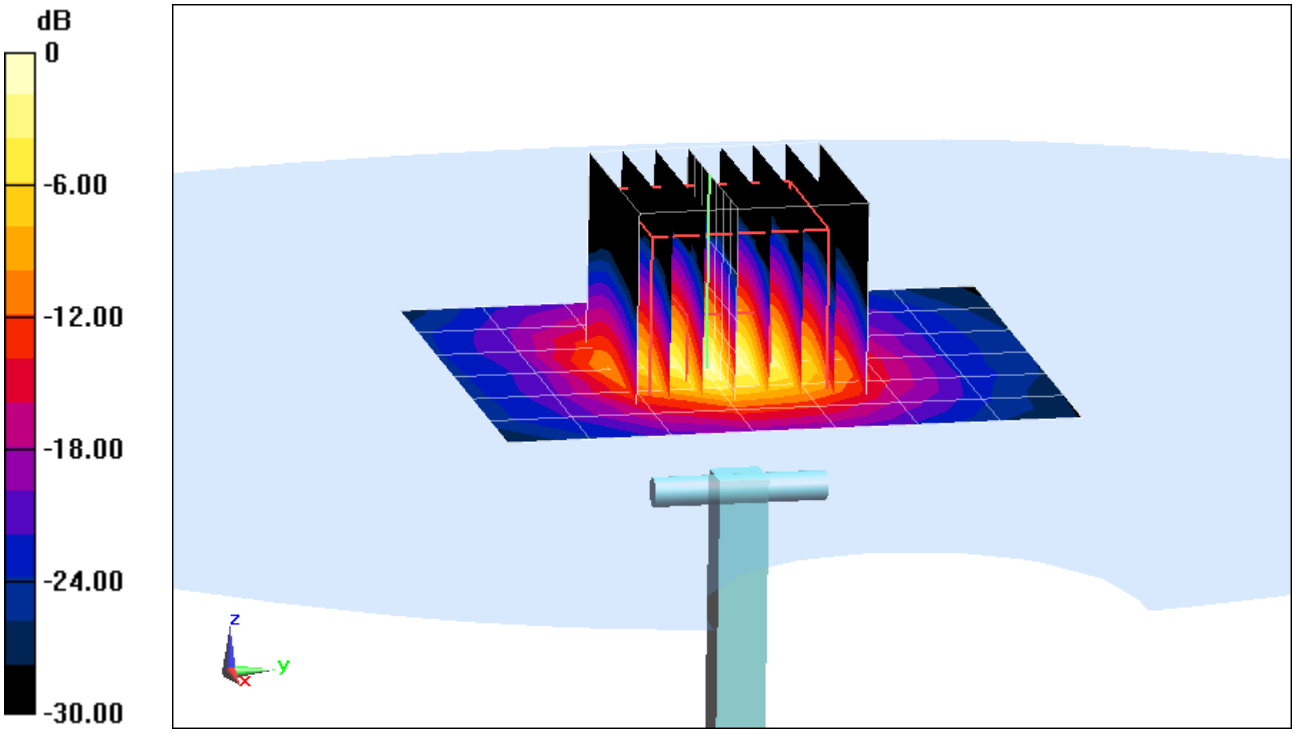
Communication System: UID 0, CW; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5300 MHz; σ = 4.587 S/m; ε_r = 35.645; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-18-2014; Ambient Temp: 24.6°C; Tissue Temp: 24.1°C

Probe: EX3DV4 - SN3914; ConvF(4.82, 4.82, 4.82); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5300 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 35.2 W/kg
SAR(1 g) = 7.94 W/kg
Deviation = -4.34%



0 dB = 19.1 W/kg = 12.81 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

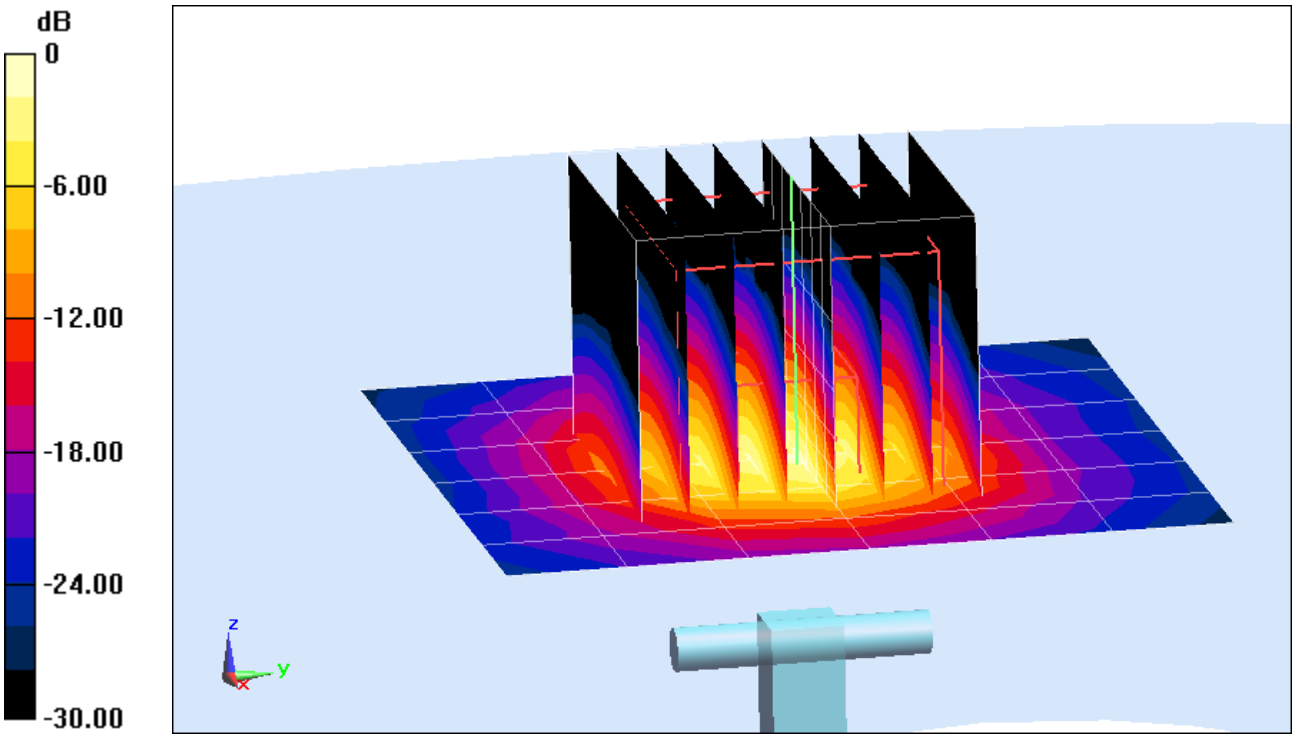
Communication System: UID 0, CW; Frequency: 5500 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5500 MHz; σ = 4.803 S/m; ε_r = 35.376; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-18-2014; Ambient Temp: 24.5°C; Tissue Temp: 24.1°C

Probe: EX3DV4 - SN3914; ConvF(4.55, 4.55, 4.55); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5500 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 34.7 W/kg
SAR(1 g) = 7.83 W/kg
Deviation = -7.12%



0 dB = 19.3 W/kg = 12.86 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

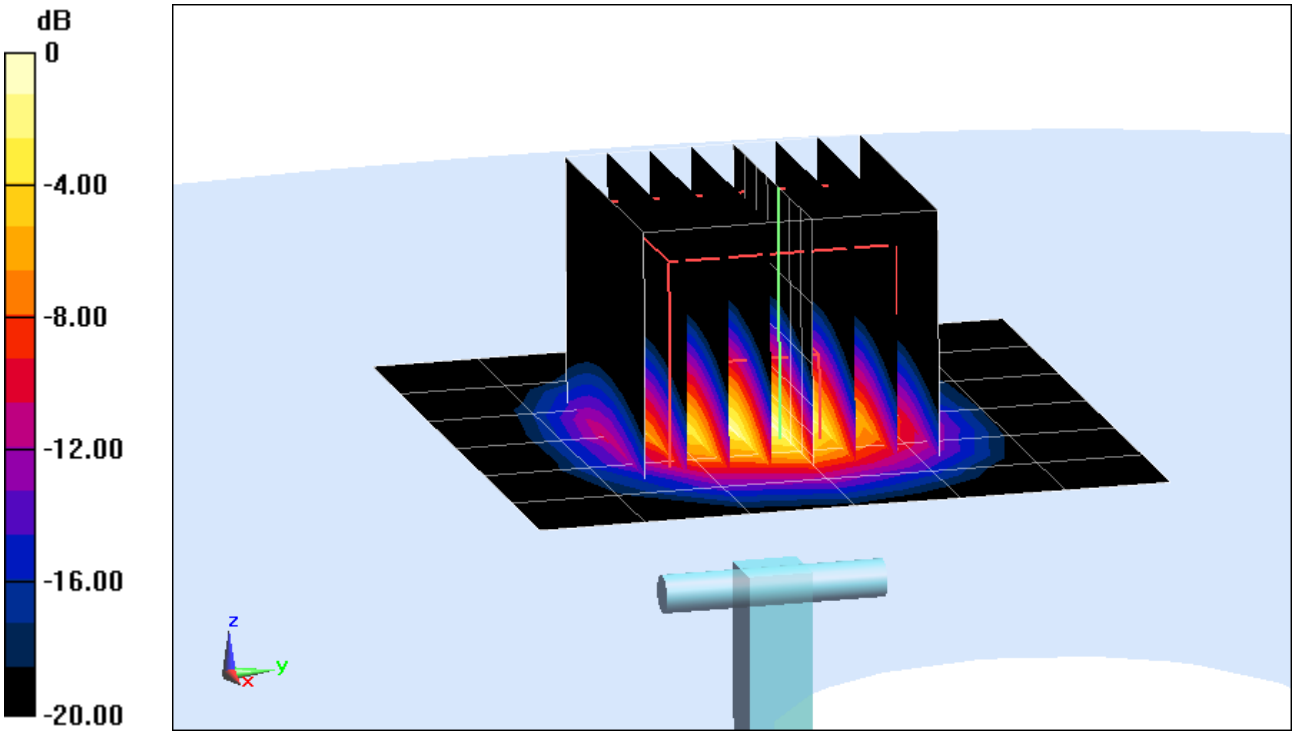
Communication System: UID 0, CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5600 MHz; σ = 4.878 S/m; ε_r = 35.236; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-18-2014; Ambient Temp: 24.5°C; Tissue Temp: 24.1°C

Probe: EX3DV4 - SN3914; ConvF(4.37, 4.37, 4.37); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5600 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 36.4 W/kg
SAR(1 g) = 8.07 W/kg
Deviation = -3.35%



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

PCTEST ENGINEERING LABORATORY, INC.

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

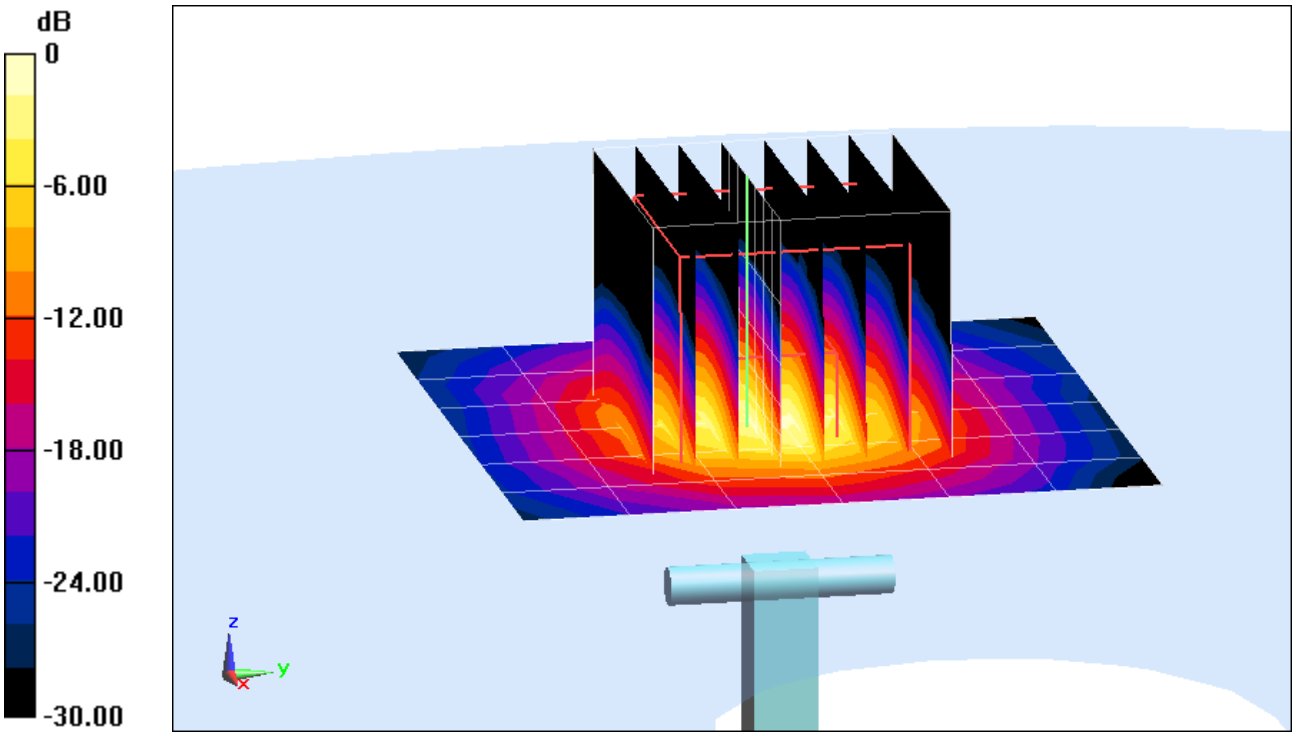
Communication System: UID 0, CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5800 MHz; σ = 5.077 S/m; ε_r = 35.056; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-18-2014; Ambient Temp: 24.5°C; Tissue Temp: 24.1°C

Probe: EX3DV4 - SN3914; ConvF(4.52, 4.52, 4.52); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5800 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 37.5 W/kg
SAR(1 g) = 7.55 W/kg
Deviation = -4.79%



0 dB = 18.6 W/kg = 12.70 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

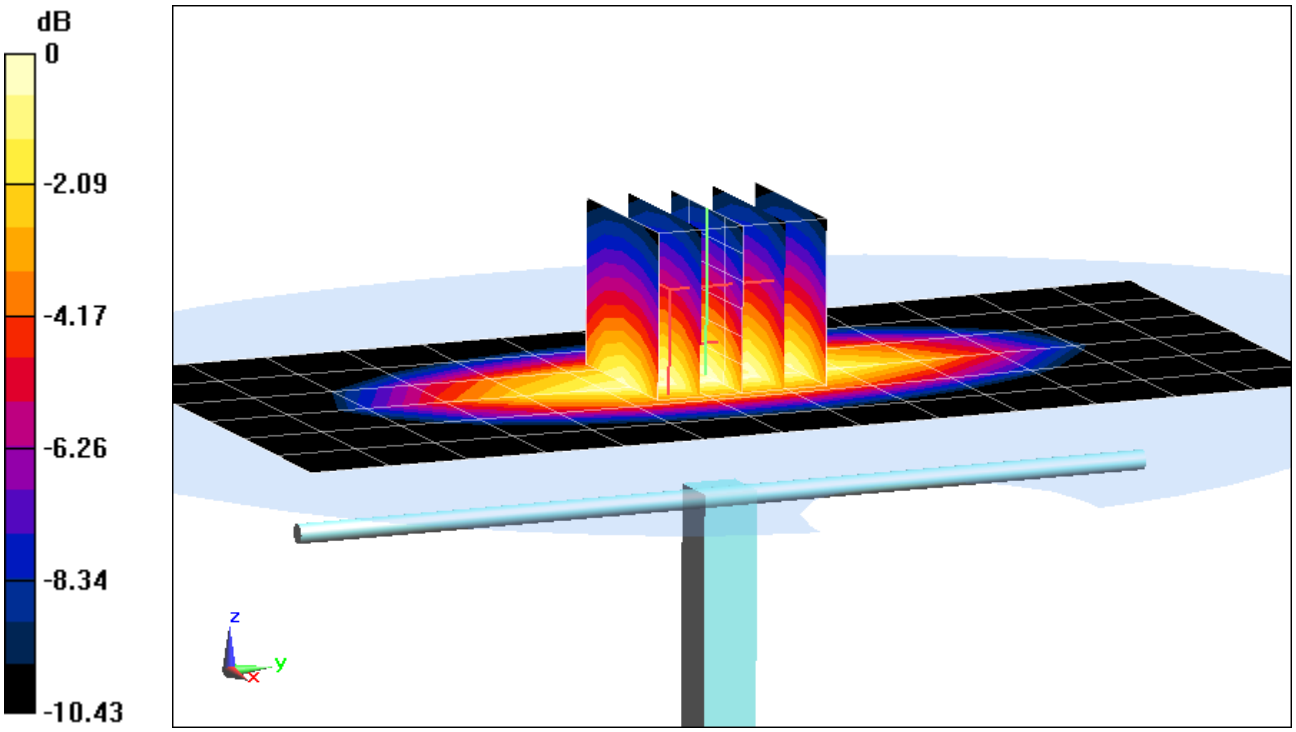
Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used:
f = 835 MHz; σ = 0.997 S/m; ε_r = 53.013; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-14-2014; Ambient Temp: 23.9°C; Tissue Temp: 23.1°C

Probe: ES3DV3 - SN3263; ConvF(6.16, 6.16, 6.16); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 1.35 W/kg
SAR(1 g) = 0.912 W/kg
Deviation = -2.36%



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

PCTEST ENGINEERING LABORATORY, INC.

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

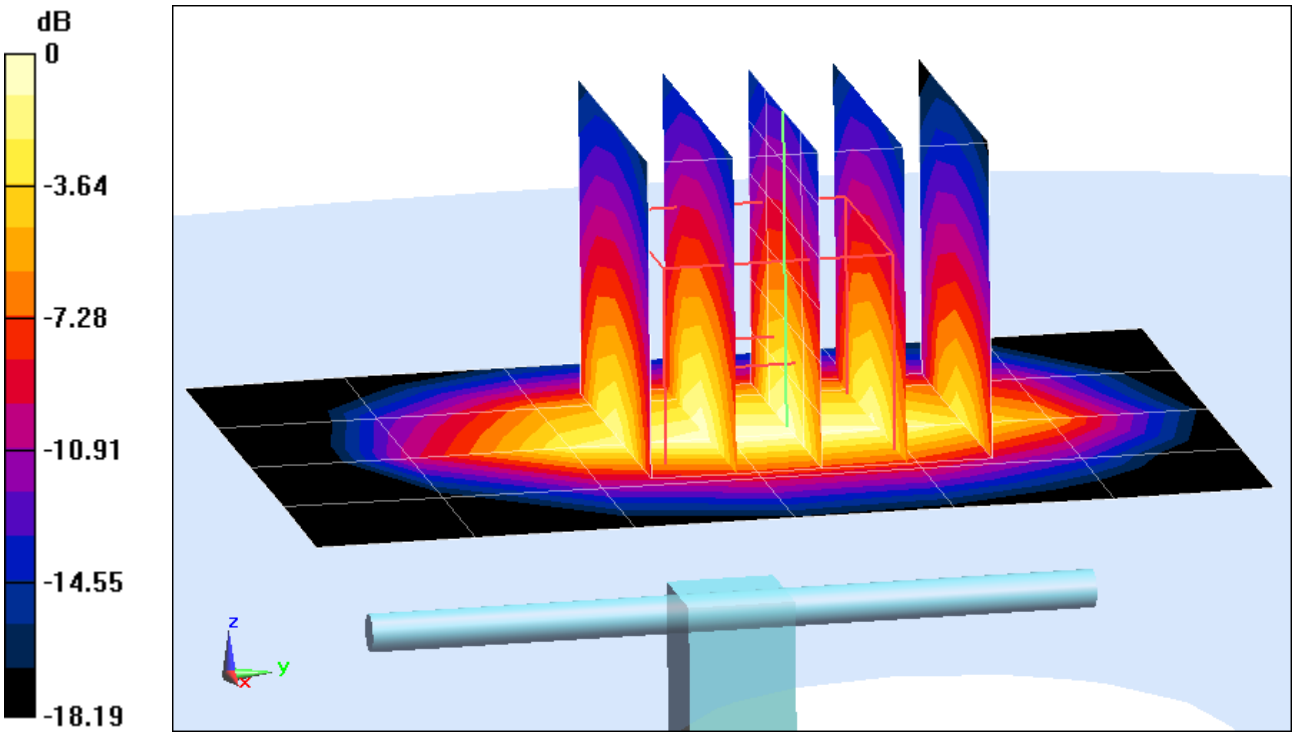
Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.549 S/m; ε_r = 51.908; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-11-2014; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3288; ConvF(4.82, 4.82, 4.82); Calibrated: 9/23/2013;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2013
Phantom: SAM with CRP; Type: SAM; Serial: TP1375
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

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 dBm (100 mW)
Peak SAR (extrapolated) = 7.24 W/kg
SAR(1 g) = 4.11 W/kg
Deviation = 4.58%



0 dB = 5.13 W/kg = 7.10 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

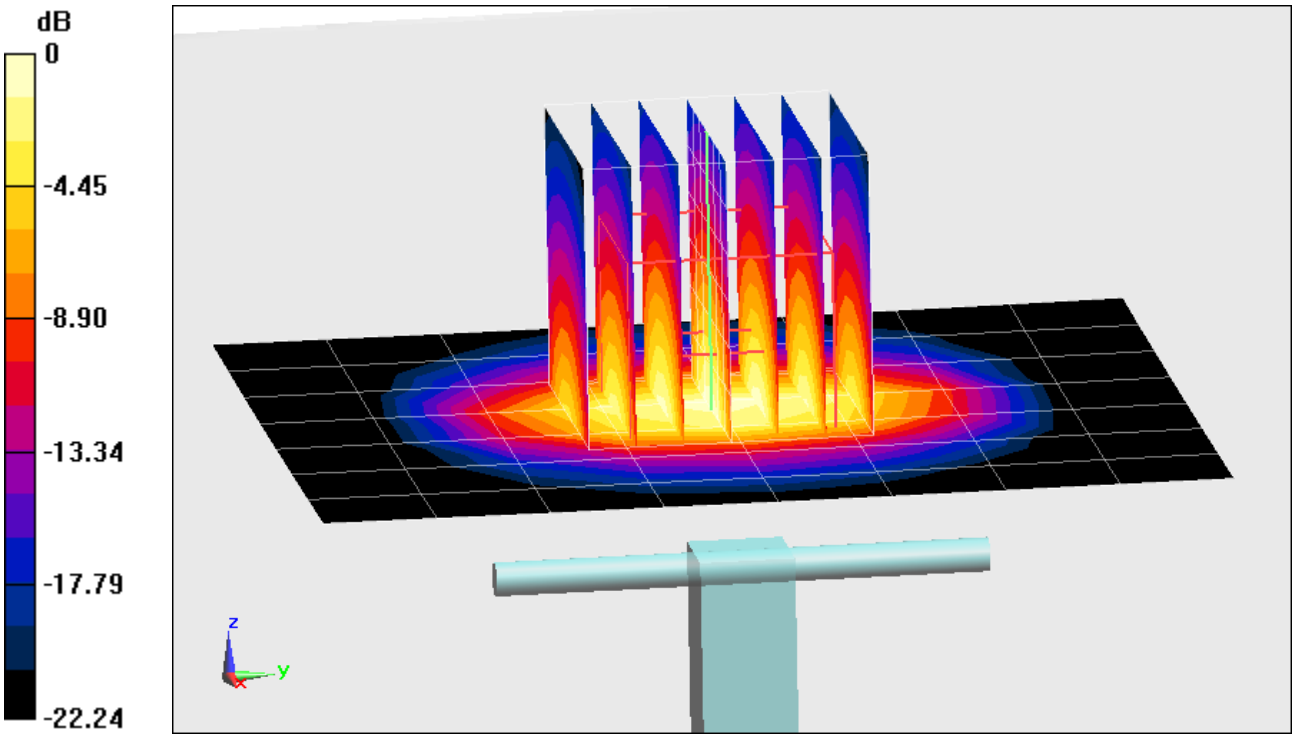
Communication System: UID 0, CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used:
f = 2450 MHz; σ = 1.943 S/m; ε_r = 51.913; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-11-2014; Ambient Temp: 23.2°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3319; ConvF(4.24, 4.24, 4.24); Calibrated: 4/17/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 4/11/2014
Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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 dBm (100 mW)
Peak SAR (extrapolated) = 10.2 W/kg
SAR(1 g) = 4.86 W/kg
Deviation = -1.62%



0 dB = 6.37 W/kg = 8.04 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

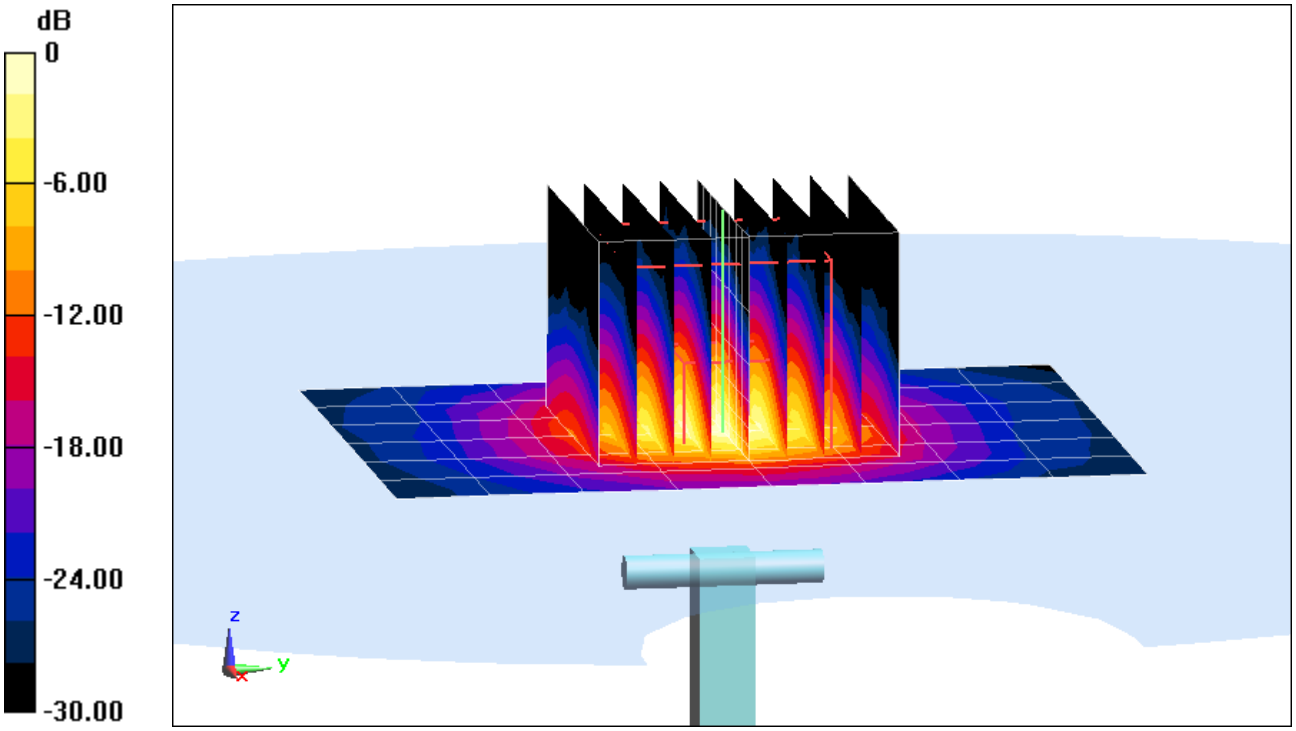
Communication System: UID 0, CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5200 MHz; σ = 5.106 S/m; ε_r = 47.285; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-18-2014; Ambient Temp: 23.4°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN3920; ConvF(4.23, 4.23, 4.23); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

5200MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 7.49 W/kg
Deviation = 3.17%



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

PCTEST ENGINEERING LABORATORY, INC.

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

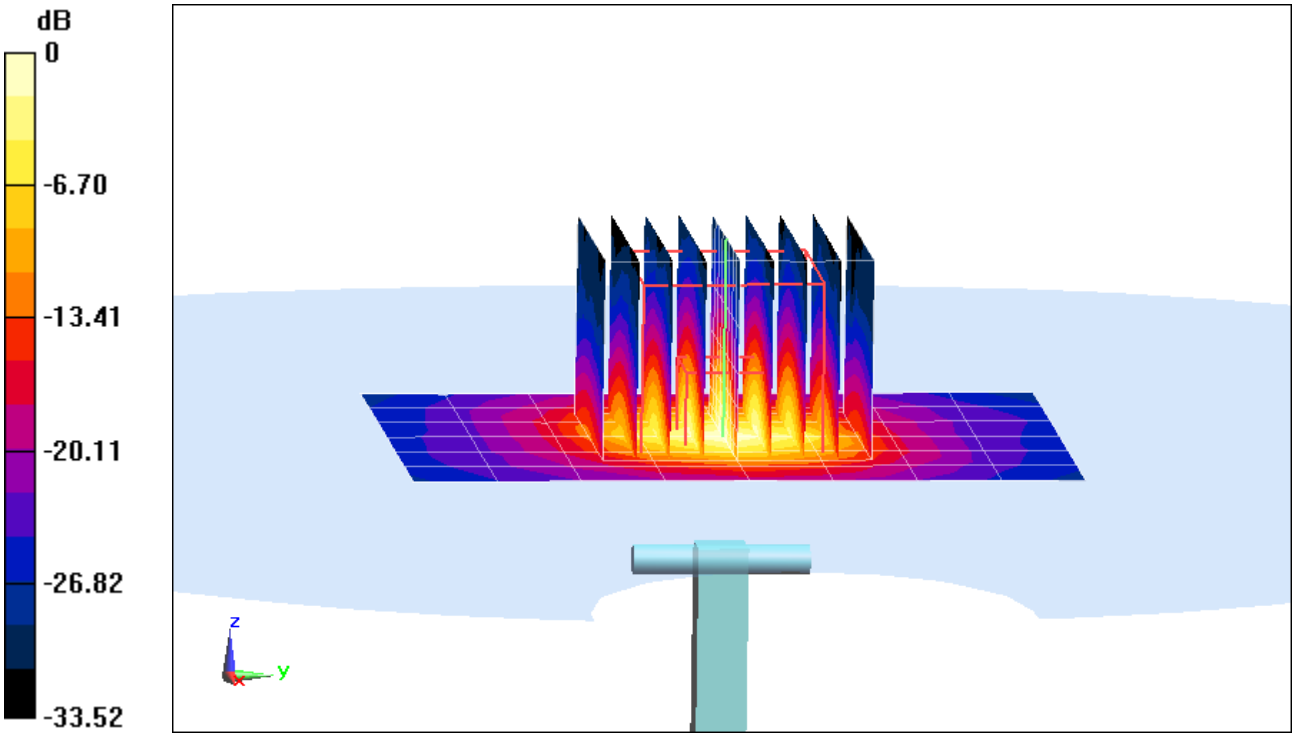
Communication System: UID 0, CW; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5300 MHz; σ = 5.228 S/m; ε_r = 47.061; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-18-2014; Ambient Temp: 23.4°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN3920; ConvF(4.11, 4.11, 4.11); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

5300MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 28.9 W/kg
SAR(1 g) = 7.62 W/kg
Deviation = 2.01%



0 dB = 18.9 W/kg = 12.76 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1007

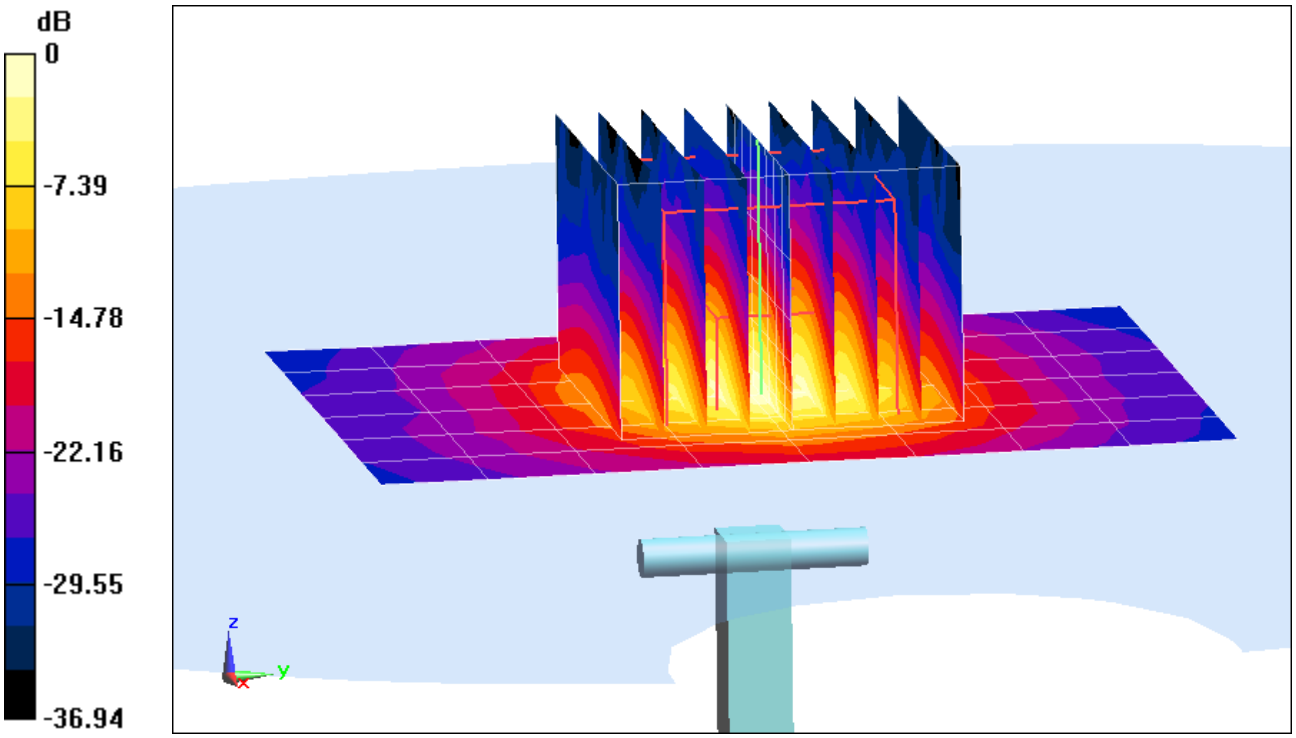
Communication System: UID 0, CW; Frequency: 5500 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5500 MHz; σ = 5.509 S/m; ε_r = 46.844; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-18-2014; Ambient Temp: 23.4°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN3920; ConvF(3.8, 3.8, 3.8); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

5500MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 32.3 W/kg
SAR(1 g) = 7.67 W/kg
Deviation (1g) = 1.05%



0 dB = 19.1 W/kg = 12.81 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

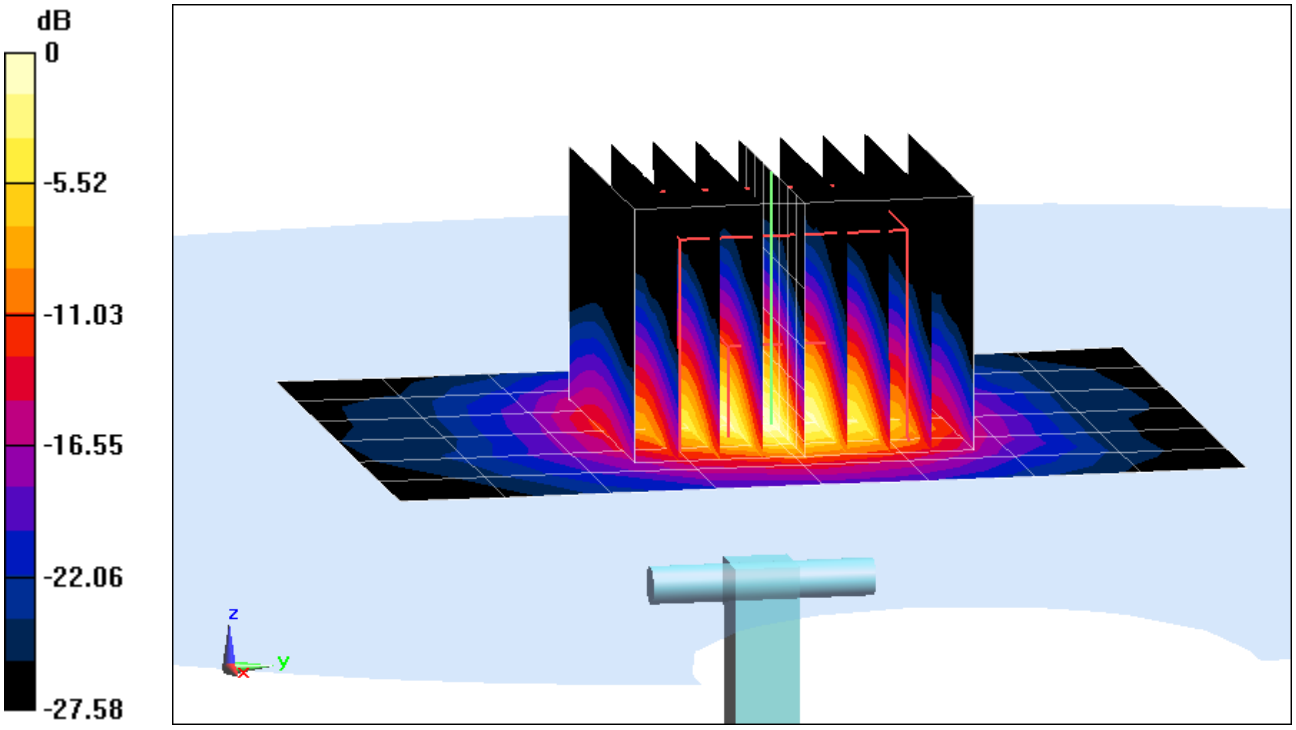
Communication System: UID 0, CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5600 MHz; σ = 5.653 S/m; ε_r = 46.714; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-18-2014; Ambient Temp: 23.4°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN3920; ConvF(3.62, 3.62, 3.62); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

5600MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 32.6 W/kg
SAR(1 g) = 7.74 W/kg
Deviation = 0.13%



0 dB = 19.8 W/kg = 12.97 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

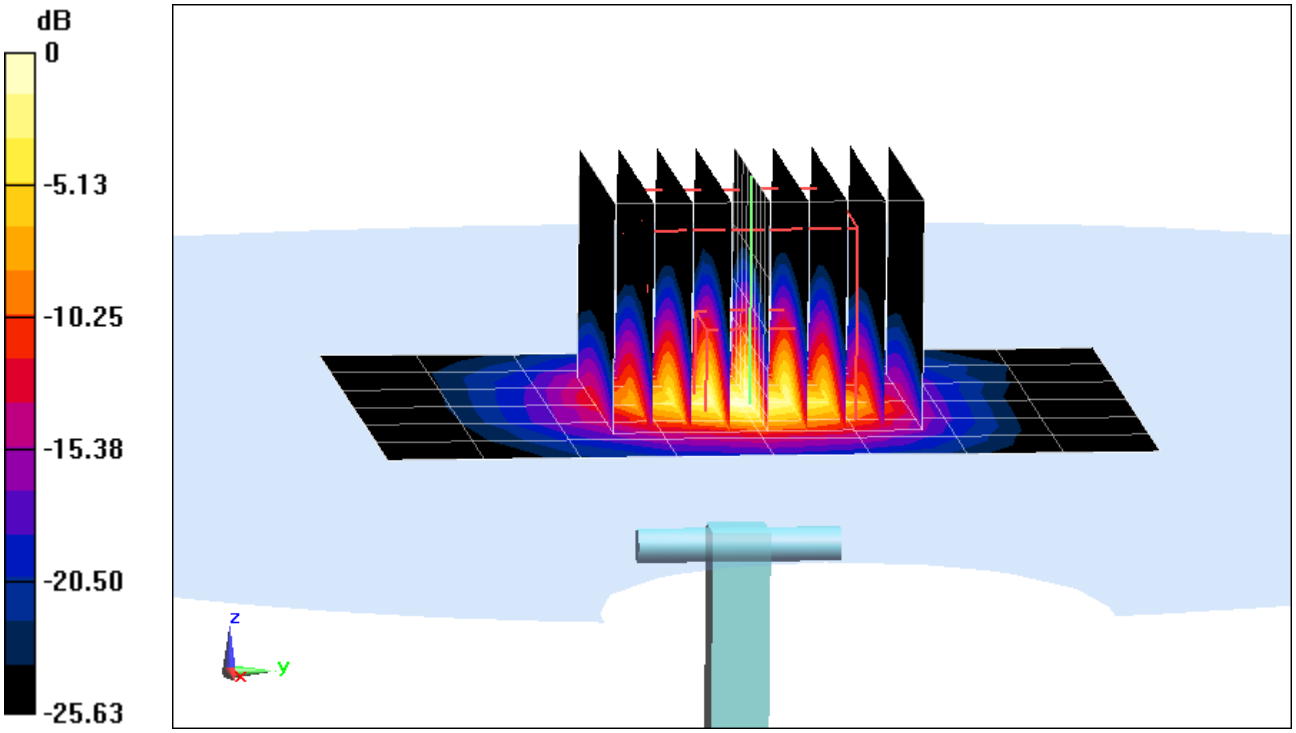
Communication System: UID 0, CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5800 MHz; σ = 5.842 S/m; ε_r = 46.461; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-18-2014; Ambient Temp: 23.4°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN3920; ConvF(4, 4, 4); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

5800MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 32.5 W/kg
SAR(1 g) = 7.12 W/kg
Deviation = -2.33%



0 dB = 19.1 W/kg = 12.81 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

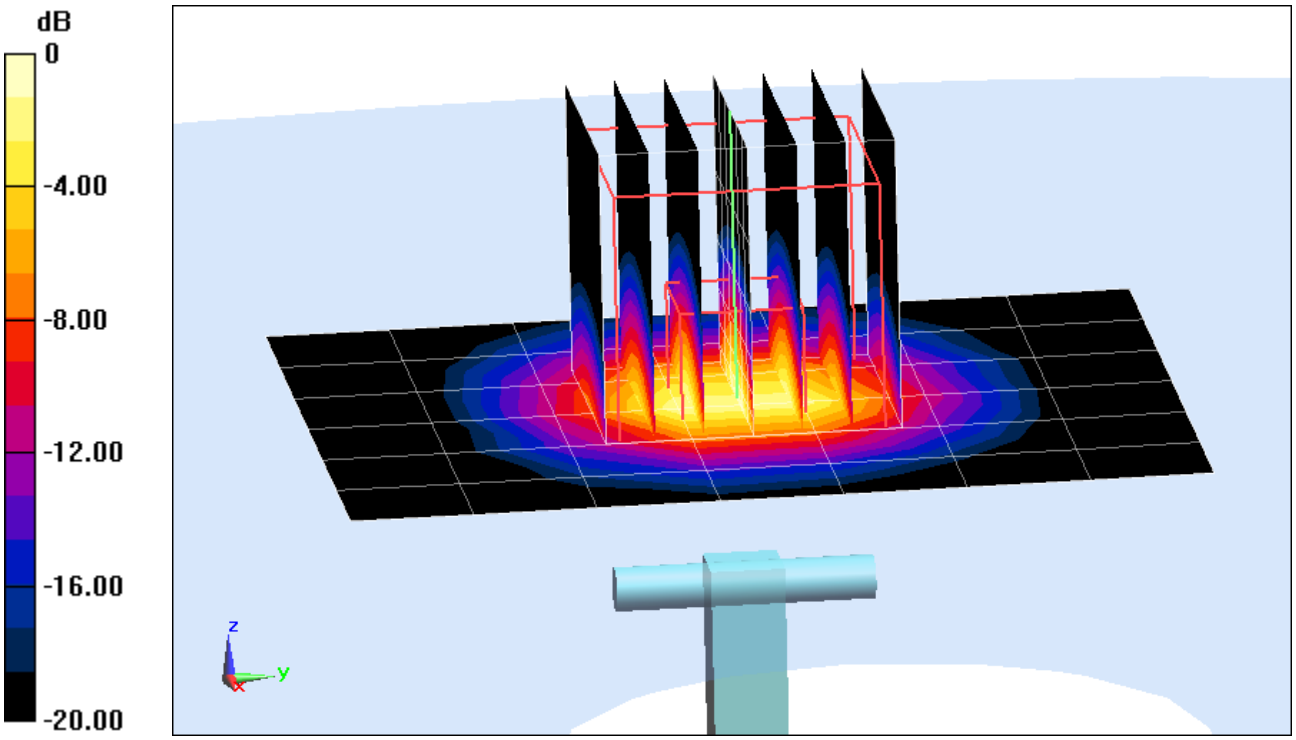
Communication System: UID 0, CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5200 MHz; σ = 5.257 S/m; ε_r = 47.753; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-20-2014; Ambient Temp: 24.2°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3589; ConvF(4.19, 4.19, 4.19); Calibrated: 1/29/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/17/2014
Phantom: SAM front; Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5200 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 30.1 W/kg
SAR(10 g) = 2.13 W/kg
Deviation = 1.43%



0 dB = 19.4 W/kg = 12.88 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

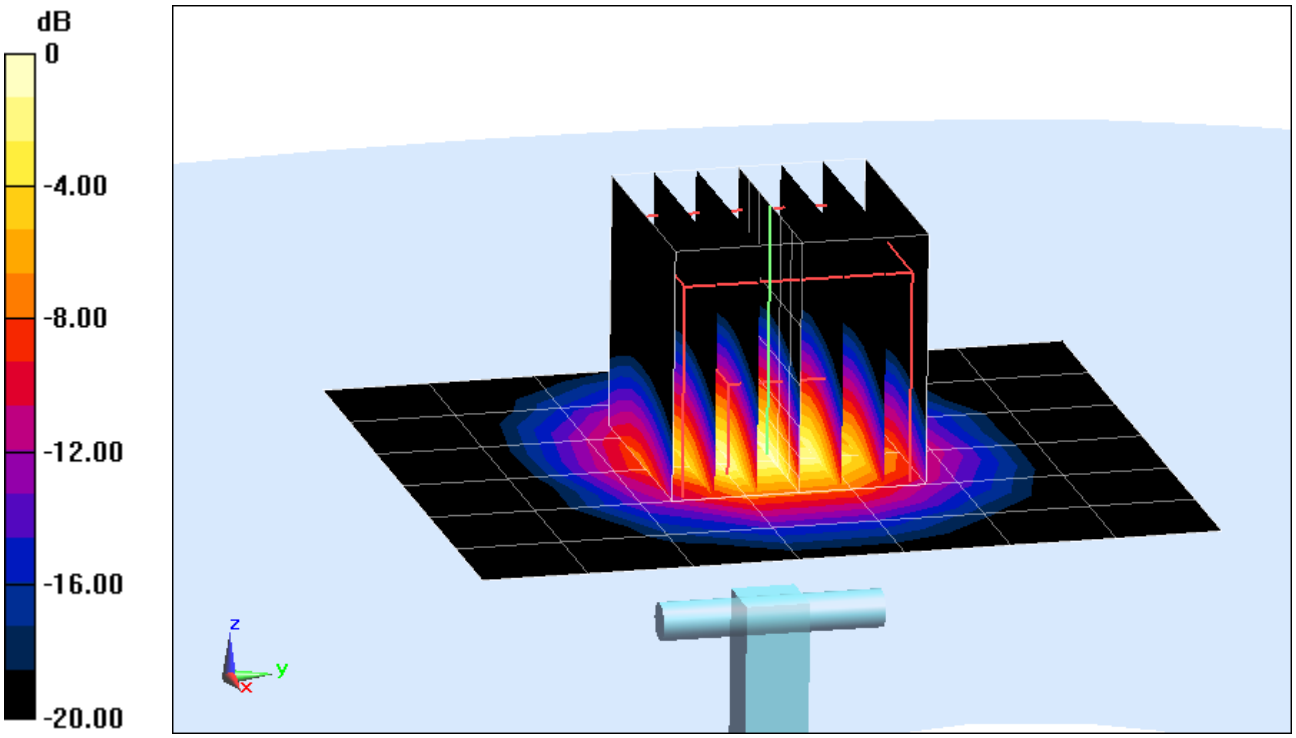
Communication System: UID 0, CW; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5300 MHz; σ = 5.394 S/m; ε_r = 47.602; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-20-2014; Ambient Temp: 24.2°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3589; ConvF(3.98, 3.98, 3.98); Calibrated: 1/29/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/17/2014
Phantom: SAM front; Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5300 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 35.5 W/kg
SAR(10 g) = 2.3 W/kg
Deviation = 6.98%



0 dB = 21.1 W/kg = 13.24 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

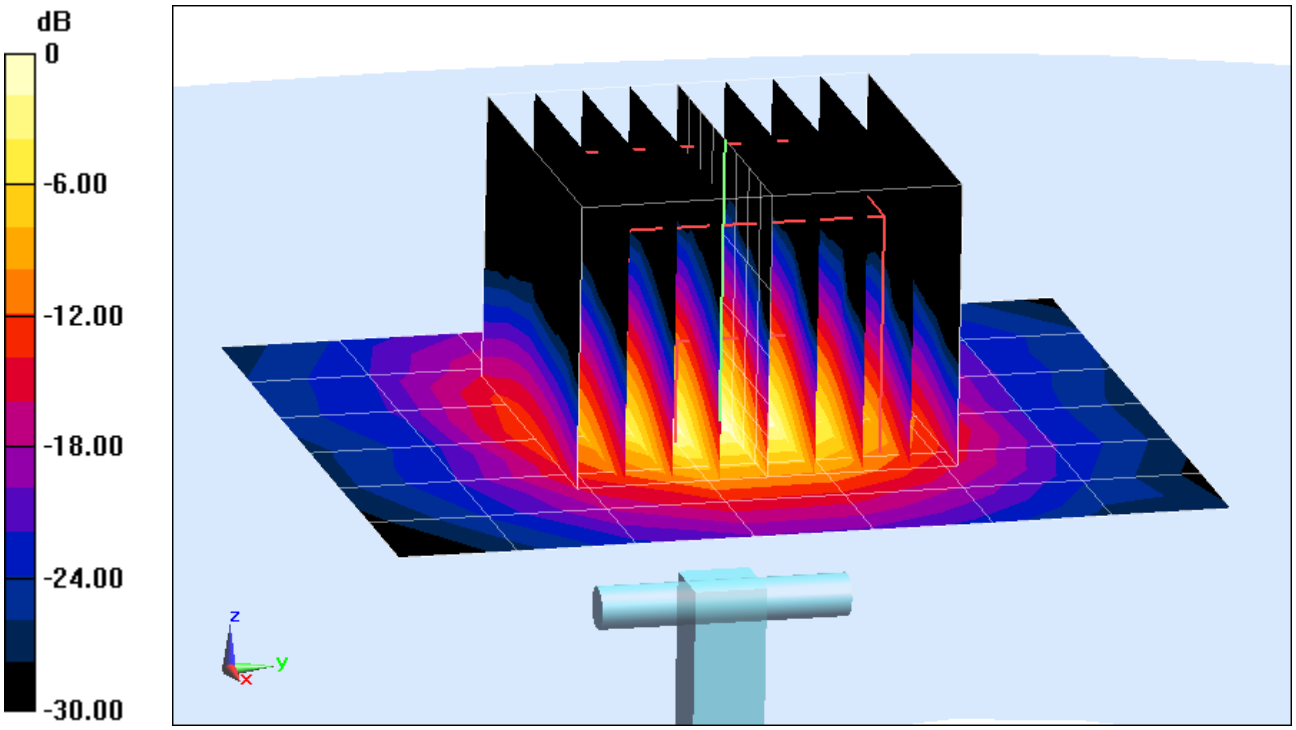
Communication System: UID 0, CW; Frequency: 5500 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5500 MHz; σ = 5.736 S/m; ε_r = 47.095; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-20-2014; Ambient Temp: 24.2°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3589; ConvF(3.76, 3.76, 3.76); Calibrated: 1/29/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/17/2014
Phantom: SAM front; Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5500 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 37.2 W/kg
SAR(10 g) = 2.33 W/kg
Deviation = 5.91%



0 dB = 21.8 W/kg = 13.38 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

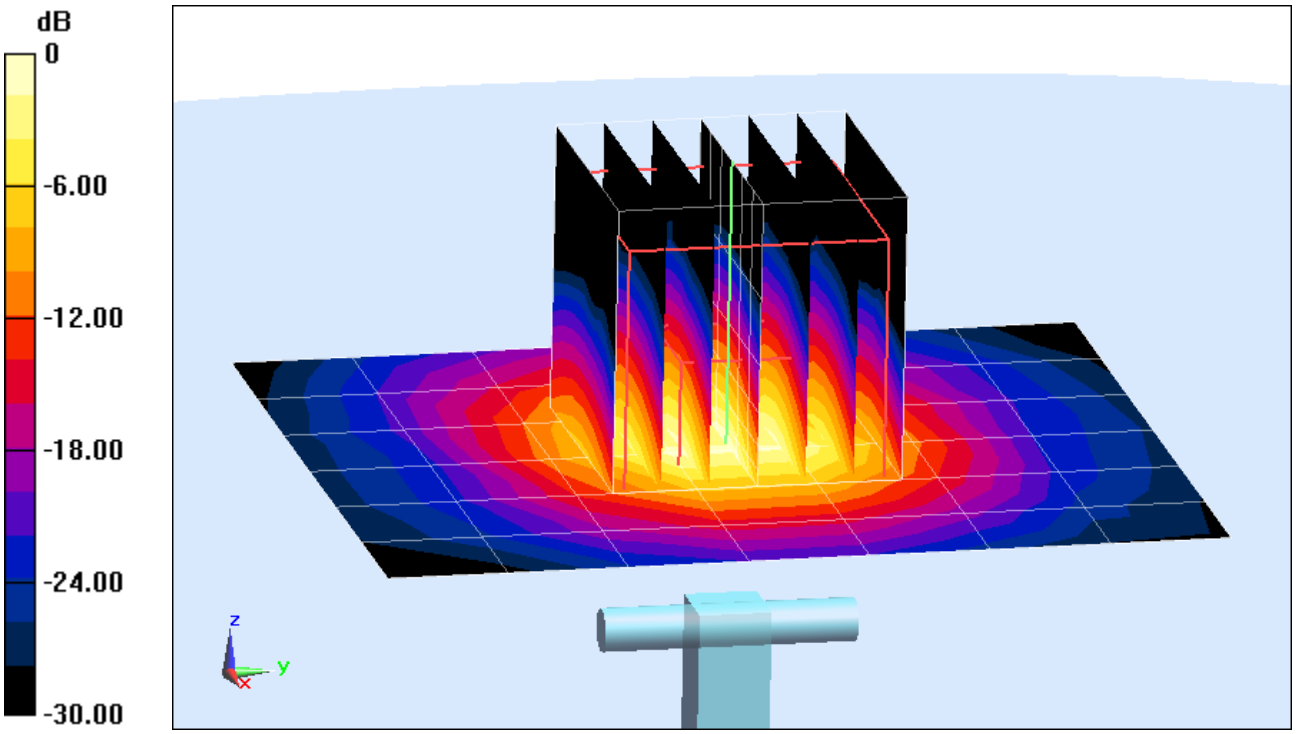
Communication System: UID 0, CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5600 MHz; σ = 5.873 S/m; ε_r = 46.807; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-20-2014; Ambient Temp: 24.2°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3589; ConvF(3.81, 3.81, 3.81); Calibrated: 1/29/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/17/2014
Phantom: SAM front; Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5600 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 38.8 W/kg
SAR(10 g) =2.15 W/kg
Deviation = -3.15%



0 dB = 22.9 W/kg = 13.60 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

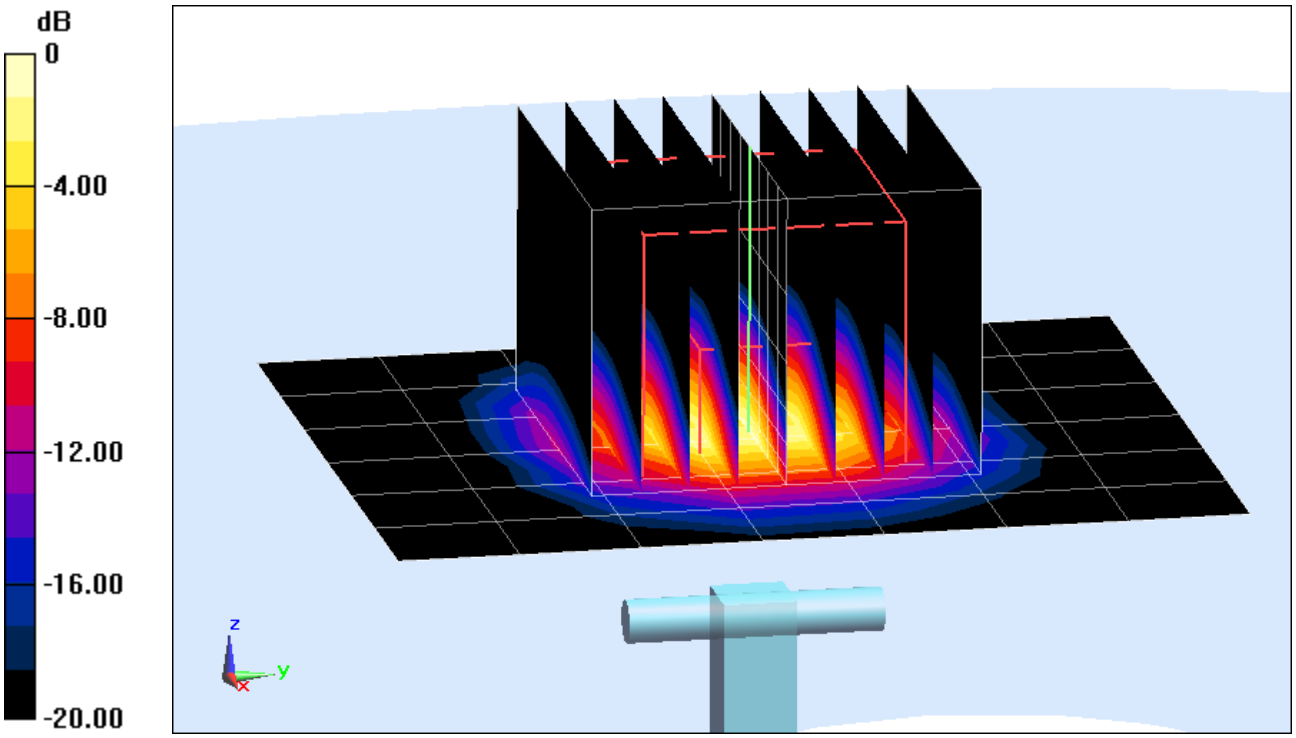
Communication System: UID 0, CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5800 MHz; σ = 6.167 S/m; ε_r = 46.375; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-20-2014; Ambient Temp: 24.2°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3589; ConvF(3.97, 3.97, 3.97); Calibrated: 1/29/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/17/2014
Phantom: SAM front; Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5800 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 37.2 W/kg
SAR(10 g) = 2.14 W/kg
Deviation = 4.90%



0 dB = 20.5 W/kg = 13.12 dBW/kg

APPENDIX C: PROBE CALIBRATION

© 2014 PCTEST Engineering Laboratory, Inc.

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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D835V2-4d119_Apr14

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d119
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 07, 2014

CC✓ 4/25/14

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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: April 9, 2014

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

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.6 ± 6 %	0.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.22 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.97 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.6 ± 6 %	1.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.34 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.15 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.2 Ω - 1.6 jΩ
Return Loss	- 34.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.3 Ω - 4.5 jΩ
Return Loss	- 24.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.386 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 29, 2010

DASY5 Validation Report for Head TSL

Date: 07.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

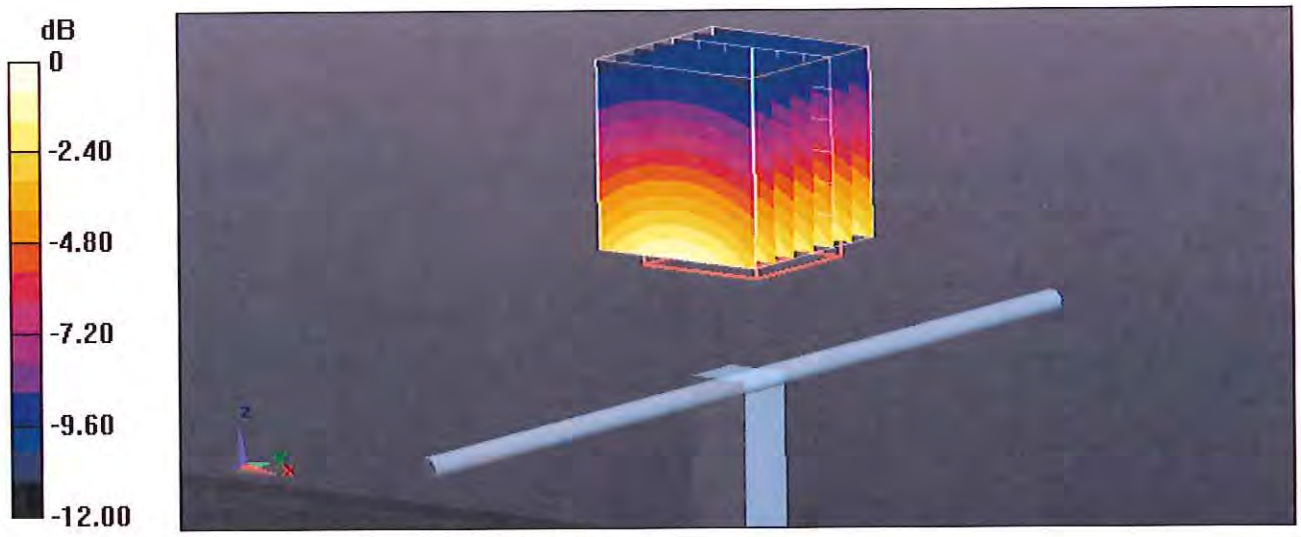
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 41.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.22, 6.22, 6.22); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

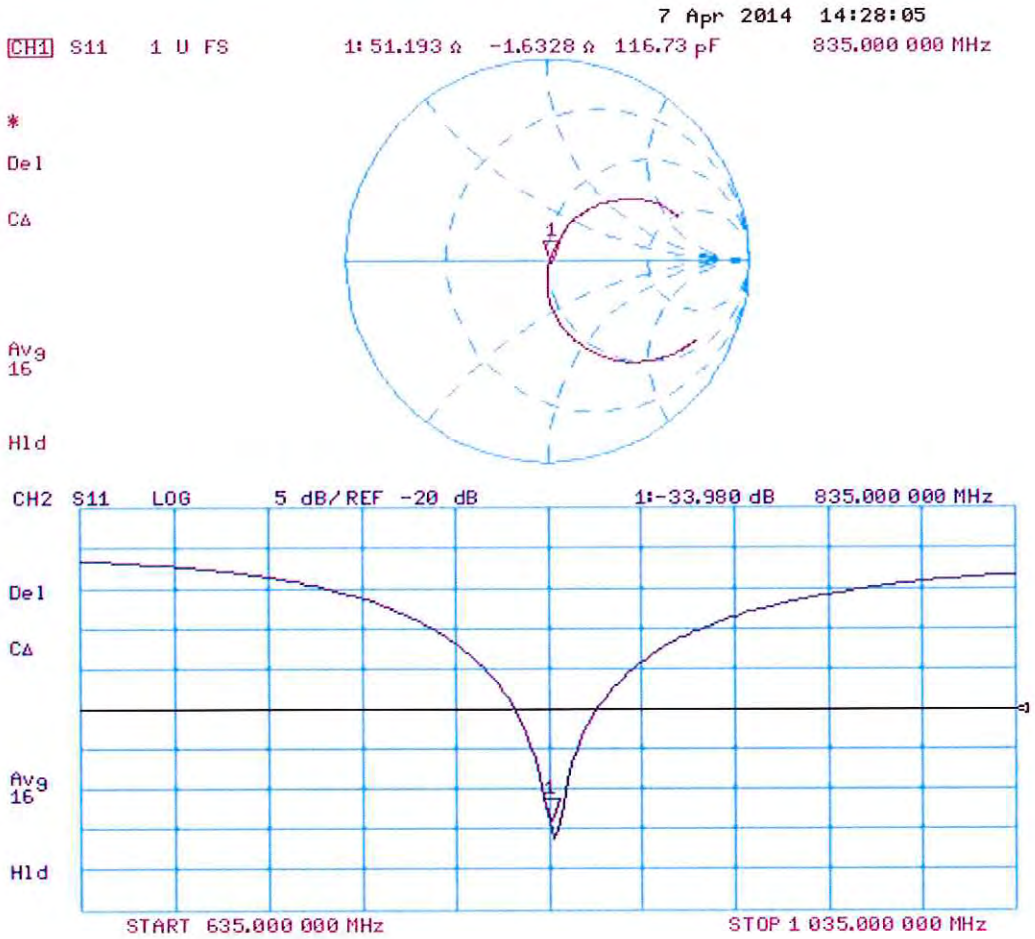
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.289 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.59 W/kg
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.53 W/kg
Maximum value of SAR (measured) = 2.80 W/kg



0 dB = 2.80 W/kg = 4.47 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

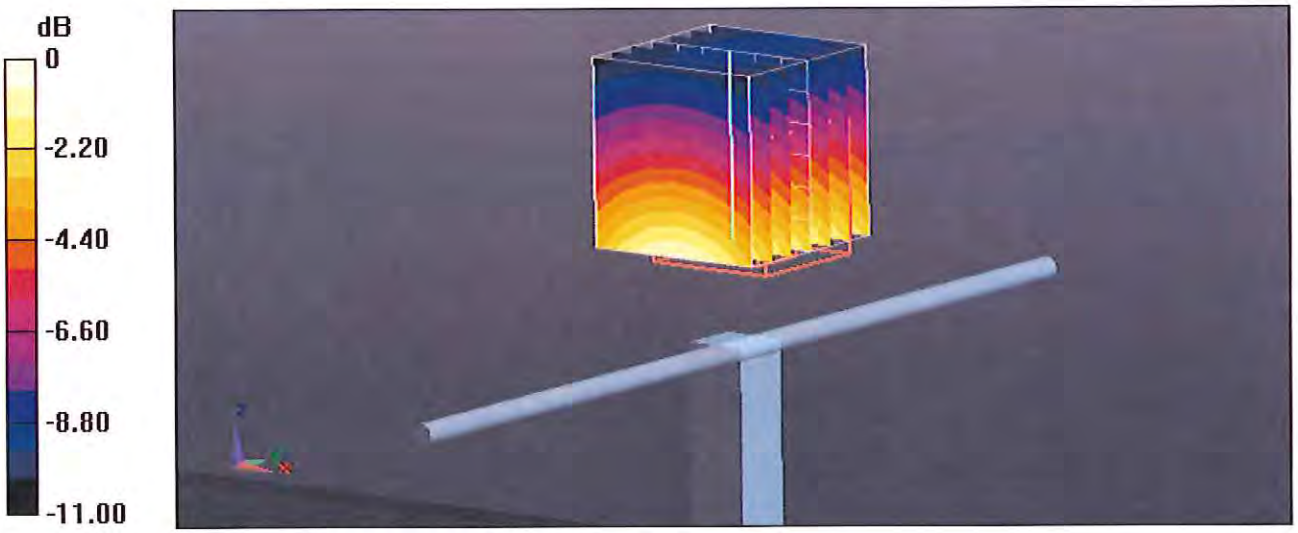
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.02 S/m; ε_r = 53.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

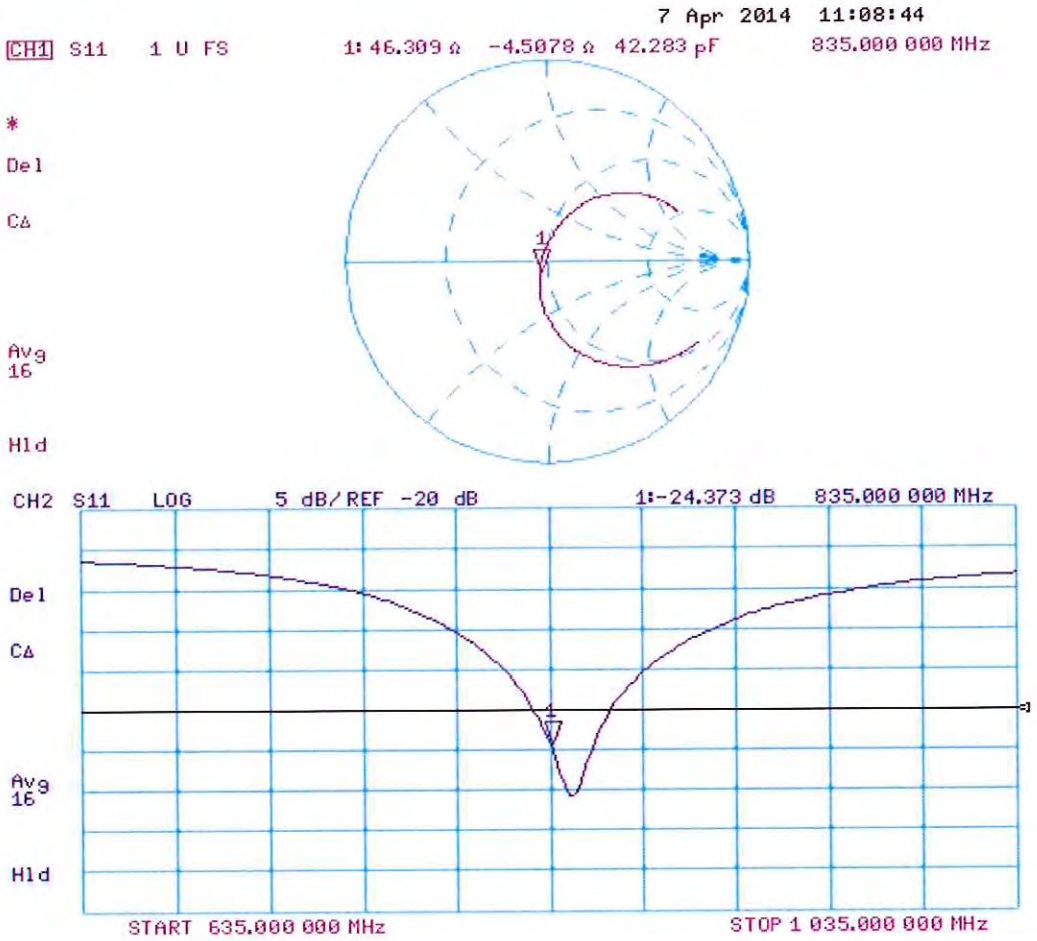
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.594 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.61 W/kg
SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.59 W/kg
Maximum value of SAR (measured) = 2.85 W/kg



0 dB = 2.85 W/kg = 4.55 dBW/kg

Impedance Measurement Plot for Body TSL



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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D835V2-4d132_Jul14

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d132
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 10, 2014

✓ KOK 7/17/14

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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M. Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 11, 2014

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

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.1 ± 6 %	0.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.27 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.55 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.03 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.8 ± 6 %	1.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.50 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.58 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.63 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.30 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.0 Ω - 1.6 jΩ
Return Loss	- 31.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.7 Ω - 3.4 jΩ
Return Loss	- 27.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.386 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	July 22, 2011

DASY5 Validation Report for Head TSL

Date: 10.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d132

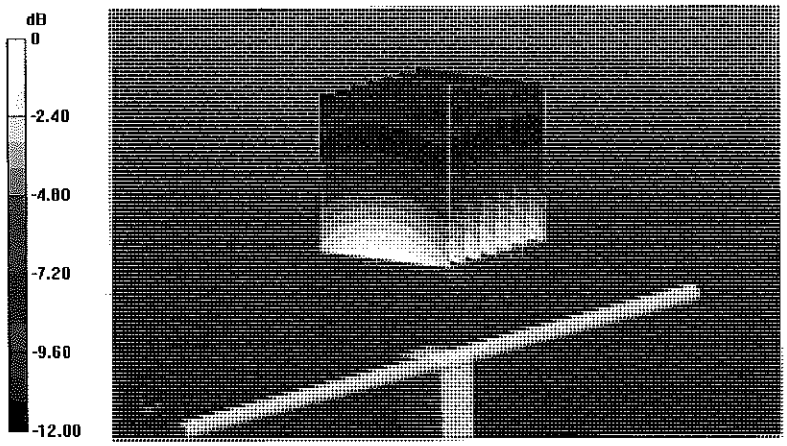
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 41.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.22, 6.22, 6.22); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

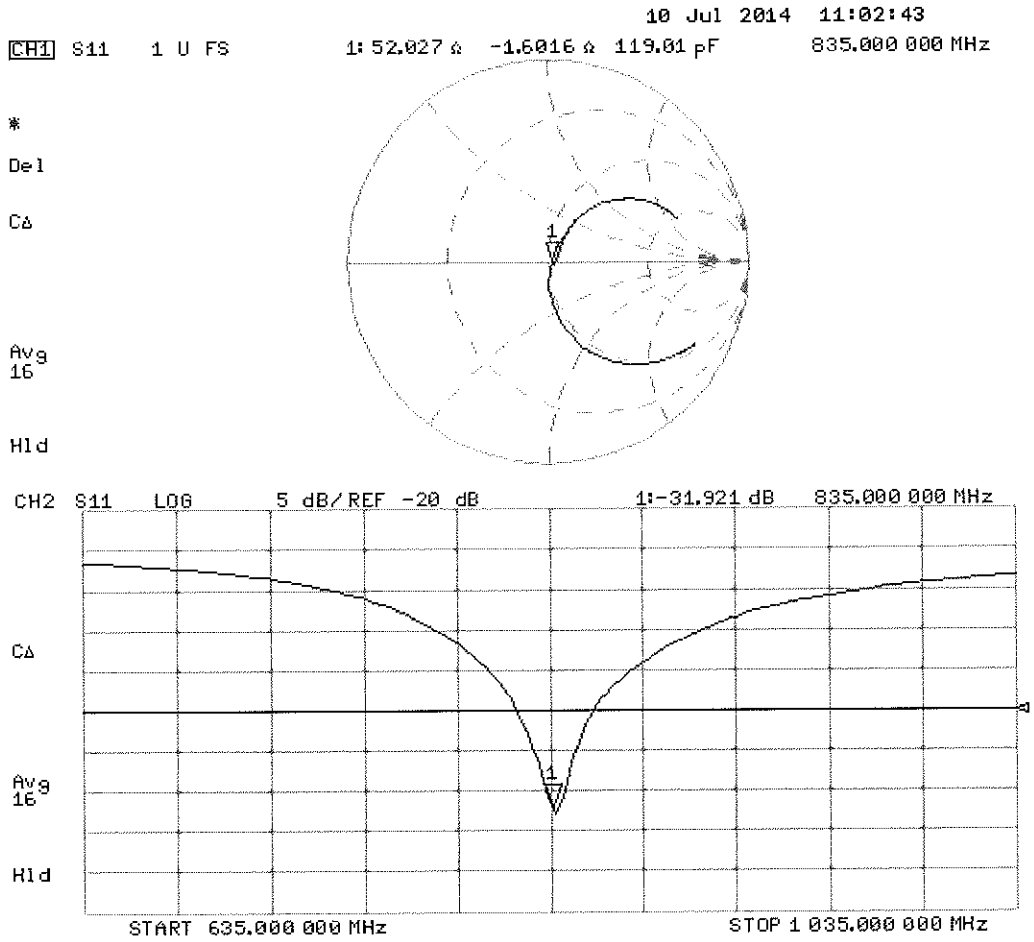
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.43 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.62 W/kg
SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.55 W/kg
Maximum value of SAR (measured) = 2.83 W/kg



0 dB = 2.83 W/kg = 4.52 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 09.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d132

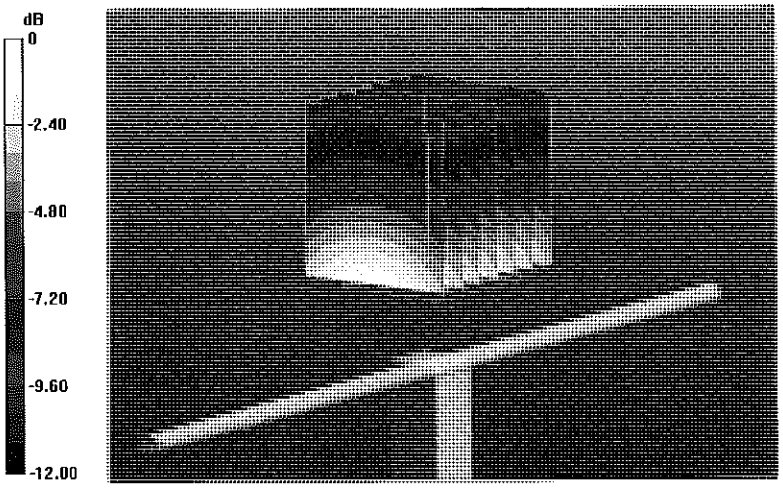
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.02 S/m; ε_r = 53.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

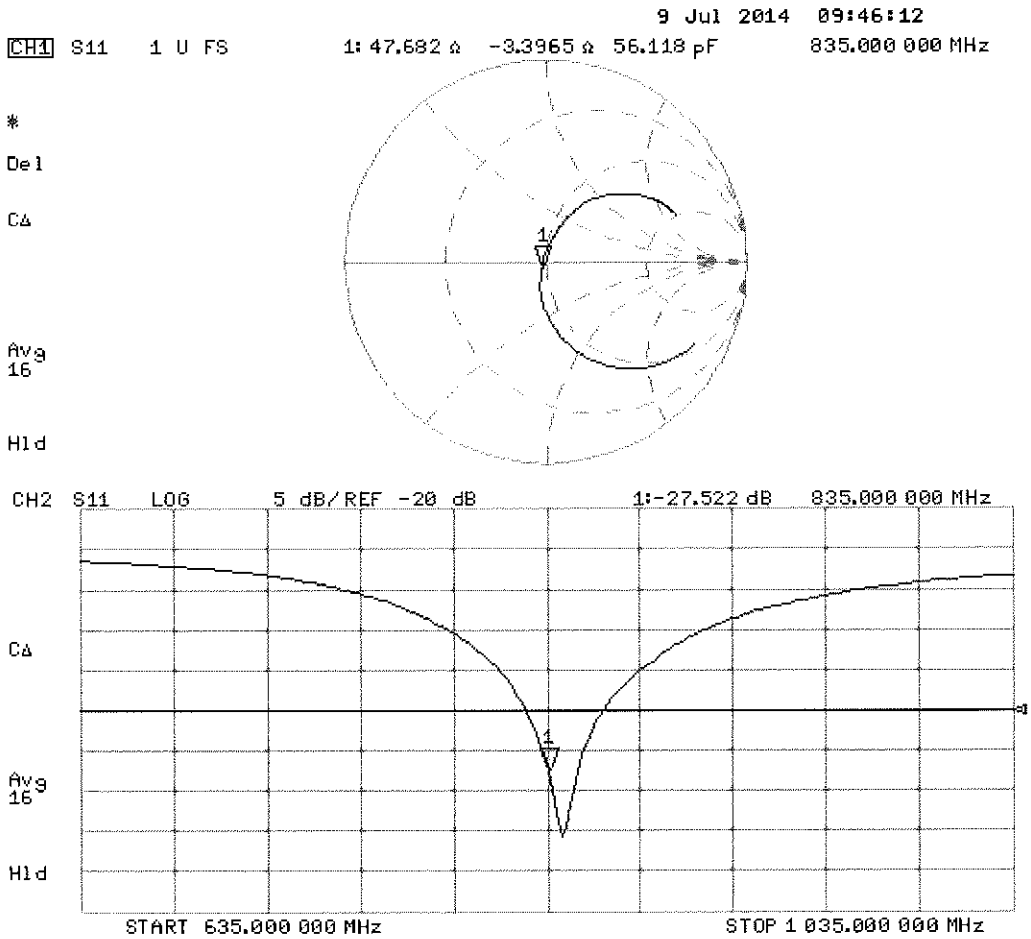
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.35 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.72 W/kg
SAR(1 g) = 2.5 W/kg; SAR(10 g) = 1.63 W/kg
Maximum value of SAR (measured) = 2.91 W/kg



0 dB = 2.91 W/kg = 4.64 dBW/kg

Impedance Measurement Plot for Body TSL



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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D1900V2-5d148_Feb14

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d148
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	February 27, 2014

OCV 3/4/2014

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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 27, 2014

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

PCT # 80833

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.39 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	10.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.2 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.8 ± 6 %	1.49 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	9.73 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.7 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.5 Ω + 5.5 jΩ
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 27.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

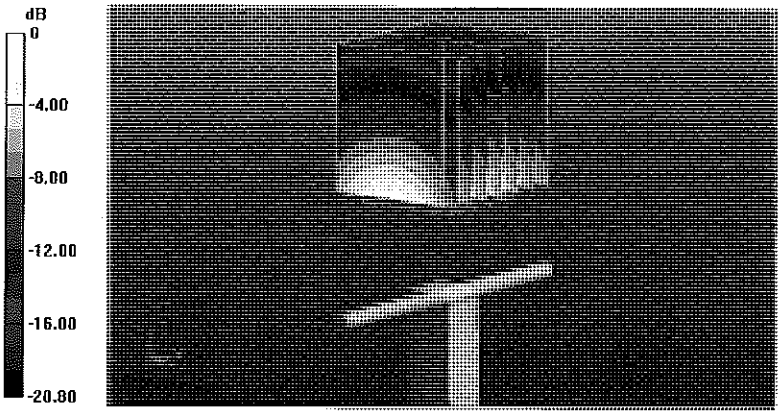
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.39 S/m; ε_r = 38.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

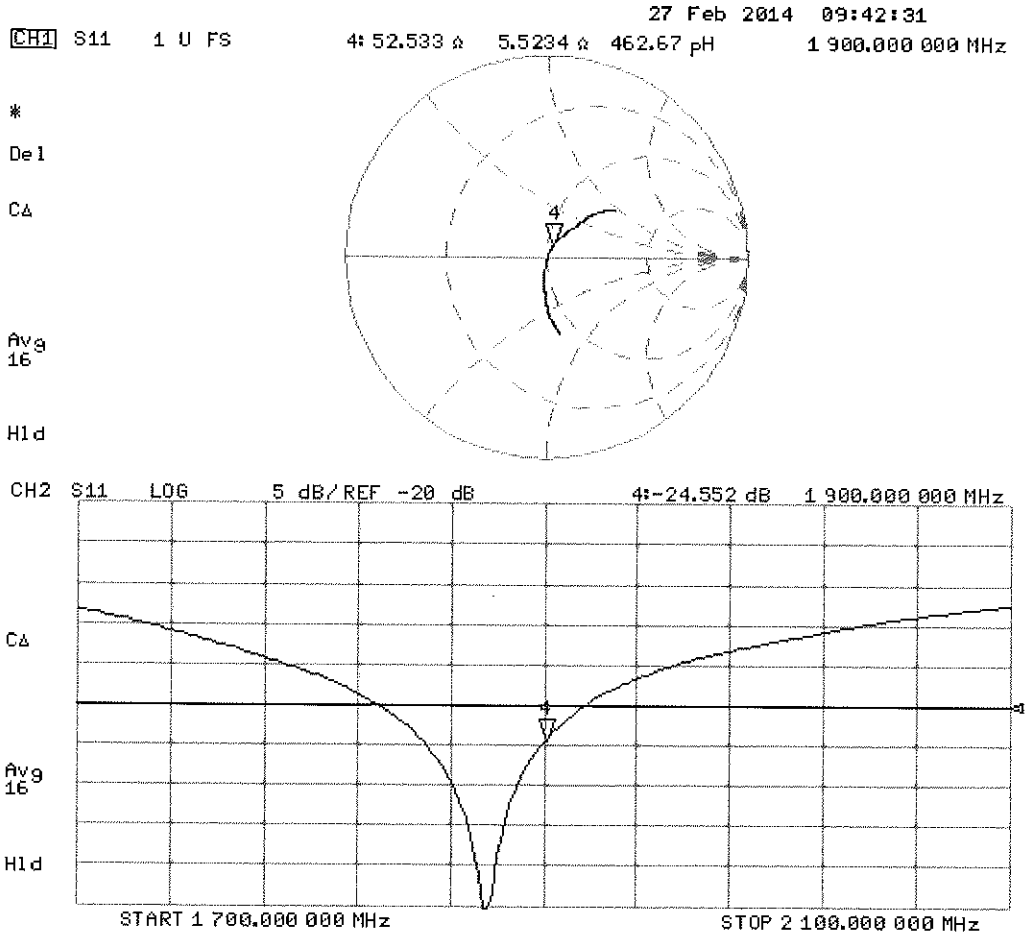
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.796 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 18.9 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.31 W/kg
Maximum value of SAR (measured) = 12.8 W/kg



0 dB = 12.8 W/kg = 11.07 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 27.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

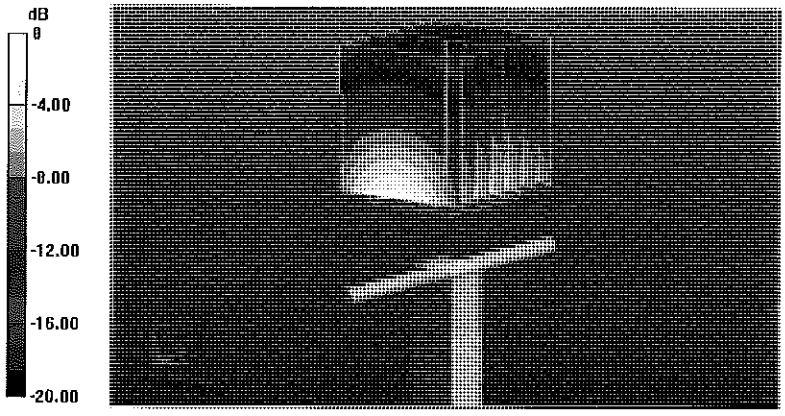
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.49 S/m; ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

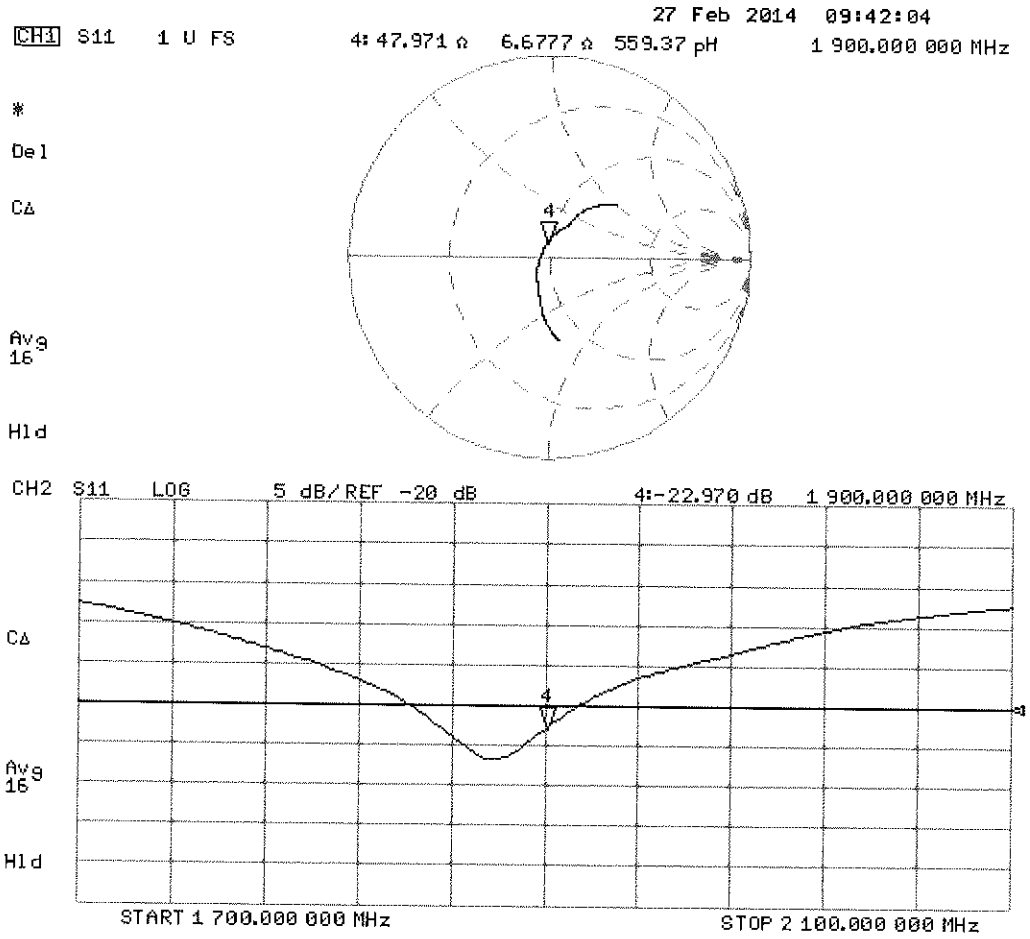
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.520 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 17.0 W/kg
SAR(1 g) = 9.73 W/kg; SAR(10 g) = 5.15 W/kg
Maximum value of SAR (measured) = 12.2 W/kg



0 dB = 12.2 W/kg = 10.86 dBW/kg

Impedance Measurement Plot for Body TSL



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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D2450V2-797_Jan14

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 797
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	January 21, 2014

CC ✓
2/5/14

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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: January 21, 2014

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

PCT# 751

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
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	38.7 ± 6 %	1.86 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 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.3 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.3 ± 6 %	2.04 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	12.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**49.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.86 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.1 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.5 Ω + 3.2 jΩ
Return Loss	- 26.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.0 Ω + 4.9 jΩ
Return Loss	- 26.2 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: 21.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

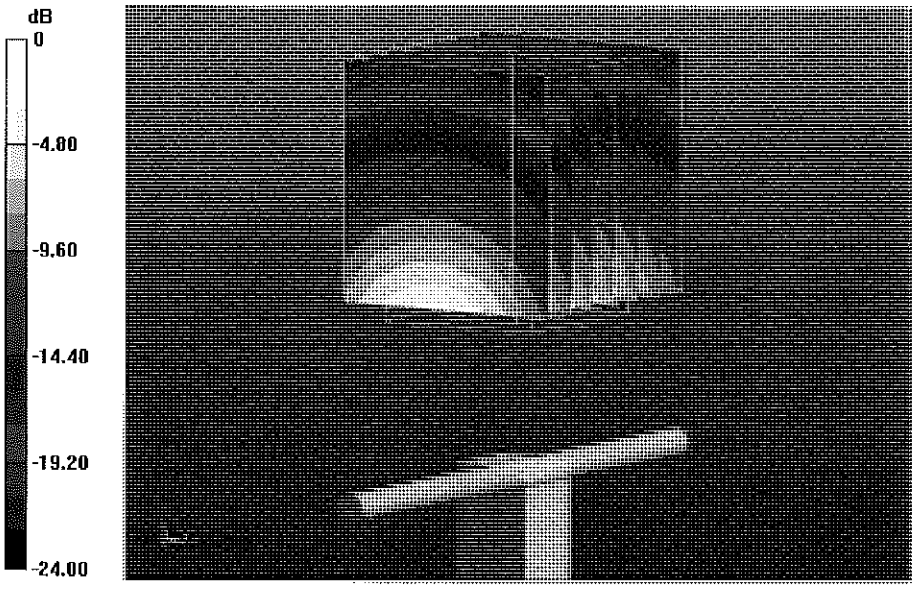
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ε_r = 38.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

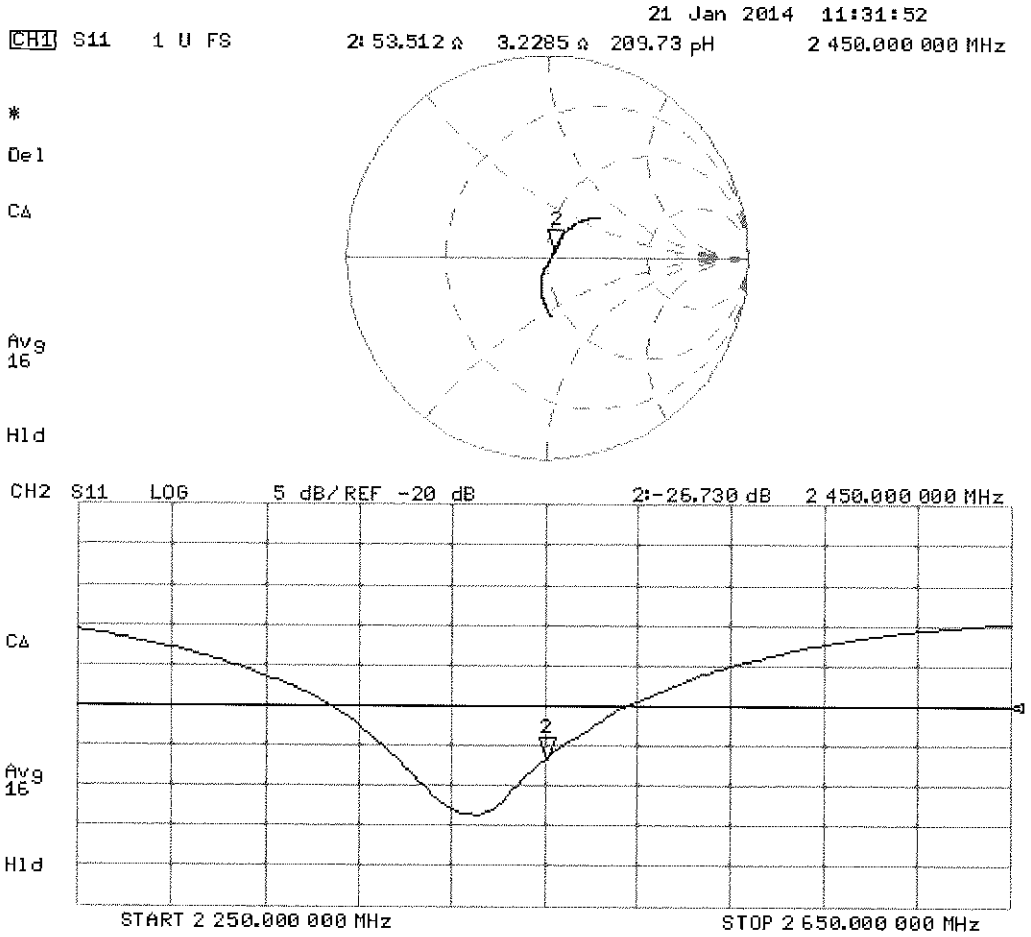
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.151 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 27.5 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.13 W/kg
Maximum value of SAR (measured) = 16.9 W/kg



0 dB = 16.9 W/kg = 12.28 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 21.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

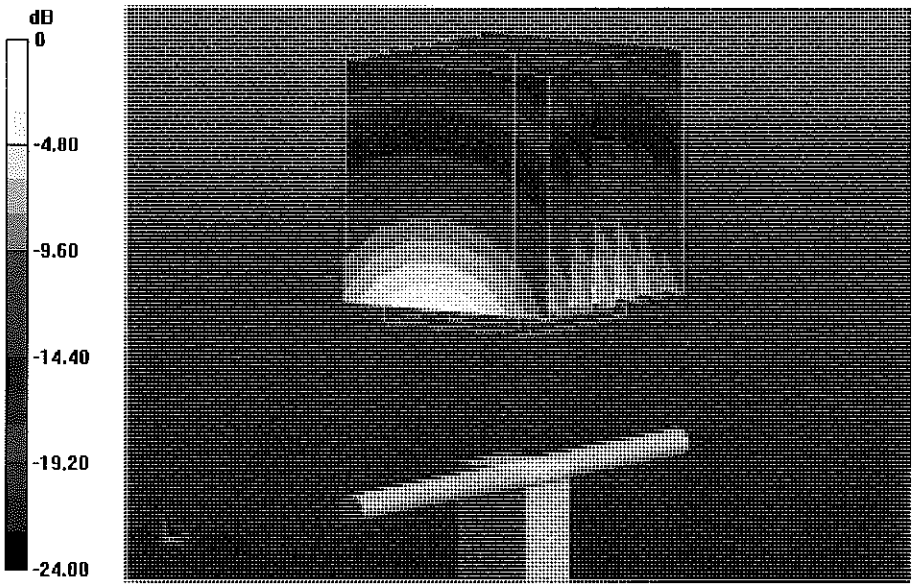
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.04 S/m; ε_r = 51.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

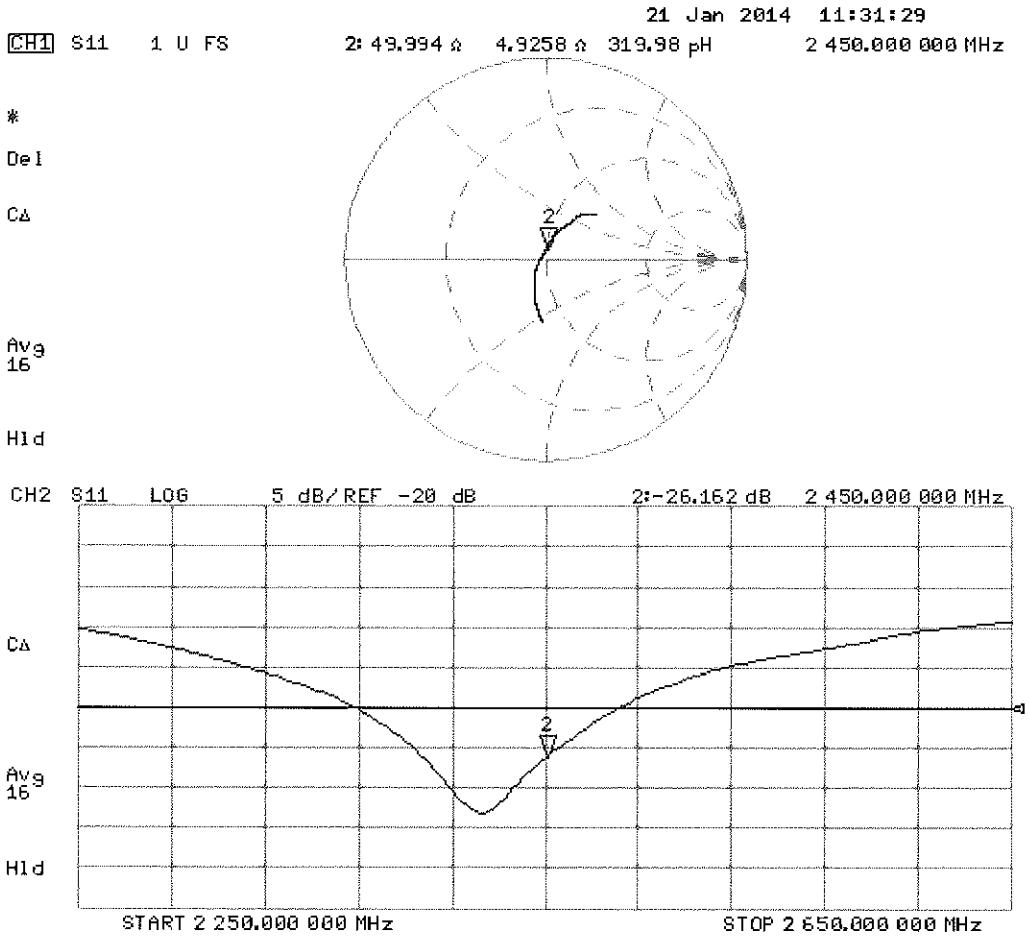
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.709 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 26.4 W/kg
SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.86 W/kg
Maximum value of SAR (measured) = 16.8 W/kg



0 dB = 16.8 W/kg = 12.25 dBW/kg

Impedance Measurement Plot for Body TSL



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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D5GHzV2-1007_Sep13/2

CALIBRATION CERTIFICATE (Replacement of No: D5GHzV2-1007_Sep13)

Object: D5GHzV2 - SN: 1007

CC✓ 10/5/13

Calibration procedure(s): QA CAL-22.v2
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: September 23, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

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

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

Issued: October 4, 2013

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

PCT# 685

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) 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
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
c) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
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	35.8 ± 6 %	4.48 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	7.77 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**77.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.2 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	35.6 ± 6 %	4.62 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	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.2 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.9 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	35.4 ± 6 %	4.76 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	8.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**81.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.1 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	35.2 ± 6 %	4.86 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	8.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.7 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	35.0 ± 6 %	5.07 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	7.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**77.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.9 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	48.3 ± 6 %	5.36 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	7.28 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**72.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.2 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	48.1 ± 6 %	5.56 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	7.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.8 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	47.8 ± 6 %	5.75 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	7.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 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	47.6 ± 6 %	5.88 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	7.75 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 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	47.3 ± 6 %	6.17 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	7.31 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**72.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.02 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.1 W/kg ± 19.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	52.4 Ω - 11.0 jΩ
Return Loss	- 19.2 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	56.8 Ω - 4.4 jΩ
Return Loss	- 22.3 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	48.8 Ω - 5.4 jΩ
Return Loss	- 25.1 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	57.3 Ω - 8.7 jΩ
Return Loss	- 19.5 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.9 Ω + 1.6 jΩ
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	53.1 Ω - 10.3 jΩ
Return Loss	- 19.7 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	54.3 Ω - 1.5 jΩ
Return Loss	- 27.2 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	49.7 Ω - 3.6 jΩ
Return Loss	- 28.7 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.2 Ω - 5.2 jΩ
Return Loss	- 20.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	58.7 Ω + 3.9 jΩ
Return Loss	- 21.1 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: 23.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.48 S/m; ε_r = 35.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 4.62 S/m; ε_r = 35.6; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.76 S/m; ε_r = 35.4; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.86 S/m; ε_r = 35.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.07 S/m; ε_r = 35; ρ = 1000 kg/m^3
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: 28.12.2012, ConvF(5.1, 5.1, 5.1); Calibrated: 28.12.2012, ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.76, 4.76, 4.76); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

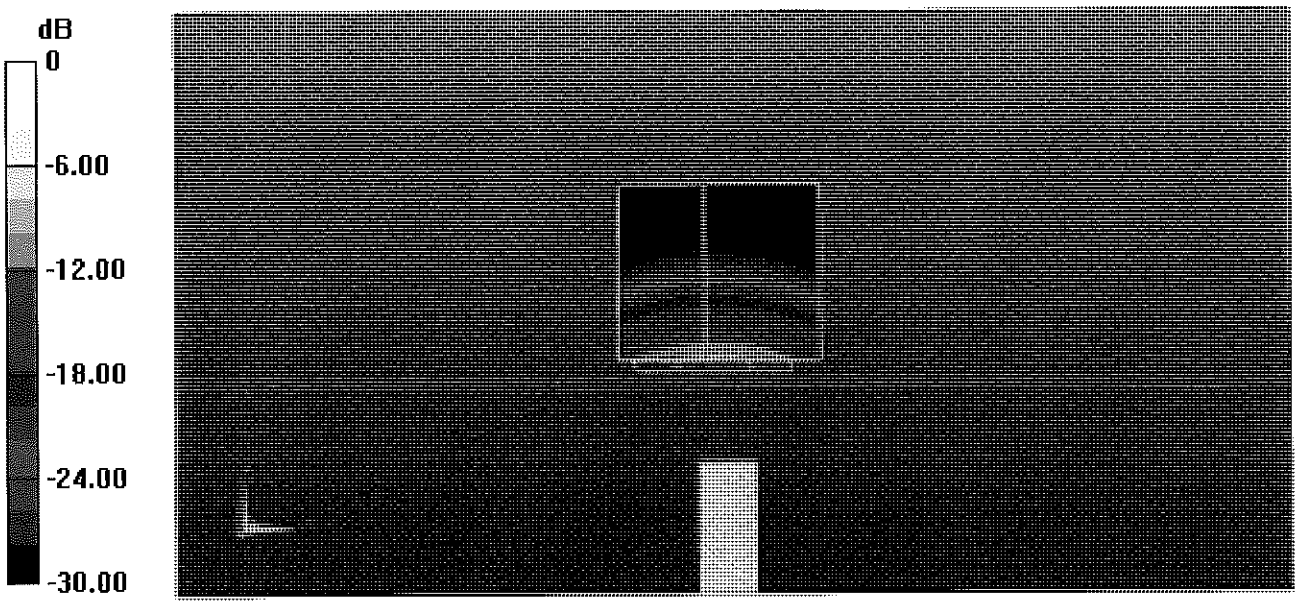
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.505 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 28.1 W/kg
SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.23 W/kg
Maximum value of SAR (measured) = 18.1 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 = 63.817 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 29.7 W/kg
SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.3 W/kg
Maximum value of SAR (measured) = 18.7 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 = 64.029 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 32.0 W/kg
SAR(1 g) = 8.17 W/kg; SAR(10 g) = 2.32 W/kg
Maximum value of SAR (measured) = 19.7 W/kg

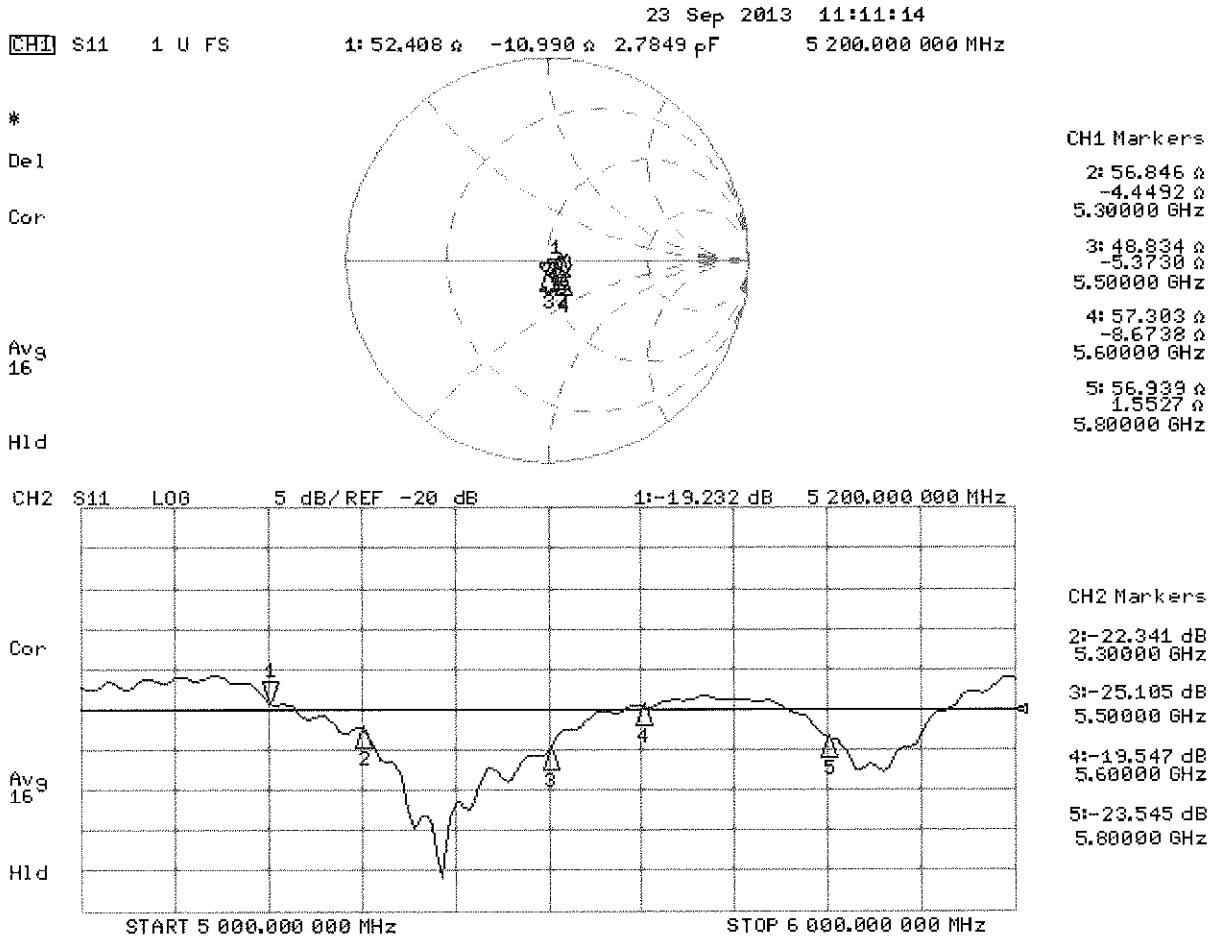
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.403 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 31.3 W/kg
SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.28 W/kg
Maximum value of SAR (measured) = 19.3 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 = 60.987 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 31.9 W/kg
SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.2 W/kg
Maximum value of SAR (measured) = 19.0 W/kg



0 dB = 19.0 W/kg = 12.79 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 20.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.36 S/m; ε_r = 48.3; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 5.56 S/m; ε_r = 48.1; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 5.75 S/m; ε_r = 47.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 5.88 S/m; ε_r = 47.6; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.17 S/m; ε_r = 47.3; ρ = 1000 kg/m^3
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: 28.12.2012, ConvF(4.67, 4.67, 4.67); Calibrated: 28.12.2012, ConvF(4.43, 4.43, 4.43); Calibrated: 28.12.2012, ConvF(4.22, 4.22, 4.22); Calibrated: 28.12.2012, ConvF(4.38, 4.38, 4.38); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

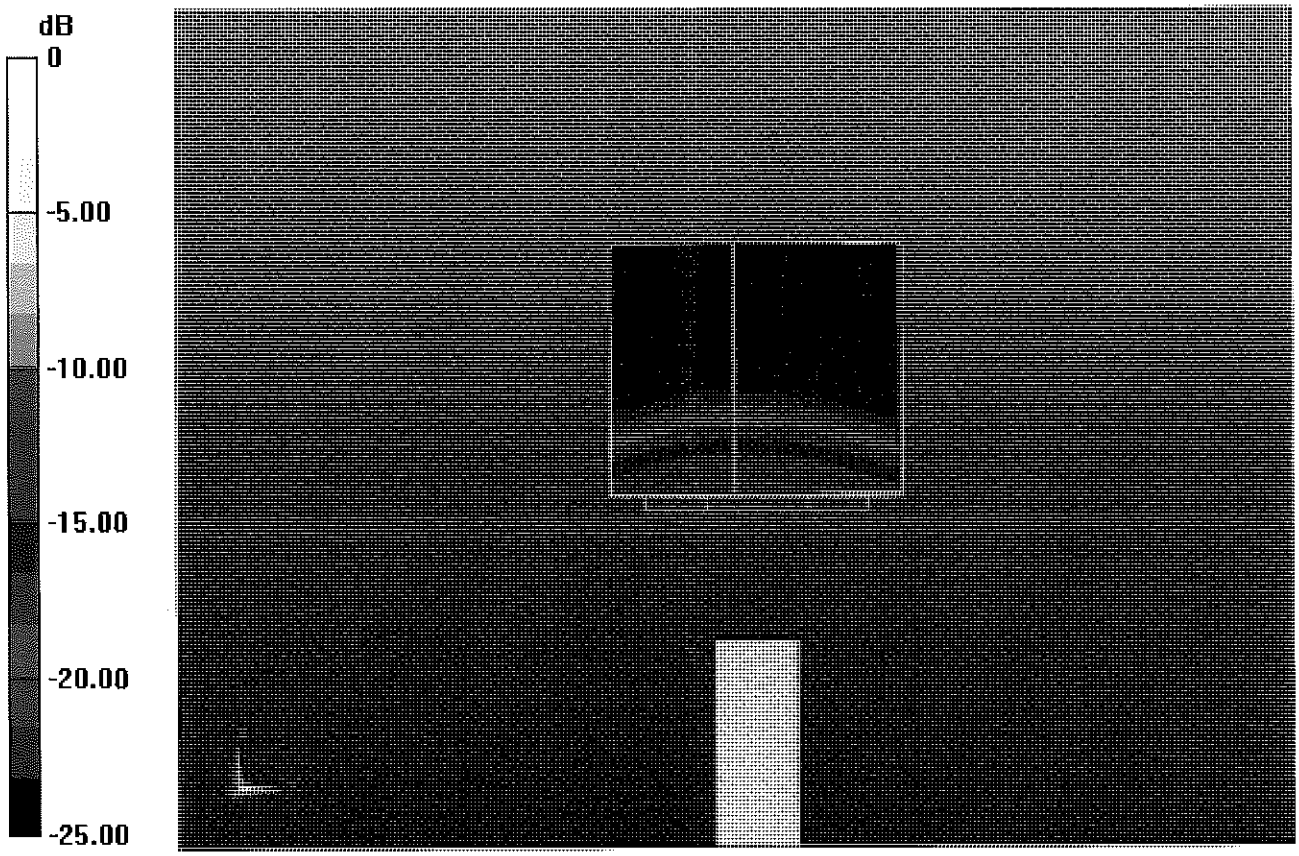
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.606 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 28.6 W/kg
SAR(1 g) = 7.28 W/kg; SAR(10 g) = 2.03 W/kg
Maximum value of SAR (measured) = 17.2 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 = 58.305 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 30.3 W/kg
SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.09 W/kg
Maximum value of SAR (measured) = 17.8 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 = 58.471 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 32.4 W/kg
SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.11 W/kg
Maximum value of SAR (measured) = 18.5 W/kg

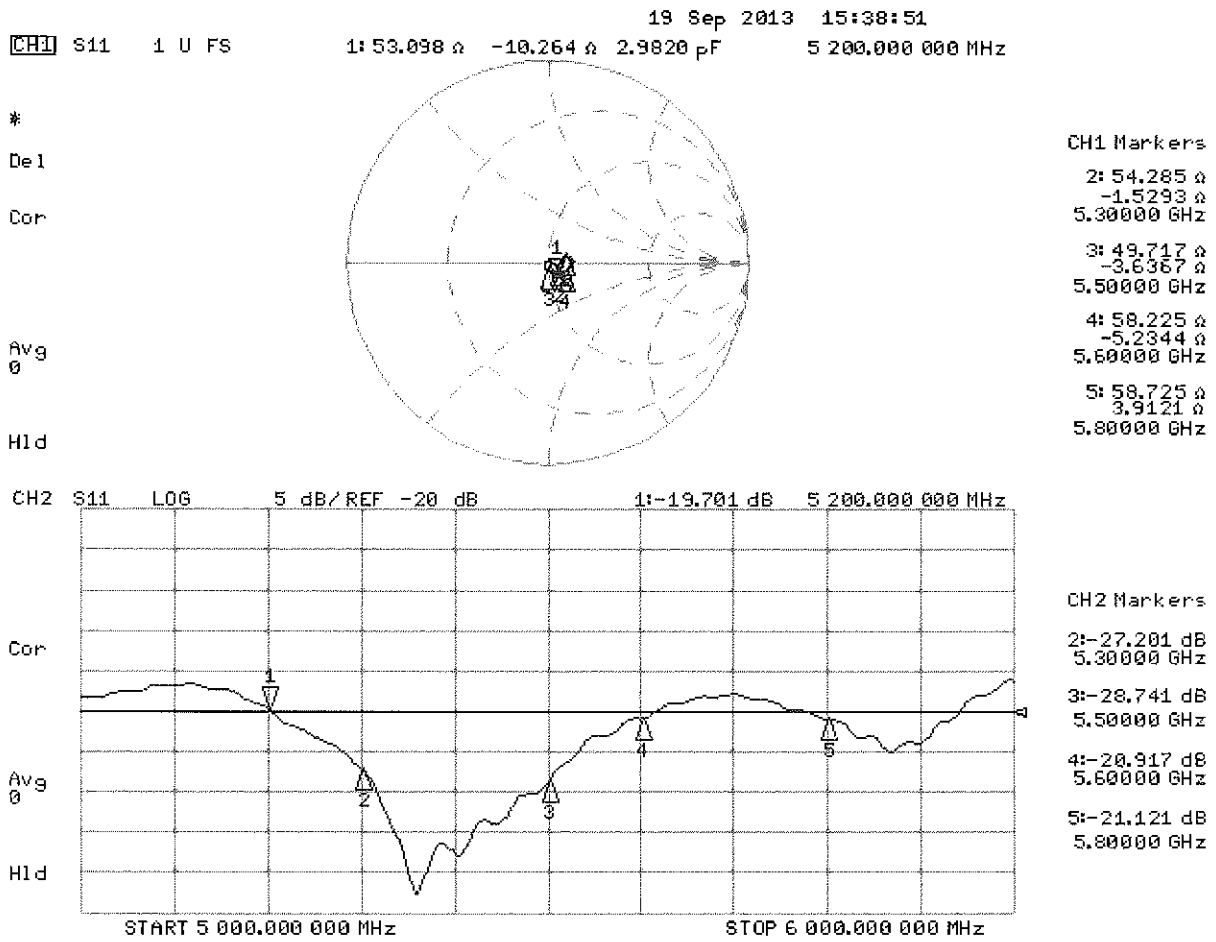
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.333 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 33.8 W/kg
SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.16 W/kg
Maximum value of SAR (measured) = 19.1 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 = 55.389 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 34.1 W/kg
SAR(1 g) = 7.31 W/kg; SAR(10 g) = 2.02 W/kg
Maximum value of SAR (measured) = 18.3 W/kg



0 dB = 18.3 W/kg = 12.62 dBW/kg

Impedance Measurement Plot for Body TSL



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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D5GHzV2-1057_Jan14

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1057
Calibration procedure(s)	QA CAL-22.v2 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	January 27, 2014

CC 2/5/14 ✓

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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	30-Dec-13 (No. EX3-3503_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: January 27, 2014

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

PCT# 753

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) 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
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
c) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
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	35.0 ± 6 %	4.45 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	7.85 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**78.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.3 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	34.9 ± 6 %	4.54 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	8.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**83.0 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.8 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	34.6 ± 6 %	4.74 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	8.50 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**84.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.0 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	34.5 ± 6 %	4.86 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	8.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**83.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.8 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	34.2 ± 6 %	5.07 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	8.00 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.6 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	47.3 ± 6 %	5.44 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	7.58 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 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	47.2 ± 6 %	5.57 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	7.79 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 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	46.8 ± 6 %	5.84 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	7.96 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**79.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.0 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	46.6 ± 6 %	5.98 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	**80.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.24 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	46.3 ± 6 %	6.23 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	7.48 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	2.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.4 W/kg ± 19.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	43.1 Ω - 4.6 jΩ
Return Loss	- 21.0 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	46.5 Ω - 1.3 jΩ
Return Loss	- 28.1 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	46.2 Ω - 2.5 jΩ
Return Loss	- 26.4 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	48.9 Ω - 5.7 jΩ
Return Loss	- 24.6 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	48.7 Ω - 3.1 jΩ
Return Loss	- 29.5 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	49.4 Ω - 7.7 jΩ
Return Loss	- 22.2 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	49.6 Ω - 3.0 jΩ
Return Loss	- 30.3 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	50.8 Ω - 3.9 jΩ
Return Loss	- 28.0 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	55.4 Ω - 2.5 jΩ
Return Loss	- 25.0 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	52.3 Ω - 0.7 jΩ
Return Loss	- 32.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.186 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	November 27, 2006

DASY5 Validation Report for Head TSL

Date: 27.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1057

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.45 S/m; ε_r = 35; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 4.54 S/m; ε_r = 34.9; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.74 S/m; ε_r = 34.6; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.86 S/m; ε_r = 34.5; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.07 S/m; ε_r = 34.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.52, 5.52, 5.52); Calibrated: 30.12.2013, ConvF(5.2, 5.2, 5.2); Calibrated: 30.12.2013, ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2013, ConvF(4.86, 4.86, 4.86); Calibrated: 30.12.2013, ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

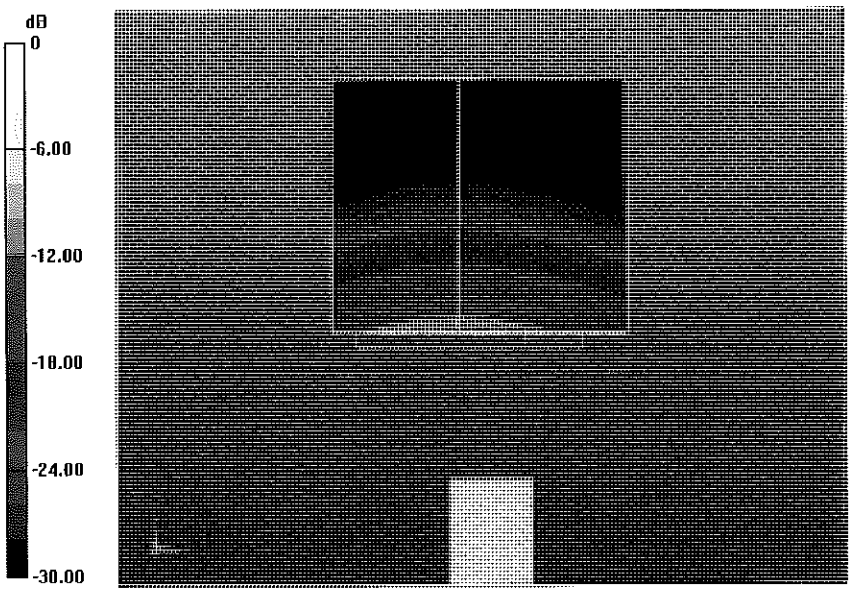
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.497 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 28.2 W/kg
SAR(1 g) = 7.85 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR (measured) = 18.6 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 = 64.444 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 31.2 W/kg
SAR(1 g) = 8.36 W/kg; SAR(10 g) = 2.4 W/kg
Maximum value of SAR (measured) = 20.1 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 = 63.807 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 33.0 W/kg
SAR(1 g) = 8.5 W/kg; SAR(10 g) = 2.42 W/kg
Maximum value of SAR (measured) = 20.8 W/kg

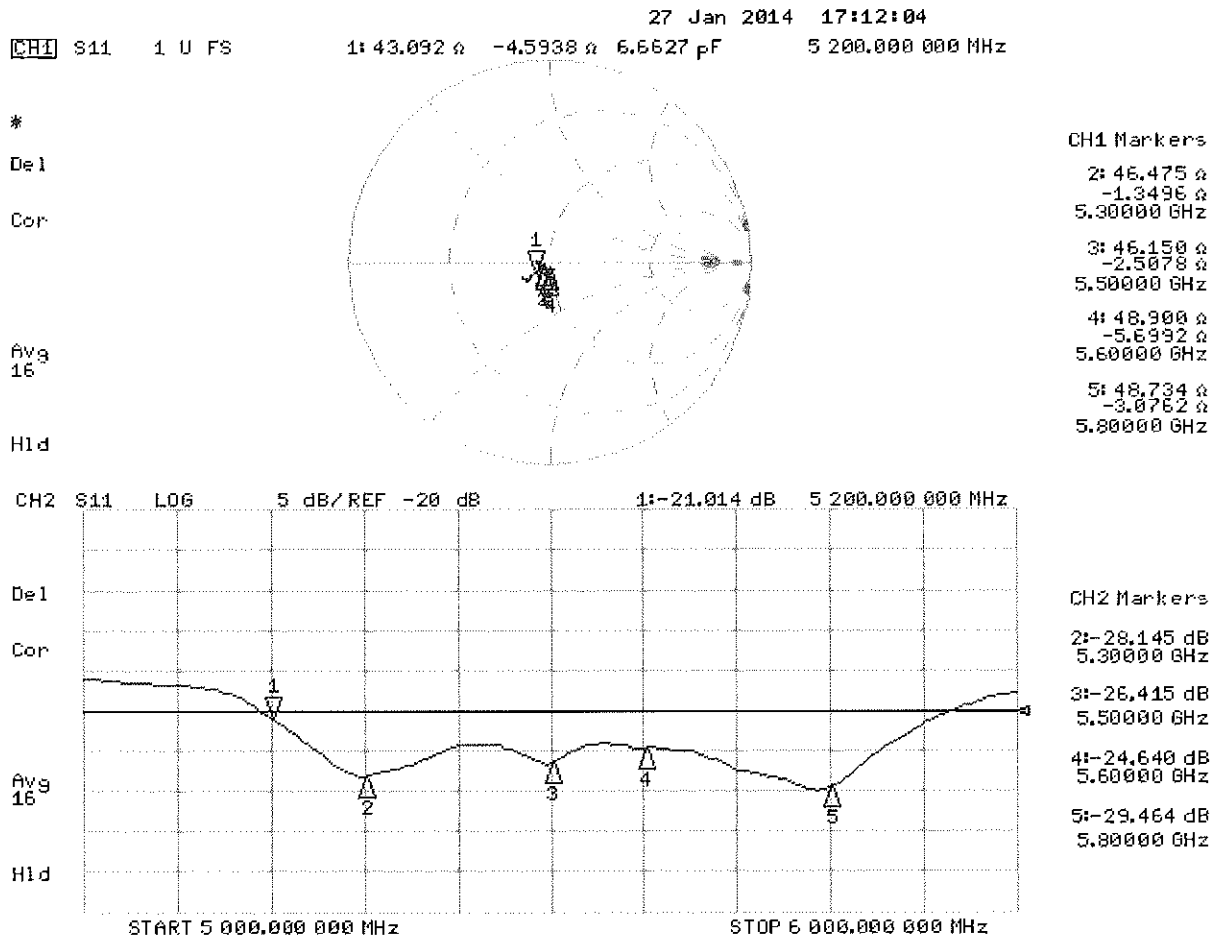
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.194 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 33.2 W/kg
SAR(1 g) = 8.42 W/kg; SAR(10 g) = 2.4 W/kg

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 = 60.646 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 32.9 W/kg
SAR(1 g) = 8 W/kg; SAR(10 g) = 2.28 W/kg
Maximum value of SAR (measured) = 19.9 W/kg



0 dB = 19.9 W/kg = 12.99 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 24.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1057

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.44 S/m; ε_r = 47.3; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 5.57 S/m; ε_r = 47.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 5.84 S/m; ε_r = 46.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 5.98 S/m; ε_r = 46.6; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.23 S/m; ε_r = 46.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2013, ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013, ConvF(4.52, 4.52, 4.52); Calibrated: 30.12.2013, ConvF(4.3, 4.3, 4.3); Calibrated: 30.12.2013, ConvF(4.47, 4.47, 4.47); Calibrated: 30.12.2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

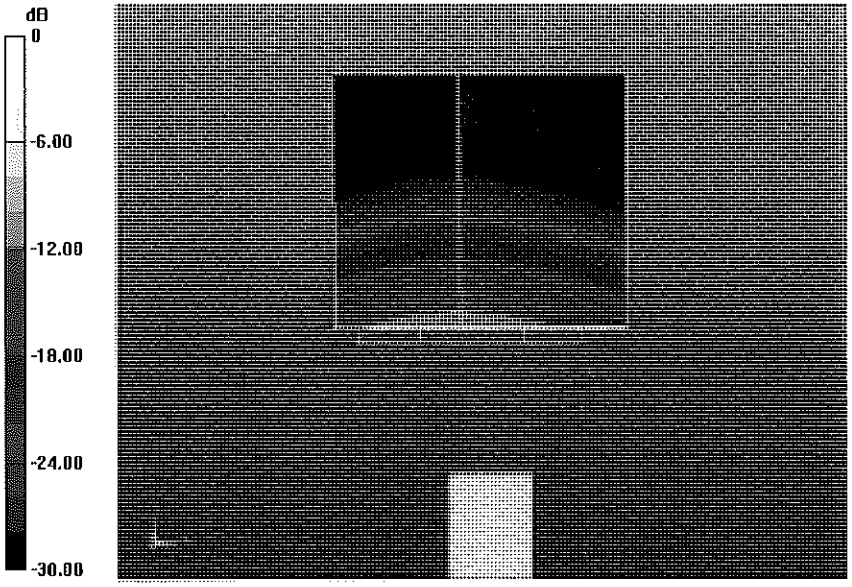
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.809 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 30.1 W/kg
SAR(1 g) = 7.58 W/kg; SAR(10 g) = 2.12 W/kg
Maximum value of SAR (measured) = 18.2 W/kg

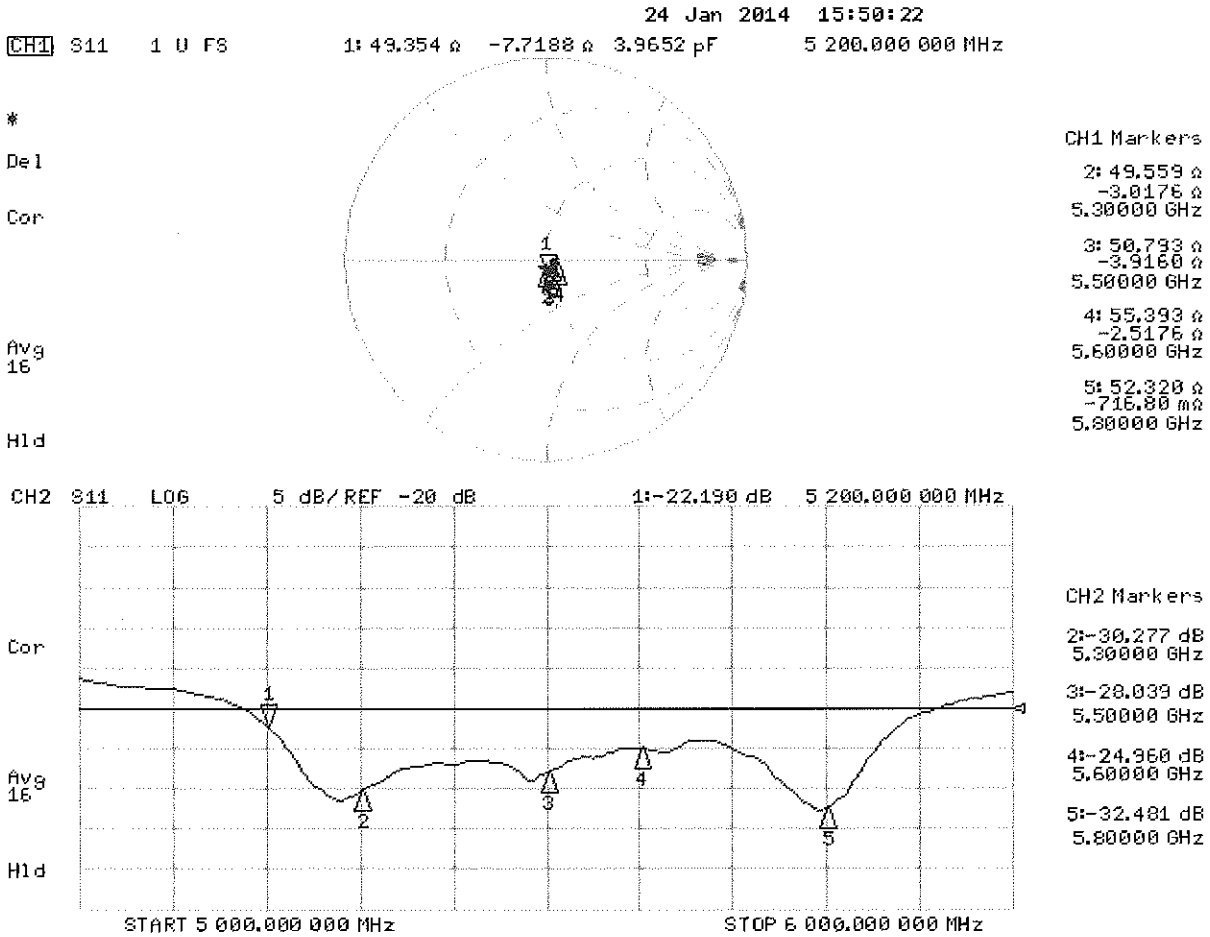
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.585 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 32.2 W/kg
SAR(1 g) = 7.79 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 19.1 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 = 58.364 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 34.4 W/kg
SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.22 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 = 57.864 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 35.8 W/kg
SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.24 W/kg
Maximum value of SAR (measured) = 19.8 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 = 54.817 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 35.1 W/kg
SAR(1 g) = 7.48 W/kg; SAR(10 g) = 2.06 W/kg
Maximum value of SAR (measured) = 18.8 W/kg



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

Impedance Measurement Plot for Body TSL