



SAR EVALUATION REPORT

Applicant Name:

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

Date of Testing:

08/27/13 - 09/13/13

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

0Y1308271673 – R1.A3L

FCC ID:

A3LSCHR890

APPLICANT:

SAMSUNG ELECTRONICS, CO. LTD.

DUT Type:

Portable Handset

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

SCH-R890

Equipment Class	Band & Mode	Tx Frequency	Measured Conducted Power [dBm]	SAR		
				1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Hotspot (W/kg)
PCE	Cell. CDMA/EVDO	824.70 - 848.31 MHz	24.88	0.42	0.38	0.58
PCE	PCS CDMA/EVDO	1851.25 - 1908.75 MHz	24.71	0.67	0.57	0.77
PCE	LTE Band 5 (Cell)	826.5 - 846.5 MHz	23.66	0.33	0.33	0.44
PCE	LTE Band 12	701.5 - 713.5 MHz	24.25	0.39	0.16	0.25
DTS	2.4 GHz WLAN	2412 - 2462 MHz	17.02	0.45	< 0.1	0.23
DTS	5.8 GHz WLAN	5745 - 5825 MHz	12.83	0.27	0.20	0.42
NII	5.2 GHz WLAN	5180 - 5240 MHz	12.99	0.20	0.13	
NII	5.3 GHz WLAN	5260 - 5320 MHz	12.99	0.22	0.13	
NII	5.5 GHz WLAN	5500 - 5700 MHz	12.94	0.26	0.19	
DSS/DTS	Bluetooth	2402 - 2480 MHz	9.65	N/A		
Simultaneous SAR per KDB 690783 D01v01r02:				1.12	1.04	1.53

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

Note: This revised Test Report (S/N: 0Y1308271673-R1.A3L) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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

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


Randy Ortanez
President



FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 1 of 61	

T A B L E O F C O N T E N T S

1	DEVICE UNDER TEST	3
2	LTE INFORMATION	10
3	INTRODUCTION	11
4	DOSIMETRIC ASSESSMENT	12
5	DEFINITION OF REFERENCE POINTS	13
6	TEST CONFIGURATION POSITIONS FOR HANDSETS	14
7	RF EXPOSURE LIMITS	18
8	FCC MEASUREMENT PROCEDURES.....	19
9	RF CONDUCTED POWERS.....	23
10	SYSTEM VERIFICATION.....	33
11	SAR DATA SUMMARY	35
12	FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS.....	44
13	SAR MEASUREMENT VARIABILITY	55
14	EQUIPMENT LIST	56
15	MEASUREMENT UNCERTAINTIES	57
16	CONCLUSION.....	59
17	REFERENCES	60
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		

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 2 of 61	

1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
Cell. CDMA/EVDO	Voice/Data	824.70 - 848.31 MHz
PCS CDMA/EVDO	Voice/Data	1851.25 - 1908.75 MHz
LTE Band 5 (Cell)	Data	826.5 - 846.5 MHz
LTE Band 12	Data	701.5 - 713.5 MHz
LTE Band 17	Data	706.5 - 713.5 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

Note: LTE Band 12 and LTE B17 share the same transmission path. LTE B17 was not evaluated for SAR since the supported frequency range falls within the LTE Band 12 supported frequency range.

1.2 Power Reduction for SAR

This device utilizes power reduction under some portable hotspot conditions (tethering) for SAR compliance. There is power reduction for PCS CDMA/EVDO. There is no power reduction for Cellular CDMA/EVDO, LTE Band 5, LTE B12, LTE B17, and WLAN modes. The reduced powers were confirmed via conducted power measurement at the RF port (see section 9). Detailed description of the hotspot power reduction mechanism is included in the operational description.

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 3 of 61	

1.3 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.

Reduced Power with hotspot mode activated:

Mode / Band	Power Reduction		Modulated Average (dBm)
PCS CDMA/EVDO	Active	Maximum	22.0
		Nominal	21.5

Maximum Power with hotspot power reduction not activated:

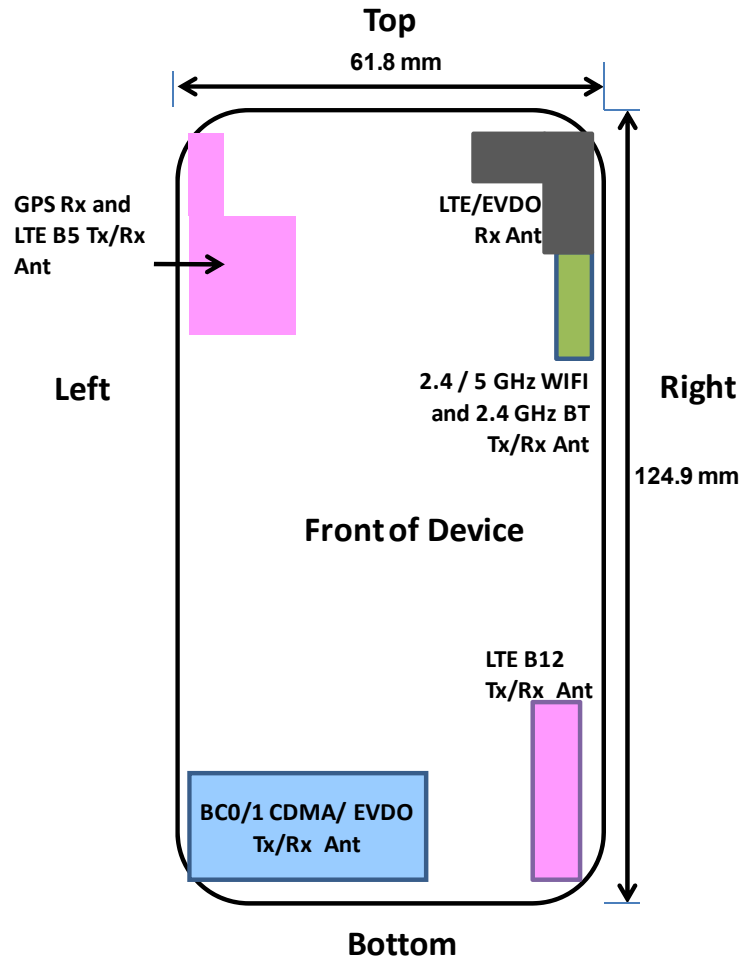
Mode / Band	Power Reduction		Modulated Average (dBm)
Cell. CDMA/EVDO	Not Active	Maximum	25.0
		Nominal	24.5
PCS CDMA/EVDO	Not Active	Maximum	25.0
		Nominal	24.5

Mode / Band		Modulated Average (dBm)
LTE Band 5 (Cell)	Maximum	24.0
	Nominal	23.5
LTE Band 12	Maximum	24.5
	Nominal	24.0

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	17.5
	Nominal	17.0
IEEE 802.11g (2.4 GHz)	Maximum	11.5
	Nominal	11.0
IEEE 802.11n (2.4 GHz)	Maximum	10.5
	Nominal	10.0
IEEE 802.11a (5 GHz)	Maximum	13.5
	Nominal	13.0
IEEE 802.11n (5 GHz 20 MHz Bandwidth)	Maximum	13.0
	Nominal	12.5
IEEE 802.11n (5 GHz 40 MHz Bandwidth)	Maximum	12.0
	Nominal	11.5
Bluetooth	Maximum	10.0
	Nominal	9.5
Bluetooth LE	Maximum	3.0
	Nominal	2.5

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 4 of 61	

1.4 DUT Antenna Locations



Note: Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC Filing.

Figure 1-1
DUT Antenna Locations

Table 1-1
Mobile Hotspot Sides for SAR Testing

Mode	Back	Front	Top	Bottom	Right	Left
Cell. EVDO	Yes	Yes	No	Yes	No	Yes
PCS EVDO	Yes	Yes	No	Yes	No	Yes
LTE Band 5 (Cell)	Yes	Yes	Yes	No	No	Yes
LTE Band 12	Yes	Yes	No	Yes	Yes	No
2.4 GHz WLAN	Yes	Yes	Yes	No	Yes	No
5.8 GHz WLAN	Yes	Yes	Yes	No	Yes	No

Note: Particular DUT edges were not required to be evaluated for Wireless Router SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v01 guidance, page 2.

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 5 of 61

1.5 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the battery. The SAR tests were performed with the specialized battery (model: B500BU).

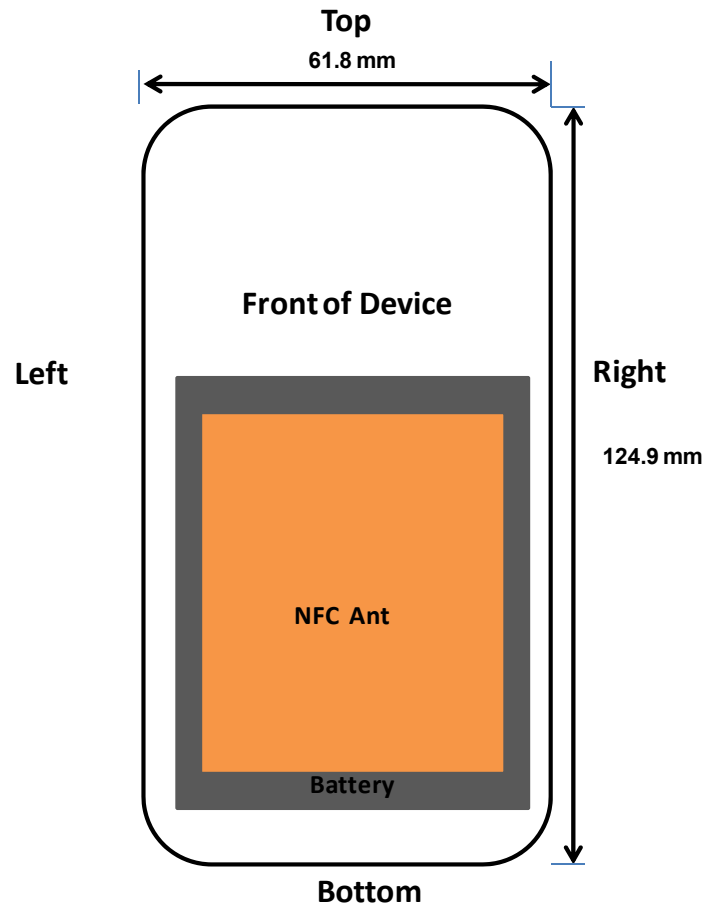


Figure 1-2
NFC Antenna Locations

FCC ID A3LSCHR890	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 6 of 61

1.6 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D05v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-3 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.



Figure 1-3
Simultaneous Transmission Paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v05 3) procedures.

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configurations	Head	Body-Worn Accessory	Hot Spot	Note
		IEEE 1528, Supp C	Supplement C	FCC KDB 941225 D06 edges/sides	
1	1X CDMA Voice + LTE Data	Yes	Yes	N/A	SVLTE
2	1X CDMA Voice + LTE Data + 2.4 GHz WIFI	Yes	Yes	Yes	SVLTE
3	1X CDMA Voice + LTE Data + 5.8 GHz WIFI	Yes	Yes	Yes	SVLTE
4	1X CDMA Voice + LTE Data + Bluetooth	N/A	Yes	N/A	SVLTE
5	1X CDMA Voice + 2.4 GHz WIFI	Yes	Yes	N/A	
6	1X CDMA Voice + 5 GHz WIFI	Yes	Yes	N/A	
7	1X CDMA Voice + Bluetooth	N/A	Yes	N/A	
8	1X/EVDO Data + 2.4 GHz WIFI	Yes*	Yes*	Yes	
9	1X/EVDO Data + 5.8 GHz WIFI	Yes*	Yes*	Yes	
10	1X/EVDO Data + Bluetooth	N/A	Yes*	N/A	
11	LTE Data + 2.4 GHz WIFI	Yes*	Yes*	Yes	
12	LTE Data + Bluetooth	N/A	Yes*	N/A	
13	LTE Data + 5.8 GHz WIFI	Yes*	Yes*	Yes	
14	1X CDMA Voice + EVDO	N/A	N/A	N/A	Not available by HW
15	EVDO data + LTE Data	N/A	N/A	N/A	Not available by SW

Note:

- (*) = for VOIP 3rd party applications possibly installed and used by the end-user
- 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 is no simultaneous transmission scenarios involving WIFI direct beyond that listed in the above table.
- CDMA and EVDO share the same antenna path and cannot transmit simultaneously.
- Bluetooth and 2.4GHz / 5GHz WLAN share same antenna path and cannot transmit simultaneously.

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 7 of 61

1.7 SAR Test Exclusions Applied

(A) WIFI/BT

Since Wireless Router operations are not allowed by the chipset firmware using 5 GHz WIFI except 5.8 GHz WIFI, only 2.4 GHz WIFI and 5.8 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 SAR exclusion threshold for distances <50mm is defined by the following equation:

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

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

Based on the maximum conducted power of Bluetooth LE (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth LE SAR was not required; $[(2/10) * \sqrt{2.441}] = 0.3 < 3.0$. 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.

(B) Licensed Transmitter(s)

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

This Device additionally supports LTE B17. LTE Band 12 and LTE Band 17 share the same transmission path. LTE Band 17 was not evaluated for SAR since the supported frequency range falls within the LTE Band 12 supported frequency range.

1.8 Guidance Applied

- FCC OET Bulletin 65 Supplement C [June 2001]
- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (2G/3G/4G and Hotspot)
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05 (General SAR Guidance)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)

FCC ID A3LSCHR890	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 8 of 61

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.

Mode/Band	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
Cell. CDMA/EVDO	70	40	40
PCS CDMA/EVDO	69	69	41
LTE Band 5 (Cell)	40	943	943
LTE Band 12	942	943	943
2.4 GHz WLAN	53	53	53
5 GHz WLAN	59	59	59

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 9 of 61

2

LTE INFORMATION

LTE Information			
FCC ID	A3LSCHR890		
Form Factor	Portable Handset		
Frequency Range of each LTE transmission band	LTE Band 5 (Cell) (826.5 - 846.5 MHz)		
	LTE Band 12 (701.5 - 713.5 MHz)		
	LTE Band 17 (706.5 - 713.5 MHz)		
Channel Bandwidths	LTE Band 5 (Cell): 5 MHz, 10 MHz		
	LTE Band 12: 5 MHz, 10 MHz		
	LTE Band 17: 5 MHz, 10 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
LTE Band 12: 5 MHz	701.5 (23035)	707.5 (23095)	713.5 (23155)
LTE Band 12: 10 MHz	704 (23060)	707.5 (23095)	711 (23130)
LTE Band 17: 5 MHz	706.5 (23755)	710 (23790)	713.5 (23825)
LTE Band 17: 10 MHz	709 (23780)	710 (23790)	711 (23800)
UE Category	3		
Modulations Supported in UL	QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 10 of 61	

3 INTRODUCTION

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

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

3.1 SAR Definition

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

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

- σ = conductivity of the tissue-simulating material (S/m)
- ρ = mass density of the tissue-simulating material (kg/m³)
- E = Total RMS electric field strength (V/m)

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

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 11 of 61

4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01 (See Table 4-1).
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table 4-1). On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):
 - a. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
 - b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
 - c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

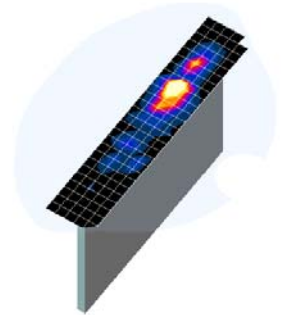


Figure 4-1
Sample SAR Area Scan

Table 4-1
Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01

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

FCC ID A3LSCHR890		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset			Page 12 of 61

5 DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

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

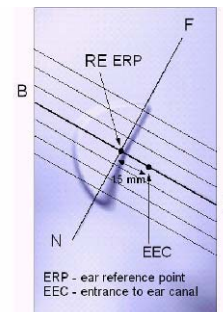


Figure 5-1
Close-Up Side view
of ERP

5.2 HANDSET REFERENCE POINTS

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (See Figure 5-3). The “test device reference point” was then located at the same level as the center of the ear reference point. The test device was positioned so that the “vertical centerline” was bisecting the front surface of the handset at its top and bottom edges, positioning the “ear reference point” on the outer surface of the both the left and right head phantoms on the ear reference point.



Figure 5-2
Front, back and side view of SAM Twin Phantom

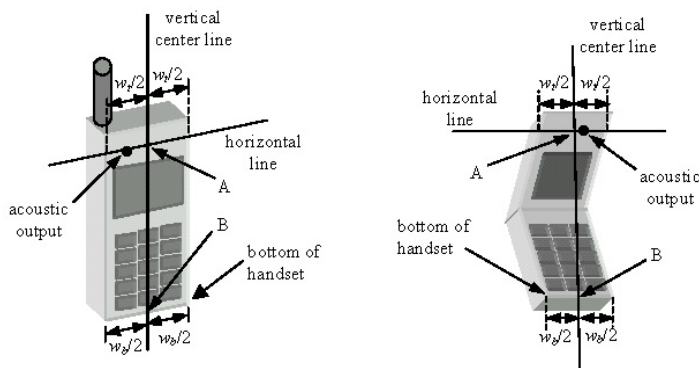


Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

FCC ID A3LSCHR890	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 13 of 61

6 TEST CONFIGURATION POSITIONS FOR HANDSETS

6.1 Device Holder

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

6.2 Positioning for Cheek

1. The test device was positioned with the device close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6-1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

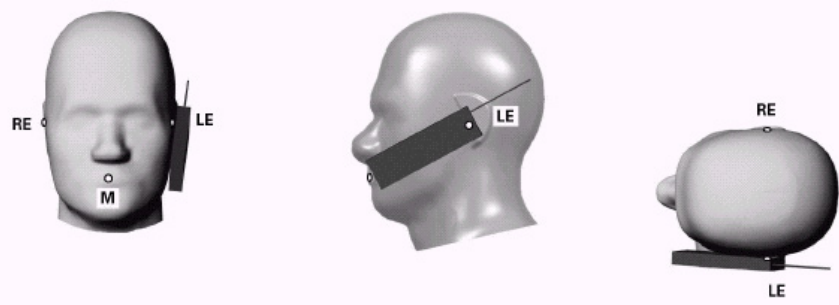


Figure 6-1 Front, Side and Top View of Cheek Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).
4. The phone was then rotated around the vertical centerline until the phone (horizontal line) was symmetrical with respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the device contact with the ear, the device was rotated about the NF line until any point on the handset made contact with a phantom point below the ear (cheek) (See Figure 6-2).

6.3 Positioning for Ear / 15° Tilt

With the test device aligned in the “Cheek Position”:

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15 degrees.
2. The phone was then rotated around the horizontal line by 15 degrees.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the handset touched the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 6-2).

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 14 of 61

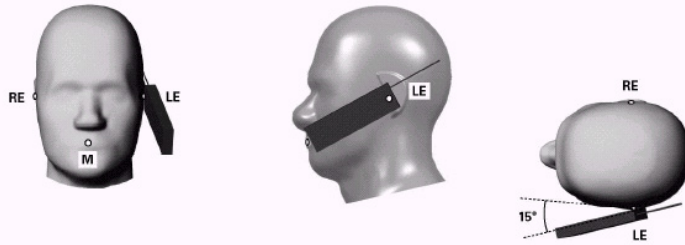


Figure 6-2 Front, Side and Top View of Ear/15° Tilt Position

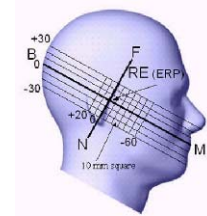


Figure 6-3 Side view w/ relevant markings

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

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

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

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

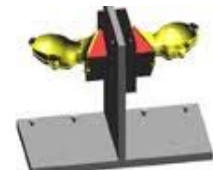


Figure 6-4 Twin SAM Chin20

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 15 of 61

6.5 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6-5). Per FCC KDB Publication 648474 D04v01, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v05 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is $> 1.2 \text{ W/kg}$, 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.

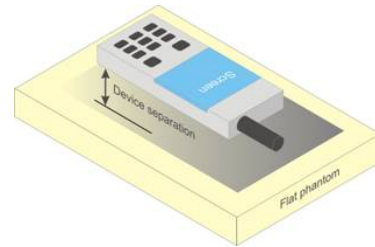


Figure 6-5
Sample Body-Worn Diagram

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

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

6.6 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.

Per KDB Publication 44798 D01v05, Cell phones (handsets) are not normally designed to be used on extremities or operated in extremity only exposure conditions. The maximum output power levels of handsets generally do not require extremity SAR testing to show compliance. Therefore, extremity SAR was not evaluated for this device.

6.7 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

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 16 of 61

provided guidance in FCC KDB Publication 941225 D06 v01 where SAR test considerations for handsets ($L \times W \geq 9 \text{ cm} \times 5 \text{ cm}$) 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.

This device utilizes power reduction for some bands/modes during portable hotspot (tethering) operations for SAR compliance. A detailed description of the hotspot power reduction mechanism is included in the operational description.

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 17 of 61	

7 RF EXPOSURE LIMITS

7.1 Uncontrolled Environment

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

7.2 Controlled Environment

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

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

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT <i>General Population</i> (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT <i>Occupational</i> (W/kg) or (mW/g)
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.

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 18 of 61

8 FCC MEASUREMENT PROCEDURES

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

8.1 Measured and Reported SAR

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

8.2 Procedures Used to Establish RF Signal for SAR

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

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

8.3 SAR Measurement Conditions for CDMA2000

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

8.3.1 Output Power Verification

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

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

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 19 of 61

Table 8-1
Parameters for Max. Power for RC1

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

Table 8-2
Parameters for Max. Power for RC3

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

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

8.3.2 Head SAR Measurements

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

Head SAR was additionally evaluated using EVDO Rev. A to support compliance for VoIP operations. See Section 8.3.4 for EVDO Rev. A configuration parameters.

8.3.3 Body SAR Measurements

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

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

8.3.4 Handsets with EVDO

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

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 20 of 61

8.3.5 Body SAR Measurements for EVDO Hotspot

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

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

8.4 SAR Measurement Conditions for LTE

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

8.4.1 Spectrum Plots for RB Configurations

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

8.4.2 MPR

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

8.4.3 A-MPR

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

8.4.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r01:

- a. Per Section 5.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
 - i. The required channel and offset combination with the highest maximum output power is required for SAR.
 - ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
 - iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 21 of 61

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

8.5 SAR Testing with 802.11 Transmitters

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

8.5.1 General Device Setup

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

8.5.2 Frequency Channel Configurations [27]

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

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

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

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 22 of 61	

9 RF CONDUCTED POWERS

9.1 CDMA Conducted Powers

Table 9-1
Maximum CDMA/EVDO Average RF Conducted Powers
(Representing Hotspot Mode Not Active)

Band	Channel	Frequency	SO55 [dBm]	SO55 [dBm]	TDSO SO32 [dBm]	TDSO SO32 [dBm]	1x EvDO Rev. 0 [dBm]	1x EvDO Rev. A [dBm]
	F-RC	MHz	RC1	RC3	FCH+SCH	FCH	(RTAP)	(RETAP)
Cellular	1013	824.7	24.77	24.86	24.85	24.86	24.85	24.83
	384	836.52	24.85	24.80	24.86	24.88	24.86	24.85
	777	848.31	24.78	24.80	24.84	24.83	24.84	24.83
PCS	25	1851.25	24.57	24.65	24.64	24.69	24.75	24.60
	600	1880	24.53	24.71	24.73	24.63	24.71	24.66
	1175	1908.75	24.27	24.38	24.34	24.42	24.57	24.56

Table 9-2
Reduced CDMA/EVDO Average RF Conducted Powers
(Representing Hotspot Mode Activated)

Band	Channel	Frequency	SO55 [dBm]	SO55 [dBm]	TDSO SO32 [dBm]	TDSO SO32 [dBm]	1x EvDO Rev. 0 [dBm]	1x EvDO Rev. A [dBm]
	F-RC	MHz	RC1	RC3	FCH+SCH	FCH	(RTAP)	(RETAP)
PCS	25	1851.25	21.82	21.80	21.86	21.84	21.80	21.76
	600	1880	21.92	21.86	21.98	21.92	22.00	21.92
	1175	1908.75	21.54	21.97	21.89	21.80	21.75	21.73

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

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 23 of 61

Per KDB Publication 941225 D01v02:

1. Head SAR was tested with SO55 RC3. SO55 RC1 was not required since the average output power was not more than 0.25 dB than the SO55 RC3 powers.
2. Body-Worn SAR was tested with 1x RTT with TDSO / SO32 FCH Only. Ev-Do and TDSO / SO32 FCH+SCH SAR tests were not required since the average output power was not more than 0.25 dB higher than the TDSO / SO32 FCH only powers.
3. Hotspot SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0. If the average output power of Subtype 2 for Rev. A is less than the Rev. 0 power levels, then Rev. A SAR is not required. Otherwise, SAR is measured on the maximum output channel for Rev. A using the exposure configuration that results in the highest SAR for that RF channel in Rev. 0. SAR is not required for 1x RTT for Ev-Do hotspot devices when the maximum average output of each channel is less than 1/4 dB higher than that measured in Subtype 0/1 Physical Layer configurations for Rev. 0.
4. CDMA 1x-RTT SAR was additionally required to be evaluated for Hotspot exposure conditions to support simultaneous transmission capabilities.
5. Head SAR was additionally evaluated with EVDO Rev. A to determine compliance for held-to-ear VoIP operations.
6. There is no power reduction for Cellular CDMA/EVDO.



Figure 9-1
Power Measurement Setup

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 24 of 61	

9.2 LTE Conducted Powers

9.2.1 LTE Band 5 (Cell)

Table 9-3
LTE Band 5 (Cell) Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	836.5	20525	10	QPSK	1	0	23.57	0	0
	836.5	20525	10	QPSK	1	25	23.66	0	0
	836.5	20525	10	QPSK	1	49	23.61	0	0
	836.5	20525	10	QPSK	25	0	22.44	1	0-1
	836.5	20525	10	QPSK	25	12	22.48	1	0-1
	836.5	20525	10	QPSK	25	25	22.38	1	0-1
	836.5	20525	10	QPSK	50	0	22.32	1	0-1
	836.5	20525	10	16QAM	1	0	22.49	1	0-1
	836.5	20525	10	16QAM	1	25	22.48	1	0-1
	836.5	20525	10	16QAM	1	49	22.50	1	0-1
	836.5	20525	10	16QAM	25	0	21.59	2	0-2
	836.5	20525	10	16QAM	25	12	21.56	2	0-2
	836.5	20525	10	16QAM	25	25	21.51	2	0-2
	836.5	20525	10	16QAM	50	0	21.43	2	0-2

Note: LTE Band 5 (Cell) at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 25 of 61

Table 9-4
LTE Band 5 (Cell) Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	826.5	20425	5	QPSK	1	0	23.47	0	0
	826.5	20425	5	QPSK	1	12	23.26	0	0
	826.5	20425	5	QPSK	1	24	23.41	0	0
	826.5	20425	5	QPSK	12	0	22.43	1	0-1
	826.5	20425	5	QPSK	12	6	22.31	1	0-1
	826.5	20425	5	QPSK	12	13	22.27	1	0-1
	826.5	20425	5	QPSK	25	0	22.28	1	0-1
	826.5	20425	5	16-QAM	1	0	22.37	1	0-1
	826.5	20425	5	16-QAM	1	12	22.20	1	0-1
	826.5	20425	5	16-QAM	1	24	22.33	1	0-1
	826.5	20425	5	16-QAM	12	0	21.58	2	0-2
	826.5	20425	5	16-QAM	12	6	21.50	2	0-2
Mid	826.5	20425	5	16-QAM	12	13	21.51	2	0-2
	826.5	20425	5	16-QAM	25	0	21.44	2	0-2
	836.5	20525	5	QPSK	1	0	23.69	0	0
	836.5	20525	5	QPSK	1	12	23.64	0	0
	836.5	20525	5	QPSK	1	24	23.61	0	0
	836.5	20525	5	QPSK	12	0	22.56	1	0-1
	836.5	20525	5	QPSK	12	6	22.63	1	0-1
	836.5	20525	5	QPSK	12	13	22.61	1	0-1
	836.5	20525	5	QPSK	25	0	22.50	1	0-1
	836.5	20525	5	16-QAM	1	0	22.56	1	0-1
	836.5	20525	5	16-QAM	1	12	22.52	1	0-1
	836.5	20525	5	16-QAM	1	24	22.56	1	0-1
High	846.5	20625	5	16-QAM	12	0	21.78	2	0-2
	846.5	20625	5	16-QAM	12	6	21.73	2	0-2
	846.5	20625	5	16-QAM	12	13	21.79	2	0-2
	846.5	20625	5	16-QAM	25	0	21.60	2	0-2
	846.5	20625	5	QPSK	1	0	23.36	0	0
	846.5	20625	5	QPSK	1	12	23.38	0	0
	846.5	20625	5	QPSK	1	24	23.50	0	0
	846.5	20625	5	QPSK	12	0	22.39	1	0-1
	846.5	20625	5	QPSK	12	6	22.41	1	0-1
	846.5	20625	5	QPSK	12	13	22.52	1	0-1
	846.5	20625	5	QPSK	25	0	22.44	1	0-1
	846.5	20625	5	16-QAM	1	0	22.27	1	0-1
	846.5	20625	5	16-QAM	1	12	22.31	1	0-1
	846.5	20625	5	16-QAM	1	24	22.42	1	0-1
	846.5	20625	5	16-QAM	12	0	21.55	2	0-2
	846.5	20625	5	16-QAM	12	6	21.58	2	0-2
	846.5	20625	5	16-QAM	12	13	21.68	2	0-2
	846.5	20625	5	16-QAM	25	0	21.54	2	0-2

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 26 of 61	

9.2.2 LTE Band 12

Table 9-5
LTE Band 12 Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	707.5	23095	10	QPSK	1	0	23.90	0	0
	707.5	23095	10	QPSK	1	25	24.25	0	0
	707.5	23095	10	QPSK	1	49	23.99	0	0
	707.5	23095	10	QPSK	25	0	22.94	1	0-1
	707.5	23095	10	QPSK	25	12	23.05	1	0-1
	707.5	23095	10	QPSK	25	25	22.92	1	0-1
	707.5	23095	10	QPSK	50	0	22.73	1	0-1
	707.5	23095	10	16QAM	1	0	22.98	1	0-1
	707.5	23095	10	16QAM	1	25	23.35	1	0-1
	707.5	23095	10	16QAM	1	49	23.15	1	0-1
	707.5	23095	10	16QAM	25	0	22.02	2	0-2
	707.5	23095	10	16QAM	25	12	22.17	2	0-2
	707.5	23095	10	16QAM	25	25	21.95	2	0-2
	707.5	23095	10	16QAM	50	0	21.89	2	0-2

Note: LTE Band 12 at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 27 of 61

Table 9-6
LTE Band 12 Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	701.5	23035	5	QPSK	1	0	23.59	0	0
	701.5	23035	5	QPSK	1	12	23.97	0	0
	701.5	23035	5	QPSK	1	24	23.95	0	0
	701.5	23035	5	QPSK	12	0	22.53	1	0-1
	701.5	23035	5	QPSK	12	6	22.82	1	0-1
	701.5	23035	5	QPSK	12	13	22.88	1	0-1
	701.5	23035	5	QPSK	25	0	22.61	1	0-1
	701.5	23035	5	16-QAM	1	0	22.64	1	0-1
	701.5	23035	5	16-QAM	1	12	23.07	1	0-1
	701.5	23035	5	16-QAM	1	24	23.06	1	0-1
	701.5	23035	5	16-QAM	12	0	21.79	2	0-2
	701.5	23035	5	16-QAM	12	6	22.00	2	0-2
Mid	707.5	23095	5	QPSK	1	0	23.98	0	0
	707.5	23095	5	QPSK	1	12	24.21	0	0
	707.5	23095	5	QPSK	1	24	23.88	0	0
	707.5	23095	5	QPSK	12	0	23.23	1	0-1
	707.5	23095	5	QPSK	12	6	23.33	1	0-1
	707.5	23095	5	QPSK	12	13	22.88	1	0-1
	707.5	23095	5	QPSK	25	0	22.97	1	0-1
	707.5	23095	5	16-QAM	1	0	22.89	1	0-1
	707.5	23095	5	16-QAM	1	12	23.35	1	0-1
	707.5	23095	5	16-QAM	1	24	23.04	1	0-1
	707.5	23095	5	16-QAM	12	0	22.29	2	0-2
	707.5	23095	5	16-QAM	12	6	22.38	2	0-2
High	713.5	23155	5	QPSK	1	0	23.81	0	0
	713.5	23155	5	QPSK	1	12	24.47	0	0
	713.5	23155	5	QPSK	1	24	24.45	0	0
	713.5	23155	5	QPSK	12	0	23.06	1	0-1
	713.5	23155	5	QPSK	12	6	23.46	1	0-1
	713.5	23155	5	QPSK	12	13	23.38	1	0-1
	713.5	23155	5	QPSK	25	0	23.31	1	0-1
	713.5	23155	5	16-QAM	1	0	22.99	1	0-1
	713.5	23155	5	16-QAM	1	12	23.50	1	0-1
	713.5	23155	5	16-QAM	1	24	23.49	1	0-1
	713.5	23155	5	16-QAM	12	0	22.23	2	0-2
	713.5	23155	5	16-QAM	12	6	22.44	2	0-2
	713.5	23155	5	16-QAM	12	13	22.50	2	0-2
	713.5	23155	5	16-QAM	25	0	22.36	2	0-2

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 28 of 61	

9.3 WLAN Conducted Powers

Table 9-7
IEEE 802.11b Average RF Power

Mode	Freq	Channel	802.11b (2.4 GHz) Conducted Power [dBm]			
			Data Rate [Mbps]			
	[MHz]		1	2	5.5	11
802.11b	2412	1*	16.66	16.72	16.70	16.68
802.11b	2437	6*	17.02	16.69	16.65	16.61
802.11b	2462	11*	16.90	16.68	16.64	16.64

Table 9-8
IEEE 802.11g Average RF Power

Mode	Freq	Channel	802.11g (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6	9	12	18	24	36	48	54
802.11g	2412	1	10.99	10.80	10.95	10.84	10.92	10.91	10.95	10.84
802.11g	2437	6	11.40	10.88	10.86	10.92	10.91	10.98	10.82	10.82
802.11g	2462	11	11.29	10.88	11.00	10.85	10.85	10.88	10.85	10.90

Table 9-9
IEEE 802.11n Average RF Power

Mode	Freq	Channel	802.11n (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6.5	13	20	26	39	52	58	65
802.11n	2412	1	9.94	10.00	9.92	9.95	10.00	9.95	10.12	10.00
802.11n	2437	6	10.44	9.87	9.95	9.95	9.92	9.80	9.90	9.95
802.11n	2462	11	9.85	10.00	9.95	9.90	10.00	9.85	9.86	9.88

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 29 of 61

Table 9-10
IEEE 802.11a Average RF Power

Mode	Freq	Channel	802.11a (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6	9	12	18	24	36	48	54
802.11a	5180	36*	12.99	13.02	12.96	13.04	13.04	13.02	13.07	13.10
802.11a	5200	40	12.98	12.93	12.98	13.04	12.98	13.01	13.07	13.05
802.11a	5220	44	12.99	12.95	12.98	13.01	12.98	13.09	13.03	13.01
802.11a	5240	48*	12.91	12.90	12.93	12.95	12.95	13.06	13.01	13.03
802.11a	5260	52*	12.99	12.95	12.99	12.93	12.91	13.06	12.97	12.99
802.11a	5280	56	12.87	12.91	12.89	13.00	12.95	13.02	12.97	12.99
802.11a	5300	60	12.87	12.91	12.93	12.93	12.97	12.95	13.00	13.05
802.11a	5320	64*	12.89	13.00	13.00	12.95	12.93	13.02	12.98	12.98
802.11a	5500	100	12.91	12.90	12.91	12.98	12.95	13.01	12.99	12.96
802.11a	5520	104*	12.94	12.88	12.93	12.98	12.98	13.02	12.97	12.99
802.11a	5540	108	12.91	12.89	12.99	12.94	12.92	12.96	12.98	12.98
802.11a	5560	112	12.86	12.93	12.91	12.90	12.94	12.95	13.02	13.02
802.11a	5580	116*	12.91	13.01	12.97	12.93	12.89	12.97	12.97	12.95
802.11a	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5660	132	12.86	12.87	12.88	12.95	13.00	13.00	12.92	13.00
802.11a	5680	136*	12.82	12.88	12.90	12.90	12.96	12.97	12.98	12.98
802.11a	5700	140	12.90	12.87	12.99	12.97	13.04	12.91	12.91	12.93
802.11a	5745	149*	12.25	12.37	12.26	12.41	12.33	12.38	12.42	12.42
802.11a	5765	153	12.83	12.36	12.32	12.30	12.39	12.39	12.27	12.45
802.11a	5785	157*	12.61	12.41	12.31	12.34	12.30	12.36	12.39	12.39
802.11a	5805	161*	12.63	12.35	12.27	12.37	12.35	12.31	12.34	12.34
802.11a	5825	165	12.42	12.23	12.32	12.27	12.23	12.28	12.28	12.28

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.

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 30 of 61	

Table 9-11
IEEE 802.11n Average RF Power – 20 MHz Bandwidth

Mode	Freq	Channel	20MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6.5	13	19.5	26	39	52	58.5	65
802.11n	5180	36	12.36	12.48	12.36	12.36	12.37	12.43	12.49	12.49
802.11n	5200	40	12.30	12.31	12.31	12.38	12.43	12.44	12.48	12.44
802.11n	5220	44	12.38	12.33	12.35	12.34	12.33	12.40	12.40	12.42
802.11n	5240	48	12.25	12.28	12.33	12.32	12.36	12.42	12.38	12.40
802.11n	5260	52	12.29	12.32	12.33	12.35	12.42	12.36	12.38	12.35
802.11n	5280	56	12.29	12.33	12.32	12.31	12.46	12.40	12.38	12.36
802.11n	5300	60	12.32	12.36	12.29	12.32	12.34	12.39	12.30	12.39
802.11n	5320	64	12.19	12.29	12.27	12.28	12.29	12.33	12.35	12.33
802.11n	5500	100	12.32	12.30	12.33	12.36	12.40	12.41	12.38	12.38
802.11n	5520	104	12.37	12.32	12.36	12.29	12.40	12.37	12.43	12.40
802.11n	5540	108	12.28	12.32	12.28	12.31	12.39	12.37	12.40	12.36
802.11n	5560	112	12.62	12.31	12.30	12.30	12.35	12.33	12.36	12.37
802.11n	5580	116	12.86	12.29	12.31	12.29	12.35	12.35	12.40	12.50
802.11n	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5660	132	12.27	12.43	12.43	12.37	12.27	12.38	12.22	12.39
802.11n	5680	136	12.27	12.22	12.37	12.38	12.39	12.44	12.41	12.44
802.11n	5700	140	12.72	12.35	12.35	12.34	12.43	12.33	12.40	12.40
802.11n	5745	149	12.29	12.35	12.39	12.39	12.44	12.41	12.45	12.50
802.11n	5765	153	12.39	12.50	12.46	12.36	12.41	12.44	12.47	12.52
802.11n	5785	157	12.46	12.54	12.46	12.39	12.40	12.42	12.43	12.48
802.11n	5805	161	12.58	12.29	12.40	12.37	12.38	12.48	12.55	12.42
802.11n	5825	165	12.55	12.35	12.43	12.47	12.50	12.48	12.55	12.45

Table 9-12
IEEE 802.11n Average RF Power – 40 MHz Bandwidth

Mode	Freq	Channel	40MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		13.5	27	40.5	54	81	108	121.5	135
802.11n	5190	38	10.40	10.48	10.45	10.38	10.40	10.44	10.45	10.58
802.11n	5230	46	10.50	10.66	10.64	10.60	10.65	10.55	10.67	10.62
802.11n	5270	54	11.25	11.32	11.31	11.22	11.34	11.29	11.38	11.22
802.11n	5310	62	11.42	11.44	11.52	11.38	11.32	11.28	11.44	11.34
802.11n	5510	102	10.89	11.00	10.92	11.02	10.85	10.85	10.95	10.91
802.11n	5550	110	11.10	11.00	10.93	10.95	10.95	10.80	10.92	10.91
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	10.54	10.62	10.62	10.56	10.55	10.58	10.56	10.54
802.11n	5755	151	11.04	11.05	11.12	11.09	11.02	11.05	11.10	11.02
802.11n	5795	159	11.35	11.32	11.30	11.34	11.26	11.35	11.25	11.30

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

- For 2.4 GHz, highest average RF output power channel for the lowest data rate for IEEE 802.11b were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
- For 5 GHz, highest average RF output power channel for the lowest data rate for IEEE 802.11a were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11n 20 MHz and 40 MHz) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
- 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.
- There is no power reduction to WIFI modes.

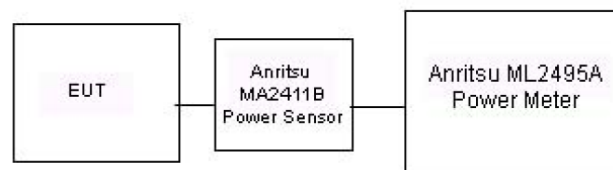


Figure 9-2
Power Measurement Setup

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 32 of 61	

10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
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
09/07/2013	750H	22.6	695	0.866	42.971	0.886	42.193	-2.26%	1.84%
			710	0.880	42.737	0.887	42.113	-0.79%	1.48%
			740	0.908	42.311	0.889	41.953	2.14%	0.85%
			755	0.921	42.111	0.891	41.876	3.37%	0.56%
08/28/2013	835H	22.6	820	0.924	43.534	0.898	41.571	2.90%	4.72%
			835	0.937	43.339	0.900	41.500	4.11%	4.43%
			850	0.951	43.211	0.916	41.500	3.82%	4.12%
09/11/2013	835H	23.8	820	0.893	41.422	0.898	41.571	-0.56%	-0.36%
			835	0.908	41.264	0.900	41.500	0.89%	-0.57%
			850	0.922	41.162	0.916	41.500	0.66%	-0.81%
08/29/2013	1900H	22.5	1850	1.403	40.735	1.400	40.000	0.21%	1.84%
			1880	1.428	40.625	1.400	40.000	2.00%	1.56%
			1910	1.465	40.582	1.400	40.000	4.64%	1.46%
08/28/2013	2450H	22.5	2401	1.729	39.344	1.758	39.298	-1.65%	0.12%
			2450	1.784	39.207	1.800	39.200	-0.89%	0.02%
			2499	1.839	38.944	1.852	39.135	-0.70%	-0.49%
08/30/2013	5200H - 5800H	23.5	5180	4.545	35.048	4.639	36.020	-2.03%	-2.70%
			5200	4.535	35.117	4.660	36.000	-2.68%	-2.45%
			5260	4.646	34.914	4.720	35.940	-1.57%	-2.85%
			5300	4.664	34.813	4.760	35.900	-2.02%	-3.03%
			5500	4.922	34.329	4.965	35.650	-0.87%	-3.71%
			5520	4.964	34.295	4.986	35.620	-0.44%	-3.72%
			5765	5.286	33.860	5.235	35.335	0.97%	-4.17%
			5800	5.317	33.808	5.270	35.300	0.89%	-4.23%
09/06/2013	750B	22.9	695	0.919	56.506	0.959	55.745	-4.17%	1.37%
			710	0.934	56.370	0.960	55.687	-2.71%	1.23%
			740	0.966	56.188	0.963	55.570	0.31%	1.11%
			755	0.978	56.032	0.964	55.512	1.45%	0.94%
09/06/2013	835B	22.3	820	0.985	53.783	0.969	55.258	1.65%	-2.67%
			835	1.000	53.534	0.970	55.200	3.09%	-3.02%
			850	1.018	53.480	0.988	55.154	3.04%	-3.04%
09/12/2013	835B	23.7	820	0.956	55.201	0.969	55.258	-1.34%	-0.10%
			835	0.968	55.024	0.970	55.200	-0.21%	-0.32%
			850	0.980	54.952	0.988	55.154	-0.81%	-0.37%
08/29/2013	1900B	22.4	1850	1.480	52.049	1.520	53.300	-2.63%	-2.35%
			1880	1.511	51.938	1.520	53.300	-0.59%	-2.56%
			1910	1.543	51.857	1.520	53.300	1.51%	-2.71%
09/13/2013	1900B	23.3	1850	1.458	52.406	1.520	53.300	-4.08%	-1.68%
			1880	1.488	52.288	1.520	53.300	-2.11%	-1.90%
			1910	1.515	52.171	1.520	53.300	-0.33%	-2.12%
08/28/2013	2450B	22.1	2401	1.944	51.000	1.903	52.765	2.15%	-3.35%
			2450	2.005	50.840	1.950	52.700	2.82%	-3.53%
			2499	2.083	50.675	2.019	52.638	3.17%	-3.73%
09/04/2013	2450B	22.2	2401	1.970	52.296	1.903	52.765	3.52%	-0.89%
			2450	2.036	52.070	1.950	52.700	4.41%	-1.20%
			2499	2.103	51.867	2.019	52.638	4.16%	-1.46%
08/27/2013	5800B	22.7	5765	6.138	47.824	5.959	48.220	3.00%	-0.82%
			5785	6.136	47.804	5.982	48.282	2.57%	-0.99%
			5800	6.145	47.810	6.000	48.200	2.42%	-0.81%
			5805	6.135	47.855	6.005	48.166	2.16%	-0.65%
09/04/2013	5200B - 5800B	22.4	5180	5.230	50.650	5.276	49.041	-0.87%	3.28%
			5200	5.269	50.562	5.299	49.014	-0.57%	3.16%
			5260	5.364	50.503	5.369	48.906	-0.09%	3.27%
			5300	5.418	50.323	5.416	48.851	0.04%	3.01%
			5500	5.716	49.975	5.650	48.580	1.17%	2.87%
			5520	5.747	49.839	5.673	48.553	1.30%	2.65%
			5765	6.117	49.324	5.959	48.220	2.65%	2.29%
			5800	6.189	49.082	6.000	48.200	3.15%	1.83%

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

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 33 of 61	

10.2 Test System Verification

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

Table 10-2
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR _{1g} (W/kg)	1 W Target SAR _{1g} (W/kg)	1 W Normalized SAR _{1g} (W/kg)	Deviation _{1g} (%)
B	750	HEAD	09/07/2013	23.0	22.6	0.100	1054	3287	0.856	8.500	8.560	0.71%
G	835	HEAD	08/28/2013	24.3	23.0	0.100	4d119	3209	0.972	9.680	9.720	0.41%
E	835	HEAD	09/11/2013	23.5	23.8	0.100	4d119	3920	0.980	9.680	9.800	1.24%
E	1900	HEAD	08/29/2013	22.0	22.5	0.100	5d148	3920	4.020	39.700	40.200	1.26%
D	2450	HEAD	08/28/2013	23.3	22.5	0.100	797	3288	5.120	52.500	51.200	-2.48%
A	5200	HEAD	08/30/2013	22.8	21.6	0.100	1057	3589	7.260	75.900	72.600	-4.35%
A	5300	HEAD	08/30/2013	22.8	21.6	0.100	1057	3589	7.900	76.900	79.000	2.73%
A	5500	HEAD	08/30/2013	22.8	21.6	0.100	1057	3589	7.610	80.100	76.100	-4.99%
A	5800	HEAD	08/30/2013	22.9	21.7	0.100	1057	3589	7.630	76.100	76.300	0.26%
E	750	BODY	09/06/2013	23.8	22.9	0.100	1003	3920	0.846	8.830	8.460	-4.19%
G	835	BODY	09/06/2013	24.4	22.3	0.100	4d119	3209	0.980	9.540	9.800	2.73%
G	835	BODY	09/12/2013	24.4	23.7	0.100	4d119	3209	0.958	9.540	9.580	0.42%
E	1900	BODY	08/29/2013	23.1	22.5	0.100	5d148	3920	4.140	40.800	41.400	1.47%
D	1900	BODY	09/13/2013	24.5	23.1	0.100	5d148	3022	4.100	40.800	41.000	0.49%
H	2450	BODY	08/28/2013	22.6	22.4	0.100	797	3318	4.990	49.600	49.900	0.60%
C	2450	BODY	09/04/2013	22.3	20.8	0.100	882	3263	5.200	49.900	52.000	4.21%
E	5200	BODY	09/04/2013	24.1	22.9	0.100	1120	3920	7.230	76.600	72.300	-5.61%
E	5300	BODY	09/04/2013	23.9	22.9	0.100	1120	3920	7.180	76.800	71.800	-6.51%
E	5500	BODY	09/04/2013	24.0	23.0	0.100	1120	3920	8.270	79.800	82.700	3.63%
A	5800	BODY	08/27/2013	24.1	23.3	0.100	1057	3589	7.860	75.100	78.600	4.66%
E	5800	BODY	09/04/2013	23.9	23.0	0.100	1120	3920	7.560	75.500	75.600	0.13%

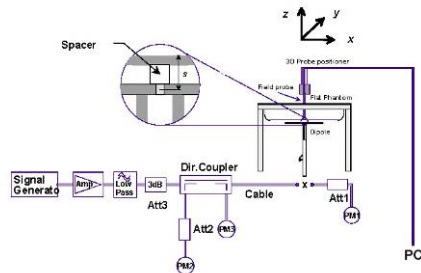


Figure 10-1
System Verification Setup Diagram



Figure 10-2
System Verification Setup Photo

FCC ID A3LSCHR890	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 34 of 61

11 SAR DATA SUMMARY

11.1 Standalone Head SAR Data

Table 11-1
Cell. CDMA 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)	
836.52	384	Cell. CDMA	RC3 / SO55	25.0	24.80	-0.08	Right	Cheek	70	1:1	0.357	1.047	0.374	
836.52	384	Cell. CDMA	RC3 / SO55	25.0	24.80	0.04	Right	Tilt	70	1:1	0.265	1.047	0.277	
836.52	384	Cell. CDMA	RC3 / SO55	25.0	24.80	0.03	Left	Cheek	70	1:1	0.399	1.047	0.418	
836.52	384	Cell. CDMA	RC3 / SO55	25.0	24.80	0.02	Left	Tilt	70	1:1	0.250	1.047	0.262	
836.52	384	Cell. CDMA	EVDO Rev. A	25.0	24.85	-0.02	Right	Cheek	70	1:1	0.360	1.035	0.373	
836.52	384	Cell. CDMA	EVDO Rev. A	25.0	24.85	0.06	Right	Tilt	70	1:1	0.291	1.035	0.301	
836.52	384	Cell. CDMA	EVDO Rev. A	25.0	24.85	0.02	Left	Cheek	70	1:1	0.401	1.035	0.415	A1
836.52	384	Cell. CDMA	EVDO Rev. A	25.0	24.85	0.03	Left	Tilt	70	1:1	0.267	1.035	0.276	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 35 of 61

Table 11-2
PCS CDMA 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	600	PCS CDMA	RC3 / SO55	25.0	24.71	0.02	Right	Cheek	69	1:1	0.309	1.069	0.330	
1880.00	600	PCS CDMA	RC3 / SO55	25.0	24.71	0.09	Right	Tilt	69	1:1	0.210	1.069	0.224	
1880.00	600	PCS CDMA	RC3 / SO55	25.0	24.71	0.05	Left	Cheek	69	1:1	0.623	1.069	0.666	A2
1880.00	600	PCS CDMA	RC3 / SO55	25.0	24.71	0.15	Left	Tilt	69	1:1	0.222	1.069	0.237	
1880.00	600	PCS CDMA	RC3 / SO55	22.0	21.86	-0.04	Right	Cheek	69	1:1	0.175	1.033	0.181	
1880.00	600	PCS CDMA	RC3 / SO55	22.0	21.86	0.00	Right	Tilt	69	1:1	0.128	1.033	0.132	
1880.00	600	PCS CDMA	RC3 / SO55	22.0	21.86	0.07	Left	Cheek	69	1:1	0.311	1.033	0.321	
1880.00	600	PCS CDMA	RC3 / SO55	22.0	21.86	0.19	Left	Tilt	69	1:1	0.130	1.033	0.134	
1880.00	600	PCS CDMA	EVDO Rev. A	25.0	24.66	-0.03	Right	Cheek	69	1:1	0.317	1.081	0.343	
1880.00	600	PCS CDMA	EVDO Rev. A	25.0	24.66	-0.02	Right	Tilt	69	1:1	0.231	1.081	0.250	
1880.00	600	PCS CDMA	EVDO Rev. A	25.0	24.66	0.09	Left	Cheek	69	1:1	0.603	1.081	0.652	
1880.00	600	PCS CDMA	EVDO Rev. A	25.0	24.66	0.05	Left	Tilt	69	1:1	0.232	1.081	0.251	
1880.00	600	PCS CDMA	EVDO Rev. A	22.0	21.92	-0.04	Right	Cheek	69	1:1	0.186	1.019	0.190	
1880.00	600	PCS CDMA	EVDO Rev. A	22.0	21.92	0.19	Right	Tilt	69	1:1	0.098	1.019	0.100	
1880.00	600	PCS CDMA	EVDO Rev. A	22.0	21.92	-0.01	Left	Cheek	69	1:1	0.346	1.019	0.353	
1880.00	600	PCS CDMA	EVDO Rev. A	22.0	21.92	0.09	Left	Tilt	69	1:1	0.111	1.019	0.113	
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 11-3
LTE Band 5 (Cell) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.	(W/kg)														(W/kg)			
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.66	-0.01	0	Right	Cheek	QPSK	1	25	40	1:1	0.308	1.081	0.333	A3
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.48	0.01	1	Right	Cheek	QPSK	25	12	40	1:1	0.243	1.127	0.274	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.66	0.11	0	Right	Tilt	QPSK	1	25	40	1:1	0.196	1.081	0.212	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.48	0.01	1	Right	Tilt	QPSK	25	12	40	1:1	0.153	1.127	0.172	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.66	0.04	0	Left	Cheek	QPSK	1	25	40	1:1	0.175	1.081	0.189	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.48	0.04	1	Left	Cheek	QPSK	25	12	40	1:1	0.129	1.127	0.145	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.66	0.05	0	Left	Tilt	QPSK	1	25	40	1:1	0.114	1.081	0.123	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.48	0.18	1	Left	Tilt	QPSK	25	12	40	1:1	0.087	1.127	0.098	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

FCC ID A3LSCHR890	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 36 of 61

Table 11-4
LTE Band 12 Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
707.50	23095	Mid	LTE Band 12	10	24.5	24.25	0.01	0	Right	Cheek	QPSK	1	25	942	1:1	0.368	1.059	0.390	A4
707.50	23095	Mid	LTE Band 12	10	23.5	23.05	-0.07	1	Right	Cheek	QPSK	25	12	942	1:1	0.304	1.109	0.337	
707.50	23095	Mid	LTE Band 12	10	24.5	24.25	0.12	0	Right	Tilt	QPSK	1	25	942	1:1	0.133	1.059	0.141	
707.50	23095	Mid	LTE Band 12	10	23.5	23.05	-0.07	1	Right	Tilt	QPSK	25	12	942	1:1	0.109	1.109	0.121	
707.50	23095	Mid	LTE Band 12	10	24.5	24.25	0.06	0	Left	Cheek	QPSK	1	25	942	1:1	0.201	1.059	0.213	
707.50	23095	Mid	LTE Band 12	10	23.5	23.05	0.04	1	Left	Cheek	QPSK	25	12	942	1:1	0.167	1.109	0.185	
707.50	23095	Mid	LTE Band 12	10	24.5	24.25	0.04	0	Left	Tilt	QPSK	1	25	942	1:1	0.116	1.059	0.123	
707.50	23095	Mid	LTE Band 12	10	23.5	23.05	-0.08	1	Left	Tilt	QPSK	25	12	942	1:1	0.095	1.109	0.105	
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 11-5
DTS Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2437	6	IEEE 802.11b	DSSS	17.5	17.02	0.08	Right	Cheek	53	1	1:1	0.158	1.117	0.176	
2437	6	IEEE 802.11b	DSSS	17.5	17.02	0.08	Right	Tilt	53	1	1:1	0.127	1.117	0.142	
2437	6	IEEE 802.11b	DSSS	17.5	17.02	0.03	Left	Cheek	53	1	1:1	0.402	1.117	0.449	A5
2437	6	IEEE 802.11b	DSSS	17.5	17.02	0.00	Left	Tilt	53	1	1:1	0.126	1.117	0.141	
5765	153	IEEE 802.11a	OFDM	13.5	12.83	0.16	Right	Cheek	59	6	1:1	0.174	1.167	0.203	
5765	153	IEEE 802.11a	OFDM	13.5	12.83	0.10	Right	Tilt	59	6	1:1	0.085	1.167	0.099	
5765	153	IEEE 802.11a	OFDM	13.5	12.83	0.03	Left	Cheek	59	6	1:1	0.232	1.167	0.271	A6
5765	153	IEEE 802.11a	OFDM	13.5	12.83	0.09	Left	Tilt	59	6	1:1	0.109	1.167	0.127	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram						

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 37 of 61

**Table 11-6
NII Head SAR**

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
5180	36	IEEE 802.11a	OFDM	13.5	12.99	-0.03	Right	Cheek	59	6	1:1	0.056	1.125	0.063	
5180	36	IEEE 802.11a	OFDM	13.5	12.99	0.17	Right	Tilt	59	6	1:1	0.036	1.125	0.041	
5180	36	IEEE 802.11a	OFDM	13.5	12.99	0.11	Left	Cheek	59	6	1:1	0.181	1.125	0.204	
5180	36	IEEE 802.11a	OFDM	13.5	12.99	0.05	Left	Tilt	59	6	1:1	0.083	1.125	0.093	
5260	52	IEEE 802.11a	OFDM	13.5	12.99	-0.06	Right	Cheek	59	6	1:1	0.063	1.125	0.071	
5260	52	IEEE 802.11a	OFDM	13.5	12.99	0.02	Right	Tilt	59	6	1:1	0.035	1.125	0.039	
5260	52	IEEE 802.11a	OFDM	13.5	12.99	0.12	Left	Cheek	59	6	1:1	0.192	1.125	0.216	
5260	52	IEEE 802.11a	OFDM	13.5	12.99	0.10	Left	Tilt	59	6	1:1	0.089	1.125	0.100	
5520	104	IEEE 802.11a	OFDM	13.5	12.94	0.04	Right	Cheek	59	6	1:1	0.070	1.138	0.080	
5520	104	IEEE 802.11a	OFDM	13.5	12.94	0.07	Right	Tilt	59	6	1:1	0.040	1.138	0.046	
5520	104	IEEE 802.11a	OFDM	13.5	12.94	0.20	Left	Cheek	59	6	1:1	0.231	1.138	0.263	A7
5520	104	IEEE 802.11a	OFDM	13.5	12.94	0.13	Left	Tilt	59	6	1:1	0.098	1.138	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								

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 38 of 61

11.2 Standalone Body-Worn SAR Data

Table 11-7
CDMA Body-Worn SAR Data

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.52	384	Cell. CDMA	TDSO / SO32	25.0	24.88	0.05	15 mm	40	1:1	back	0.365	1.028	0.375	A8
1880.00	600	PCS CDMA	TDSO / SO32	25.0	24.63	0.03	15 mm	69	1:1	back	0.521	1.089	0.567	A9
1880.00	600	PCS CDMA	TDSO / SO32	22.0	21.92	0.07	15 mm	69	1:1	back	0.281	1.019	0.286	
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 11-8
LTE Body-Worn SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
																(W/kg)		(W/kg)	
MHz	Ch.																		
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.66	0.04	0	943	QPSK	1	25	15 mm	back	1:1	0.304	1.081	0.329	A10
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.48	-0.04	1	943	QPSK	25	12	15 mm	back	1:1	0.248	1.127	0.279	
707.50	23095	Mid	LTE Band 12	10	24.5	24.25	-0.18	0	943	QPSK	1	25	15 mm	back	1:1	0.154	1.059	0.163	A11
707.50	23095	Mid	LTE Band 12	10	23.5	23.05	0.03	1	943	QPSK	25	12	15 mm	back	1:1	0.118	1.109	0.131	
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 11-9
DTS Body-Worn SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2437	6	IEEE 802.11b	DSSS	17.5	17.02	0.01	15 mm	53	1	back	1:1	0.075	1.117	0.084	A12
5765	153	IEEE 802.11a	OFDM	13.5	12.83	0.12	15 mm	59	6	back	1:1	0.175	1.167	0.204	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 11-10
NII Body-Worn SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
5180	36	IEEE 802.11a	OFDM	13.5	12.99	0.04	15 mm	59	6	back	1:1	0.113	1.125	0.127	
5260	52	IEEE 802.11a	OFDM	13.5	12.99	0.03	15 mm	59	6	back	1:1	0.115	1.125	0.129	
5520	104	IEEE 802.11a	OFDM	13.5	12.94	0.08	15 mm	59	6	back	1:1	0.163	1.138	0.185	A14
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

FCC ID A3LSCHR890		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset			Page 39 of 61

11.3 Standalone Wireless Router SAR Data

Table 11-11
CDMA Hotspot SAR Data

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.52	384	Cell. CDMA	TDSO / SO32	25.0	24.88	0.02	10 mm	40	1:1	back	0.567	1.028	0.583	A15
836.52	384	Cell. CDMA	TDSO / SO32	25.0	24.88	0.04	10 mm	40	1:1	front	0.328	1.028	0.337	
836.52	384	Cell. CDMA	TDSO / SO32	25.0	24.88	0.04	10 mm	40	1:1	bottom	0.109	1.028	0.112	
836.52	384	Cell. CDMA	TDSO / SO32	25.0	24.88	-0.01	10 mm	40	1:1	left	0.340	1.028	0.350	
836.52	384	Cell. CDMA	EVDO Rev. 0	25.0	24.86	-0.21	10 mm	40	1:1	back	0.546	1.033	0.564	
836.52	384	Cell. CDMA	EVDO Rev. 0	25.0	24.86	0.02	10 mm	40	1:1	front	0.313	1.033	0.323	
836.52	384	Cell. CDMA	EVDO Rev. 0	25.0	24.86	-0.02	10 mm	40	1:1	bottom	0.132	1.033	0.136	
836.52	384	Cell. CDMA	EVDO Rev. 0	25.0	24.86	0.03	10 mm	40	1:1	left	0.374	1.033	0.386	
1880.00	600	PCS CDMA	TDSO / SO32	22.0	21.92	0.00	10 mm	41	1:1	back	0.665	1.019	0.678	
1880.00	600	PCS CDMA	TDSO / SO32	22.0	21.92	-0.18	10 mm	41	1:1	front	0.383	1.019	0.390	
1880.00	600	PCS CDMA	TDSO / SO32	22.0	21.92	-0.02	10 mm	41	1:1	bottom	0.386	1.019	0.393	
1880.00	600	PCS CDMA	TDSO / SO32	22.0	21.92	0.02	10 mm	41	1:1	left	0.177	1.019	0.180	
1880.00	600	PCS CDMA	EVDO Rev. 0	22.0	22.00	-0.03	10 mm	41	1:1	back	0.772	1.000	0.772	A16
1880.00	600	PCS CDMA	EVDO Rev. 0	22.0	22.00	-0.14	10 mm	41	1:1	front	0.413	1.000	0.413	
1880.00	600	PCS CDMA	EVDO Rev. 0	22.0	22.00	0.02	10 mm	41	1:1	bottom	0.374	1.000	0.374	
1880.00	600	PCS CDMA	EVDO Rev. 0	22.0	22.00	-0.02	10 mm	41	1:1	left	0.164	1.000	0.164	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram							

FCC ID A3LSCHR890	 SAR EVALUATION REPORT 		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 40 of 61

Table 11-12
LTE Band 5 (Cell) Hotspot SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.66	0.01	0	943	QPSK	1	25	10 mm	back	1:1	0.408	1.081	0.441	A17
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.48	0.02	1	943	QPSK	25	12	10 mm	back	1:1	0.337	1.127	0.380	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.66	-0.07	0	943	QPSK	1	25	10 mm	front	1:1	0.119	1.081	0.129	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.48	0.03	1	943	QPSK	25	12	10 mm	front	1:1	0.099	1.127	0.112	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.66	0.09	0	943	QPSK	1	25	10 mm	top	1:1	0.041	1.081	0.044	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.48	-0.08	1	943	QPSK	25	12	10 mm	top	1:1	0.035	1.127	0.039	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.66	0.05	0	943	QPSK	1	25	10 mm	left	1:1	0.279	1.081	0.302	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.48	0.09	1	943	QPSK	25	12	10 mm	left	1:1	0.229	1.127	0.258	
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 11-13
LTE Band 12 Hotspot SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
707.50	23095	Mid	LTE Band 12	10	24.5	24.25	0.03	0	943	QPSK	1	25	10 mm	back	1:1	0.237	1.059	0.251	A18
707.50	23095	Mid	LTE Band 12	10	23.5	23.05	0.05	1	943	QPSK	25	12	10 mm	back	1:1	0.189	1.109	0.210	
707.50	23095	Mid	LTE Band 12	10	24.5	24.25	-0.19	0	943	QPSK	1	25	10 mm	front	1:1	0.213	1.059	0.226	
707.50	23095	Mid	LTE Band 12	10	23.5	23.05	-0.03	1	943	QPSK	25	12	10 mm	front	1:1	0.162	1.109	0.180	
707.50	23095	Mid	LTE Band 12	10	24.5	24.25	0.03	0	943	QPSK	1	25	10 mm	bottom	1:1	0.031	1.059	0.033	
707.50	23095	Mid	LTE Band 12	10	23.5	23.05	0.03	1	943	QPSK	25	12	10 mm	bottom	1:1	0.024	1.109	0.027	
707.50	23095	Mid	LTE Band 12	10	24.5	24.25	-0.02	0	943	QPSK	1	25	10 mm	right	1:1	0.164	1.059	0.174	
707.50	23095	Mid	LTE Band 12	10	23.5	23.05	-0.04	1	943	QPSK	25	12	10 mm	right	1:1	0.118	1.109	0.131	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 41 of 61	

Table 11-14
WLAN Hotspot SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2437	6	IEEE 802.11b	DSSS	17.5	17.02	-0.06	10 mm	53	1	back	1:1	0.167	1.117	0.187	
2437	6	IEEE 802.11b	DSSS	17.5	17.02	0.13	10 mm	53	1	front	1:1	0.059	1.117	0.066	
2437	6	IEEE 802.11b	DSSS	17.5	17.02	0.07	10 mm	53	1	top	1:1	0.056	1.117	0.063	
2437	6	IEEE 802.11b	DSSS	17.5	17.02	-0.01	10 mm	53	1	right	1:1	0.204	1.117	0.228	A19
5765	153	IEEE 802.11a	OFDM	13.5	12.83	-0.03	10 mm	59	6	back	1:1	0.337	1.167	0.393	
5785	157	IEEE 802.11a	OFDM	13.5	12.61	0.14	10 mm	59	6	back	1:1	0.338	1.227	0.415	A20
5805	161	IEEE 802.11a	OFDM	13.5	12.63	-0.15	10 mm	59	6	back	1:1	0.311	1.222	0.380	
5765	153	IEEE 802.11a	OFDM	13.5	12.83	-0.03	10 mm	59	6	front	1:1	0.034	1.167	0.040	
5765	153	IEEE 802.11a	OFDM	13.5	12.83	0.05	10 mm	59	6	top	1:1	0.067	1.167	0.078	
5765	153	IEEE 802.11a	OFDM	13.5	12.83	0.17	10 mm	59	6	right	1:1	0.293	1.167	0.342	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

11.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, FCC/OET Bulletin 65, Supplement C [June 2001] and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements. A specialized battery with NFC Antenna was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 15 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 SAR evaluations using a headset cable were required.
8. Per FCC KDB 865664 D01, variability SAR test was not required since the measured SAR results for all frequency bands were not greater than 0.8 W/kg. Please see Section 13 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 6.7 for more details).
10. This device utilizes power reduction under some portable hotspot conditions (tethering) for SAR compliance. Therefore, hotspot was tested for some bands at reduced output power levels.

FCC ID A3LSCHR890	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 42 of 61	

CDMA Notes:

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

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r01. The general test procedures used for testing can be found in Section 8.4.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator.

WLAN Notes:

1. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 2.4 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11b. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
2. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 5 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11a. Other IEEE 802.11 modes (including 802.11n 20 MHz and 40 MHz bandwidths) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
3. When Hotspot is enabled, only 5.8 GHz band is enabled. Therefore other 5 GHz WIFI Wireless Router SAR Data was required.
4. WIFI transmission was verified using an uncalibrated spectrum analyzer.
5. When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is >1.6 W/kg or the reported 1g averaged SAR is >0.8 W/kg, SAR testing on other default channels was required.

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 43 of 61	

12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

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

12.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05 IV.C.1.iii, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific physical test configuration is ≤ 1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05 4.3.2.2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

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

Table 12-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2441	10.00	15	0.139

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.

Note: This device utilizes power reduction under some portable hotspot conditions (tethering) for SAR compliance. There is power reduction for PCS CDMA/EVDO. There is no power reduction for Cellular CDMA/EVDO, LTE Band 5, LTE B12, LTE B17, and WLAN modes.

12.3 Head SAR Simultaneous Transmission Analysis

Table 12-2
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Held to Ear)

Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.374	0.176	0.550	Head SAR	Right Cheek	0.373	0.176	0.549
	Right Tilt	0.277	0.142	0.419		Right Tilt	0.301	0.142	0.443
	Left Cheek	0.418	0.449	0.867		Left Cheek	0.415	0.449	0.864
	Left Tilt	0.262	0.141	0.403		Left Tilt	0.276	0.141	0.417

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 44 of 61

Simult Tx	Configuration	PCS CDMA SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.330	0.176	0.506	Head SAR	Right Cheek	0.190	0.176	0.366
	Right Tilt	0.224	0.142	0.366		Right Tilt	0.100	0.142	0.242
	Left Cheek	0.666	0.449	1.115		Left Cheek	0.353	0.449	0.802
	Left Tilt	0.237	0.141	0.378		Left Tilt	0.113	0.141	0.254
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.333	0.176	0.509	Head SAR	Right Cheek	0.390	0.176	0.566
	Right Tilt	0.212	0.142	0.354		Right Tilt	0.141	0.142	0.283
	Left Cheek	0.189	0.449	0.638		Left Cheek	0.213	0.449	0.662
	Left Tilt	0.123	0.141	0.264		Left Tilt	0.123	0.141	0.264

Table 12-3
Simultaneous Transmission Scenario with 5 GHz WLAN (Held to Ear)

Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.374	0.203	0.577	Head SAR	Right Cheek	0.373	0.203	0.576
	Right Tilt	0.277	0.099	0.376		Right Tilt	0.301	0.099	0.400
	Left Cheek	0.418	0.271	0.689		Left Cheek	0.415	0.271	0.686
	Left Tilt	0.262	0.127	0.389		Left Tilt	0.276	0.127	0.403
Simult Tx	Configuration	PCS CDMA SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.330	0.203	0.533	Head SAR	Right Cheek	0.190	0.203	0.393
	Right Tilt	0.224	0.099	0.323		Right Tilt	0.100	0.099	0.199
	Left Cheek	0.666	0.271	0.937		Left Cheek	0.353	0.271	0.624
	Left Tilt	0.237	0.127	0.364		Left Tilt	0.113	0.127	0.240
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.333	0.203	0.536	Head SAR	Right Cheek	0.390	0.203	0.593
	Right Tilt	0.212	0.099	0.311		Right Tilt	0.141	0.099	0.240
	Left Cheek	0.189	0.271	0.460		Left Cheek	0.213	0.271	0.484
	Left Tilt	0.123	0.127	0.250		Left Tilt	0.123	0.127	0.250

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

FCC ID A3LSCHR890	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 45 of 61	

12.4 Body-Worn Simultaneous Transmission Analysis

Table 12-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 15 mm)

Configuration	Mode	CDMA/LTE SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	Cell. CDMA	0.375	0.084	0.459
Back Side	PCS CDMA	0.567	0.084	0.651
Back Side	LTE Band 5 (Cell)	0.329	0.084	0.413
Back Side	LTE Band 12	0.163	0.084	0.247

Table 12-5
Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 15 mm)

Configuration	Mode	CDMA/LTE SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	Cell. CDMA	0.375	0.204	0.579
Back Side	PCS CDMA	0.567	0.204	0.771
Back Side	LTE Band 5 (Cell)	0.329	0.204	0.533
Back Side	LTE Band 12	0.163	0.204	0.367

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

Table 12-6
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 15 mm)

Configuration	Mode	CDMA/LTE SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back Side	Cell. CDMA	0.375	0.139	0.514
Back Side	PCS CDMA	0.567	0.139	0.706
Back Side	LTE Band 5 (Cell)	0.329	0.139	0.468
Back Side	LTE Band 12	0.163	0.139	0.302

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

FCC ID A3LSCHR890	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 46 of 61

12.5 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 12-7
Simultaneous Transmission Scenario (2.4 GHz Hotspot at 1.0 cm)

Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.564	0.187	0.751	Body SAR	Back	0.772	0.187	0.959
	Front	0.323	0.066	0.389		Front	0.413	0.066	0.479
	Top	-	0.063	0.063		Top	-	0.063	0.063
	Bottom	0.136	-	0.136		Bottom	0.374	-	0.374
	Right	-	0.228	0.228		Right	-	0.228	0.228
	Left	0.386	-	0.386		Left	0.164	-	0.164
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.441	0.187	0.628	Body SAR	Back	0.251	0.187	0.438
	Front	0.129	0.066	0.195		Front	0.226	0.066	0.292
	Top	0.044	0.063	0.107		Top	-	0.063	0.063
	Bottom	-	-	0.000		Bottom	0.033	-	0.033
	Right	-	0.228	0.228		Right	0.174	0.228	0.402
	Left	0.302	-	0.302		Left	-	-	0.000

Table 12-8
Simultaneous Transmission Scenario (5.8 GHz Hotspot at 1.0 cm)

Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.564	0.415	0.979	Body SAR	Back	0.772	0.415	1.187
	Front	0.323	0.040	0.363		Front	0.413	0.040	0.453
	Top	-	0.078	0.078		Top	-	0.078	0.078
	Bottom	0.136	-	0.136		Bottom	0.374	-	0.374
	Right	-	0.342	0.342		Right	-	0.342	0.342
	Left	0.386	-	0.386		Left	0.164	-	0.164
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.441	0.415	0.856	Body SAR	Back	0.251	0.415	0.666
	Front	0.129	0.040	0.169		Front	0.226	0.040	0.266
	Top	0.044	0.078	0.122		Top	-	0.078	0.078
	Bottom	-	-	0.000		Bottom	0.033	-	0.033
	Right	-	0.342	0.342		Right	0.174	0.342	0.516
	Left	0.302	-	0.302		Left	-	-	0.000

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 47 of 61

12.6 SVLTE SAR Simultaneous Transmission Analysis

Table 12-9
Simultaneous Transmission Scenario (Held to Ear)

Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.374	0.333	0.707	Head SAR	Right Cheek	0.374	0.390	0.764
	Right Tilt	0.277	0.212	0.489		Right Tilt	0.277	0.141	0.418
	Left Cheek	0.418	0.189	0.607		Left Cheek	0.418	0.213	0.631
	Left Tilt	0.262	0.123	0.385		Left Tilt	0.262	0.123	0.385
Simult Tx	Configuration	PCS CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.330	0.333	0.663	Head SAR	Right Cheek	0.330	0.390	0.720
	Right Tilt	0.224	0.212	0.436		Right Tilt	0.224	0.141	0.365
	Left Cheek	0.666	0.189	0.855		Left Cheek	0.666	0.213	0.879
	Left Tilt	0.237	0.123	0.360		Left Tilt	0.237	0.123	0.360

Table 12-10
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Held to Ear)

Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	Right Cheek	0.374	0.333	0.176	0.883
	Right Tilt	0.277	0.212	0.142	0.631
	Left Cheek	0.418	0.189	0.449	1.056
	Left Tilt	0.262	0.123	0.141	0.526
Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	Right Cheek	0.374	0.390	0.176	0.940
	Right Tilt	0.277	0.141	0.142	0.560
	Left Cheek	0.418	0.213	0.449	1.080
	Left Tilt	0.262	0.123	0.141	0.526

FCC ID A3LSCHR890	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 48 of 61

Simult Tx	Configuration	PCS CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	Right Cheek	0.181	0.333	0.176	0.690
	Right Tilt	0.132	0.212	0.142	0.486
	Left Cheek	0.321	0.189	0.449	0.959
	Left Tilt	0.134	0.123	0.141	0.398
Simult Tx	Configuration	PCS CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	Right Cheek	0.181	0.390	0.176	0.747
	Right Tilt	0.132	0.141	0.142	0.415
	Left Cheek	0.321	0.213	0.449	0.983
	Left Tilt	0.134	0.123	0.141	0.398

Table 12-11
Simultaneous Transmission Scenario with 5.8 GHz WLAN (Held to Ear)

Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	Right Cheek	0.374	0.333	0.203	0.910
	Right Tilt	0.277	0.212	0.099	0.588
	Left Cheek	0.418	0.189	0.271	0.878
	Left Tilt	0.262	0.123	0.127	0.512
Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	Right Cheek	0.374	0.390	0.203	0.967
	Right Tilt	0.277	0.141	0.099	0.517
	Left Cheek	0.418	0.213	0.271	0.902
	Left Tilt	0.262	0.123	0.127	0.512

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 49 of 61

Simult Tx	Configuration	PCS CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	Right Cheek	0.181	0.333	0.203	0.717
	Right Tilt	0.132	0.212	0.099	0.443
	Left Cheek	0.321	0.189	0.271	0.781
	Left Tilt	0.134	0.123	0.127	0.384
Simult Tx	Configuration	PCS CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	Right Cheek	0.181	0.390	0.203	0.774
	Right Tilt	0.132	0.141	0.099	0.372
	Left Cheek	0.321	0.213	0.271	0.805
	Left Tilt	0.134	0.123	0.127	0.384

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

Table 12-12
Simultaneous Transmission Scenario (Body-Worn at 15 mm)

Configuration	Mode	CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	Σ SAR (W/kg)
Back Side	Cell. CDMA	0.375	0.329	0.704
Back Side	PCS CDMA	0.567	0.329	0.896
Configuration	Mode	CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	Σ SAR (W/kg)
Back Side	Cell. CDMA	0.375	0.163	0.538
Back Side	PCS CDMA	0.567	0.163	0.730

Table 12-13
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 15 mm)

Configuration	Mode	CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Back Side	Cell. CDMA	0.375	0.329	0.084	0.788
Back Side	PCS CDMA	0.286	0.329	0.084	0.699

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 50 of 61	

Configuration	Mode	CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Back Side	Cell. CDMA	0.375	0.163	0.084	0.622
Back Side	PCS CDMA	0.286	0.163	0.084	0.533

Table 12-14
Simultaneous Transmission Scenario with 5.8 GHz WLAN (Body-Worn at 15 mm)

Configuration	Mode	CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Back Side	Cell. CDMA	0.375	0.329	0.204	0.908
Back Side	PCS CDMA	0.286	0.329	0.204	0.819
Configuration	Mode	CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Back Side	Cell. CDMA	0.375	0.163	0.204	0.742
Back Side	PCS CDMA	0.286	0.163	0.204	0.653

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

Table 12-15
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth (Body-Worn at 15 mm)

Configuration	Mode	CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Back Side	Cell. CDMA	0.375	0.329	0.139	0.843
Back Side	PCS CDMA	0.567	0.329	0.139	1.035
Configuration	Mode	CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Back Side	Cell. CDMA	0.375	0.163	0.139	0.677
Back Side	PCS CDMA	0.567	0.163	0.139	0.869

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

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 51 of 61

Table 12-16
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Hotspot at 10 mm)

Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body SAR	Back	0.583	0.441	0.187	1.211
	Front	0.337	0.129	0.066	0.532
	Top	-	0.044	0.063	0.107
	Bottom	0.112	-	-	0.112
	Right	-	-	0.228	0.228
	Left	0.350	0.302	-	0.652
Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body SAR	Back	0.583	0.251	0.187	1.021
	Front	0.337	0.226	0.066	0.629
	Top	-	-	0.063	0.063
	Bottom	0.112	0.033	-	0.145
	Right	-	0.174	0.228	0.402
	Left	0.350	-	-	0.350

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 52 of 61

Simult Tx	Configuration	PCS CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body SAR	Back	0.678	0.441	0.187	1.306
	Front	0.390	0.129	0.066	0.585
	Top	-	0.044	0.063	0.107
	Bottom	0.393	-	-	0.393
	Right	-	-	0.228	0.228
	Left	0.180	0.302	-	0.482
Simult Tx	Configuration	PCS CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body SAR	Back	0.678	0.251	0.187	1.116
	Front	0.390	0.226	0.066	0.682
	Top	-	-	0.063	0.063
	Bottom	0.393	0.033	-	0.426
	Right	-	0.174	0.228	0.402
	Left	0.180	-	-	0.180

Table 12-17
Simultaneous Transmission Scenario with 5.8 GHz WLAN (Hotspot at 10 mm)

Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body SAR	Back	0.583	0.441	0.415	1.439
	Front	0.337	0.129	0.040	0.506
	Top	-	0.044	0.078	0.122
	Bottom	0.112	-	-	0.112
	Right	-	-	0.342	0.342
	Left	0.350	0.302	-	0.652

Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body SAR	Back	0.583	0.251	0.415	1.249
	Front	0.337	0.226	0.040	0.603
	Top	-	-	0.078	0.078
	Bottom	0.112	0.033	-	0.145
	Right	-	0.174	0.342	0.516
	Left	0.350	-	-	0.350
Simult Tx	Configuration	PCS CDMA SAR (W/kg)	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body SAR	Back	0.678	0.441	0.415	1.534
	Front	0.390	0.129	0.040	0.559
	Top	-	0.044	0.078	0.122
	Bottom	0.393	-	-	0.393
	Right	-	-	0.342	0.342
	Left	0.180	0.302	-	0.482
Simult Tx	Configuration	PCS CDMA SAR (W/kg)	LTE Band 12 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body SAR	Back	0.678	0.251	0.415	1.344
	Front	0.390	0.226	0.040	0.656
	Top	-	-	0.078	0.078
	Bottom	0.393	0.033	-	0.426
	Right	-	0.174	0.342	0.516
	Left	0.180	-	-	0.180

12.7 Simultaneous Transmission Conclusion

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

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 54 of 61

13 SAR MEASUREMENT VARIABILITY

13.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r01, SAR measurement variability is assessed for each frequency band when measured 1g SAR is > 0.80 W/kg. Since all measured SAR for this device is < 0.80 W/kg, SAR measurement variability was not assessed.

13.2 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.

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 55 of 61	

14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/16/2013	Annual	4/16/2014	MY45470194
Agilent	8753E	(30kHz-6GHz) Network Analyzer	4/16/2013	Annual	4/16/2014	JP38020182
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8648D	(9kHz-4GHz) Signal Generator	4/17/2013	Annual	4/17/2014	3629U00687
Agilent	85070C	Dielectric Probe Kit	2/14/2013	Annual	2/14/2014	MY44300633
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00577
Agilent	E5515C	Wireless Communications Test Set	9/24/2012	Annual	9/24/2013	GB43163447
Amplifier Research	551G4	5W, 800MHz-4.2GHz	CBT	N/A	CBT	21910
Anritsu	ML2495A	Power Meter	10/11/2012	Annual	10/11/2013	1039008
Anritsu	ML2496A	Power Meter	11/28/2012	Annual	11/28/2013	1138001
Anritsu	MA2411B	Pulse Power Sensor	12/4/2012	Annual	12/4/2013	1207364
Anritsu	MA2411B	Pulse Power Sensor	12/5/2012	Annual	12/5/2013	1126066
Anritsu	MT8820C	Radio Communication Tester	11/6/2012	Annual	11/6/2013	6200901190
Anritsu	MA24106A	USB Power Sensor	12/6/2012	Annual	12/6/2013	1248508
Anritsu	MA24106A	USB Power Sensor	12/7/2012	Annual	12/7/2013	1244524
Anritsu	MA24106A	USB Power Sensor	12/7/2012	Annual	12/7/2013	1244515
Anritsu	MA24106A	USB Power Sensor	12/7/2012	Annual	12/7/2013	1244512
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
COMTECH	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M155A00-009
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/10/2012	Annual	10/10/2013	1833460
Gigatronics	8651A	Universal Power Meter	10/10/2012	Annual	10/10/2013	8650319
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+	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
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
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	8/9/2013	Annual	8/9/2014	109892
Rohde & Schwarz	NRVD	Dual Channel Power Meter	10/12/2012	Biennial	10/12/2014	101695
Rohde & Schwarz	CWV500	LTE Radio Communication Tester	9/26/2012	Annual	9/26/2013	108798
Rohde & Schwarz	NRV-Z32	Peak Power Sensor	10/12/2012	Biennial	10/12/2014	836019/013
Rohde & Schwarz	SME06	Signal Generator	10/11/2012	Annual	10/11/2013	832026
Rohde & Schwarz	SMI003B	Signal Generator	4/17/2013	Annual	4/17/2014	DE27259
Seekonk	NC-100	Torque Wrench (8" lb)	11/29/2011	Triennial	11/29/2014	21053
Seekonk	NC-100	Torque Wrench (8" lb)	3/5/2012	Triennial	3/5/2015	N/A
SPEAG	D1900V2	1900 MHz SAR Dipole	2/6/2013	Annual	2/6/2014	50148
SPEAG	D2450V2	2450 MHz SAR Dipole	1/8/2013	Annual	1/8/2014	797
SPEAG	D2450V2	2450 MHz SAR Dipole	2/11/2013	Annual	2/11/2014	882
SPEAG	D5GHZV2	5 GHz SAR Dipole	1/11/2013	Annual	1/11/2014	1057
SPEAG	D5GHZV2	5 GHz SAR Dipole	2/14/2013	Annual	2/14/2014	1120
SPEAG	D750V3	750 MHz Dipole	1/7/2013	Annual	1/7/2014	1003
SPEAG	D750V3	750 MHz Dipole	3/18/2013	Annual	3/18/2014	1054
SPEAG	DB35V2	835 MHz SAR Dipole	4/25/2013	Annual	4/25/2014	4d119
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/19/2012	Annual	9/19/2013	1323
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/13/2012	Annual	11/13/2013	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/17/2013	Annual	1/17/2014	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/6/2013	Annual	2/6/2014	649
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/8/2013	Annual	3/8/2014	1334
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/13/2013	Annual	5/13/2014	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/22/2013	Annual	4/22/2014	1364
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/21/2013	Annual	8/21/2014	1322
SPEAG	DAK-3.5	Dielectric Assessment Kit	12/11/2012	Annual	12/11/2013	1091
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/14/2013	Annual	5/14/2014	1070
SPEAG	ES3DV3	SAR Probe	9/20/2012	Annual	9/20/2013	3288
SPEAG	ES3DV3	SAR Probe	11/15/2012	Annual	11/15/2013	3287
SPEAG	EX3DV4	SAR Probe	1/17/2013	Annual	1/17/2014	3589
SPEAG	EX3DV4	SAR Probe	2/27/2013	Annual	2/27/2014	3920
SPEAG	ES3DV3	SAR Probe	3/15/2013	Annual	3/15/2014	3209
SPEAG	ES3DV3	SAR Probe	5/16/2013	Annual	5/16/2014	3263
SPEAG	ES3DV3	SAR Probe	4/29/2013	Annual	4/29/2014	3318
SPEAG	ES3DV3	SAR Probe	8/22/2013	Annual	8/22/2014	3022
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/17/2013	Annual	4/17/2014	8010177
VWR	23226-658	Long Stem Thermometer	3/30/2012	Biennial	3/30/2014	122179874
VWR	23226-658	Long Stem Thermometer	5/16/2012	Biennial	5/16/2014	122295544
VWR	62344-925	Mini-Thermometer	10/24/2011	Biennial	10/24/2013	111886414
VWR	62344-925	Mini-Thermometer	10/24/2011	Biennial	10/24/2013	111886441
VWR	36934-158	Wall-Mounted Thermometer	9/30/2011	Biennial	9/30/2013	111859323
VWR	36934-158	Wall-Mounted Thermometer	9/30/2011	Biennial	9/30/2013	111859332

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.

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 56 of 61

15 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
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.2	23.5

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

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 57 of 61

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
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.7	24.0

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

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 58 of 61

16 CONCLUSION

16.1 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]

FCC ID A3LSCHR890		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset		Page 59 of 61

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FCC ID A3LSCHR890	 SAR EVALUATION REPORT 		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 60 of 61

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FCC ID A3LSCHR890	 SAR EVALUATION REPORT 		Reviewed by: Quality Manager
Document S/N: 0Y1308271673 – R1.A3L	Test Dates: 08/27/13 - 09/13/13	DUT Type: Portable Handset	Page 61 of 61

APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 70

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

Medium: 835 Head; Medium parameters used (interpolated):

$f = 836.52 \text{ MHz}$; $\sigma = 0.938 \text{ S/m}$; $\epsilon_r = 43.326$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 08-28-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3209; ConvF(6.46, 6.46, 6.46); Calibrated: 3/15/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/8/2013

Phantom: SAM Right; Type: QD000P40CD; Serial: 1686

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: Cell EVDO, Left Head, Cheek, Mid.ch

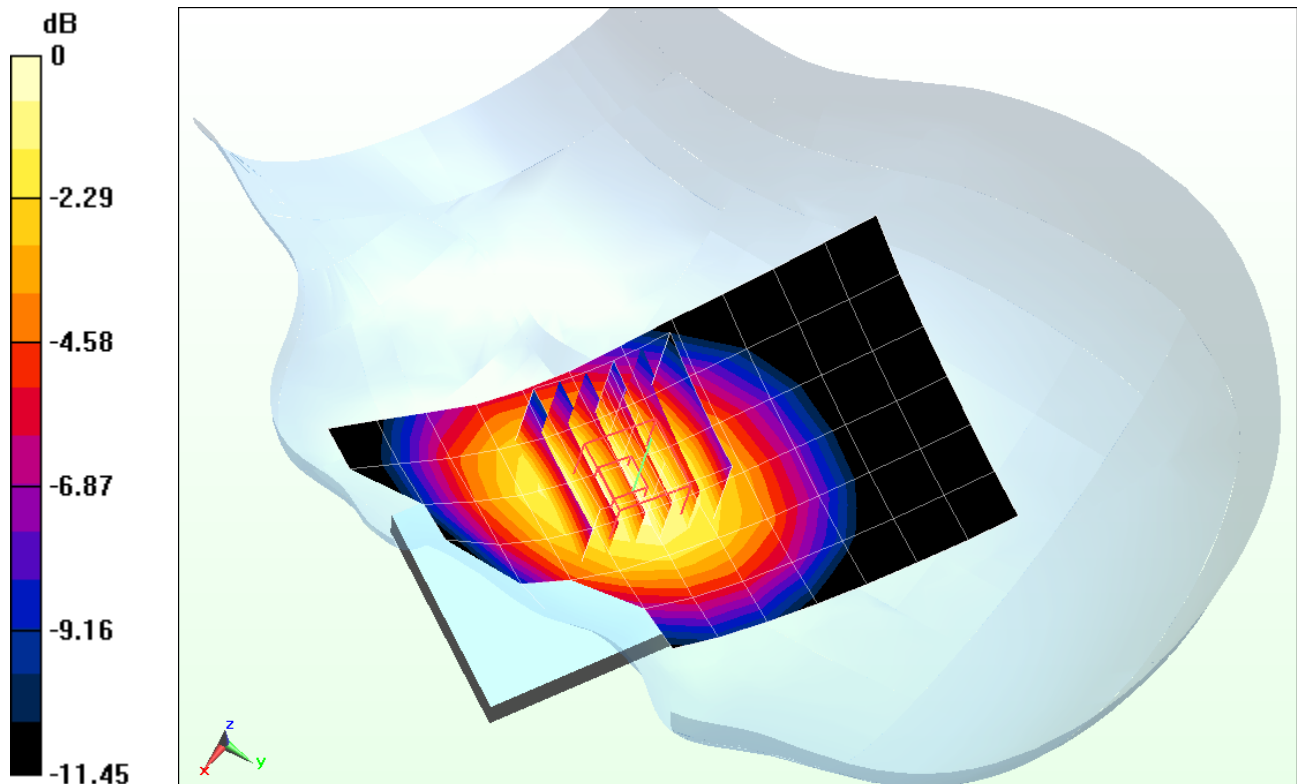
Area Scan (7x12x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 22.129 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.544 W/kg

SAR(1 g) = 0.401 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 69

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

Medium: 1900 Head; Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.428 \text{ S/m}$; $\epsilon_r = 40.625$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 08-29-2013; Ambient Temp: 22.0°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3920; ConvF(7.73, 7.73, 7.73); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

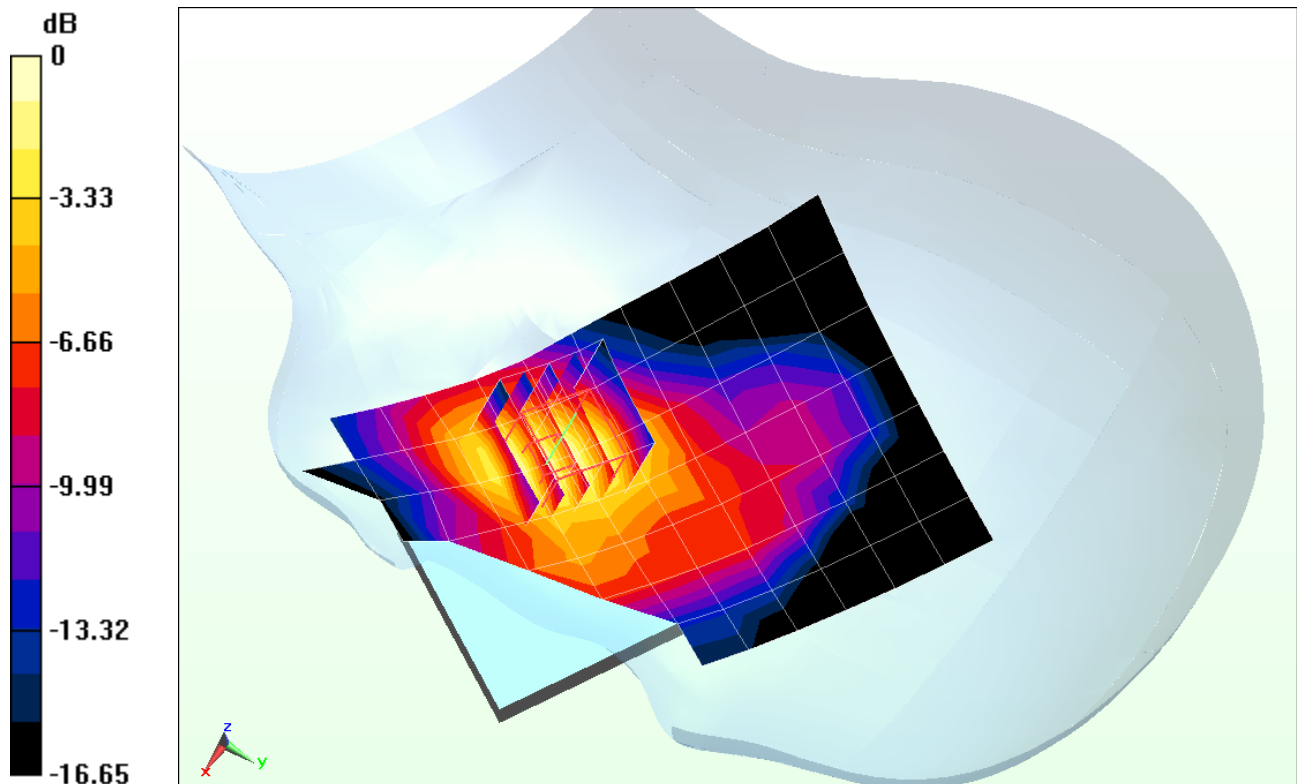
Area Scan (8x13x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 21.629 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.998 W/kg

SAR(1 g) = 0.623 W/kg



0 dB = 0.695 W/kg = -1.58 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 40

Communication System: LTE Band 5 (Cell.); Frequency: 836.5 MHz; Duty Cycle: 1:1

Medium: 835 Head; Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 0.909 \text{ S/m}$; $\epsilon_r = 41.254$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 09-11-2013; Ambient Temp: 23.5°C; Tissue Temp: 23.8°C

Probe: EX3DV4 - SN3920; ConvF(9.58, 9.58, 9.58); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

**Mode: LTE Band 5 (Cell.), Right Head, Cheek, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 25 RB Offset**

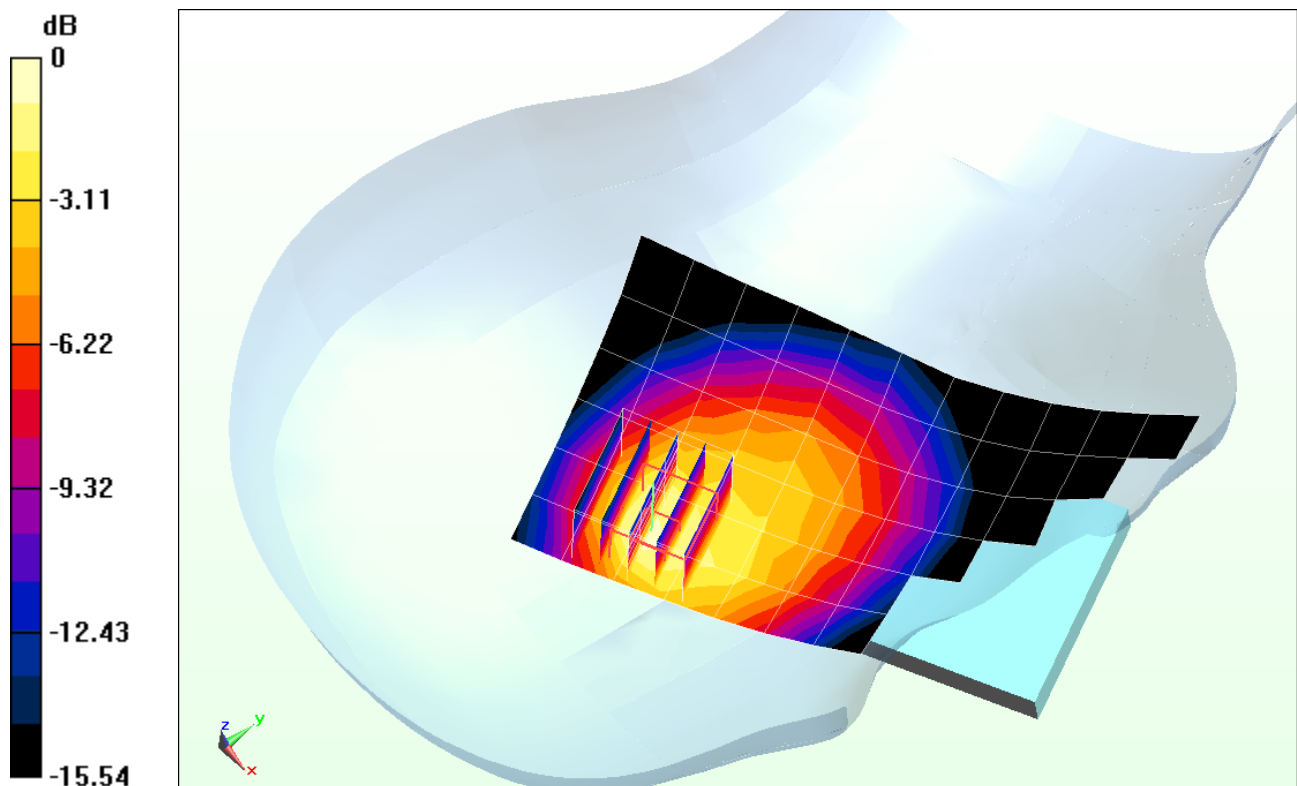
Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 18.938 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.608 W/kg

SAR(1 g) = 0.308 W/kg



0 dB = 0.344 W/kg = -4.63 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 942

Communication System: LTE RF; Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: 750 Head; Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.878 \text{ S/m}$; $\epsilon_r = 42.776$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 09-07-2013; Ambient Temp: 23.0°C; Tissue Temp: 22.6°C

Probe: ES3DV3 - SN3287; ConvF(6.4, 6.4, 6.4); Calibrated: 11/15/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/13/2012

Phantom: SAM with CRP; Type: SAM 4.0; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

**Mode: LTE Band 12, Right Head, Cheek, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 25 RB Offset**

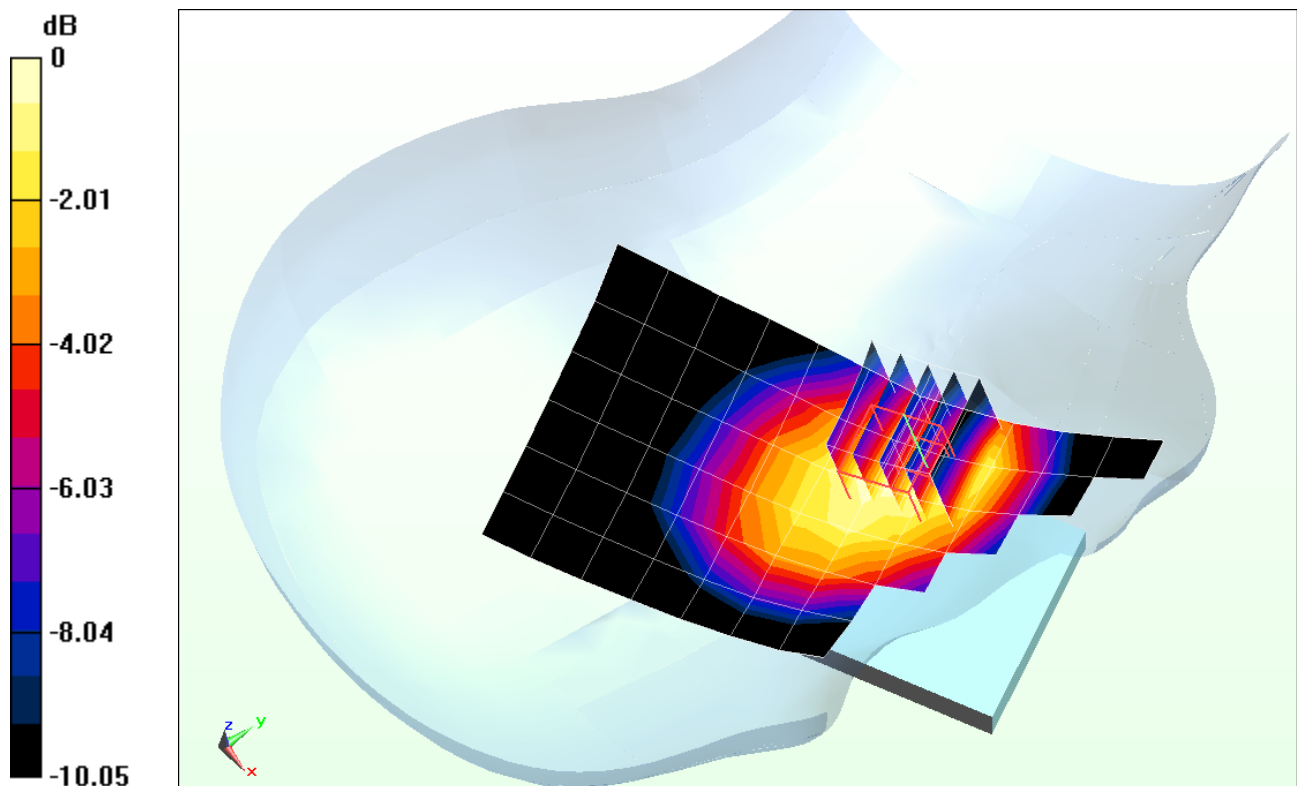
Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 22.702 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.533 W/kg

SAR(1 g) = 0.368 W/kg



0 dB = 0.393 W/kg = -4.06 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 53

Communication System: IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 Head; Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 1.769 \text{ S/m}$; $\epsilon_r = 39.243$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 08-28-2013; Ambient Temp: 23.3°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3288; ConvF(4.61, 4.61, 4.61); Calibrated: 9/20/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 9/19/2012

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11b, Left Head, Cheek, Ch 06, 1 Mbps

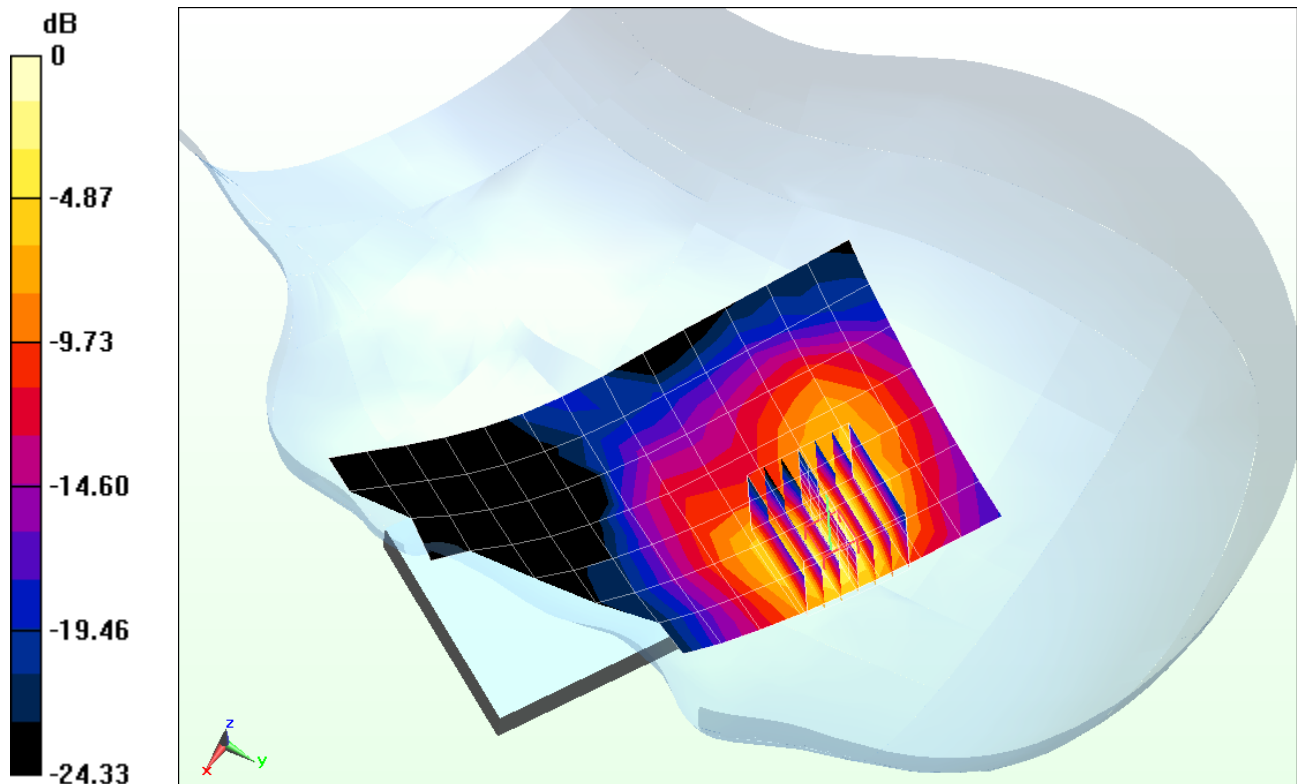
Area Scan (8x14x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 14.735 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.01 W/kg

SAR(1 g) = 0.402 W/kg



0 dB = 0.575 W/kg = -2.40 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 59

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5765 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head; Medium parameters used:

$$f = 5765 \text{ MHz}; \sigma = 5.286 \text{ S/m}; \epsilon_r = 33.86; \rho = 1000 \text{ kg/m}^3$$

Phantom section: Left Section

Test Date: 08-30-2013; Ambient Temp: 22.9°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN3589; ConvF(3.85, 3.85, 3.85); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

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

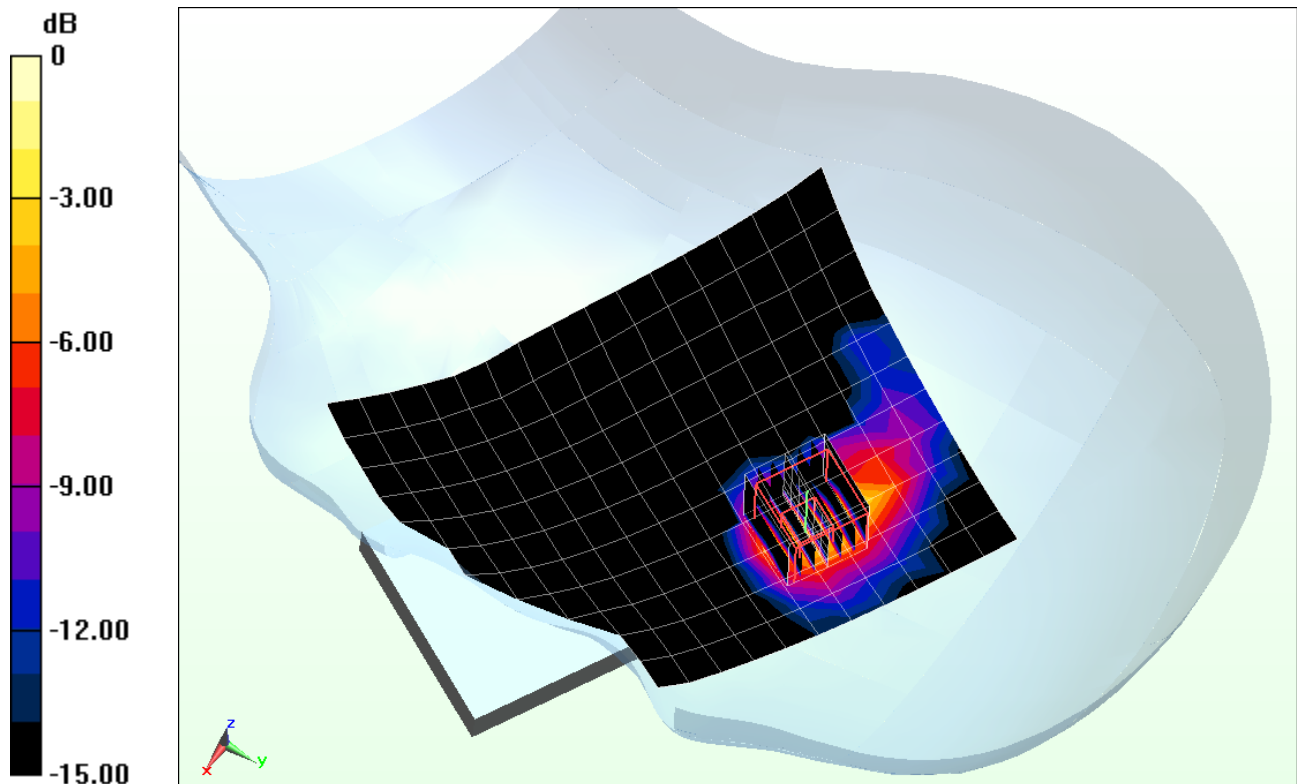
Area Scan (12x16x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 6.598 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.09 W/kg

SAR(1 g) = 0.232 W/kg



0 dB = 0.814 W/kg = -0.89 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 59

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5520 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head; Medium parameters used:

$$f = 5520 \text{ MHz}; \sigma = 4.964 \text{ S/m}; \epsilon_r = 34.295; \rho = 1000 \text{ kg/m}^3$$

Phantom section: Left Section

Test Date: 08-30-2013; Ambient Temp: 22.8°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3589; ConvF(4.14, 4.14, 4.14); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.5 GHz Left Head, Cheek, Ch 104, 6 Mbps

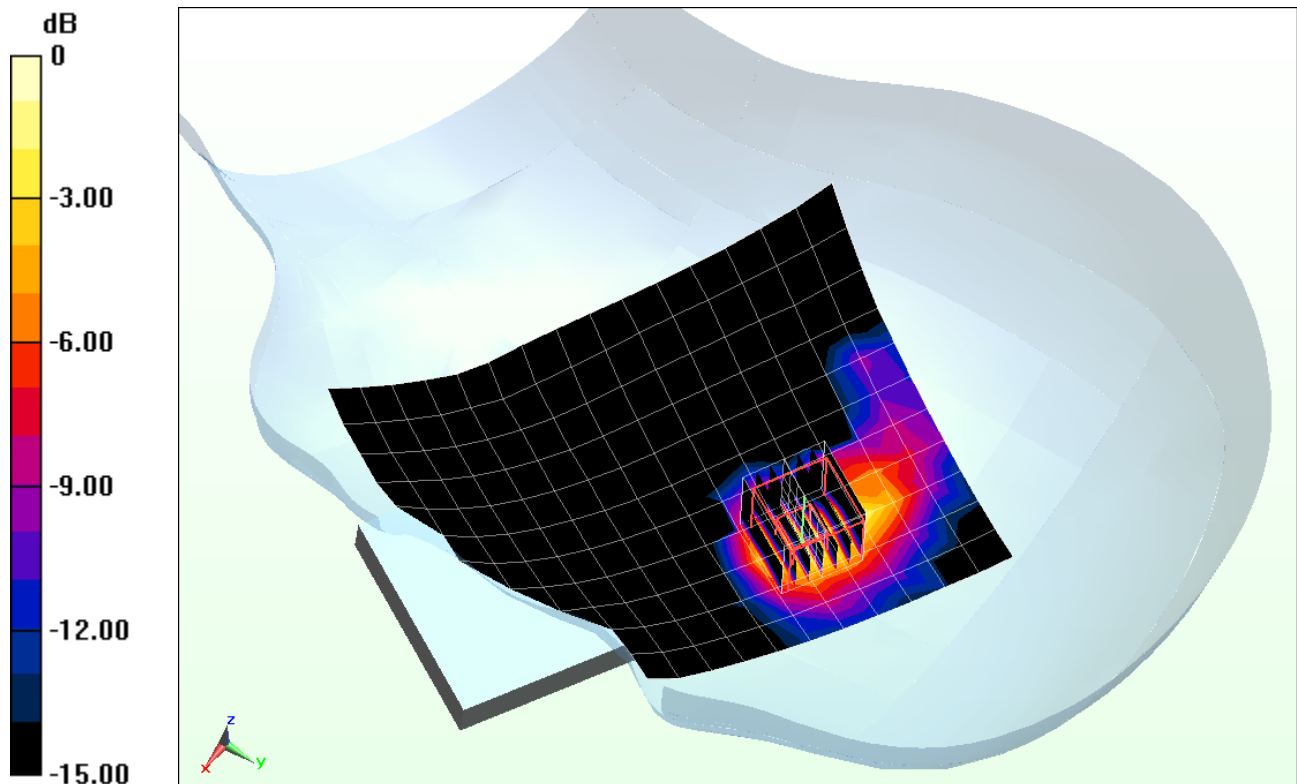
Area Scan (12x16x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 6.885 V/m; Power Drift = 0.20 dB

Peak SAR (extrapolated) = 1.01 W/kg

SAR(1 g) = 0.231 W/kg



0 dB = 0.602 W/kg = -2.20 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 40

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

Medium: 835 Body; Medium parameters used (interpolated):

$f = 836.52 \text{ MHz}$; $\sigma = 0.969 \text{ S/m}$; $\epsilon_r = 55.017$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 09-12-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.7°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/8/2013

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: Cell. CDMA, Body SAR, Back side, Mid.ch

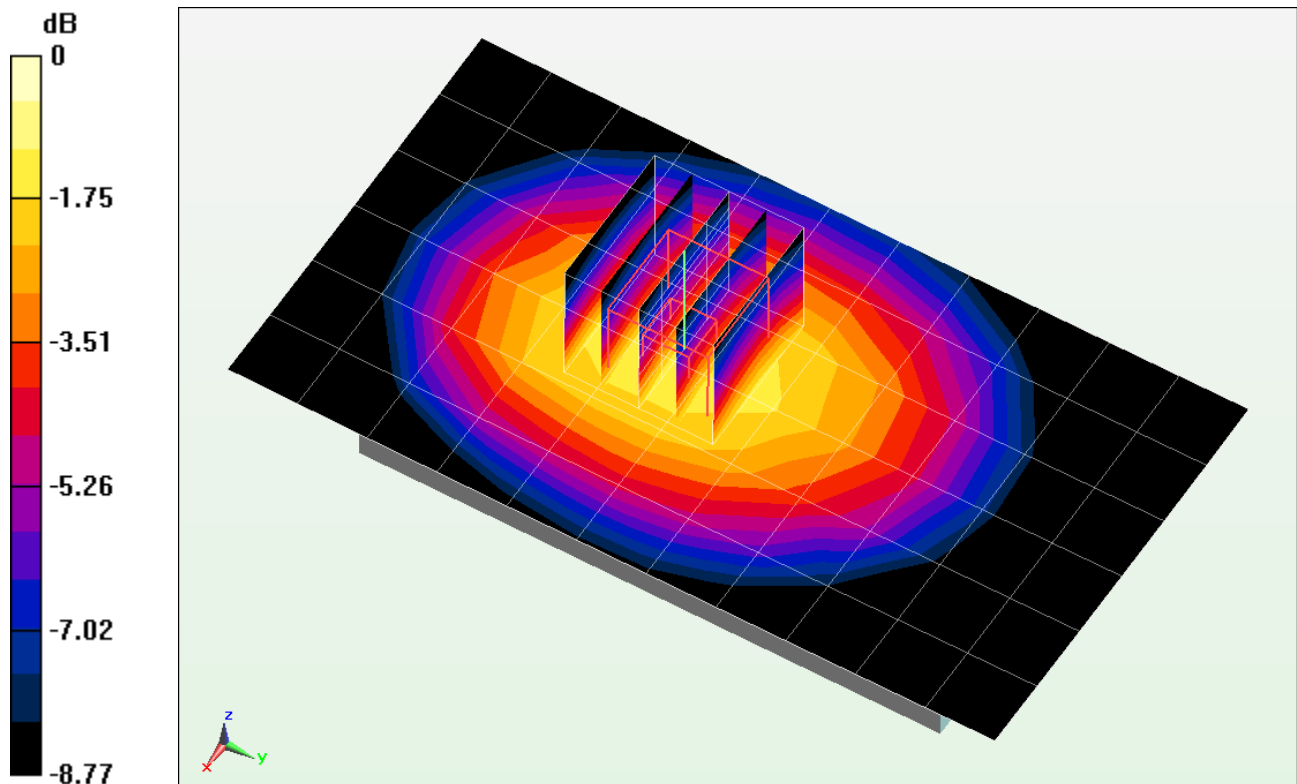
Area Scan (7x12x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 19.919 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.456 W/kg

SAR(1 g) = 0.365 W/kg



0 dB = 0.485 W/kg = -3.14 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 69

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

Medium: 1900 Body; Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.511 \text{ S/m}$; $\epsilon_r = 51.938$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 08-29-2013; Ambient Temp: 23.1°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

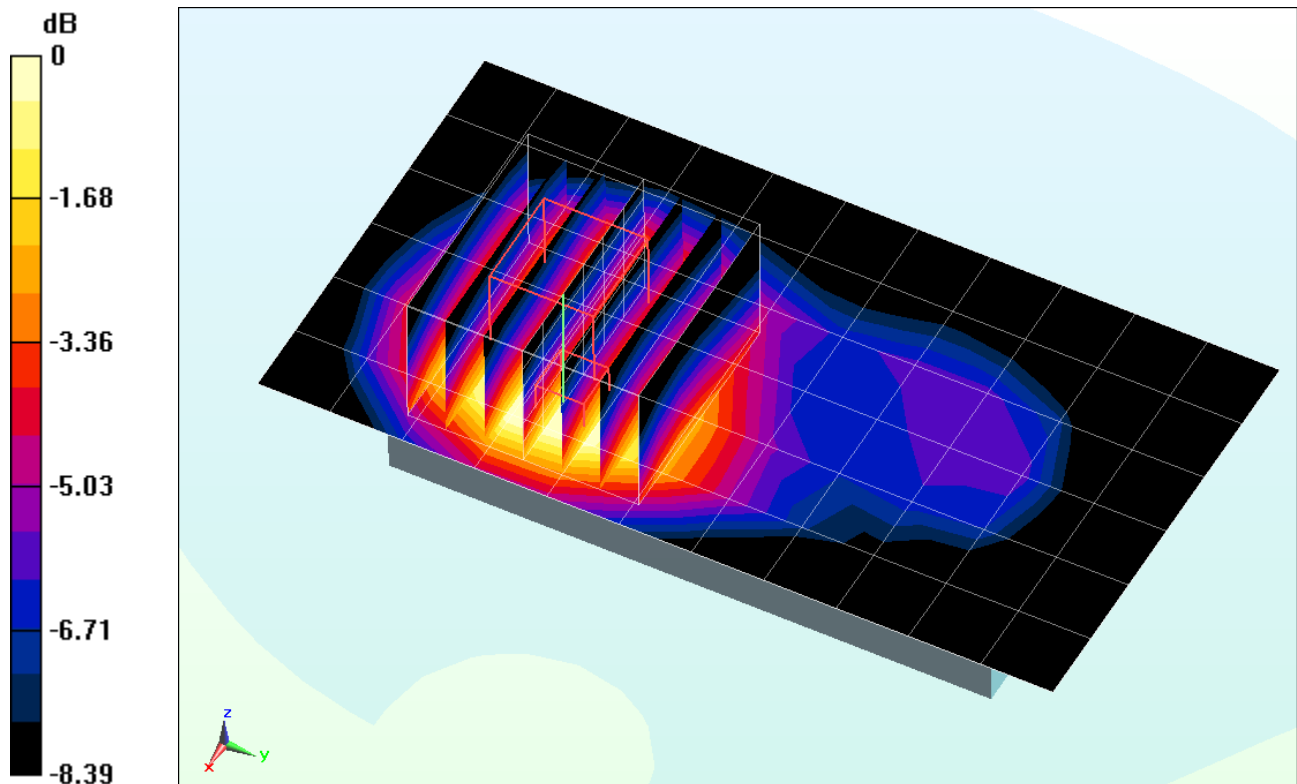
Area Scan (7x12x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 18.408 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.821 W/kg

SAR(1 g) = 0.521 W/kg



0 dB = 1.00 W/kg = 0.00 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 943

Communication System: LTE Band 5; Frequency: 836.5 MHz; Duty Cycle: 1:1

Medium: 835 Body; Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 1.002 \text{ S/m}$; $\epsilon_r = 53.529$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 09-06-2013; Ambient Temp: 24.4°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/8/2013

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Mode: LTE Band 5 (Cell.), Body SAR, Back side, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 25 RB Offset**

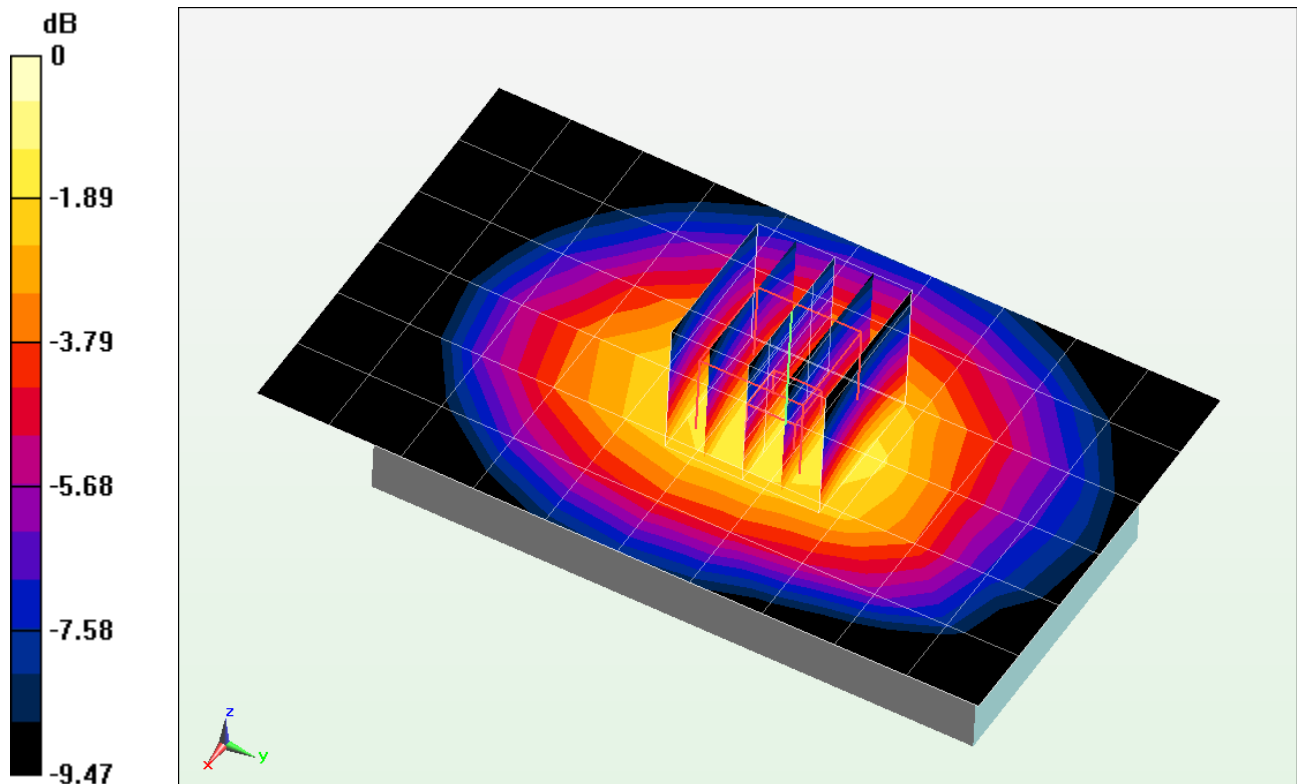
Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 18.048 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.388 W/kg

SAR(1 g) = 0.304 W/kg



0 dB = 0.425 W/kg = -3.72 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 943

Communication System: LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: 750 Body; Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.931 \text{ S/m}$; $\epsilon_r = 56.393$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 09-06-2013; Ambient Temp: 23.8°C; Tissue Temp: 22.9°C

Probe: EX3DV4 - SN3920; ConvF(9.57, 9.57, 9.57); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Mode: LTE Band 12, Body SAR, Back side, Mid.ch,
10MHz Bandwidth, QPSK, 1 RB, 25 RB Offset**

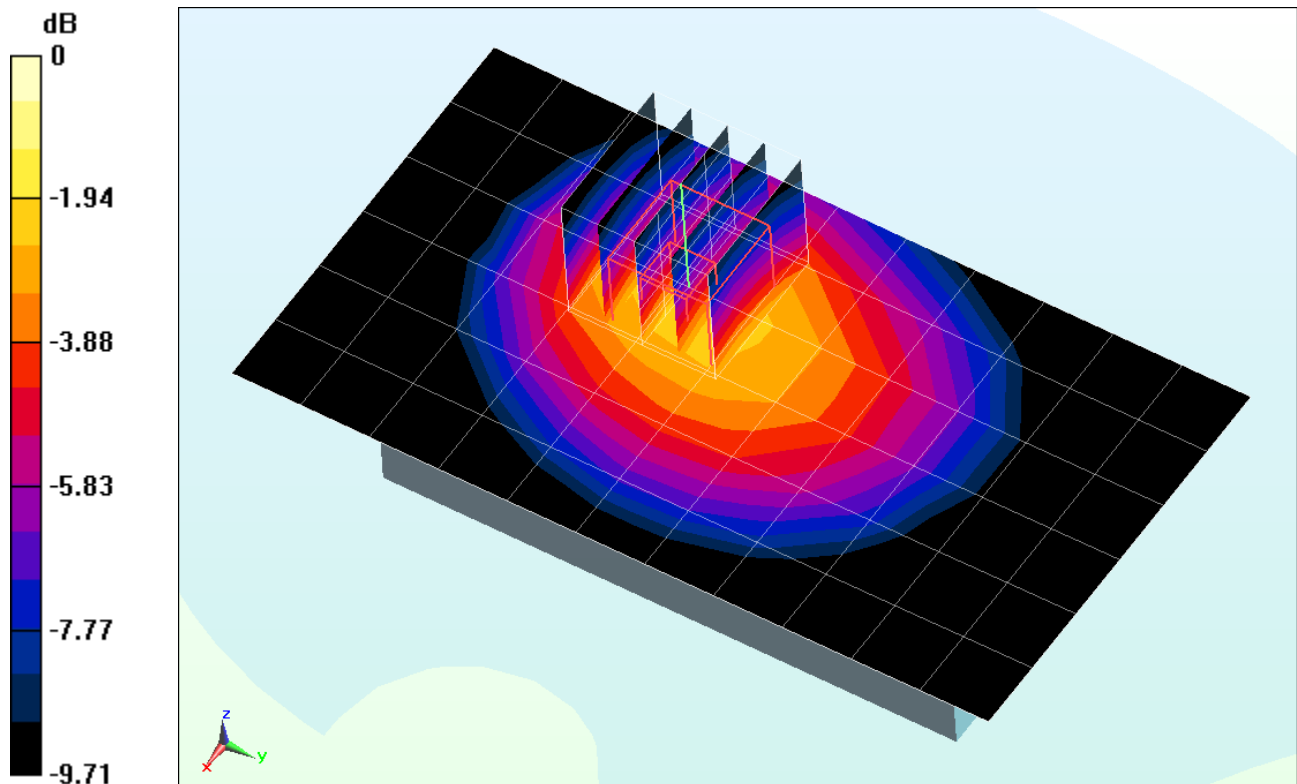
Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 13.466 V/m; Power Drift = -0.18 dB

Peak SAR (extrapolated) = 0.199 W/kg

SAR(1 g) = 0.154 W/kg



0 dB = 0.260 W/kg = -5.85 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 53

Communication System: IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 Body; Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 2.018 \text{ S/m}$; $\epsilon_r = 52.13$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 09-04-2013; Ambient Temp: 22.3°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3263; ConvF(4.33, 4.33, 4.33); Calibrated: 5/16/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/13/2013

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11b, Body SAR, Ch 06, 1 Mbps, Back Side

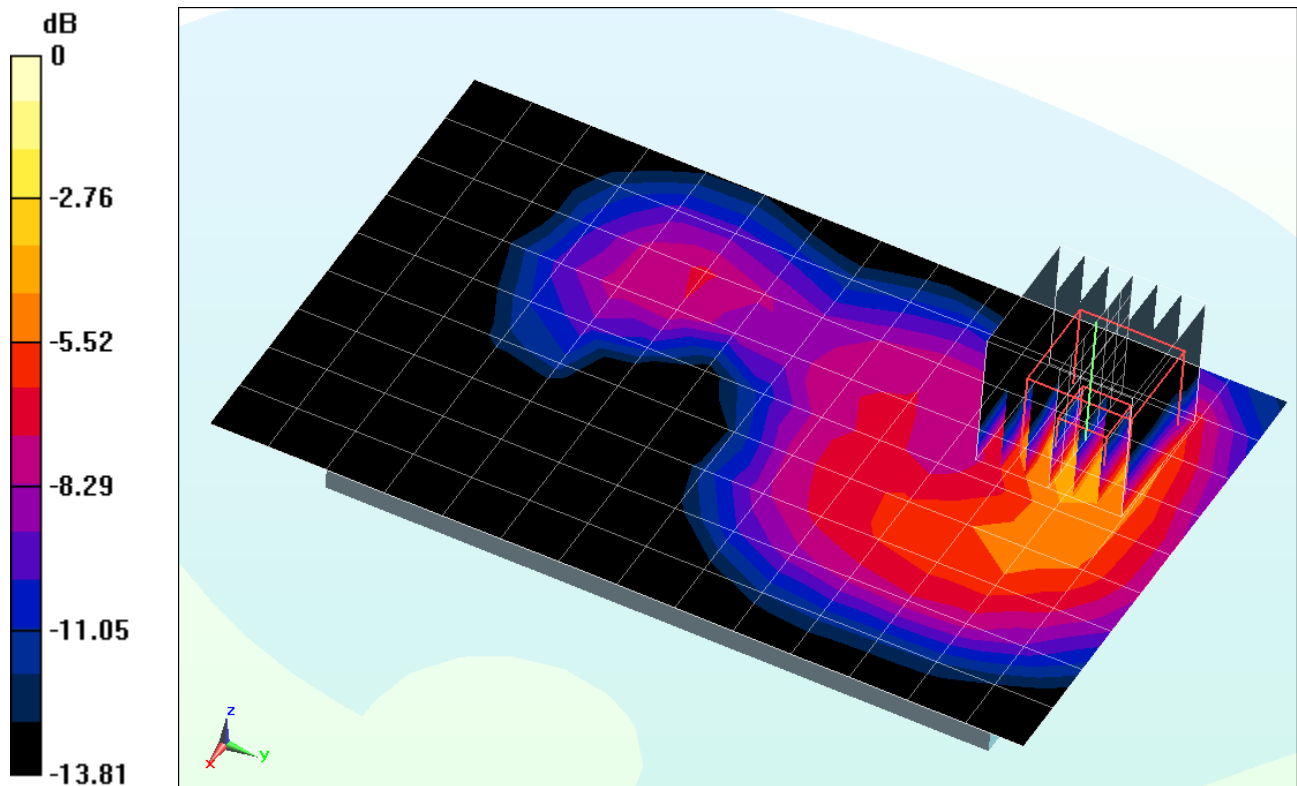
Area Scan (10x15x1): Measurement grid: dx=12mm, dy=12mm

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

Reference Value = 6.288 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.145 W/kg

SAR(1 g) = 0.0745 W/kg



0 dB = 0.193 W/kg = -7.15 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 59

Communication System: IEEE 802.11a; Frequency: 5765 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body; Medium parameters used:

$f = 5765 \text{ MHz}$; $\sigma = 6.117 \text{ S/m}$; $\epsilon_r = 49.324$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 09-04-2013; Ambient Temp: 23.9°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN3920; ConvF(3.91, 3.91, 3.91); Calibrated: 2/27/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 153, 6 Mbps, Back Side

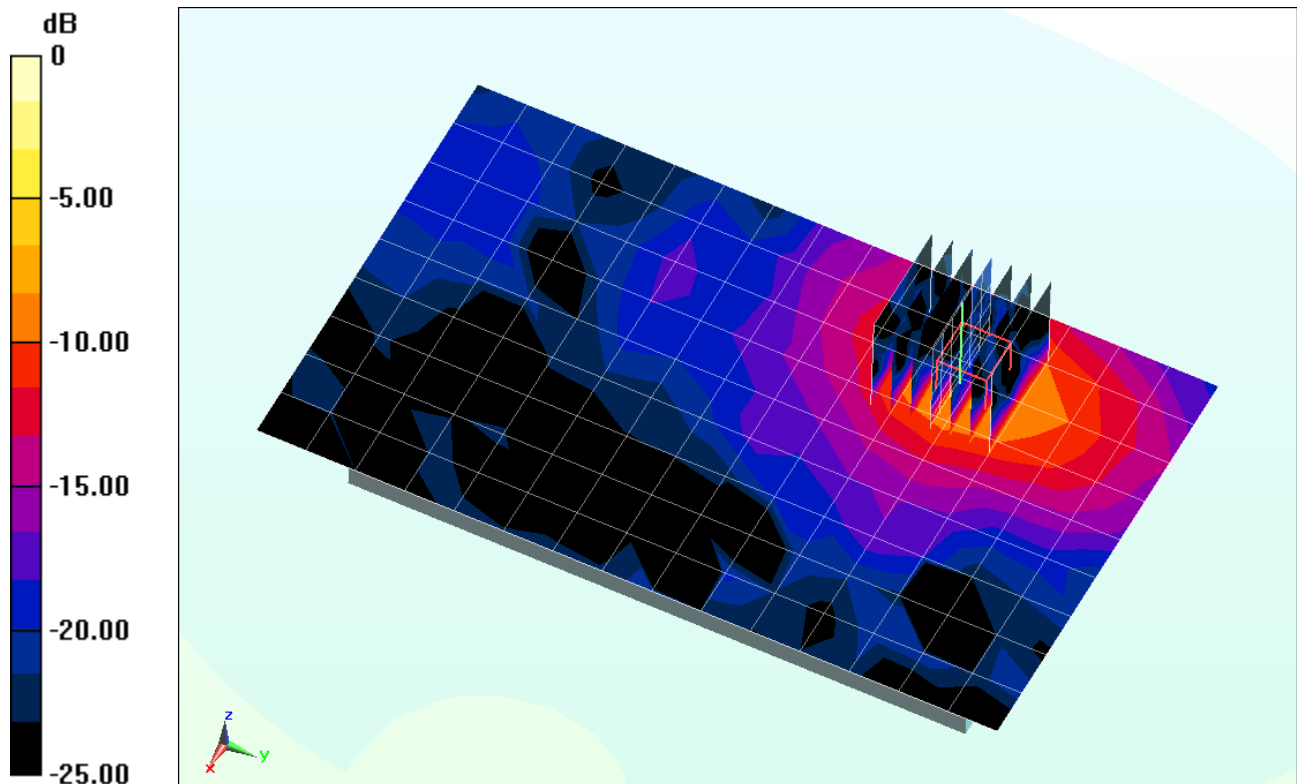
Area Scan (10x16x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 5.567 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 0.684 W/kg

SAR(1 g) = 0.175 W/kg



0 dB = 0.994 W/kg = -0.03 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 59

Communication System: IEEE 802.11a ; Frequency: 5520 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body; Medium parameters used:

$f = 5520 \text{ MHz}$; $\sigma = 5.747 \text{ S/m}$; $\epsilon_r = 49.839$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 09-04-2013; Ambient Temp: 24.0°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN3920; ConvF(3.63, 3.63, 3.63); Calibrated: 2/27/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.5 GHz, Body SAR, Ch 104, 6 Mbps, Back Side

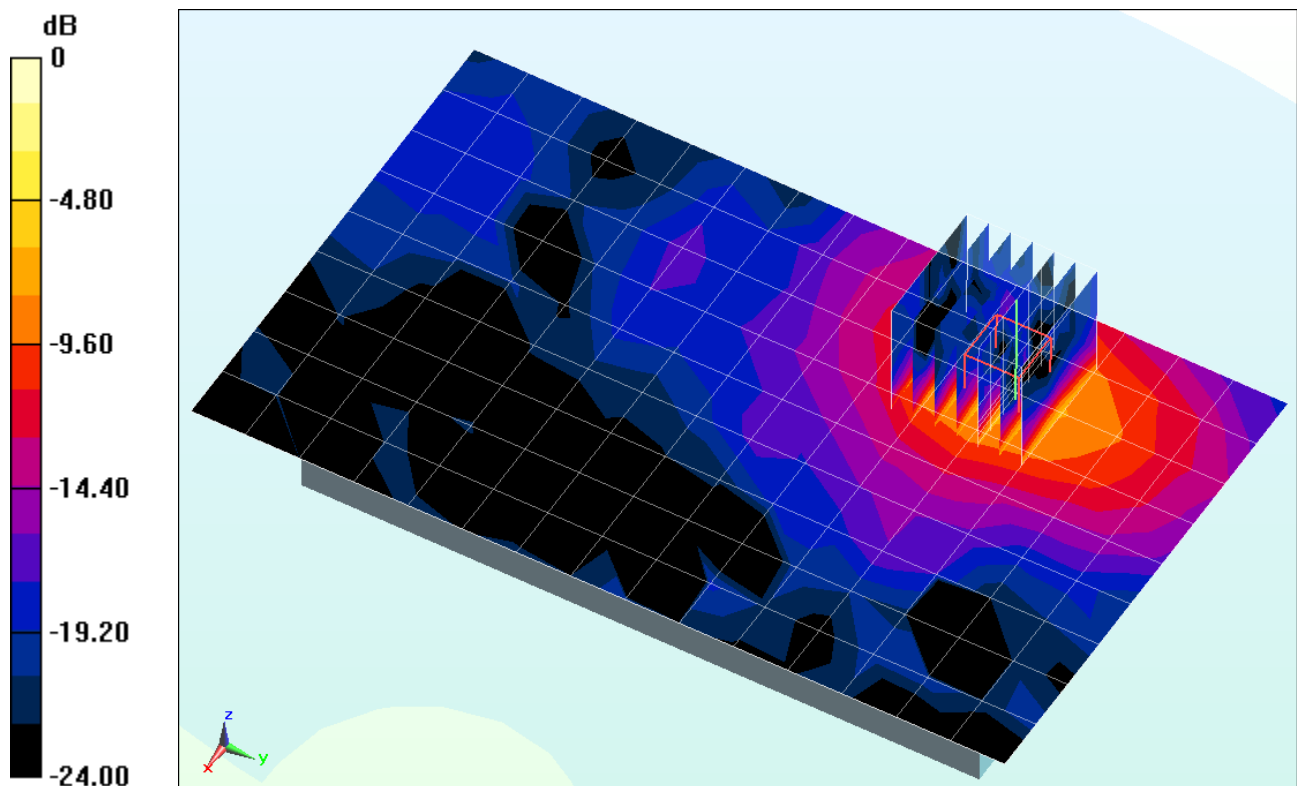
Area Scan (10x16x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 5.399 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.555 W/kg

SAR(1 g) = 0.163 W/kg



0 dB = 0.844 W/kg = -0.74 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 40

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

Medium: 835 Body; Medium parameters used (interpolated):

$f = 836.52 \text{ MHz}$; $\sigma = 0.969 \text{ S/m}$; $\epsilon_r = 55.017$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 09-12-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.7°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/8/2013

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: Cell. CDMA, Body SAR, Back side, Mid.ch

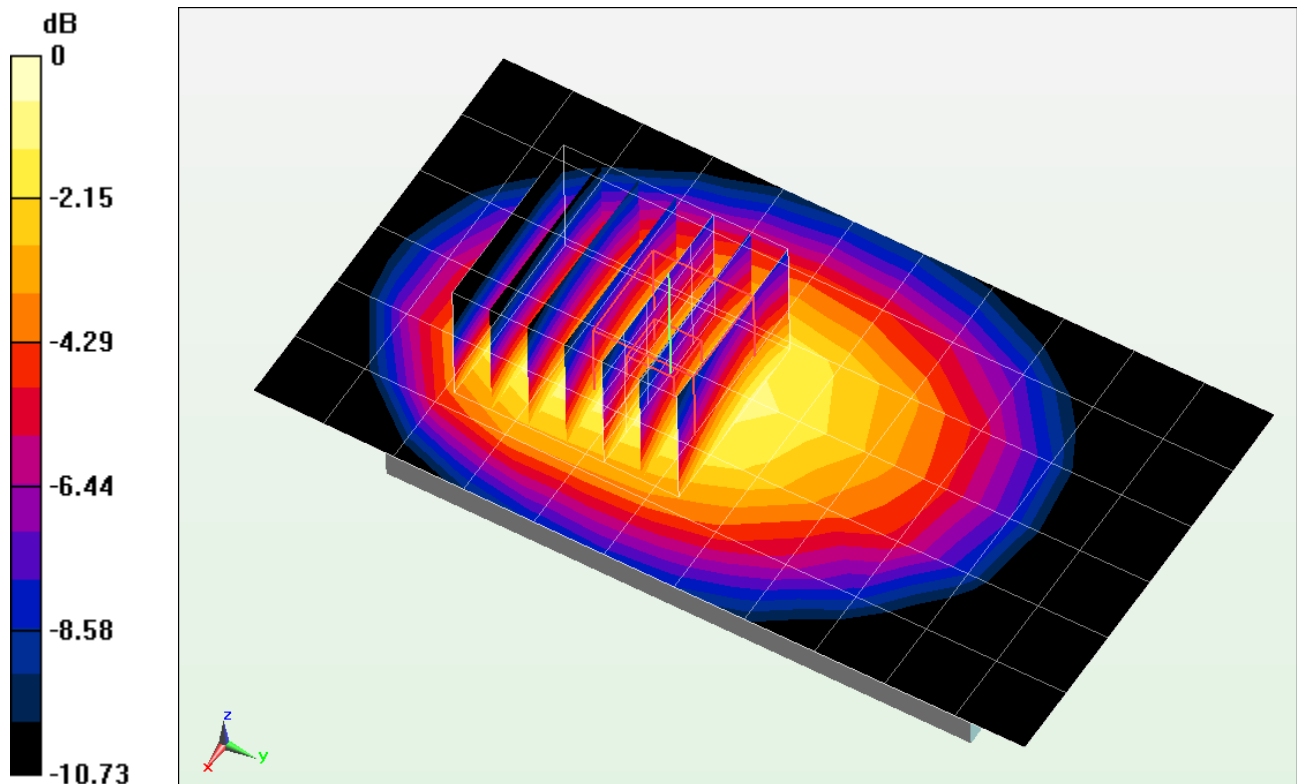
Area Scan (7x12x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (6x7x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 25.130 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.828 W/kg

SAR(1 g) = 0.567 W/kg



0 dB = 0.696 W/kg = -1.57 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 41

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

Medium: 1900 Body; Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.488 \text{ S/m}$; $\epsilon_r = 52.288$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 09-13-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.1°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/21/2013

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: PCS EVDO, Body SAR, Back side, Mid.ch

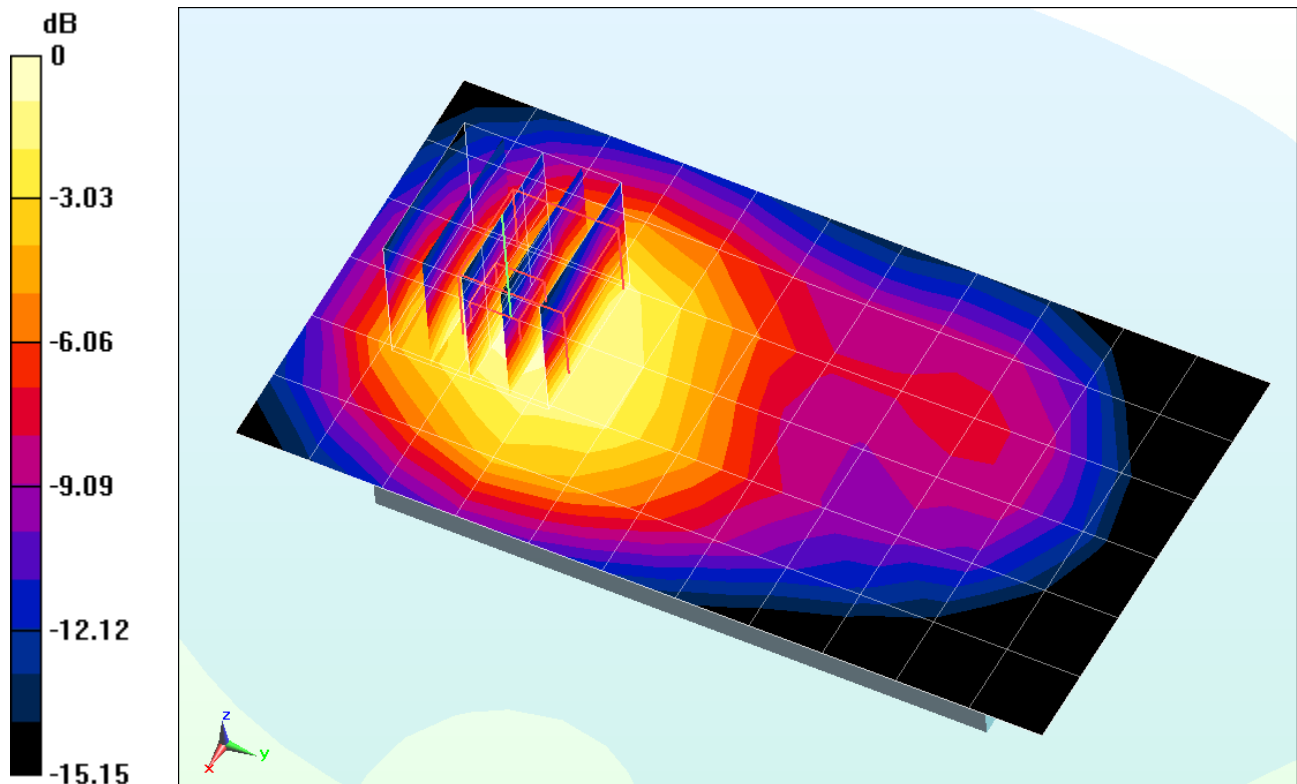
Area Scan (7x12x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 24.535 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 1.28 W/kg

SAR(1 g) = 0.772 W/kg



0 dB = 0.851 W/kg = -0.70 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 943

Communication System: LTE Band 5; Frequency: 836.5 MHz; Duty Cycle: 1:1

Medium: 835 Body; Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 1.002 \text{ S/m}$; $\epsilon_r = 53.529$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 09-06-2013; Ambient Temp: 24.4°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/8/2013

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

**Mode: LTE Band 5 (Cell.), Body SAR, Back side, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 25 RB Offset**

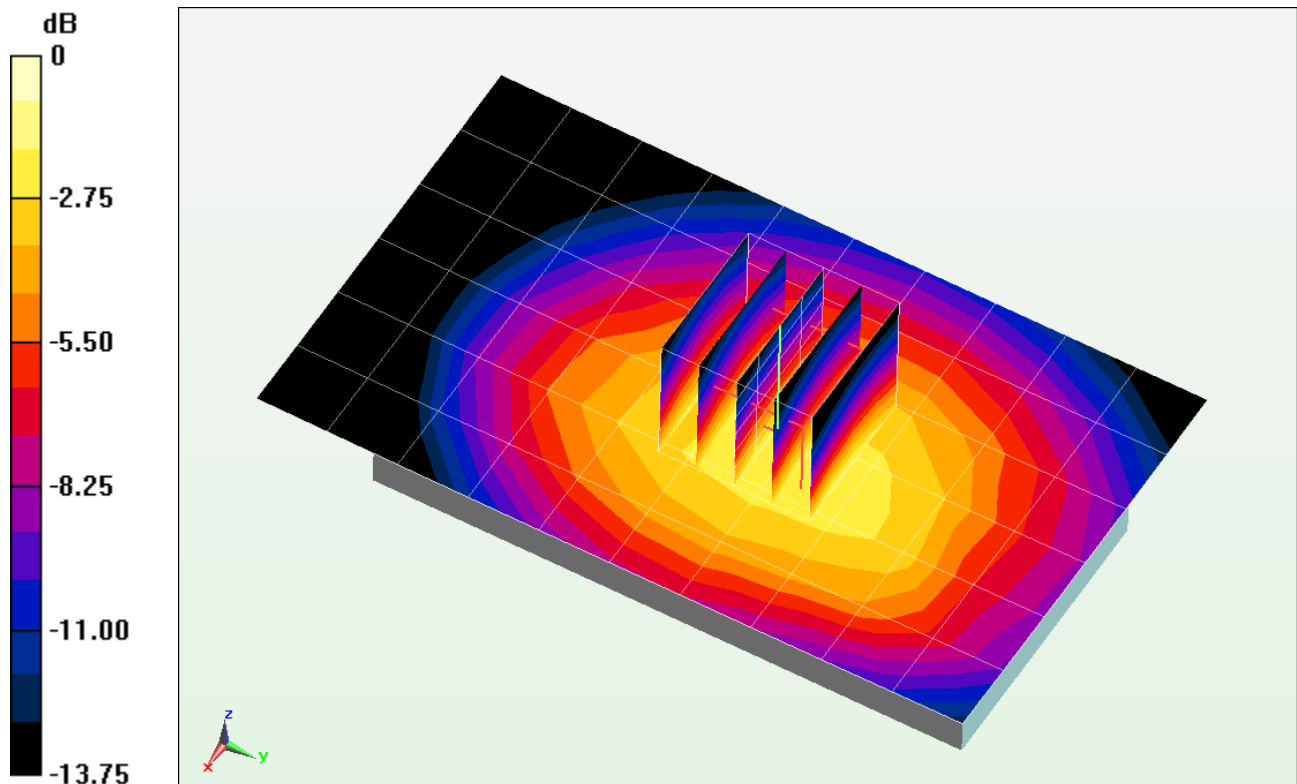
Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 21.064 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.550 W/kg

SAR(1 g) = 0.408 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 943

Communication System: LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: 740 Body; Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.931 \text{ S/m}$; $\epsilon_r = 56.393$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.0 cm

Test Date: 09-06-2013; Ambient Temp: 23.8°C; Tissue Temp: 22.9°C

Probe: EX3DV4 - SN3920; ConvF(9.57, 9.57, 9.57); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Mode: LTE Band 12, Body SAR, Back side, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 25 RB Offset**

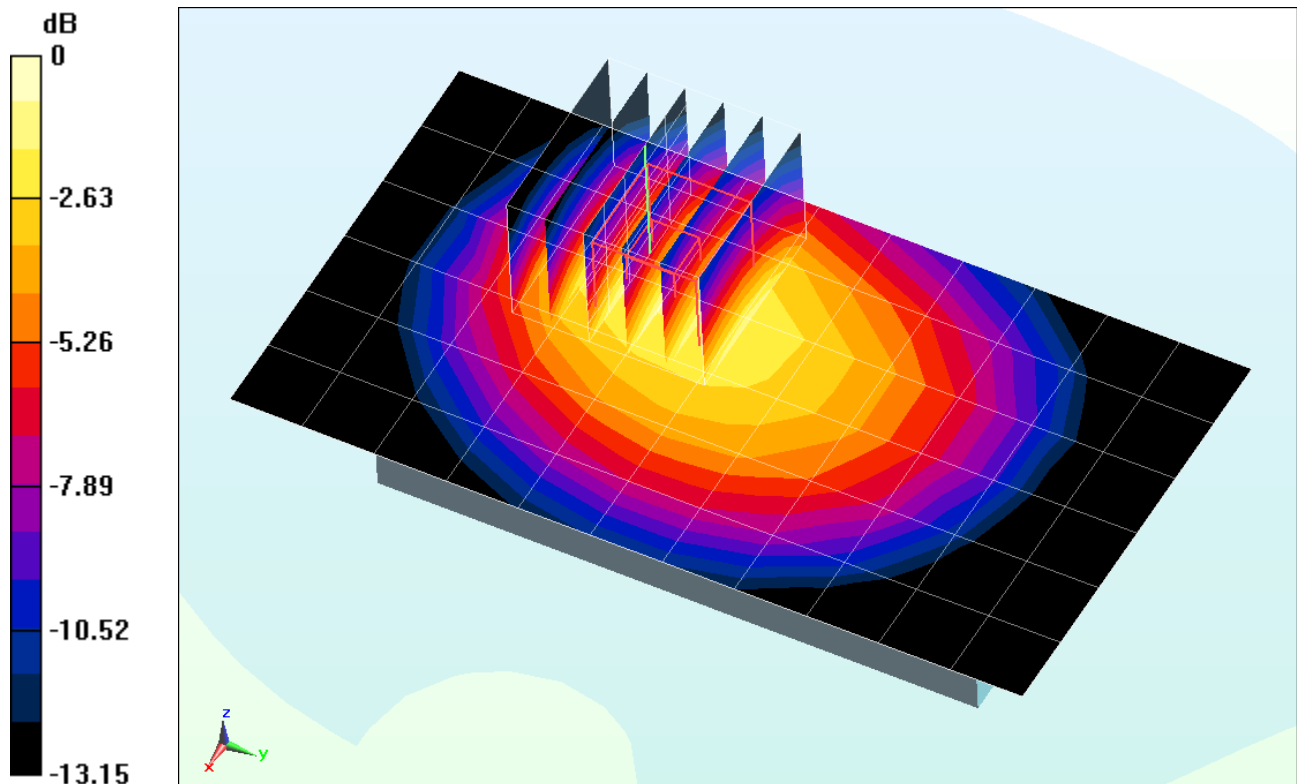
Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 16.392 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.324 W/kg

SAR(1 g) = 0.237 W/kg



0 dB = 0.250 W/kg = -6.02 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 53

Communication System: IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 Body; Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 1.989 \text{ S/m}$; $\epsilon_r = 50.882$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-28-2013; Ambient Temp: 22.6°C; Tissue Temp: 22.4°C

Probe: ES3DV3 - SN3318; ConvF(4.31, 4.31, 4.31); Calibrated: 4/29/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 4/22/2013

Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11b, Body SAR, Ch 06, 1 Mbps, Right Edge

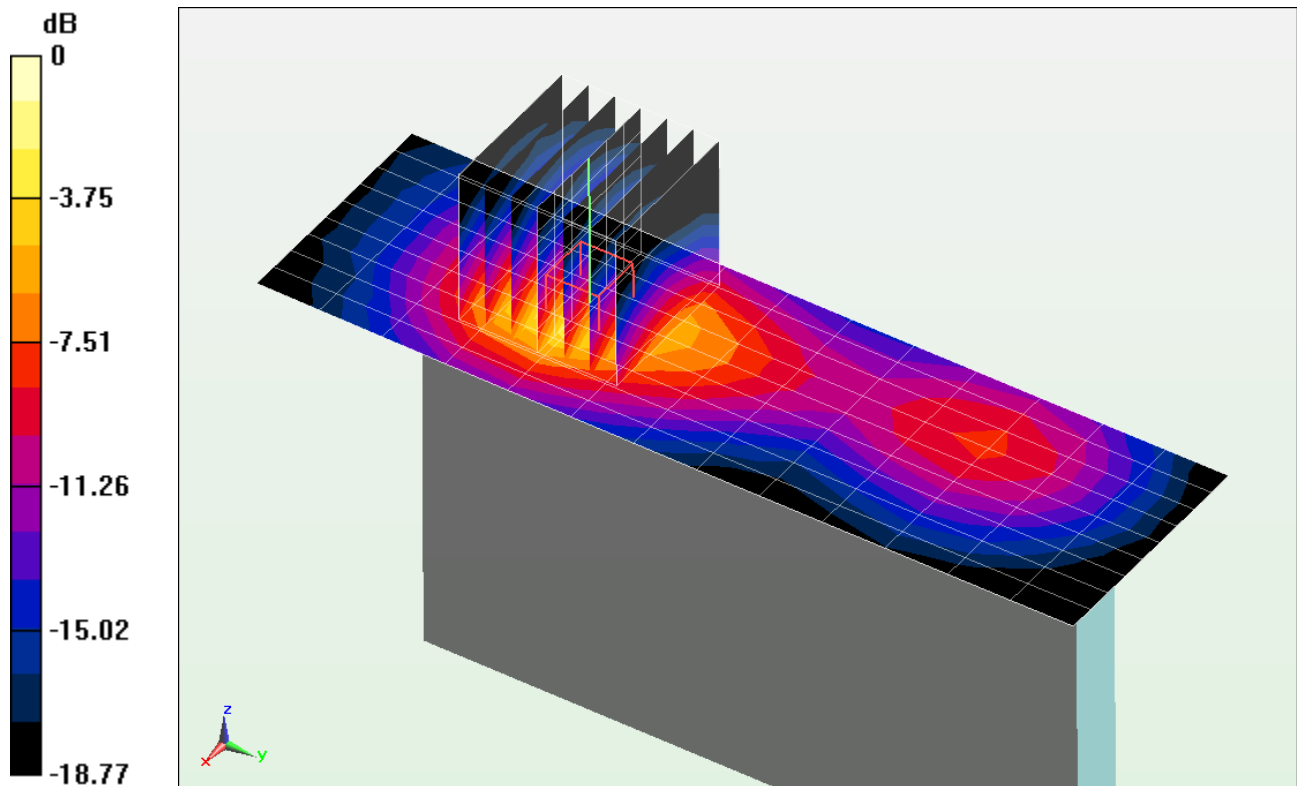
Area Scan (10x14x1): Measurement grid: $dx=5\text{mm}$, $dy=12\text{mm}$

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 10.898 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.436 W/kg

SAR(1 g) = 0.204 W/kg



0 dB = 0.371 W/kg = -4.31 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHR890; Type: Portable Handset; Serial: 59

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5785 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body; Medium parameters used:

$$f = 5785 \text{ MHz}; \sigma = 6.136 \text{ S/m}; \epsilon_r = 47.804; \rho = 1000 \text{ kg/m}^3$$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-27-2013; Ambient Temp: 24.1°C; Tissue Temp: 23.3°C

Probe: EX3DV4 - SN3589; ConvF(3.66, 3.66, 3.66); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 157, 6 Mbps, Back Side

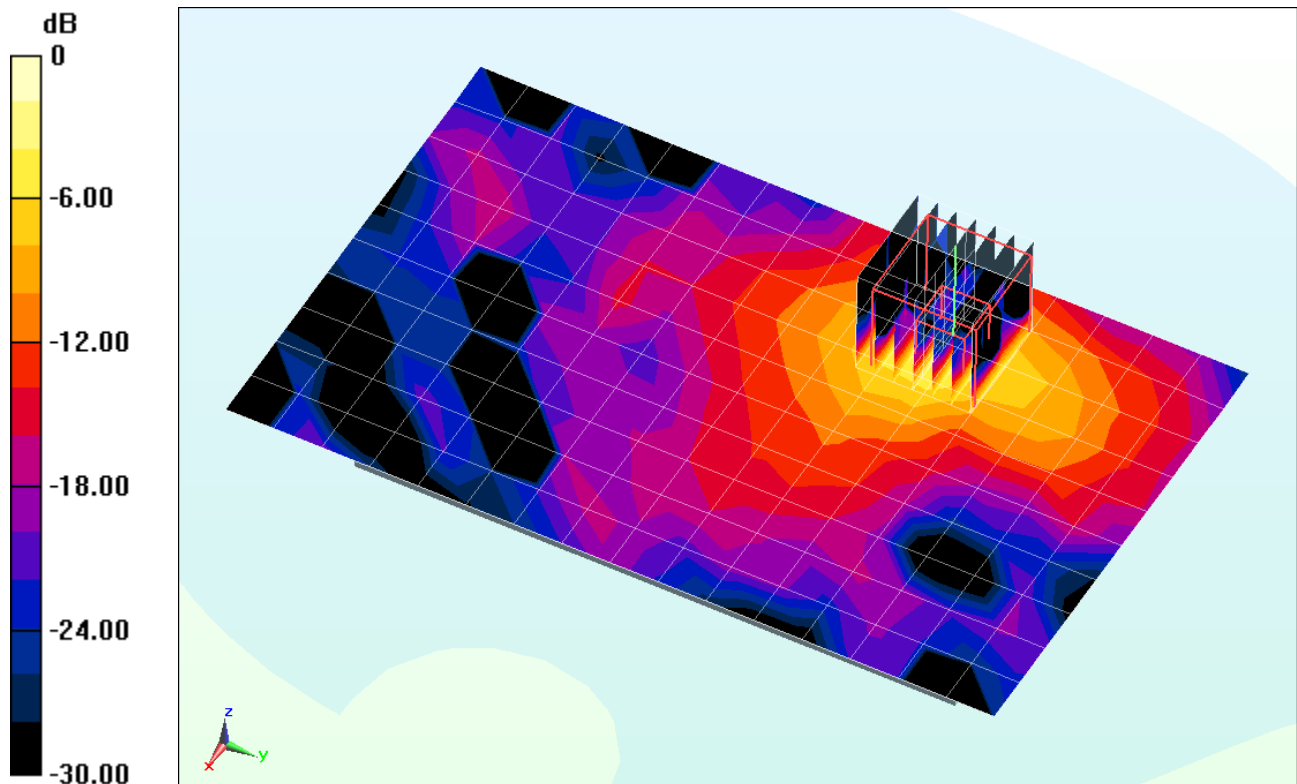
Area Scan (11x17x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 7.767 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 1.57 W/kg

SAR(1 g) = 0.338 W/kg



0 dB = 0.950 W/kg = -0.22 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 750 Head; Medium parameters used (interpolated):

$f = 750 \text{ MHz}$; $\sigma = 0.917 \text{ S/m}$; $\epsilon_r = 42.178$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 09-07-2013; Ambient Temp: 23.0°C; Tissue Temp: 22.6°C

Probe: ES3DV3 - SN3287; ConvF(6.4, 6.4, 6.4); Calibrated: 11/15/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/13/2012

Phantom: SAM with CRP; Type: SAM 4.0; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

750MHz System Verification

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

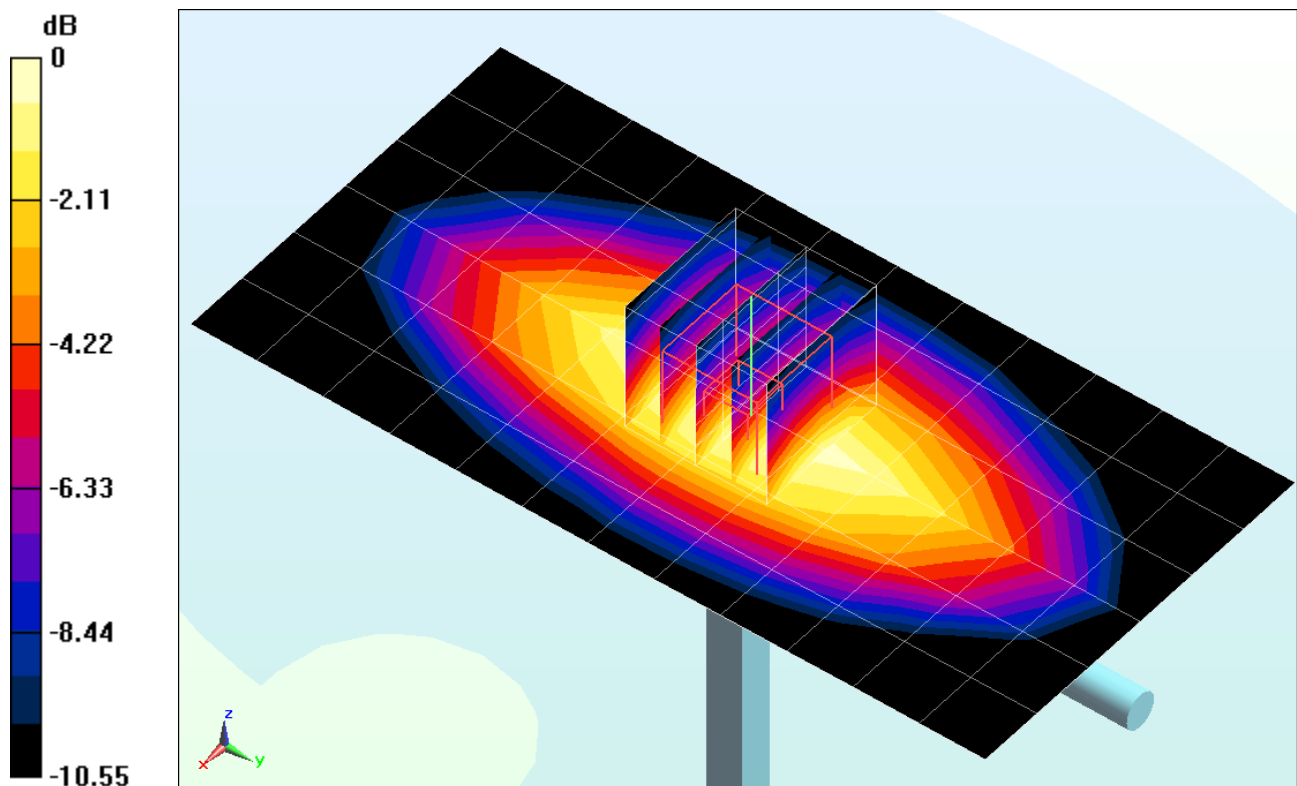
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.24 W/kg

SAR(1 g) = 0.856 W/kg

Deviation = 0.71%



0 dB = 0.925 W/kg = -0.34 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 835 Head; Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.937 \text{ S/m}$; $\epsilon_r = 43.339$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 08-28-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3209; ConvF(6.46, 6.46, 6.46); Calibrated: 3/15/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/8/2013

Phantom: SAM Right; Type: QD000P40CD; Serial: 1686

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

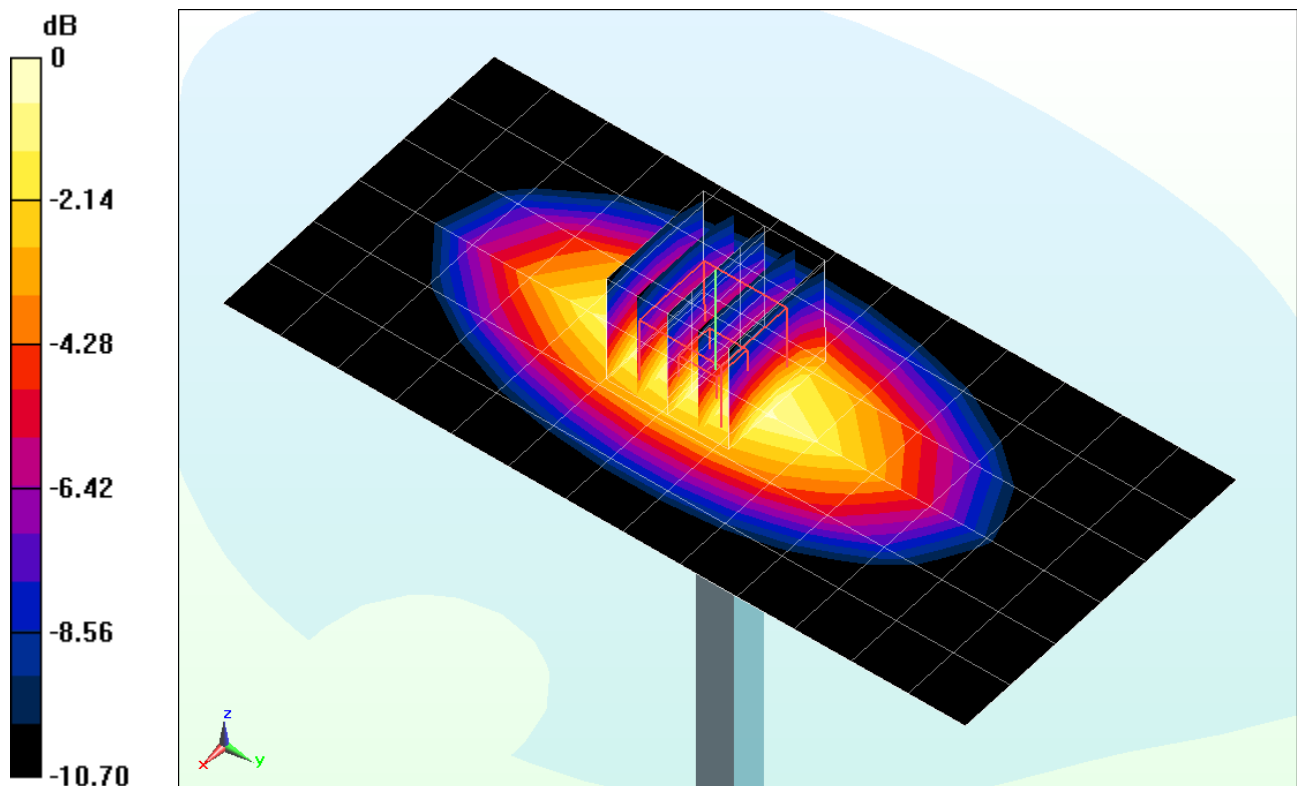
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.43 W/kg

SAR(1 g) = 0.972 W/kg

Deviation = 0.41%



0 dB = 1.06 W/kg = 0.25 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 835 Head; Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.908 \text{ S/m}$; $\epsilon_r = 41.264$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 09-11-2013; Ambient Temp: 23.5°C; Tissue Temp: 23.8°C

Probe: EX3DV4 - SN3920; ConvF(9.58, 9.58, 9.58); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

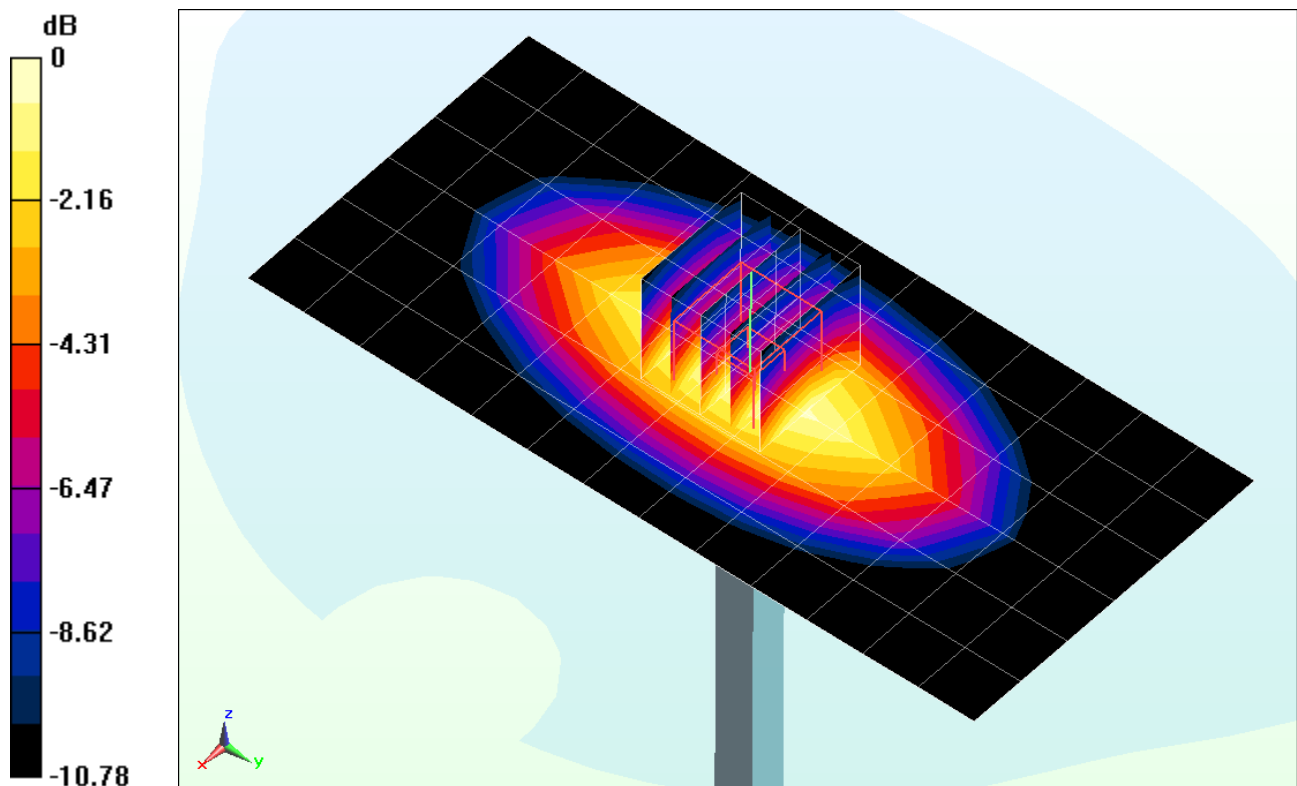
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.48 W/kg

SAR(1 g) = 0.980 W/kg

Deviation = 1.24%



0 dB = 1.06 W/kg = 0.25 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1900 Head; Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.453 \text{ S/m}$; $\epsilon_r = 40.596$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-29-2013; Ambient Temp: 22.0°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3920; ConvF(7.73, 7.73, 7.73); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

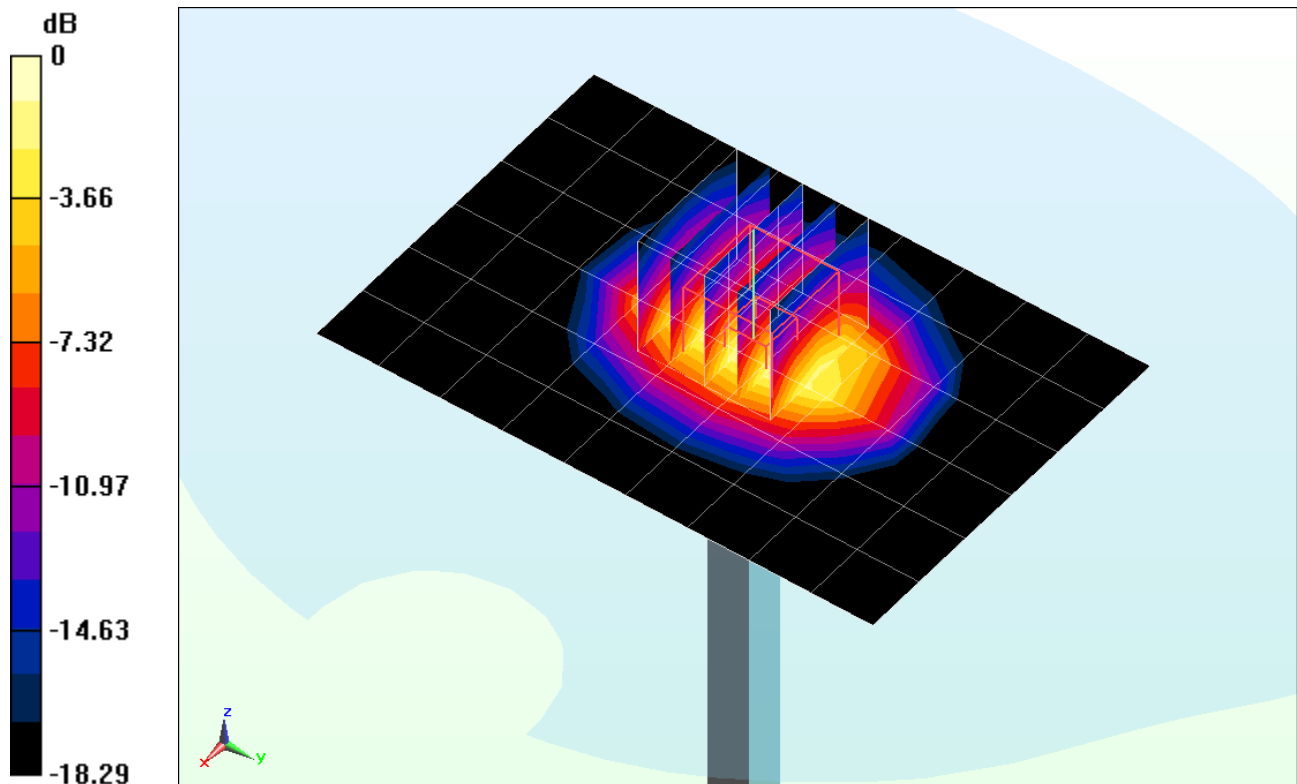
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.53 W/kg

SAR(1 g) = 4.02 W/kg

Deviation = 1.26%



0 dB = 4.51 W/kg = 6.54 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 2450 Head; Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.784 \text{ S/m}$; $\epsilon_r = 39.207$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-28-2013; Ambient Temp: 23.3°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3288; ConvF(4.61, 4.61, 4.61); Calibrated: 9/20/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 9/19/2012

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

2450 MHz System Verification

Area Scan (9x10x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

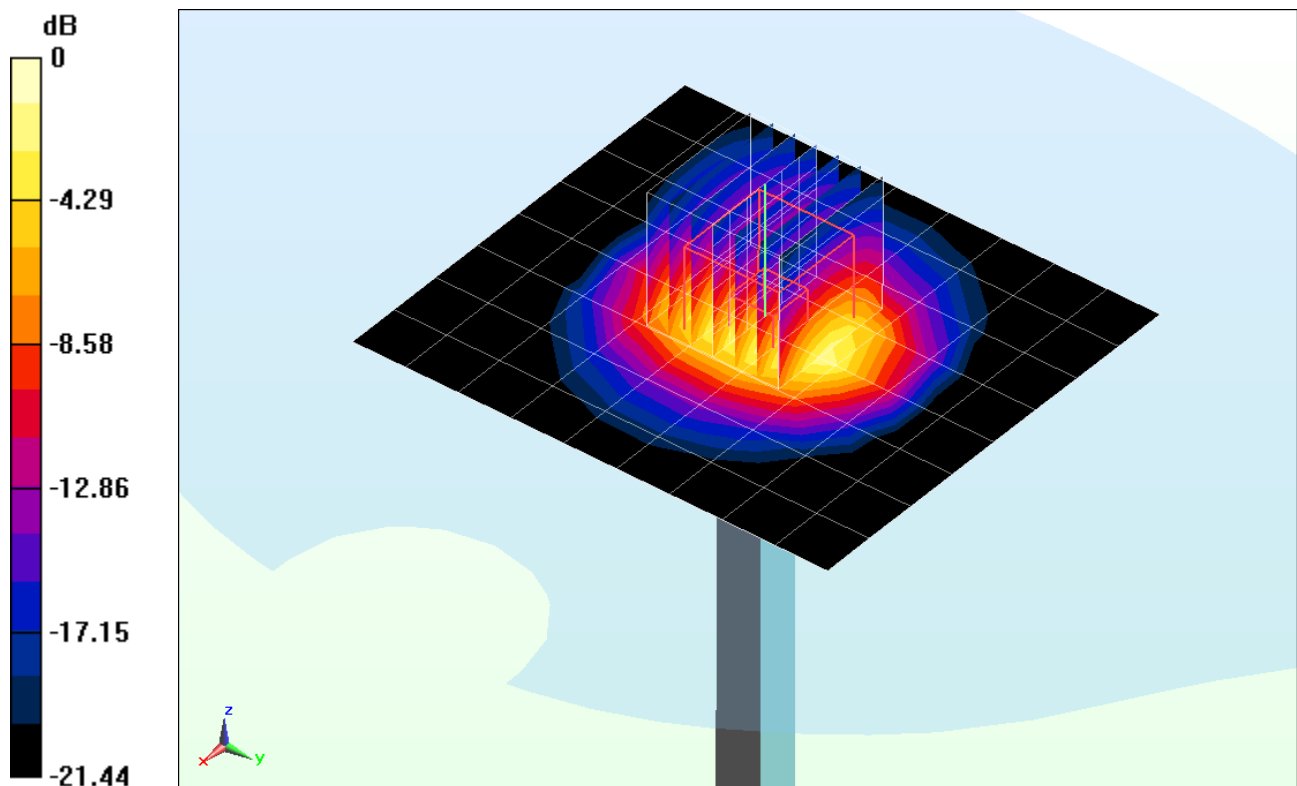
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 10.5 W/kg

SAR(1 g) = 5.12 W/kg

Deviation = -2.48%



0 dB = 5.83 W/kg = 7.66 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Head; Medium parameters used:

$f = 5200 \text{ MHz}$; $\sigma = 4.535 \text{ S/m}$; $\epsilon_r = 35.117$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-30-2013; Ambient Temp: 22.8°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3589; ConvF(4.48, 4.48, 4.48); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5200MHz System Verification

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

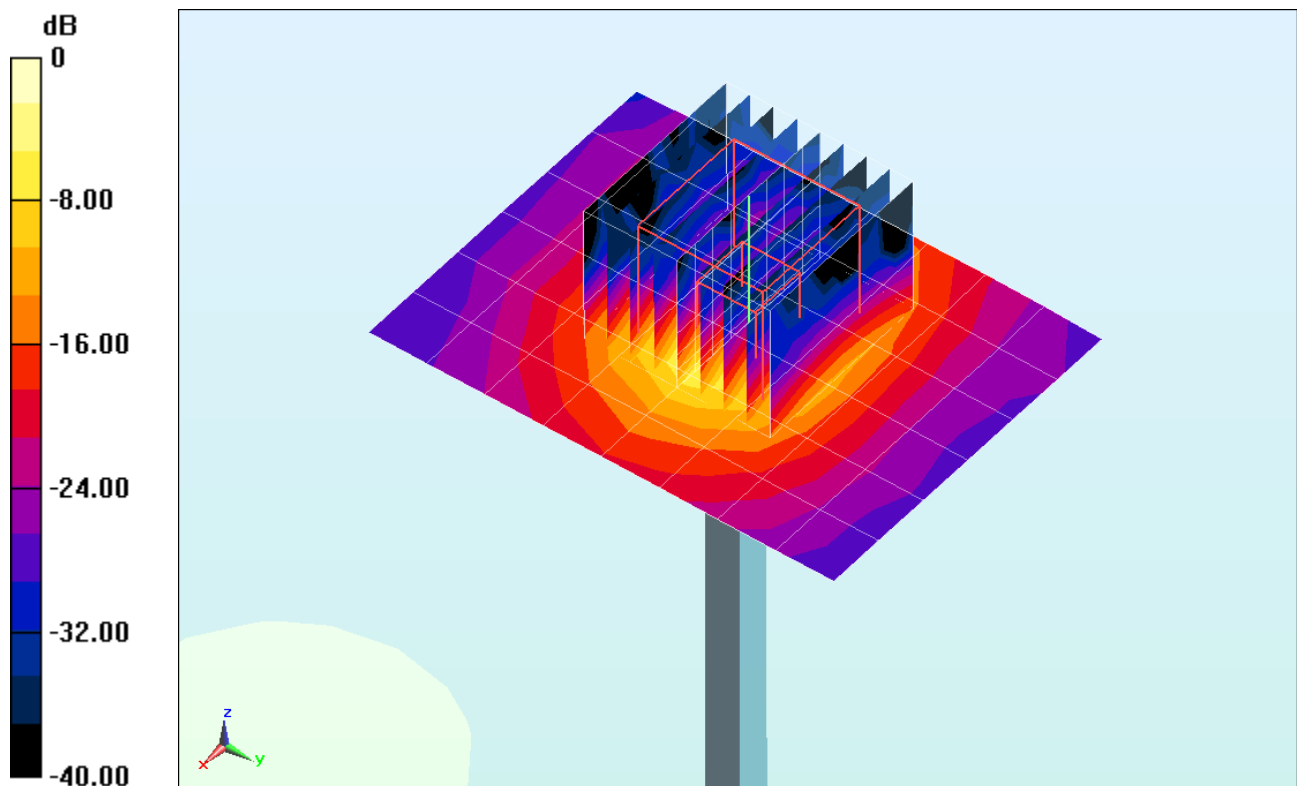
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 30.6 W/kg

SAR(1 g) = 7.26 W/kg

Deviation = -4.35%



PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Head; Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 4.664 \text{ S/m}$; $\epsilon_r = 34.813$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-30-2013; Ambient Temp: 22.8°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3589; ConvF(4.27, 4.27, 4.27); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5300MHz System Verification

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

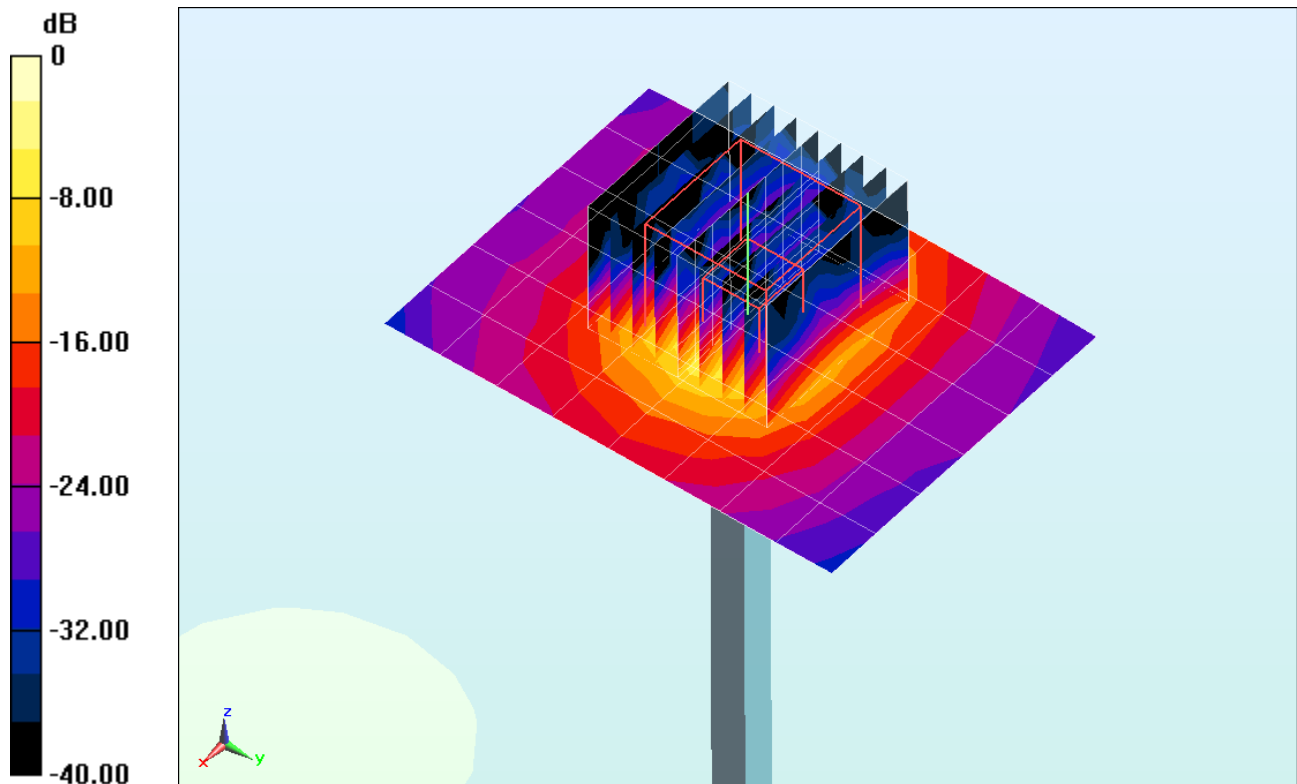
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 34.5 W/kg

SAR(1 g) = 7.9 W/kg

Deviation = 2.73%



0 dB = 20.1 W/kg = 13.03 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head; Medium parameters used:

$f = 5500 \text{ MHz}$; $\sigma = 4.922 \text{ S/m}$; $\epsilon_r = 34.329$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-30-2013; Ambient Temp: 22.8°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3589; ConvF(4.14, 4.14, 4.14); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5500MHz System Verification

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

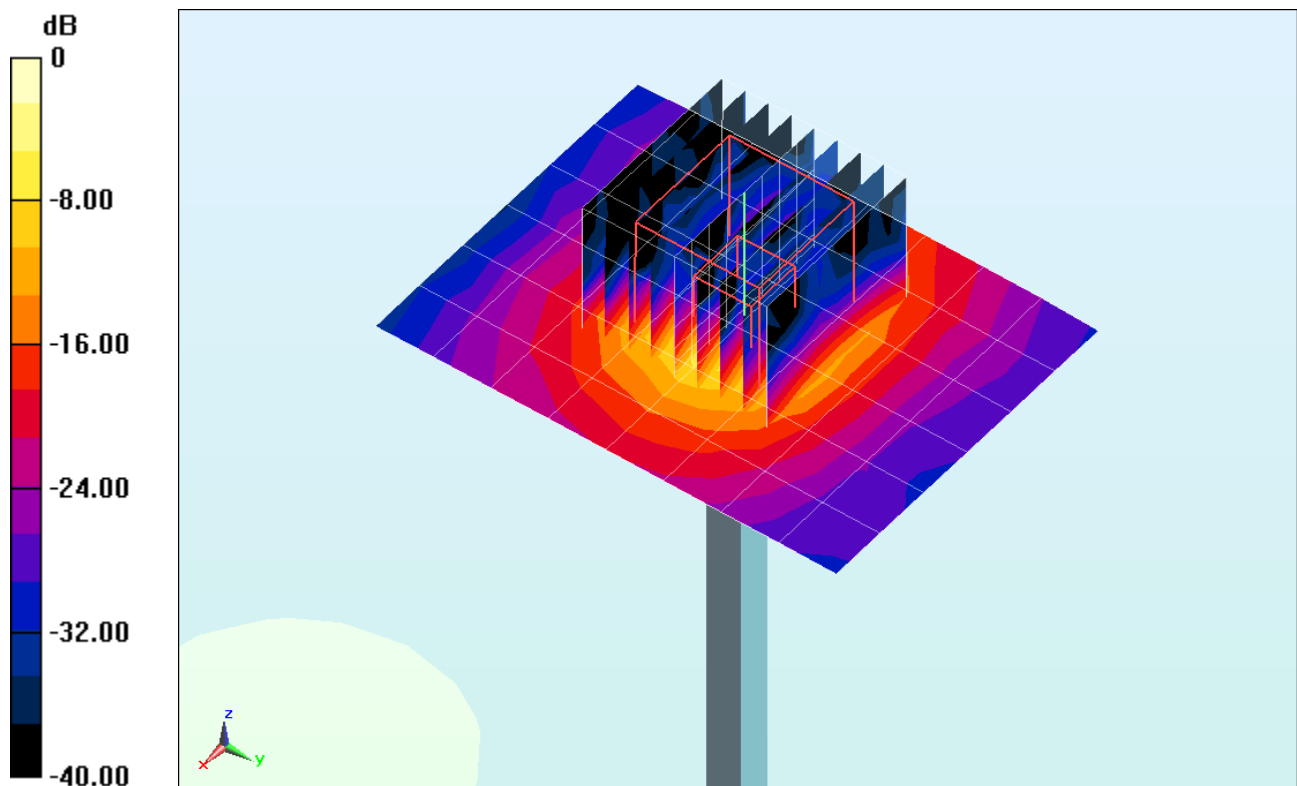
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 34.0 W/kg

SAR(1 g) = 7.61 W/kg

Deviation = -4.99%



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

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Head; Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 5.317 \text{ S/m}$; $\epsilon_r = 33.808$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-30-2013; Ambient Temp: 22.9°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN3589; ConvF(3.85, 3.85, 3.85); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5800MHz System Verification

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

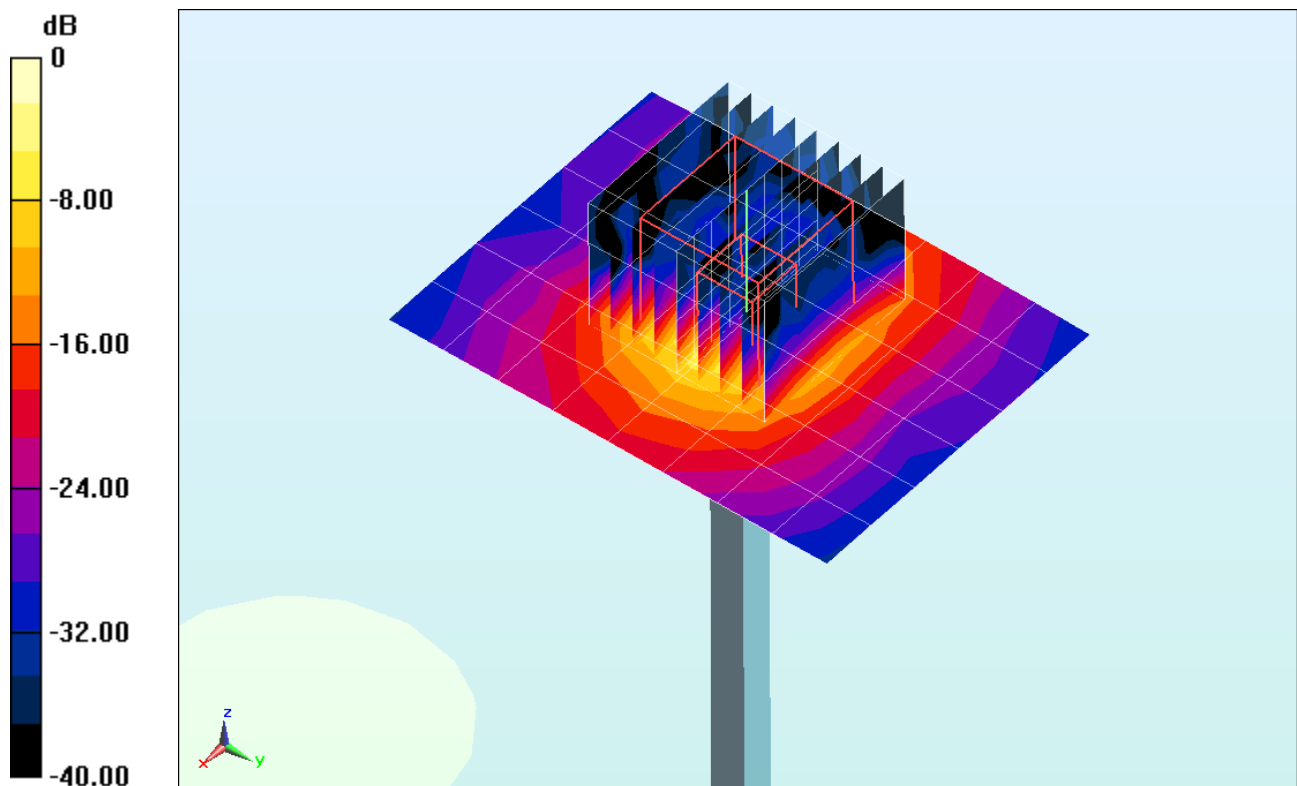
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 36.5 W/kg

SAR(1 g) = 7.63 W/kg

Deviation = 0.26%



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1003

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

Medium: 750 Body; Medium parameters used (interpolated):

$f = 750 \text{ MHz}$; $\sigma = 0.974 \text{ S/m}$; $\epsilon_r = 56.084$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 09-06-2013; Ambient Temp: 23.8°C; Tissue Temp: 22.9°C

Probe: EX3DV4 - SN3920; ConvF(9.57, 9.57, 9.57); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

750 MHz System Verification

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

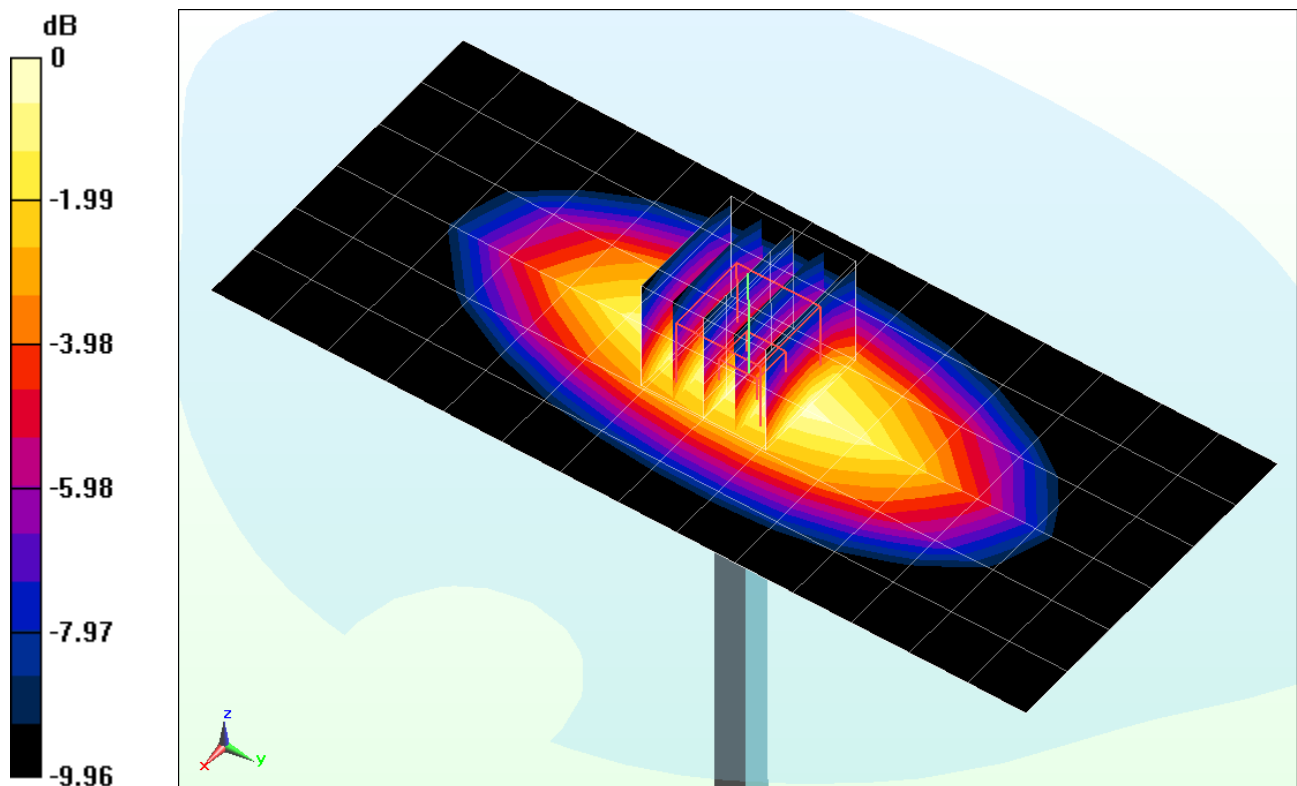
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.24 W/kg

SAR(1 g) = 0.846 W/kg

Deviation = -4.19%



0 dB = 0.912 W/kg = -0.40 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 835 Body; Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 1 \text{ S/m}$; $\epsilon_r = 53.534$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 09-06-2013; Ambient Temp: 24.4°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/8/2013

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

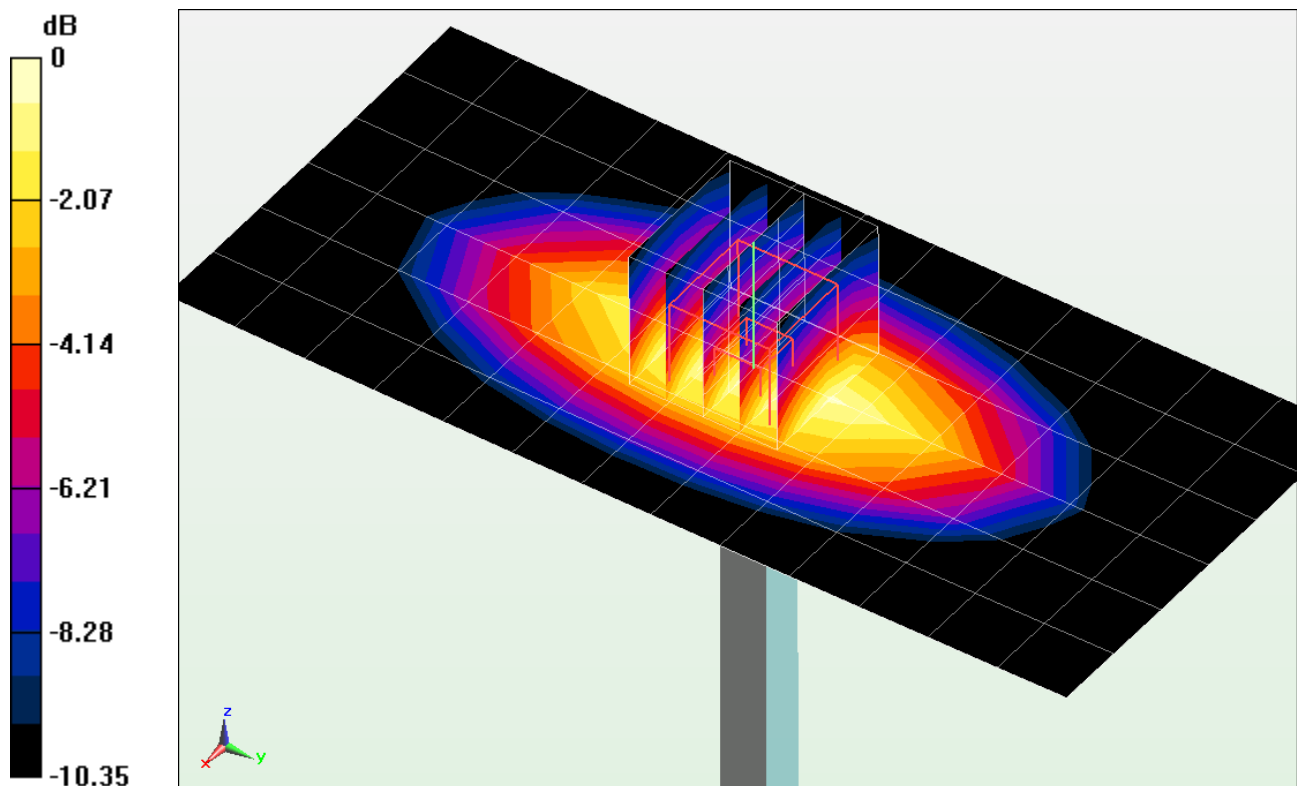
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.43 W/kg

SAR(1 g) = 0.980 W/kg

Deviation = 2.73%



0 dB = 1.06 W/kg = 0.25 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1900 Body; Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.532 \text{ S/m}$; $\epsilon_r = 51.884$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-29-2013; Ambient Temp: 23.1°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

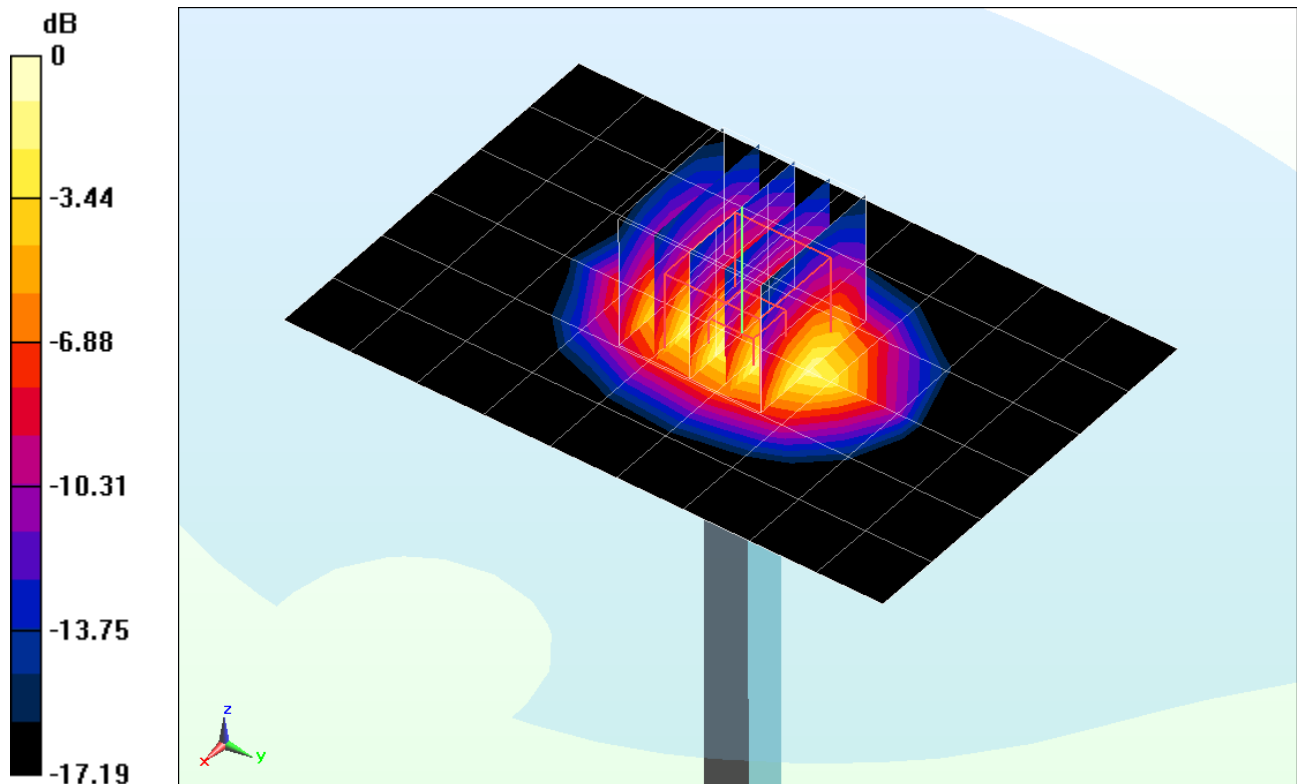
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.44 W/kg

SAR(1 g) = 4.14 W/kg

Deviation = 1.47%



0 dB = 4.64 W/kg = 6.67 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1900 Body; Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.506 \text{ S/m}$; $\epsilon_r = 52.21$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 09-13-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.1°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/21/2013

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

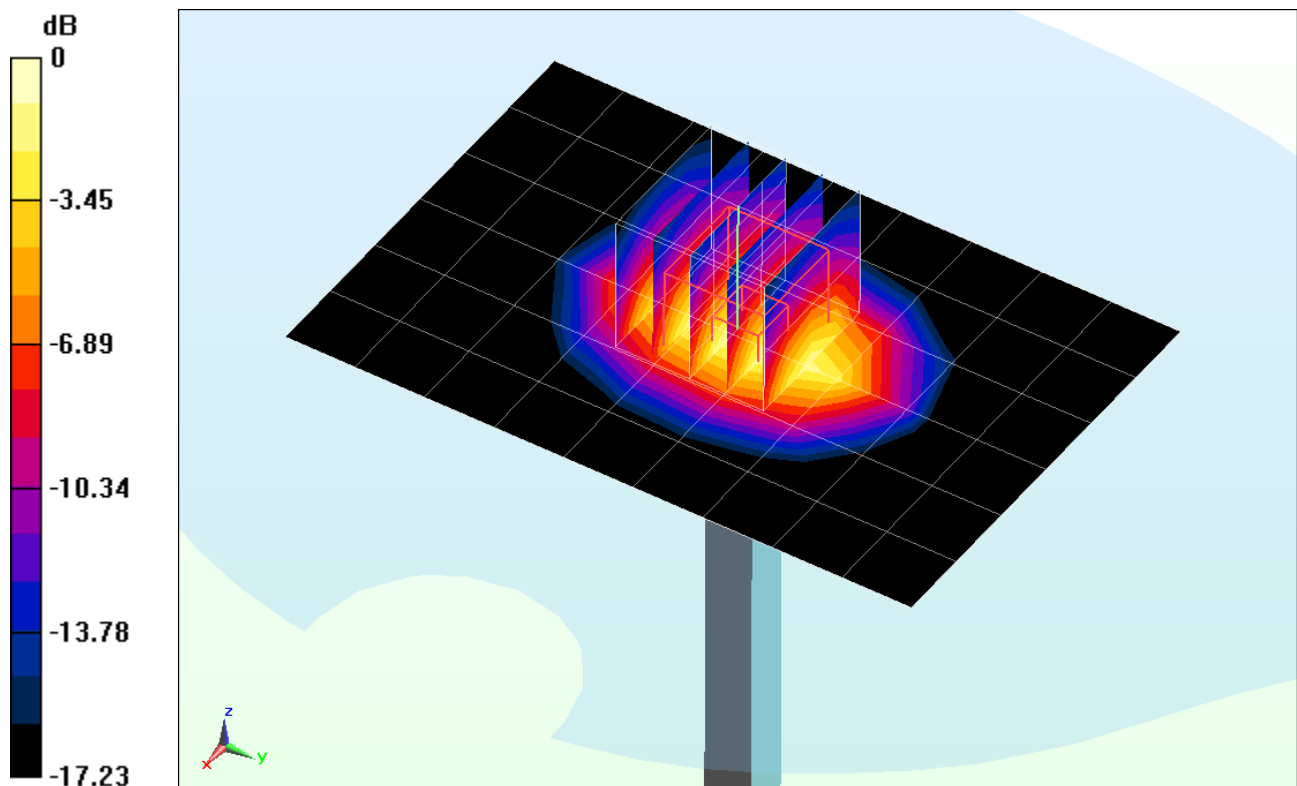
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.28 W/kg

SAR(1 g) = 4.1 W/kg

Deviation = 0.49%



0 dB = 4.58 W/kg = 6.61 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 2450 Body; Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 2.005 \text{ S/m}$; $\epsilon_r = 50.84$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-28-2013; Ambient Temp: 22.6°C; Tissue Temp: 22.4°C

Probe: ES3DV3 - SN3318; ConvF(4.31, 4.31, 4.31); Calibrated: 4/29/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 4/22/2013

Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

2450 MHz System Verification

Area Scan (8x9x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

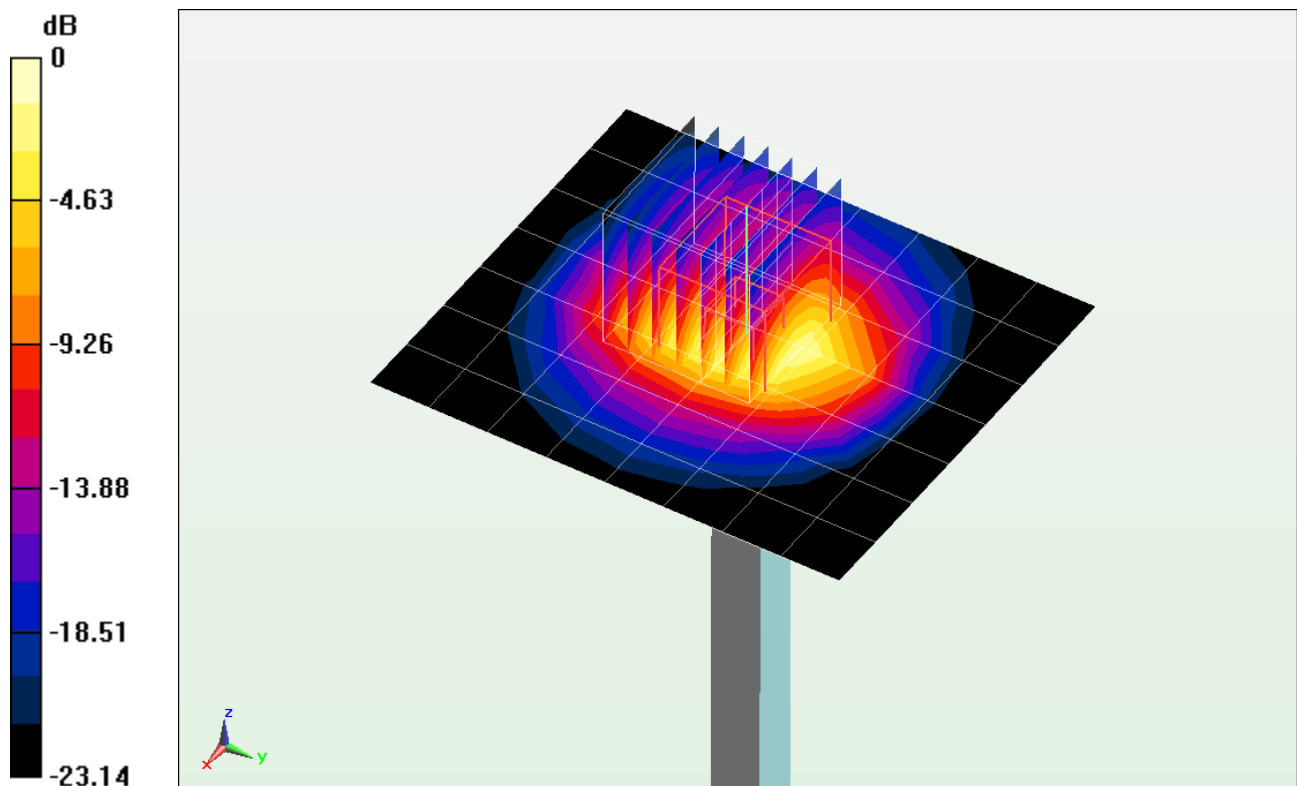
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 10.6 W/kg

SAR(1 g) = 4.99 W/kg

Deviation = 0.60%



0 dB = 6.60 W/kg = 8.20 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 2450 Body; Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 2.036 \text{ S/m}$; $\epsilon_r = 52.07$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 09-04-2013; Ambient Temp: 22.3°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3263; ConvF(4.33, 4.33, 4.33); Calibrated: 5/16/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/13/2013

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

2450MHz System Verification

Area Scan (6x9x1): Measurement grid: dx=12mm, dy=12mm

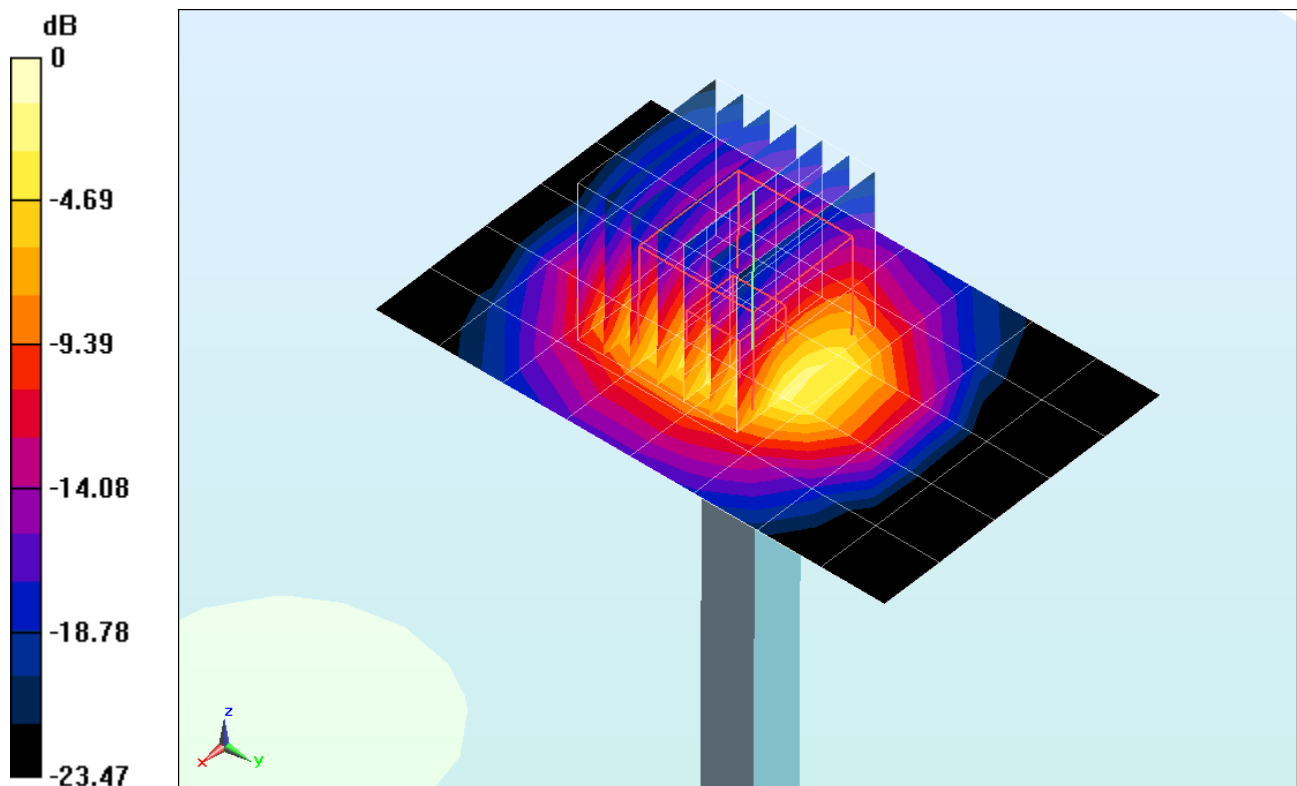
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 11.8 W/kg

SAR(1 g) = 5.2 W/kg

Deviation = 4.21%



0 dB = 6.75 W/kg = 8.29 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Body; Medium parameters used:

$f = 5200 \text{ MHz}$; $\sigma = 5.269 \text{ S/m}$; $\epsilon_r = 50.562$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 09-04-2013; Ambient Temp: 24.1°C; Tissue Temp: 22.9°C

Probe: EX3DV4 - SN3920; ConvF(4.23, 4.23, 4.23); Calibrated: 2/27/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

5200 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

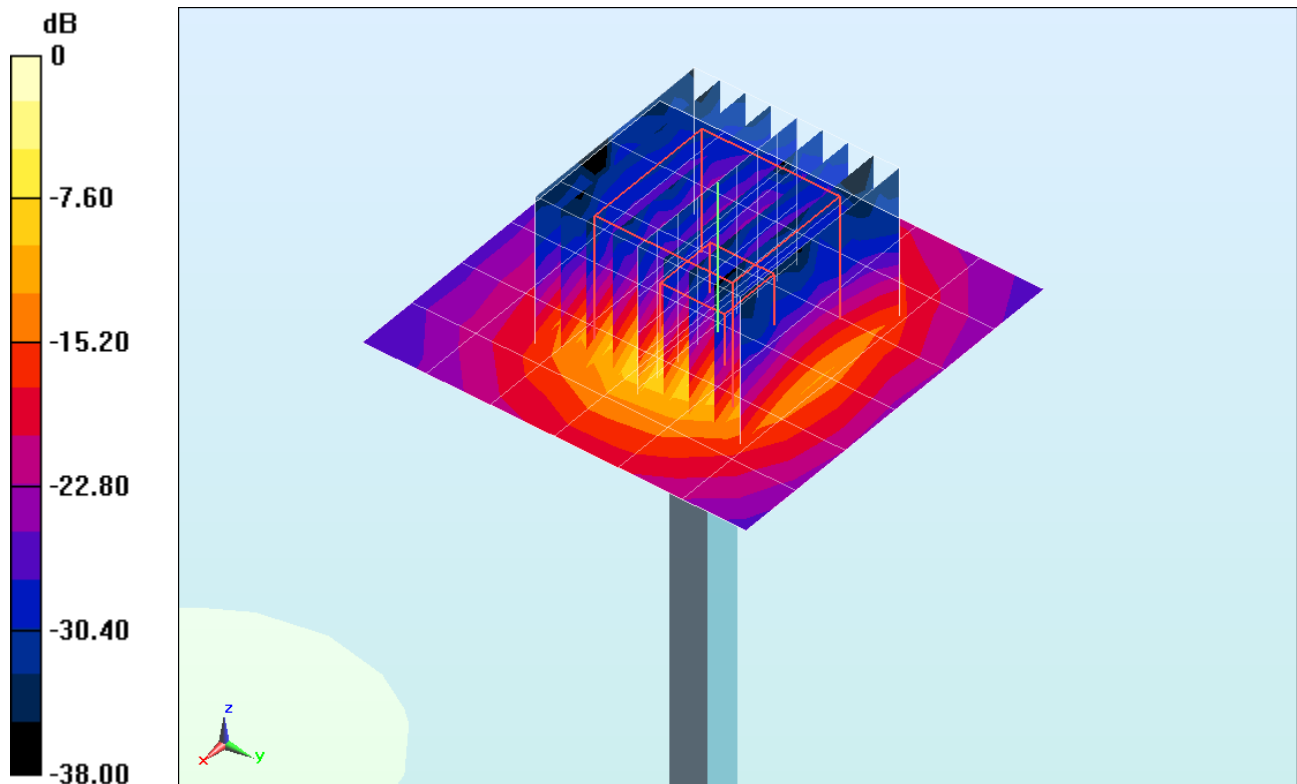
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 26.7 W/kg

SAR(1 g) = 7.23 W/kg

Deviation = -5.61%



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1120

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

Medium: 5 GHz Body; Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 5.418 \text{ S/m}$; $\epsilon_r = 50.323$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 09-04-2013; Ambient Temp: 23.9°C; Tissue Temp: 22.9°C

Probe: EX3DV4 - SN3920; ConvF(4.13, 4.13, 4.13); Calibrated: 2/27/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

5300 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm

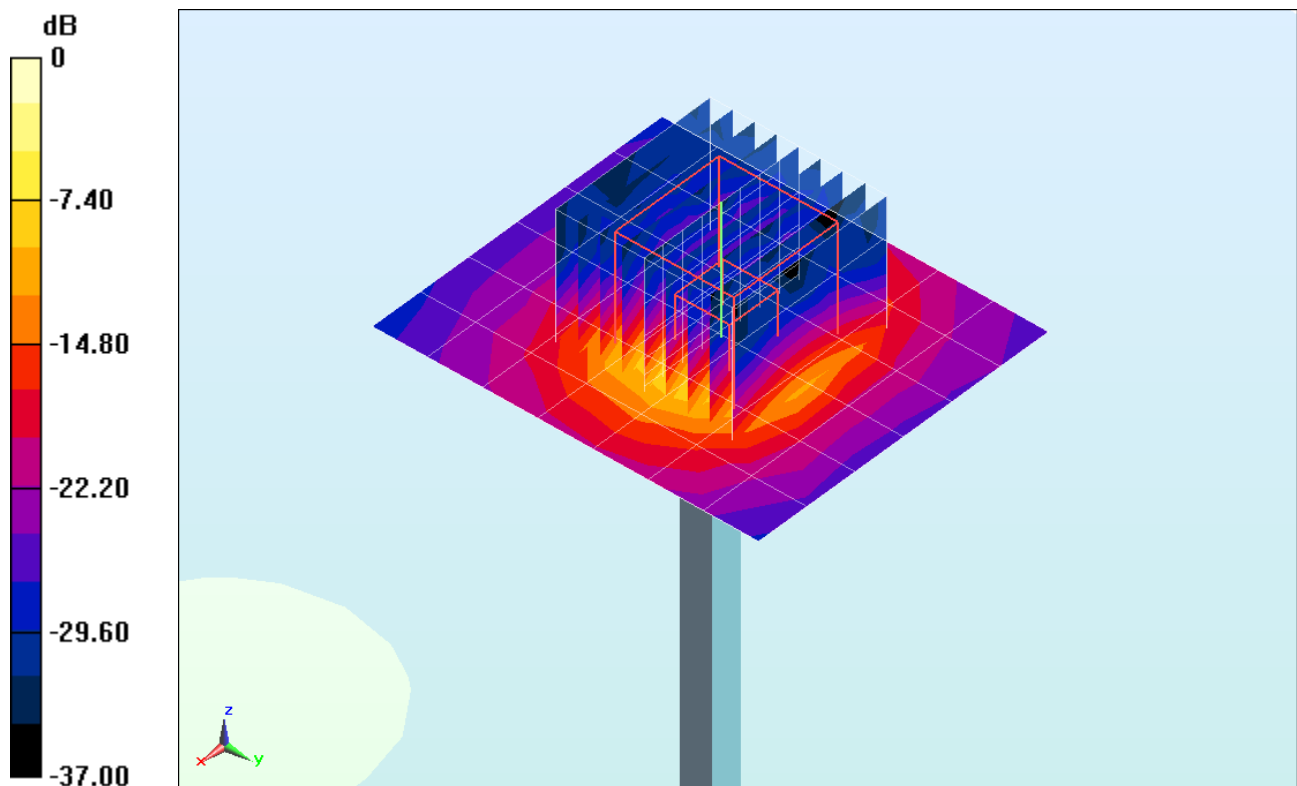
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 7.18 W/kg

Deviation = -6.51%



0 dB = 17.7 W/kg = 12.48 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1120

Communication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body; Medium parameters used:

$f = 5500 \text{ MHz}$; $\sigma = 5.716 \text{ S/m}$; $\epsilon_r = 49.975$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 09-04-2013; Ambient Temp: 24.0°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN3920; ConvF(3.63, 3.63, 3.63); Calibrated: 2/27/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

5500 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

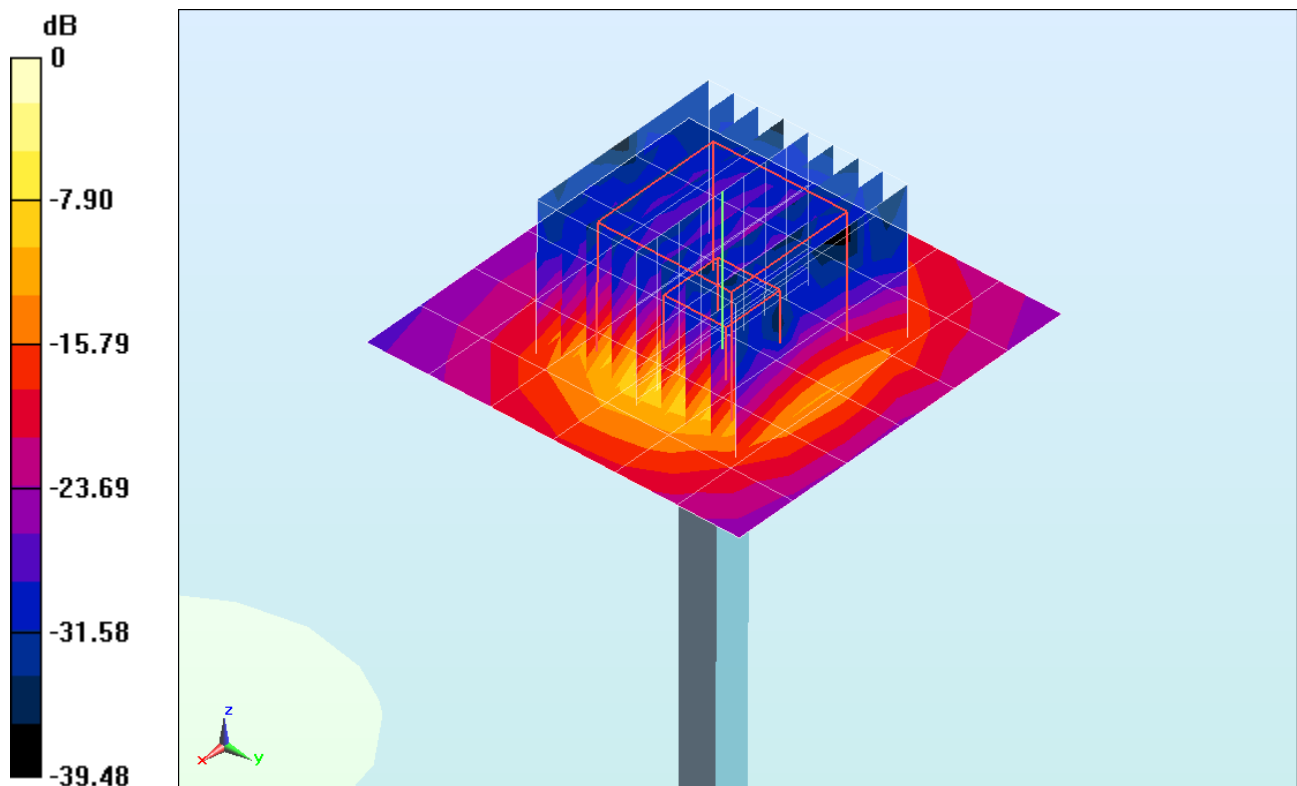
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 33.5 W/kg

SAR(1 g) = 8.27 W/kg

Deviation = 3.63%



0 dB = 21.0 W/kg = 13.22 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Body; Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 6.145 \text{ S/m}$; $\epsilon_r = 47.81$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-27-2013; Ambient Temp: 24.1°C; Tissue Temp: 23.3°C

Probe: EX3DV4 - SN3589; ConvF(3.66, 3.66, 3.66); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5800MHz System Verification

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

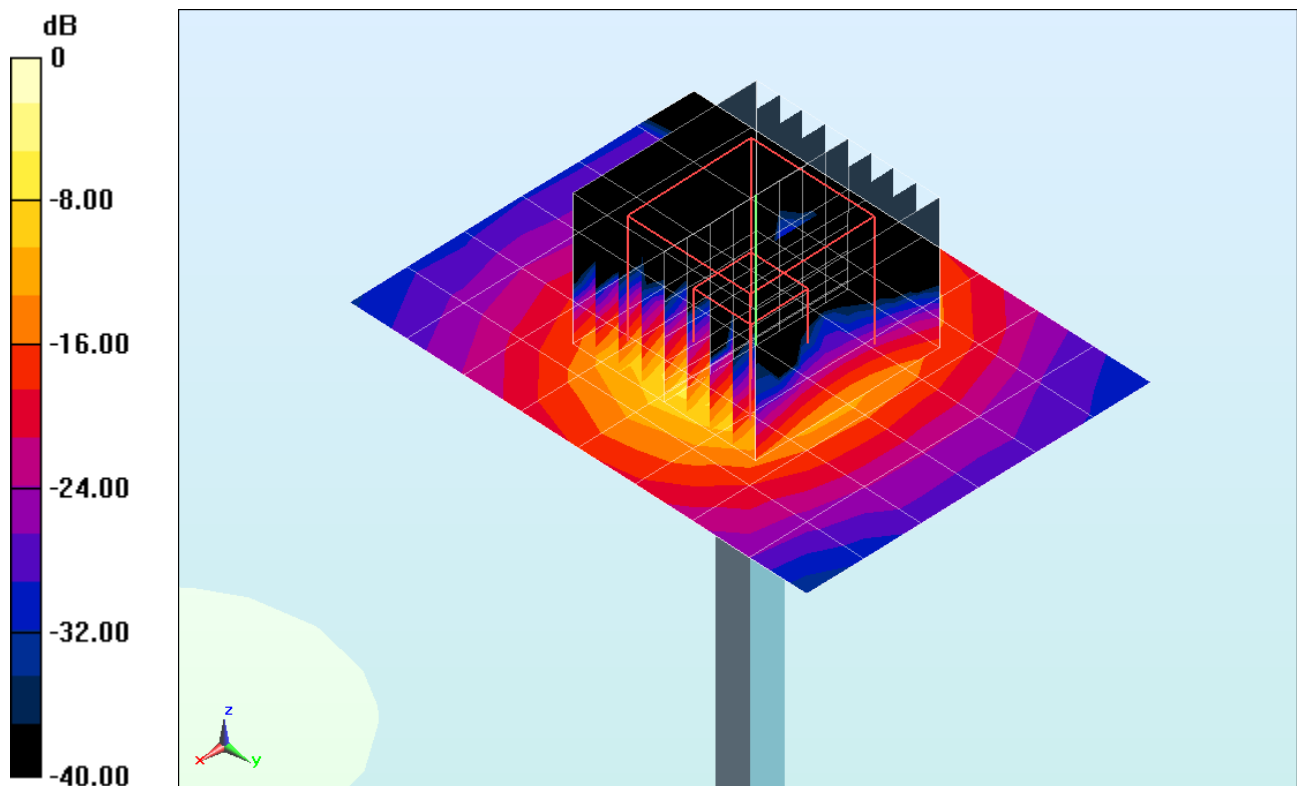
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 30.7 W/kg

SAR(1 g) = 7.86 W/kg

Deviation = 4.66%



0 dB = 19.5 W/kg = 12.90 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Body; Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 6.189 \text{ S/m}$; $\epsilon_r = 49.082$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 09-04-2013; Ambient Temp: 23.9°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN3920; ConvF(3.91, 3.91, 3.91); Calibrated: 2/27/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

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

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

5800 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

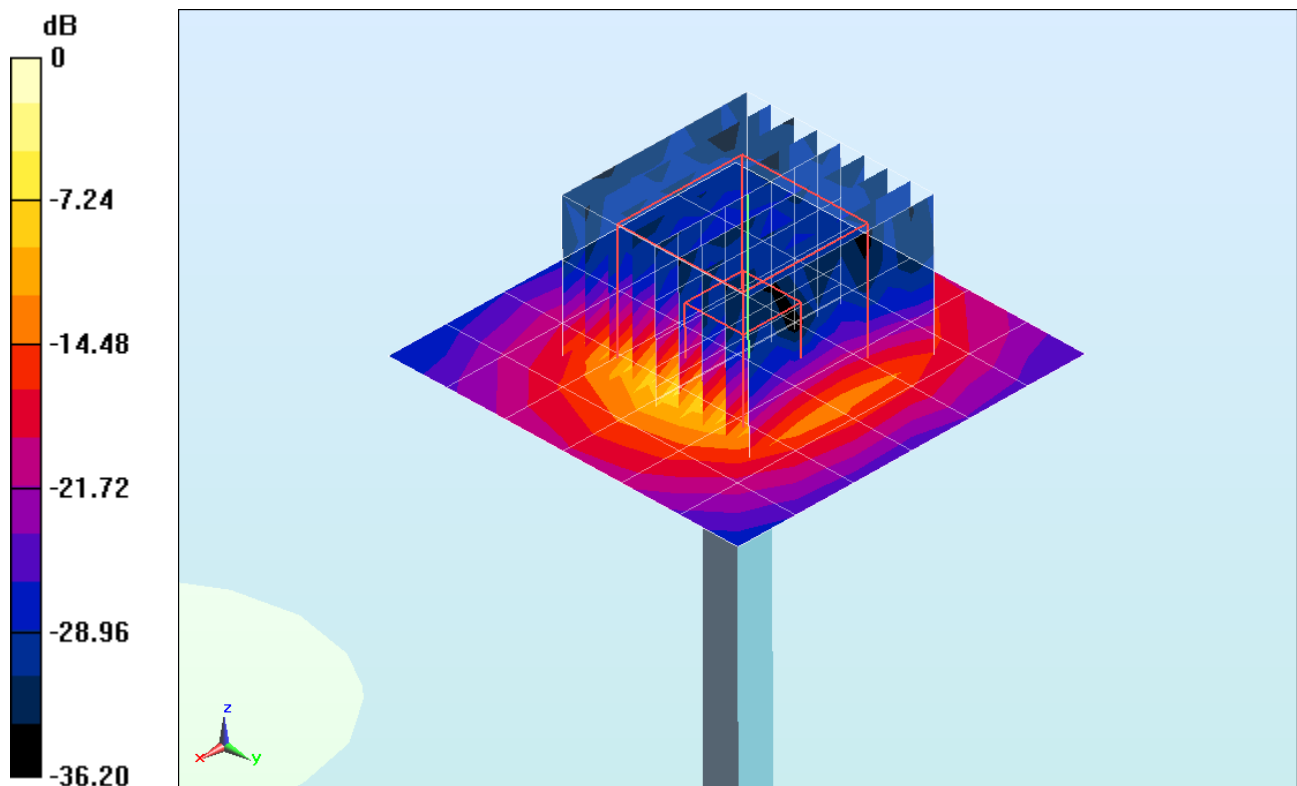
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 33.5 W/kg

SAR(1 g) = 7.56 W/kg

Deviation = 0.13%



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

APPENDIX C: PROBE CALIBRATION



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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D750V3-1054_Mar13**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1054**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **March 18, 2013**

✓ KOK
3/22/13

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: March 18, 2013

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.1 $\pm$ 6 %	0.92 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.50 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.55 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.2 $\pm$ 6 %	1.00 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.72 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.48 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.75 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.4 Ω - 0.9 j Ω
Return Loss	- 27.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.7 Ω - 2.7 j Ω
Return Loss	- 31.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.034 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 08, 2011

DASY5 Validation Report for Head TSL

Date: 18.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.92 \text{ S/m}$; $\epsilon_r = 41.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.28, 6.28, 6.28); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Head Tissue/ $P_{in}=250 \text{ mW}$, $d=15\text{mm}$ /Zoom Scan (7x7x7)/Cube 0:

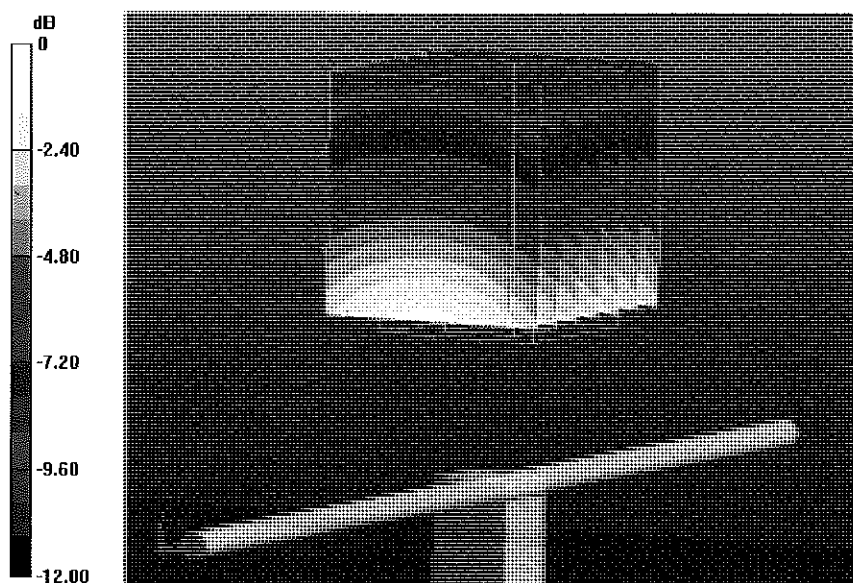
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 52.772 V/m ; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.33 W/kg

SAR(1 g) = 2.19 W/kg ; SAR(10 g) = 1.42 W/kg

Maximum value of SAR (measured) = 2.55 W/kg

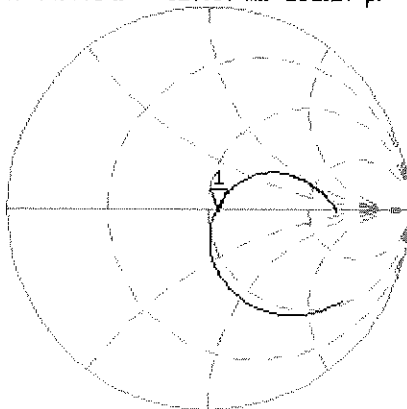


0 dB = 2.55 W/kg = 4.07 dBW/kg

Impedance Measurement Plot for Head TSL

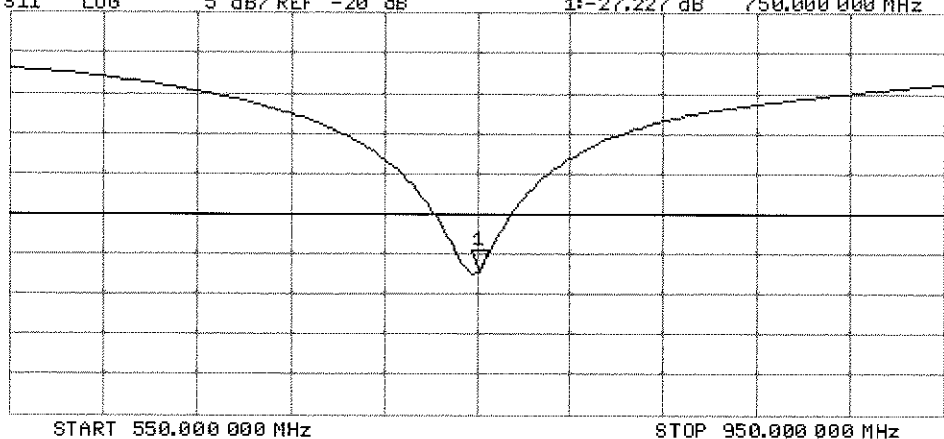
18 Mar 2013 13:14:09
CH1 S11 1 U FS 1: 54.449 Ω -917.97 m Ω 231.17 pF 750.000 000 MHz

*
 Del
 CA
 Avg
 16
 H1 d



CH2 S11 LOG 5 dB/REF -20 dB 1:-27.227 dB 750.000 000 MHz

CA
 Avg
 16
 H1 d



DASY5 Validation Report for Body TSL

Date: 18.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 1 \text{ S/m}$; $\epsilon_r = 54.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.11, 6.11, 6.11); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

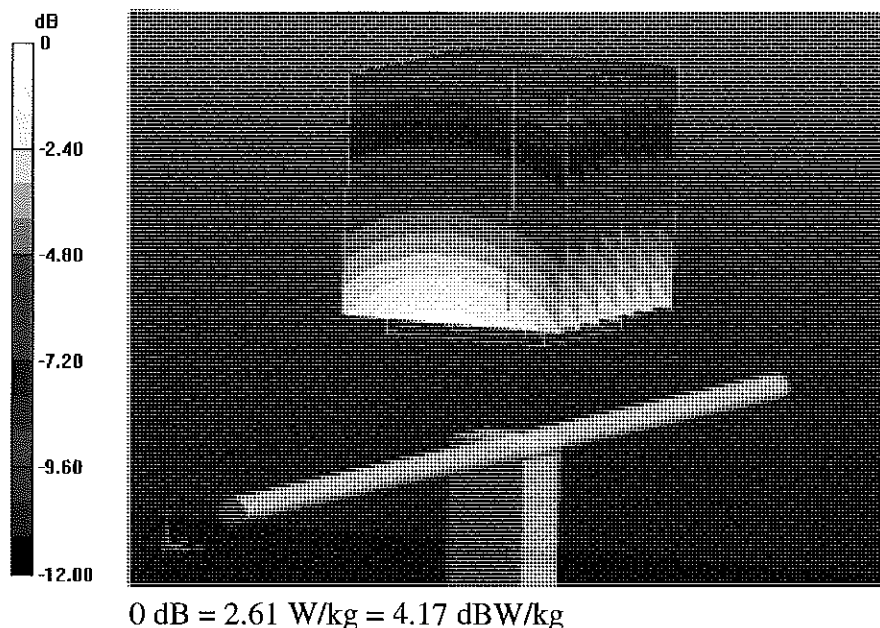
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 52.772 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.32 W/kg

SAR(1 g) = 2.26 W/kg; SAR(10 g) = 1.48 W/kg

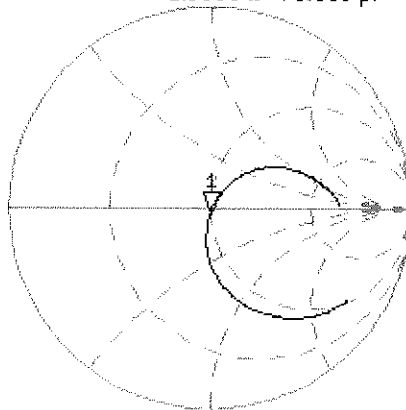
Maximum value of SAR (measured) = 2.61 W/kg



Impedance Measurement Plot for Body TSL

18 Mar 2013 12:24:11
 CH1 S11 1 U FS 1: 49.717 $\angle$ -2.6553 $\angle$ 79.890 pF 750.000 000 MHz

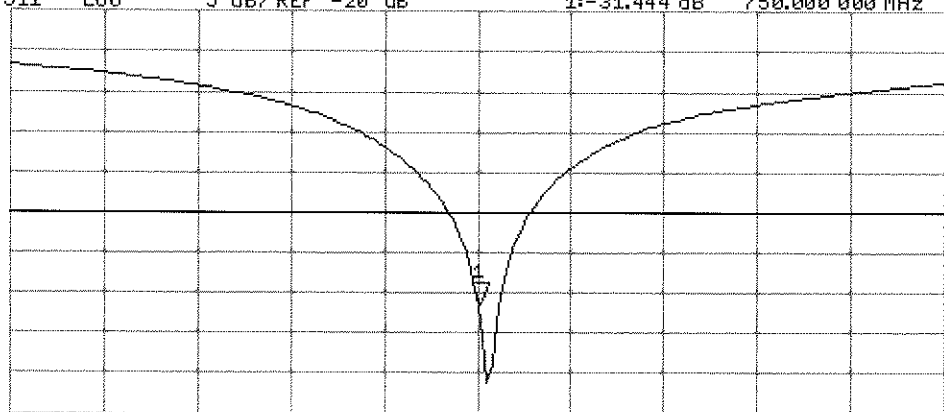
*
 De1
 CA



Av9
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -31.444 dB 750.000 000 MHz

CA



Av9
 16
 H1d



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d119_Apr13**

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 25, 2013**

✓
KOK
5/8/13

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	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	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 909	11-Sep-12 (No. DAE4-909_Sep12)	Sep-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Claudio Leubler** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

[Signature]

[Signature]

Issued: April 26, 2013

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Accredited by the Swiss Accreditation Service (SAS)

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.6
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 $\pm$ 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 $\pm$ 0.2) °C	40.8 $\pm$ 6 %	0.94 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.51 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.68 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.62 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.30 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.0 $\pm$ 6 %	1.01 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.47 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.54 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.31 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.1 Ω - 4.7 j Ω
Return Loss	- 26.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8 Ω - 6.3 j Ω
Return Loss	- 22.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.385 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: 25.04.2013

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: $f = 835 \text{ MHz}$; $\sigma = 0.94 \text{ S/m}$; $\epsilon_r = 40.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn909; Calibrated: 11.09.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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

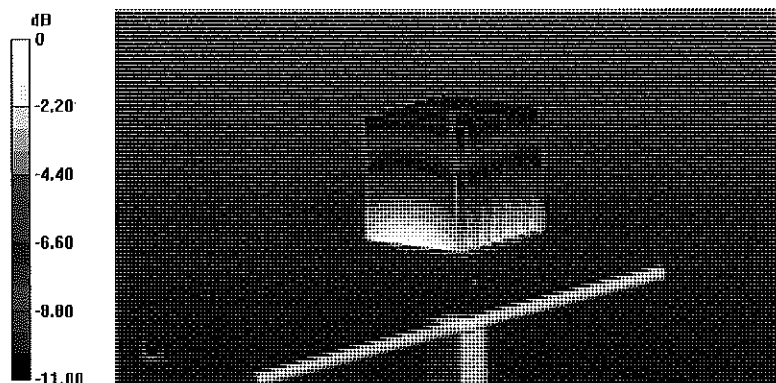
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 57.387 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.86 W/kg

SAR(1 g) = 2.51 W/kg; SAR(10 g) = 1.62 W/kg

Maximum value of SAR (measured) = 2.93 W/kg



0 dB = 2.93 W/kg = 4.67 dBW/kg

Impedance Measurement Plot for Head TSL

25 Apr 2013 09:11:06
 CH1 S11 1 U FS 1: 50.061 Ω -4.6621 Ω 40.884 pF 835.000 000 MHz

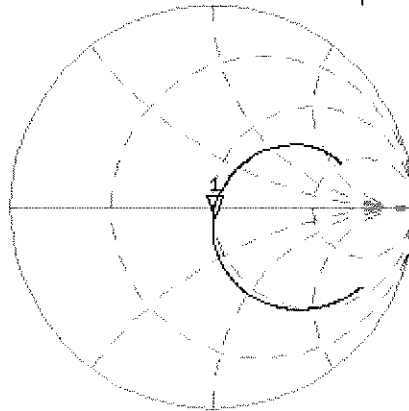
*

Del

CA

Avg
16

H1 d

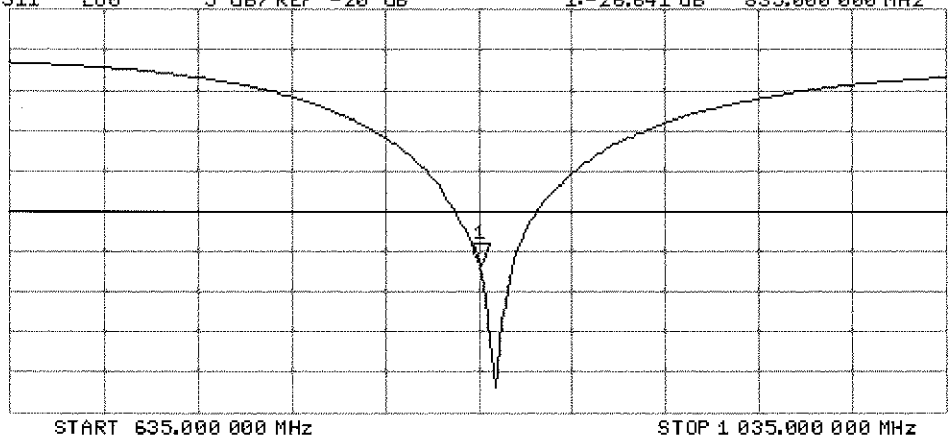


CH2 S11 LOG 5 dB/REF -20 dB 1:-26.641 dB 835.000 000 MHz

CA

Avg
16

H1 d



DASY5 Validation Report for Body TSL

Date: 24.04.2013

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: $f = 835 \text{ MHz}$; $\sigma = 1.01 \text{ S/m}$; $\epsilon_r = 54$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn909; Calibrated: 11.09.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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

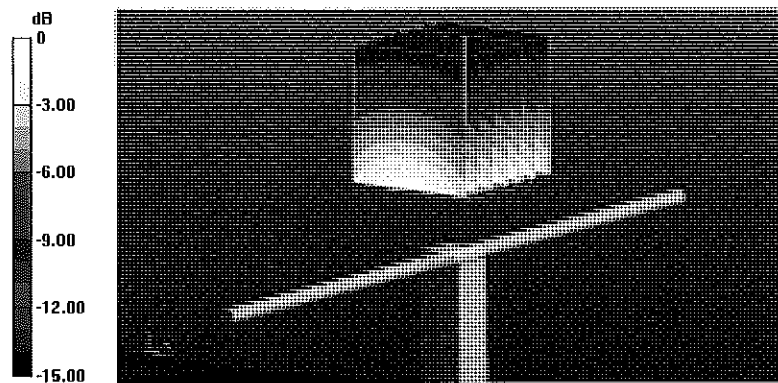
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 55.178 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.68 W/kg

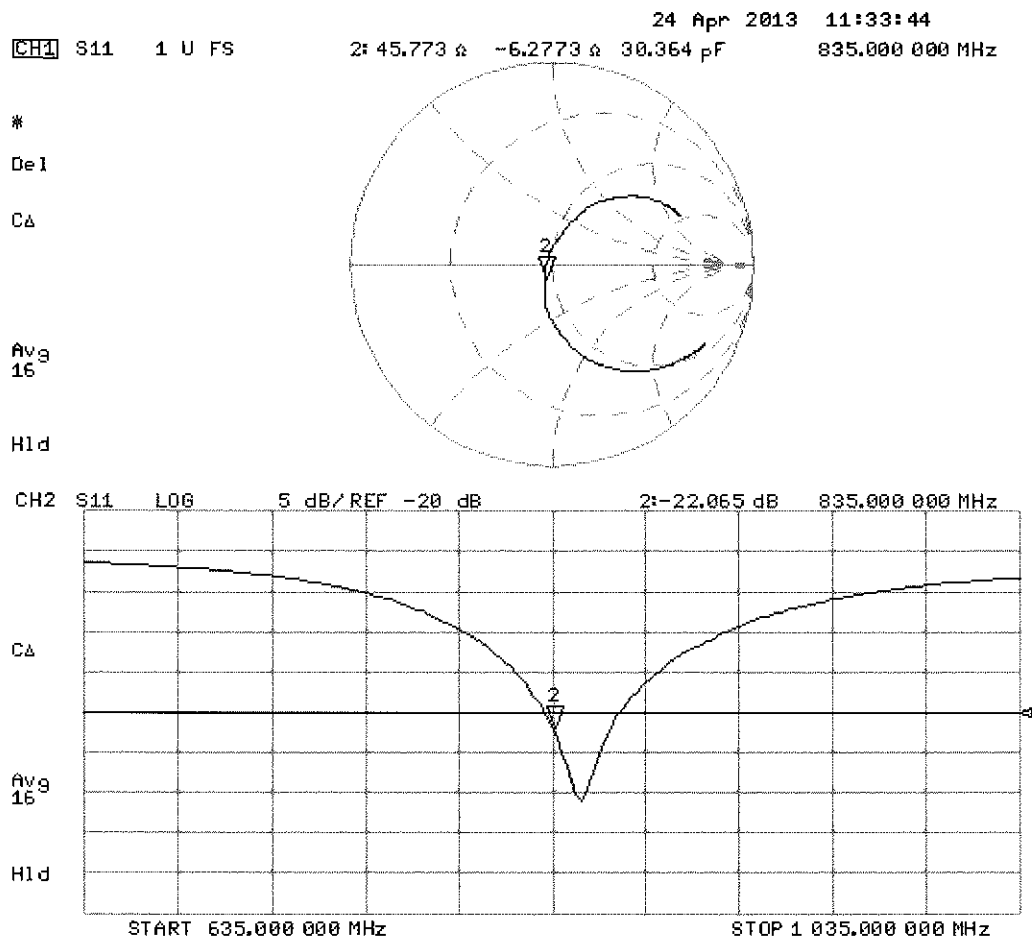
SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.62 W/kg

Maximum value of SAR (measured) = 2.89 W/kg



0 dB = 2.89 W/kg = 4.61 dBW/kg

Impedance Measurement Plot for Body TSL





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Client **PC Test**

Certificate No: **D1900V2-5d148_Feb13**

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 06, 2013**

✓
KOK
2/21/13

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Leif Klysner** Name: **Leif Klysner** Function: **Laboratory Technician**

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

Signature

Issued: February 6, 2013

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

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

SAR result with Head TSL

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

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

Body TSL parameters

The following parameters and calculations were applied.

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

SAR result with Body TSL

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

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

Appendix

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

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

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 06.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ S/m; $\epsilon_r = 39.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

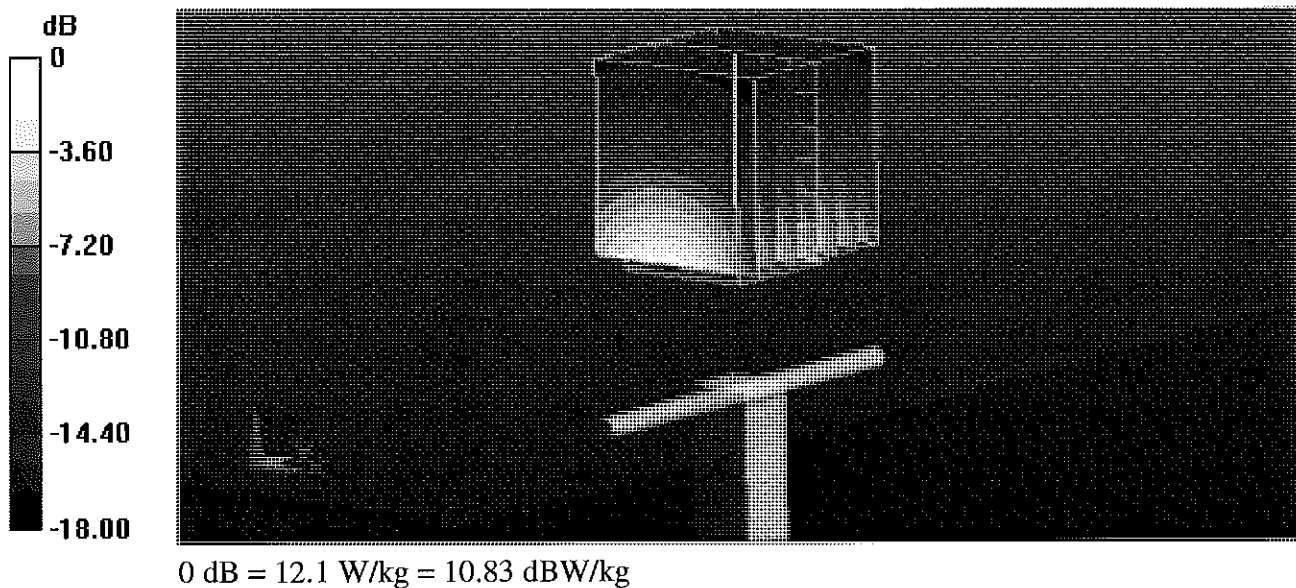
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.534 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 17.8 W/kg

SAR(1 g) = 9.87 W/kg; SAR(10 g) = 5.18 W/kg

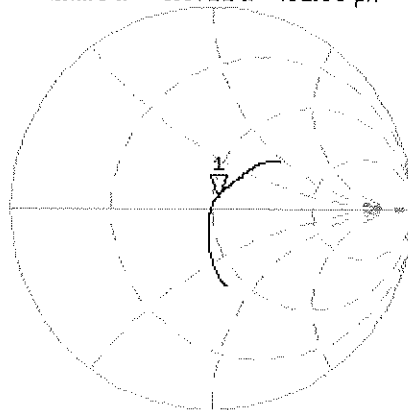
Maximum value of SAR (measured) = 12.1 W/kg



Impedance Measurement Plot for Head TSL

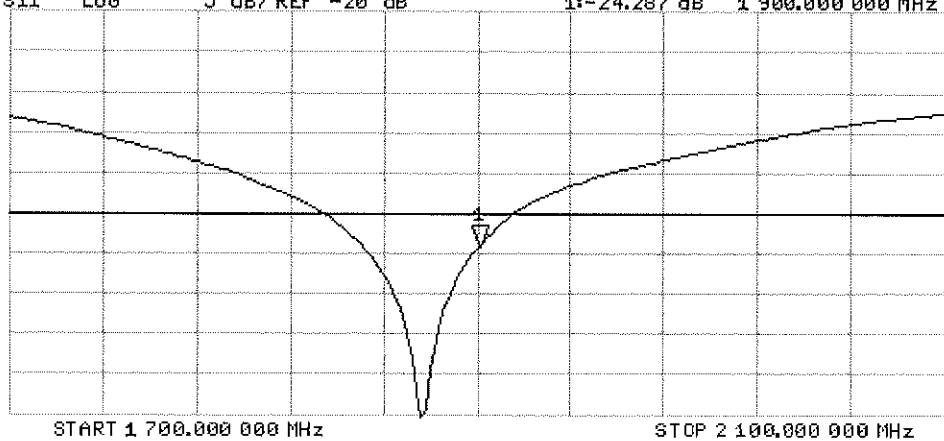
6 Feb 2013 09:25:10
 CH1 S11 1 U FS 1: 52.125 $\angle$ 5.8711 $\angle$ 491.80 μ H 1 900.000 000 MHz

*
 Del
 CA
 Avg
 16
 H1d



CH2 S11 LOG 5 dB/REF -20 dB 1: -24.287 dB 1 900.000 000 MHz

CA
 Avg
 16
 H1d



DASY5 Validation Report for Body TSL

Date: 06.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.53$ S/m; $\epsilon_r = 51.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

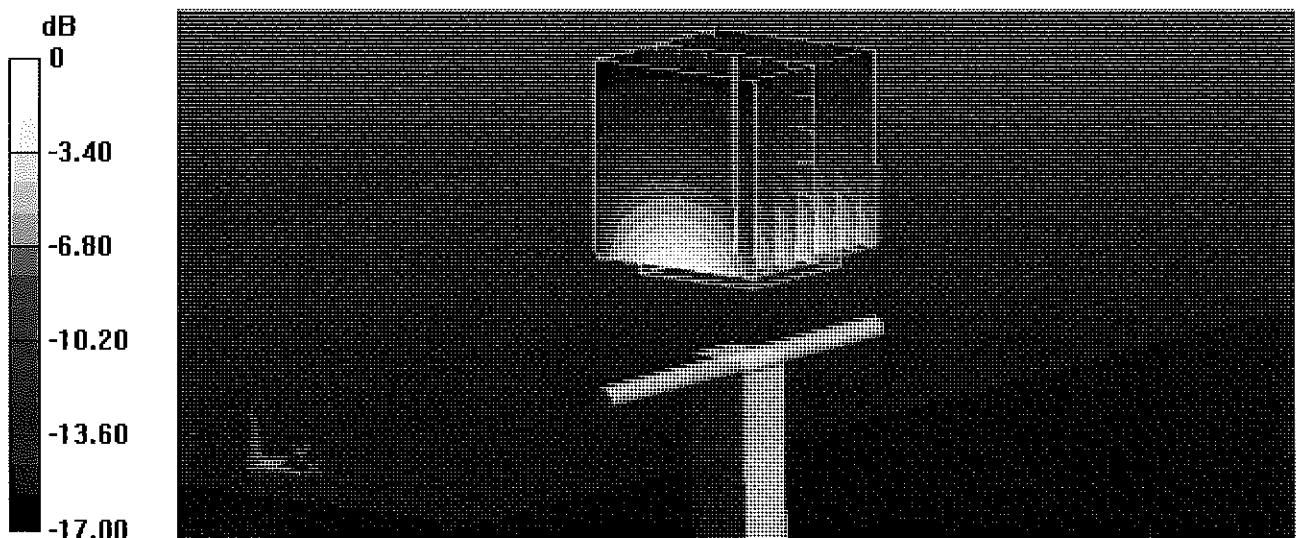
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.534 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 17.9 W/kg

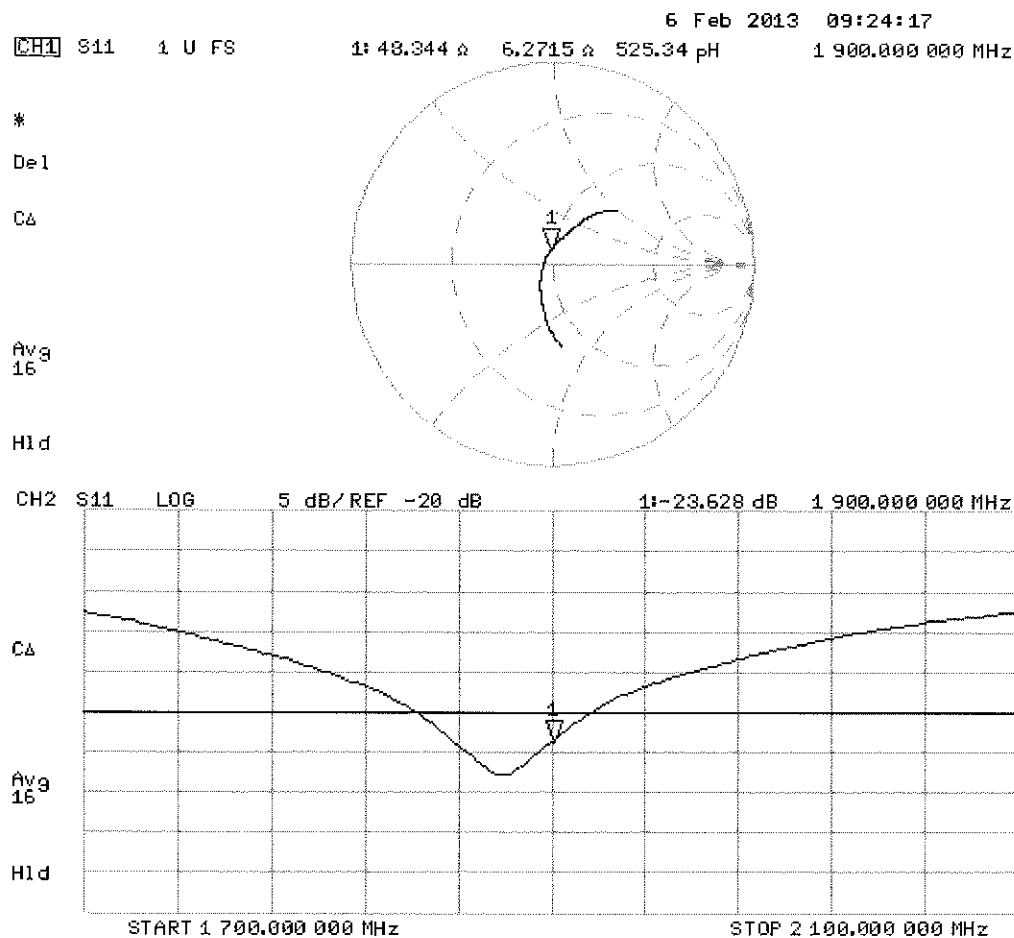
SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.45 W/kg

Maximum value of SAR (measured) = 13.1 W/kg



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

Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 108**

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Client **PC Test**

Certificate No: **D2450V2-797_Jan13**

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 08, 2013**

✓
KOK
1/28/13

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Signature

Israe El-Naouq

Approved by: **Katja Pokovic** Technical Manager

Katja Pokovic

Issued: January 8, 2013

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Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.9 $\pm$ 6 %	1.85 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.5 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.5 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	50.5 $\pm$ 6 %	2.01 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	49.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.88 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.2 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.3 \Omega + 3.1 j\Omega$
Return Loss	- 27.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.1 \Omega + 4.9 j\Omega$
Return Loss	- 26.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 24, 2006

DASY5 Validation Report for Head TSL

Date: 08.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.85$ S/m; $\epsilon_r = 37.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

Dipole Calibration for Head Tissue/ $P_{in}=250$ mW, $d=10$ mm/Zoom Scan (7x7x7)/Cube 0:

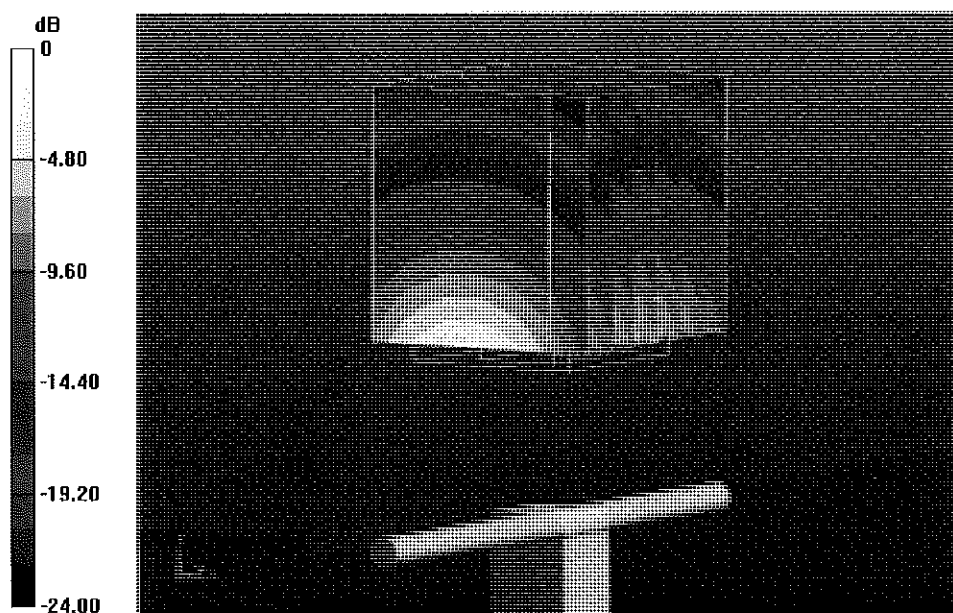
Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 99.154 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.2 W/kg

Maximum value of SAR (measured) = 17.0 W/kg

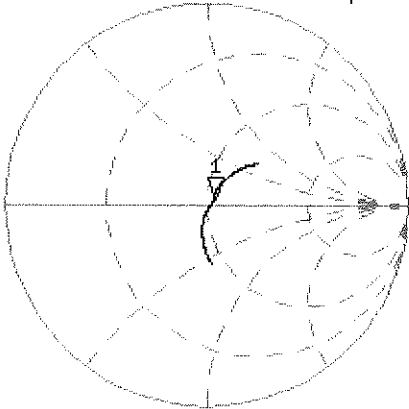


0 dB = 17.0 W/kg = 12.30 dBW/kg

Impedance Measurement Plot for Head TSL

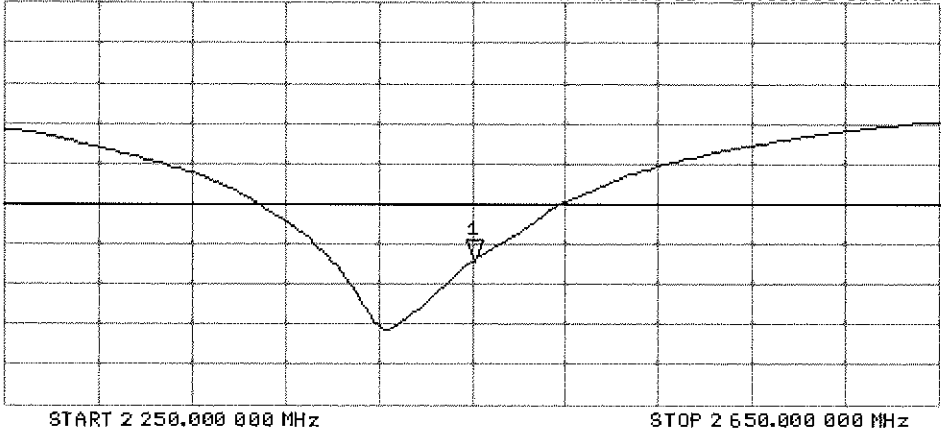
8 Jan 2013 12:37:14
CH1 S11 1 U FS 1: 53.346 $\angle$ 3.0762 $\angle$ 199.83 pH 2 450.000 000 MHz

*
De1
Cor
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1: -27.136 dB 2 450.000 000 MHz

Cor
Avg
16
H1d



DASY5 Validation Report for Body TSL

Date: 08.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.01$ S/m; $\epsilon_r = 50.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

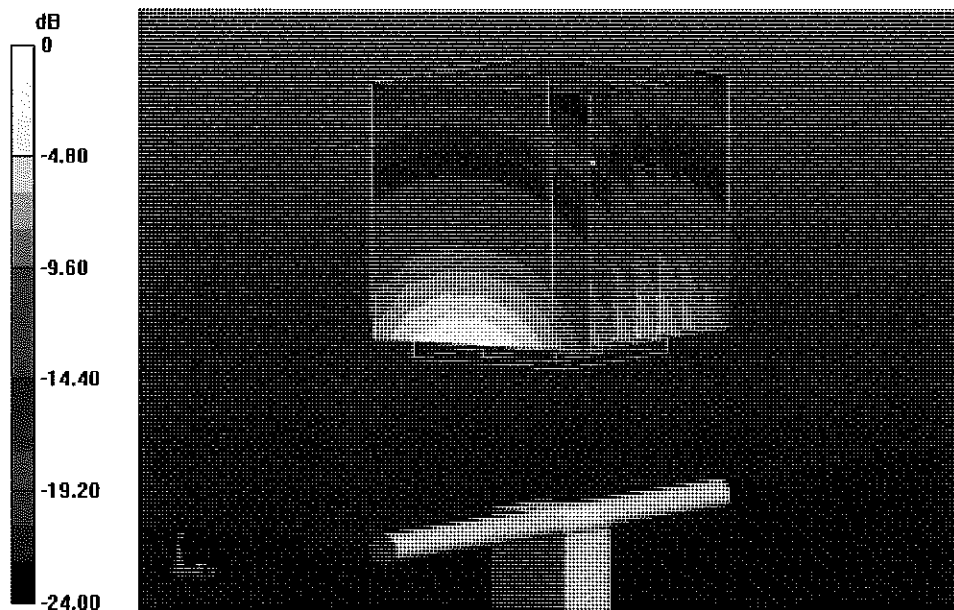
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.935 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 26.7 W/kg

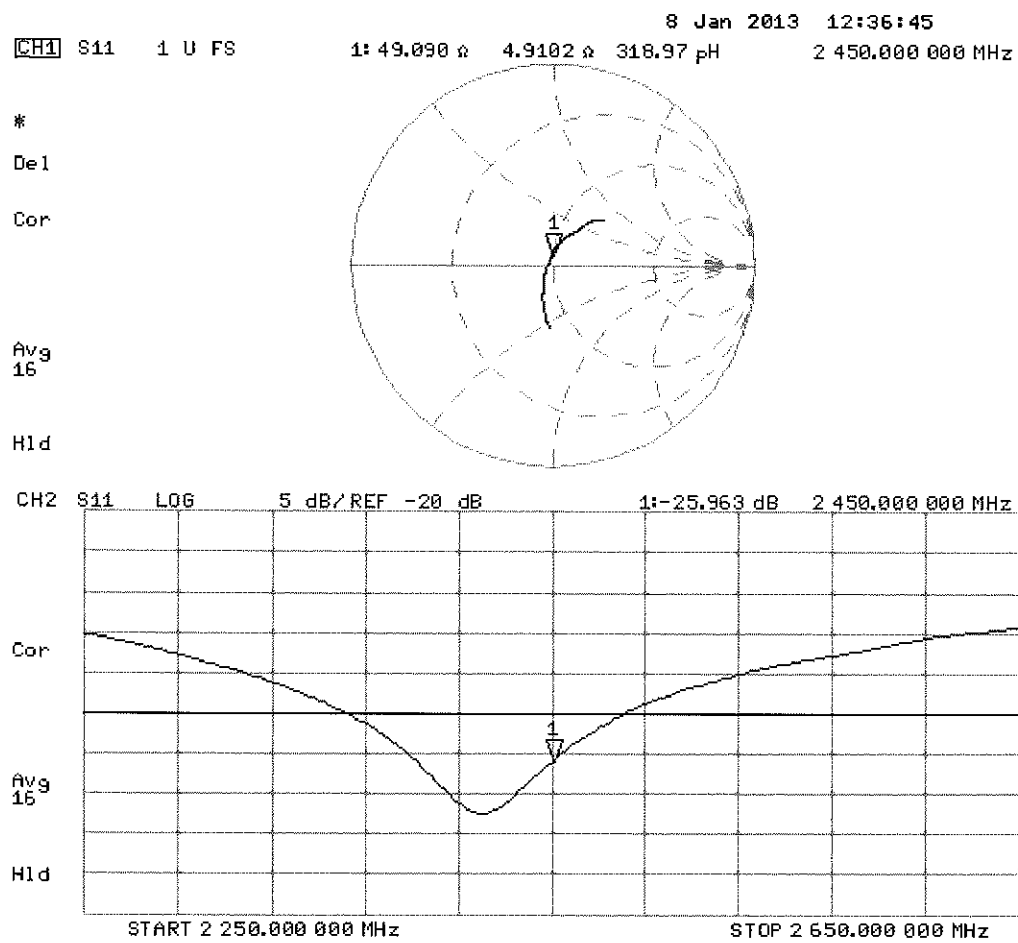
SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.88 W/kg

Maximum value of SAR (measured) = 16.7 W/kg



0 dB = 16.7 W/kg = 12.23 dBW/kg

Impedance Measurement Plot for Body TSL





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_Jan13**

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 11, 2013**

✓
KOK
1/29/13

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Approved by: **Katja Pokovic** Technical Manager

Signature
Israe El-Naouq
Katja Pokovic

Issued: January 11, 2013

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

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) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom 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 $\pm$ 1 MHz 5300 MHz $\pm$ 1 MHz 5500 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 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 $\pm$ 0.2) °C	34.6 $\pm$ 6 %	4.50 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.66 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	75.9 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.4 W/kg $\pm$ 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	34.5 ± 6 %	4.60 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	7.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	76.9 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.9 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	4.79 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	8.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.5 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	34.1 ± 6 %	4.88 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	8.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 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	33.8 ± 6 %	5.09 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	7.69 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	76.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.4 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	47.0 ± 6 %	5.42 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	7.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.55 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	7.59 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	2.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.1 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	46.5 ± 6 %	5.81 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.4 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	46.3 ± 6 %	5.94 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.3 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	46.0 ± 6 %	6.21 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	7.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.7 W/kg ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	50.5 Ω - 9.8 j Ω
Return Loss	- 20.3 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	48.5 Ω - 4.5 j Ω
Return Loss	- 26.4 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	50.6 Ω - 5.8 j Ω
Return Loss	- 24.8 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	53.9 Ω - 3.8 j Ω
Return Loss	- 25.6 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	52.5 Ω - 4.4 j Ω
Return Loss	- 26.1 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	49.3 Ω - 7.9 j Ω
Return Loss	- 22.0 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	48.7 Ω - 3.2 j Ω
Return Loss	- 29.2 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	51.2 Ω - 4.8 j Ω
Return Loss	- 26.2 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	53.6 Ω - 2.1 j Ω
Return Loss	- 27.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	53.3 Ω - 2.9 j Ω
Return Loss	- 27.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 27, 2006

DASY5 Validation Report for Head TSL

Date: 11.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.5$ S/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.6$ S/m; $\epsilon_r = 34.5$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.79$ S/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.88$ S/m; $\epsilon_r = 34.1$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.09$ S/m; $\epsilon_r = 33.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 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: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Head Tissue/Pin=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 = 63.671 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 29.4 W/kg

SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.17 W/kg

Maximum value of SAR (measured) = 18.5 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 = 63.473 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 30.3 W/kg

SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (measured) = 18.8 W/kg

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

Reference Value = 63.735 V/m; Power Drift = 0.08 dB

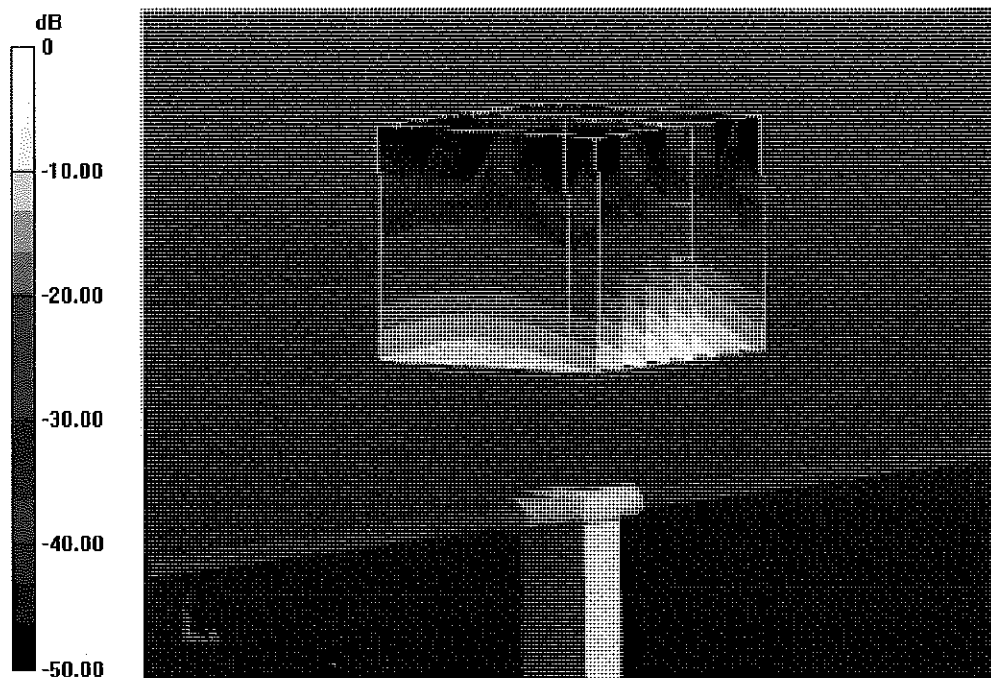
Peak SAR (extrapolated) = 33.2 W/kg

SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.28 W/kg

Maximum value of SAR (measured) = 20.1 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 = 63.848 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 33.5 W/kg
SAR(1 g) = 8.12 W/kg; SAR(10 g) = 2.3 W/kg
Maximum value of SAR (measured) = 20.2 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 = 60.467 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 33.3 W/kg
SAR(1 g) = 7.69 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 19.4 W/kg



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

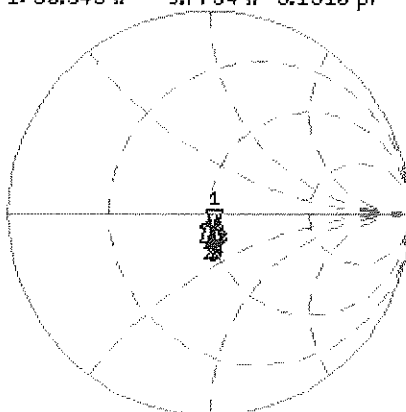
Impedance Measurement Plot for Head TSL

11 Jan 2013 09:26:56
 [CH1] S11 1 U FS 1: 50.543 Ω -9.7754 Ω 3.1310 pF 5 200.000 000 MHz

*
 Del
 CA

Avg
 16

H1 d



CH1 Markers

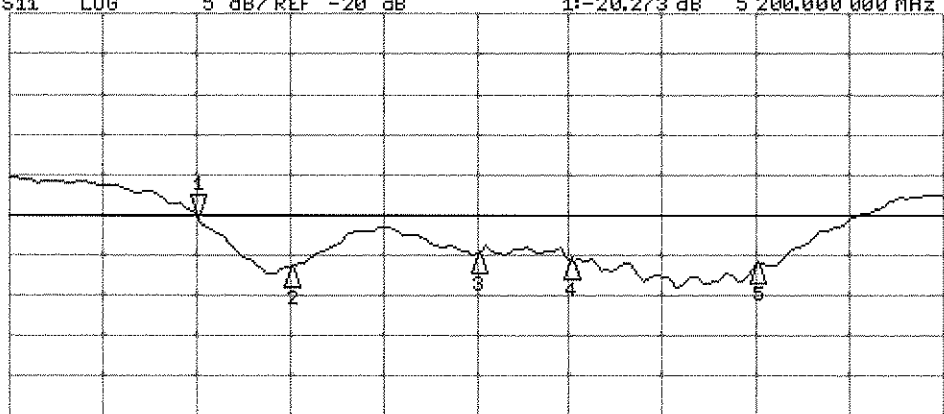
2: 48.508 Ω
 -4.4805 Ω
 5.30000 GHz
 3: 50.617 Ω
 -5.7559 Ω
 5.50000 GHz
 4: 53.891 Ω
 -3.8418 Ω
 5.60000 GHz
 5: 52.500 Ω
 -4.4160 Ω
 5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -20.273 dB 5 200.000 000 MHz

CA

Avg
 16

H1 d



CH2 Markers

2: -25.396 dB
 5.30000 GHz
 3: -24.818 dB
 5.50000 GHz
 4: -25.573 dB
 5.60000 GHz
 5: -26.115 dB
 5.80000 GHz

START 5 000.000 000 MHz

STOP 6 000.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 10.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.42$ S/m; $\epsilon_r = 47$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 5.55$ S/m; $\epsilon_r = 46.8$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.81$ S/m; $\epsilon_r = 46.5$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.94$ S/m; $\epsilon_r = 46.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.21$ S/m; $\epsilon_r = 46$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 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: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Body Tissue/Pin=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 = 59.074 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 30.4 W/kg

SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 18.0 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 = 58.924 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 30.9 W/kg

SAR(1 g) = 7.59 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 17.9 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 = 59.561 V/m; Power Drift = -0.01 dB

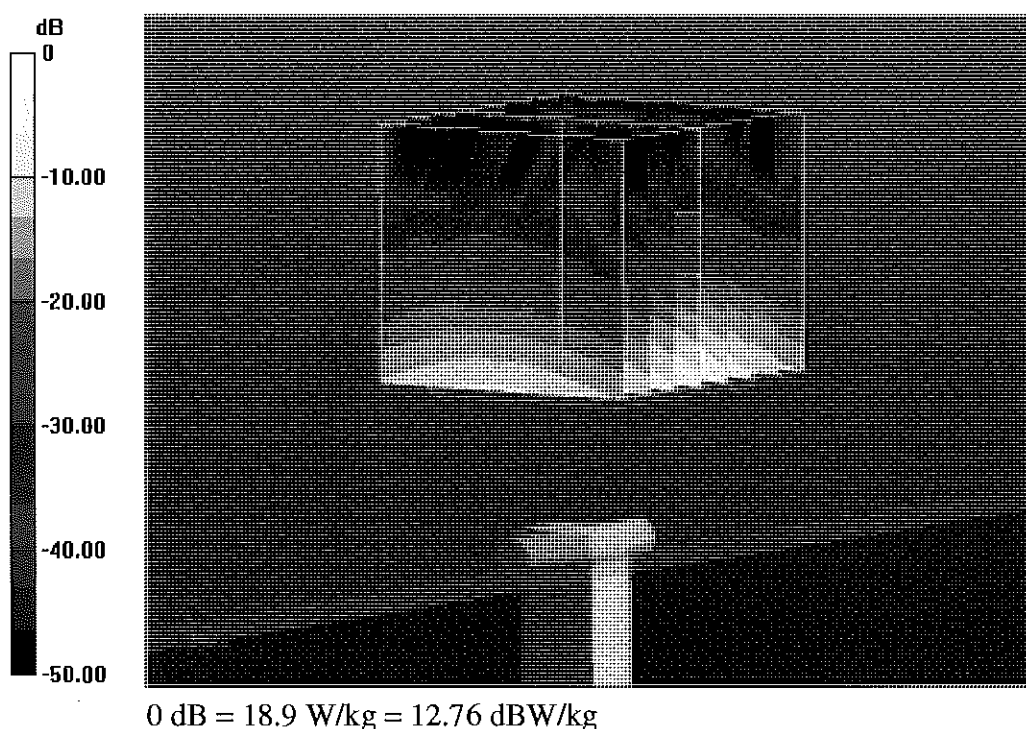
Peak SAR (extrapolated) = 35.3 W/kg

SAR(1 g) = 8.14 W/kg; SAR(10 g) = 2.26 W/kg

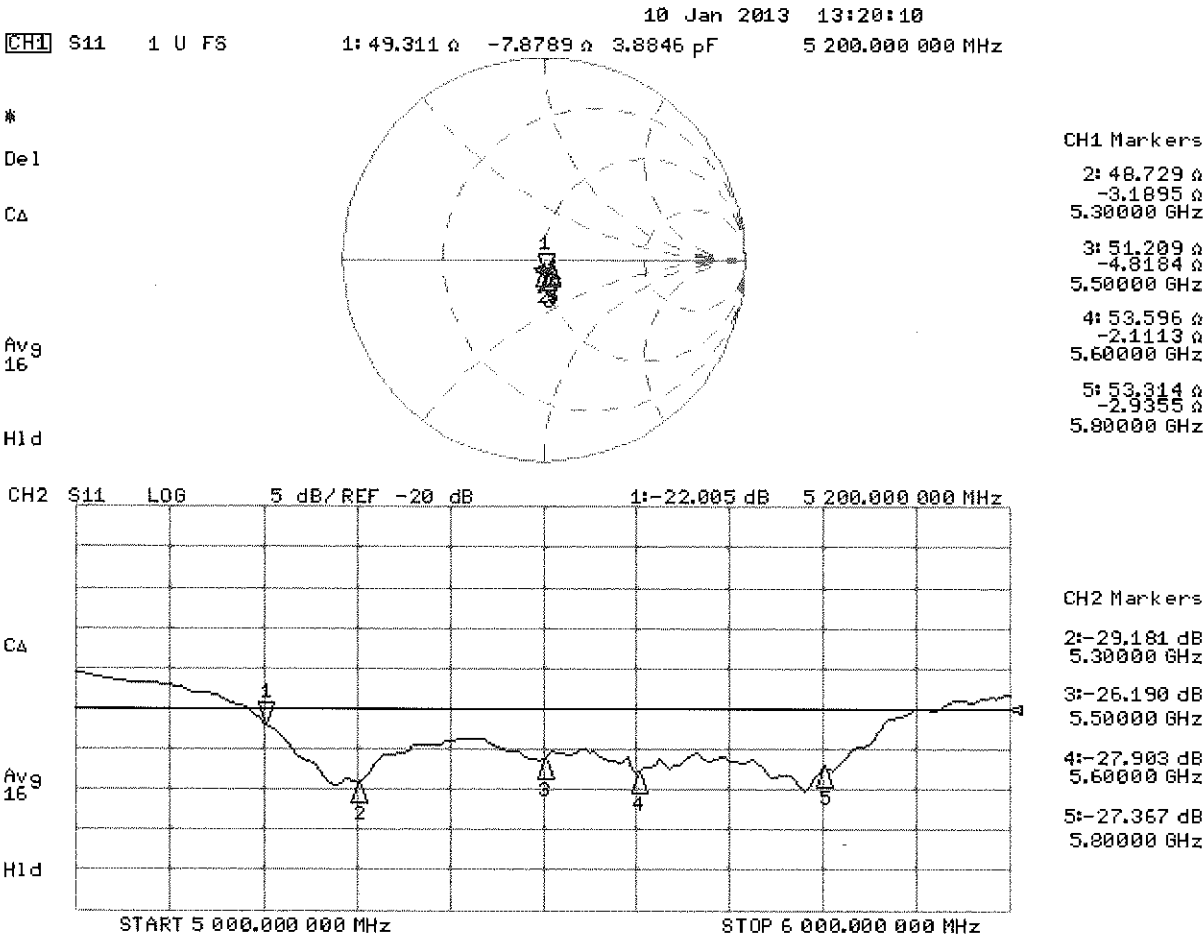
Maximum value of SAR (measured) = 19.7 W/kg

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 = 58.884 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 36.3 W/kg
SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR (measured) = 20.0 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 = 55.753 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 35.6 W/kg
SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.09 W/kg
Maximum value of SAR (measured) = 18.9 W/kg



Impedance Measurement Plot for Body TSL





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Client **PC Test**

Certificate No: **D750V3-1003_Jan13**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1003**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **January 07, 2013**

✓ KOK
1/28/13

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: January 8, 2013

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.4 $\pm$ 6 %	0.89 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.46 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.51 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.8 $\pm$ 6 %	0.97 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.83 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.48 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.87 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	56.1 Ω - 0.2 j Ω
Return Loss	- 24.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω - 3.5 j Ω
Return Loss	- 29.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.043 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 21, 2009

DASY5 Validation Report for Head TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1003

Communication System: CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.89 \text{ S/m}$; $\epsilon_r = 41.4$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.28, 6.28, 6.28); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

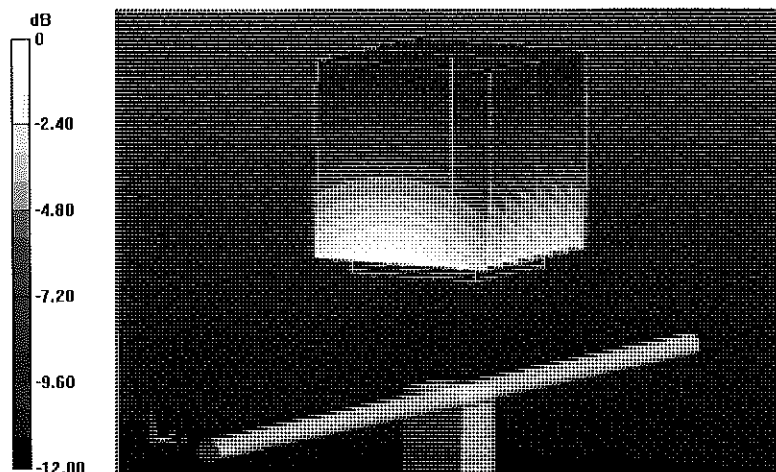
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.114 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.24 W/kg

SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.38 W/kg

Maximum value of SAR (measured) = 2.47 W/kg

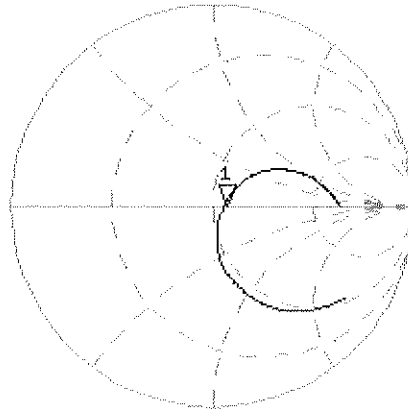


0 dB = 2.47 W/kg = 3.93 dBW/kg

Impedance Measurement Plot for Head TSL

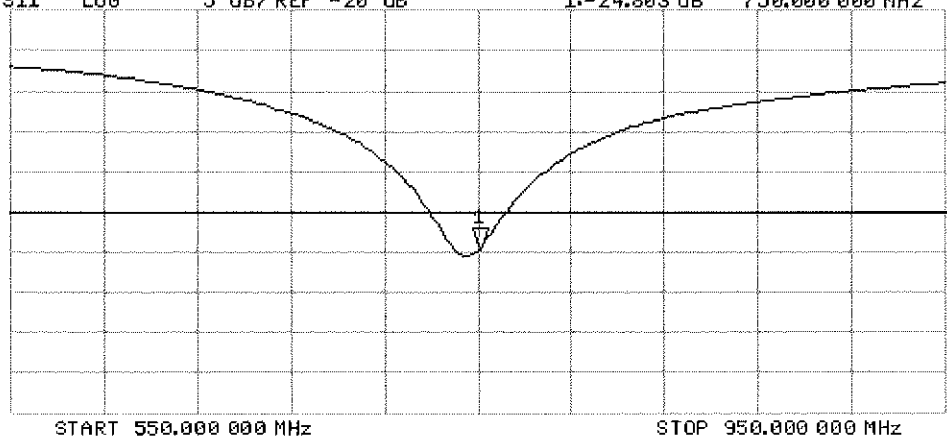
7 Jan 2013 12:55:14
 [CH1] S11 1 U FS 1: 56.100 Ω -179.69 m Ω 1.1810 nF 750.000 000 MHz

*
 De1
 Ca
 Avg
 16
 H1d



CH2 S11 LOG 5 dB/REF -20 dB 1: -24.803 dB 750.000 000 MHz

Ca
 Avg
 16
 H1d



DASY5 Validation Report for Body TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1003

Communication System: CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.97 \text{ S/m}$; $\epsilon_r = 54.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.11, 6.11, 6.11); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

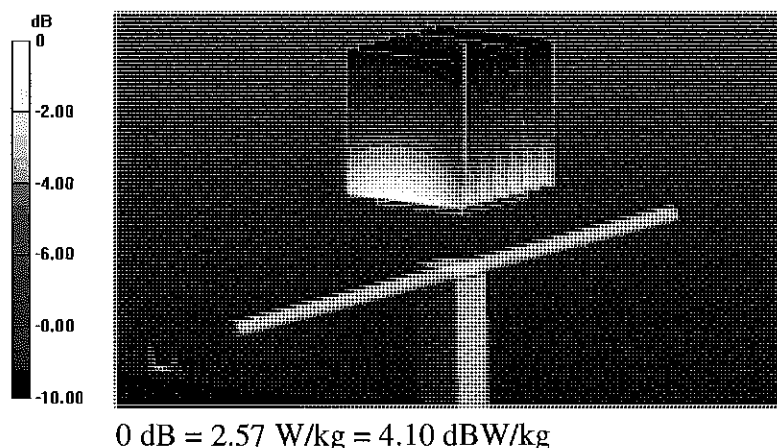
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 53.114 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.25 W/kg

SAR(1 g) = 2.23 W/kg; SAR(10 g) = 1.48 W/kg

Maximum value of SAR (measured) = 2.57 W/kg



Impedance Measurement Plot for Body TSL

7 Jan 2013 09:57:48
CH1 S11 1 U FS 1: 49.564 Ω -3.4629 Ω 61.280 pF 750.000 000 MHz

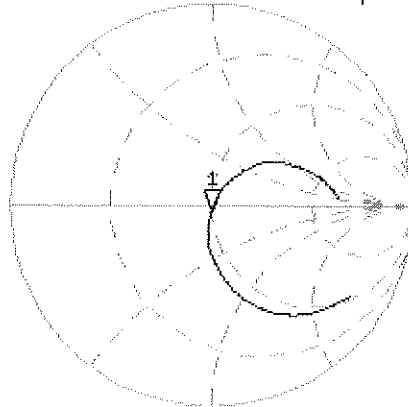
*

De1

Ca

Avg
16

H1 d

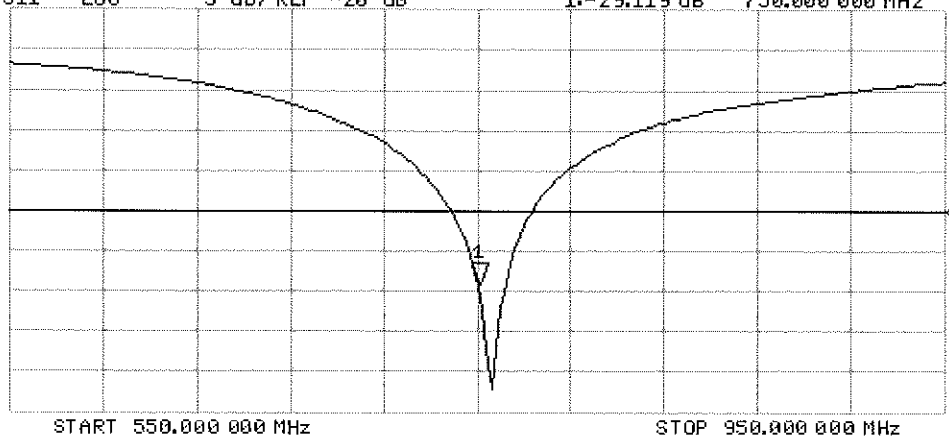


CH2 S11 LOG 5 dB/REF -20 dB 1:-29.119 dB 750.000 000 MHz

Ca

Avg
16

H1 d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D2450V2-882_Feb13**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 882**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **February 11, 2013**

KOK
2/21/13

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

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

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

Signature

Israe El-Naouq
Katja Pokovic

Issued: February 11, 2013

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.9 $\pm$ 6 %	1.85 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	51.7 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.07 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.0 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	50.9 $\pm$ 6 %	2.02 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	49.9 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.91 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.3 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.6 Ω - 0.4 j Ω
Return Loss	- 29.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.5 Ω + 1.2 j Ω
Return Loss	- 37.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.157 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 06, 2011

DASY5 Validation Report for Head TSL

Date: 11.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.85$ S/m; $\epsilon_r = 37.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

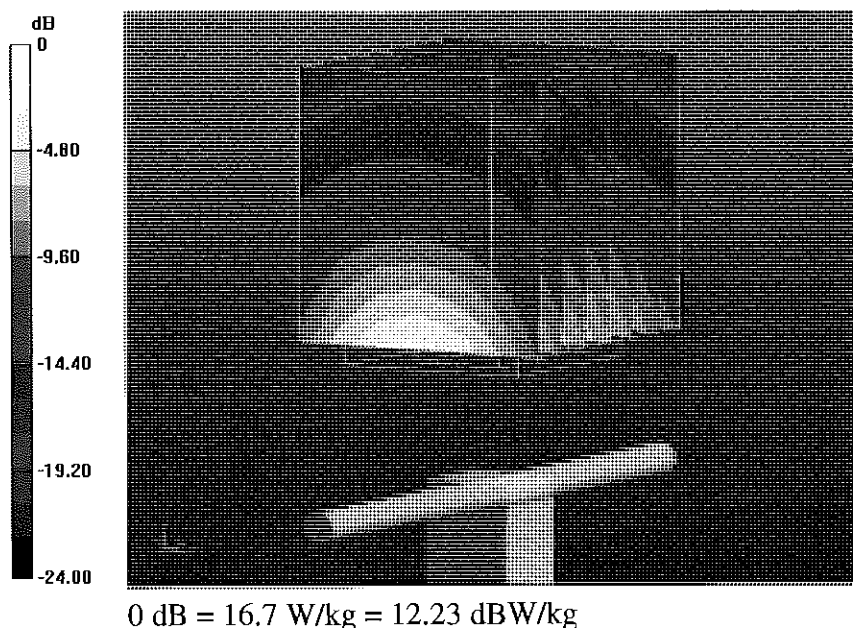
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.806 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 27.6 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.07 W/kg

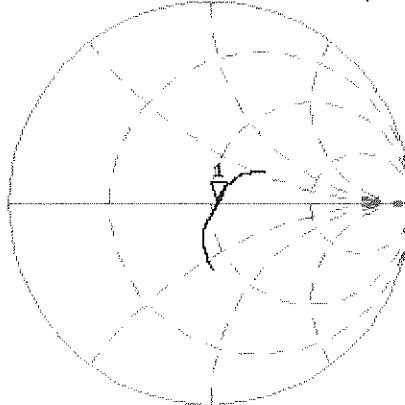
Maximum value of SAR (measured) = 16.7 W/kg



Impedance Measurement Plot for Head TSL

11 Feb 2013 11:51:51
[CH1] S11 1 U FS 1: 53.639 Ω -363.28 m Ω 178.82 pF 2 450.000 000 MHz

*
Del
Cor



Avg
16

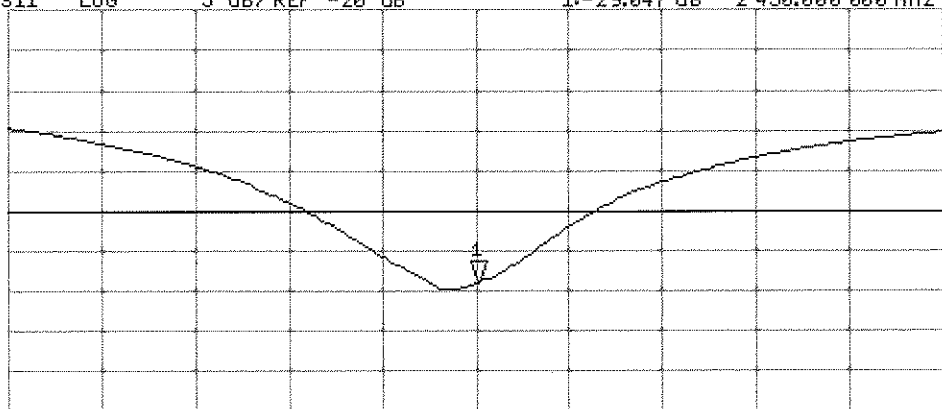
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -29.047 dB 2 450.000 000 MHz

Cor

Avg
16

H1d



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 11.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.02$ S/m; $\epsilon_r = 50.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

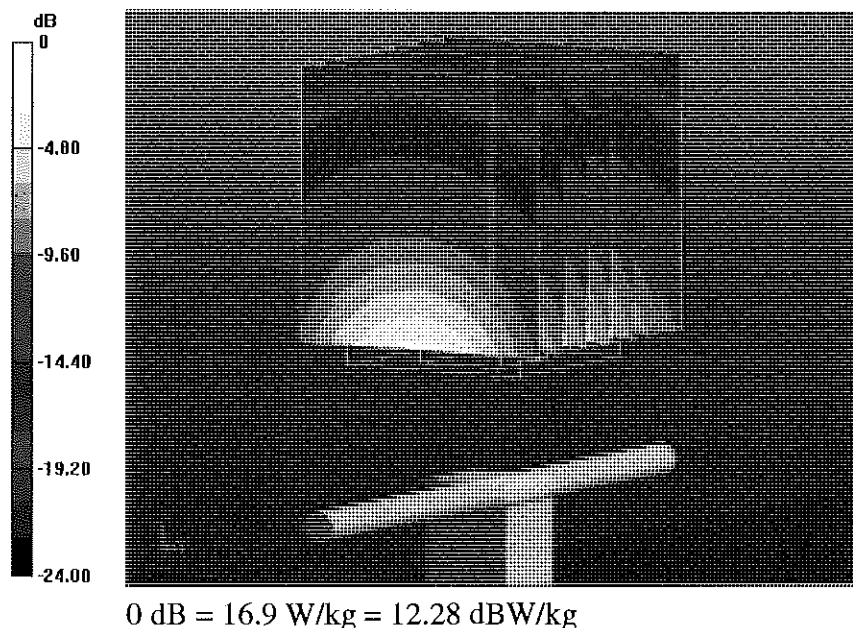
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.474 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 27.1 W/kg

SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.91 W/kg

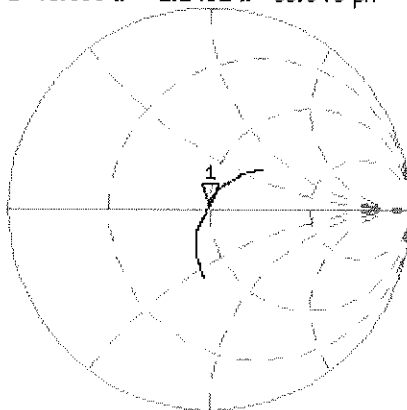
Maximum value of SAR (measured) = 16.9 W/kg



Impedance Measurement Plot for Body TSL

11 Feb 2013 11:51:25
 CH1 S11 1 U FS 1: 49.500 Ω 1.2461 μ 80.948 pH 2 450.000 000 MHz

*
 Del
 Cor



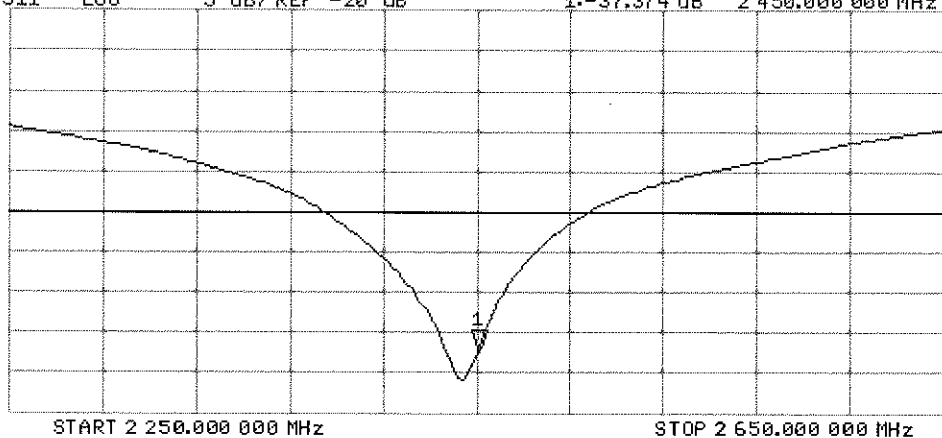
Avg
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-37.374 dB 2 450.000 000 MHz

Cor

Avg
 16

H1d





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D5GHzV2-1120_Feb13**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1120**

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

Calibration date: **February 14, 2013**

✓
Kok
2/2/13

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Approved by: **Katja Pokovic** Technical Manager

Signature

Israe El-Naouq
Katja Pokovic

Issued: February 14, 2013

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- 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) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom 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 $\pm$ 1 MHz 5300 MHz $\pm$ 1 MHz 5500 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 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 $\pm$ 0.2) °C	34.7 $\pm$ 6 %	4.47 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.67 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	76.0 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.5 W/kg $\pm$ 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	34.5 ± 6 %	4.57 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.94 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.7 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.27 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 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	34.2 ± 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 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.6 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	34.1 ± 6 %	4.83 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (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	22.5 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	33.9 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	74.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.0 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.9 ± 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 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.73 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (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 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.7 ± 6 %	5.48 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm³ (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	76.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.18 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	46.3 ± 6 %	5.71 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	79.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (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	22.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.2 ± 6 %	5.83 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.3 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	45.9 ± 6 %	6.12 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (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	20.9 W/kg ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	$53.8 \Omega - 6.3 j\Omega$
Return Loss	- 23.0 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	$50.1 \Omega + 0.5 j\Omega$
Return Loss	- 45.3 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	$51.0 \Omega - 0.9 j\Omega$
Return Loss	- 37.9 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	$55.3 \Omega - 0.9 j\Omega$
Return Loss	- 25.8 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	$53.5 \Omega + 3.3 j\Omega$
Return Loss	- 26.7 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	$53.7 \Omega - 4.8 j\Omega$
Return Loss	- 24.8 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	$50.2 \Omega + 2.4 j\Omega$
Return Loss	- 32.5 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	$51.6 \Omega - 1.5 j\Omega$
Return Loss	- 33.3 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	$57.4 \Omega + 0.9 j\Omega$
Return Loss	- 23.2 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	$53.5 \Omega + 3.2 j\Omega$
Return Loss	- 26.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.206 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 08, 2011

DASY5 Validation Report for Head TSL

Date: 08.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.47$ S/m; $\epsilon_r = 34.7$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.57$ S/m; $\epsilon_r = 34.5$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.74$ S/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.83$ S/m; $\epsilon_r = 34.1$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.05$ S/m; $\epsilon_r = 33.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 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: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Head Tissue/Pin=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 = 61.561 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 28.8 W/kg

SAR(1 g) = 7.67 W/kg; SAR(10 g) = 2.18 W/kg

Maximum value of SAR (measured) = 17.7 W/kg

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

Reference Value = 62.429 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 30.3 W/kg

SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.27 W/kg

Maximum value of SAR (measured) = 18.5 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 = 61.998 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 32.7 W/kg

SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.29 W/kg

Maximum value of SAR (measured) = 19.3 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 = 62.540 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 33.3 W/kg

SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.28 W/kg

Maximum value of SAR (measured) = 19.5 W/kg

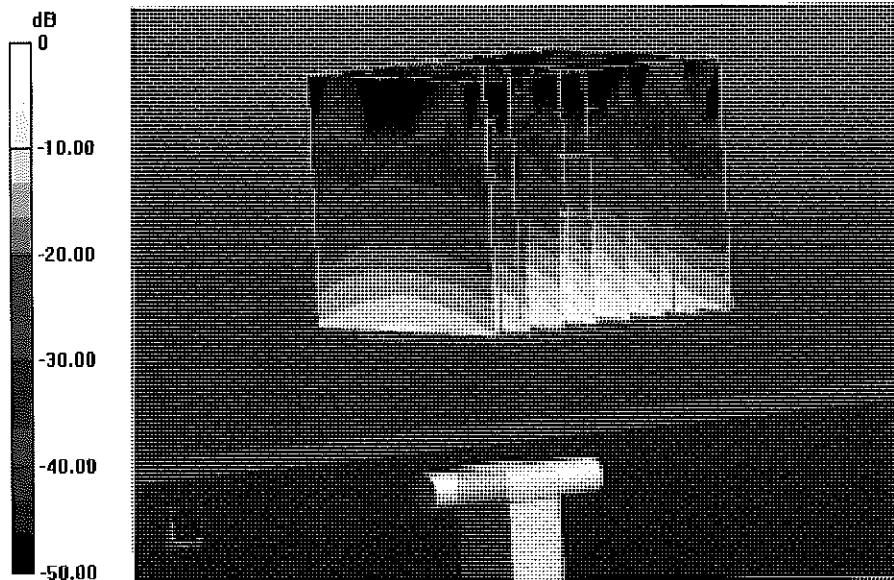
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.600 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 32.9 W/kg

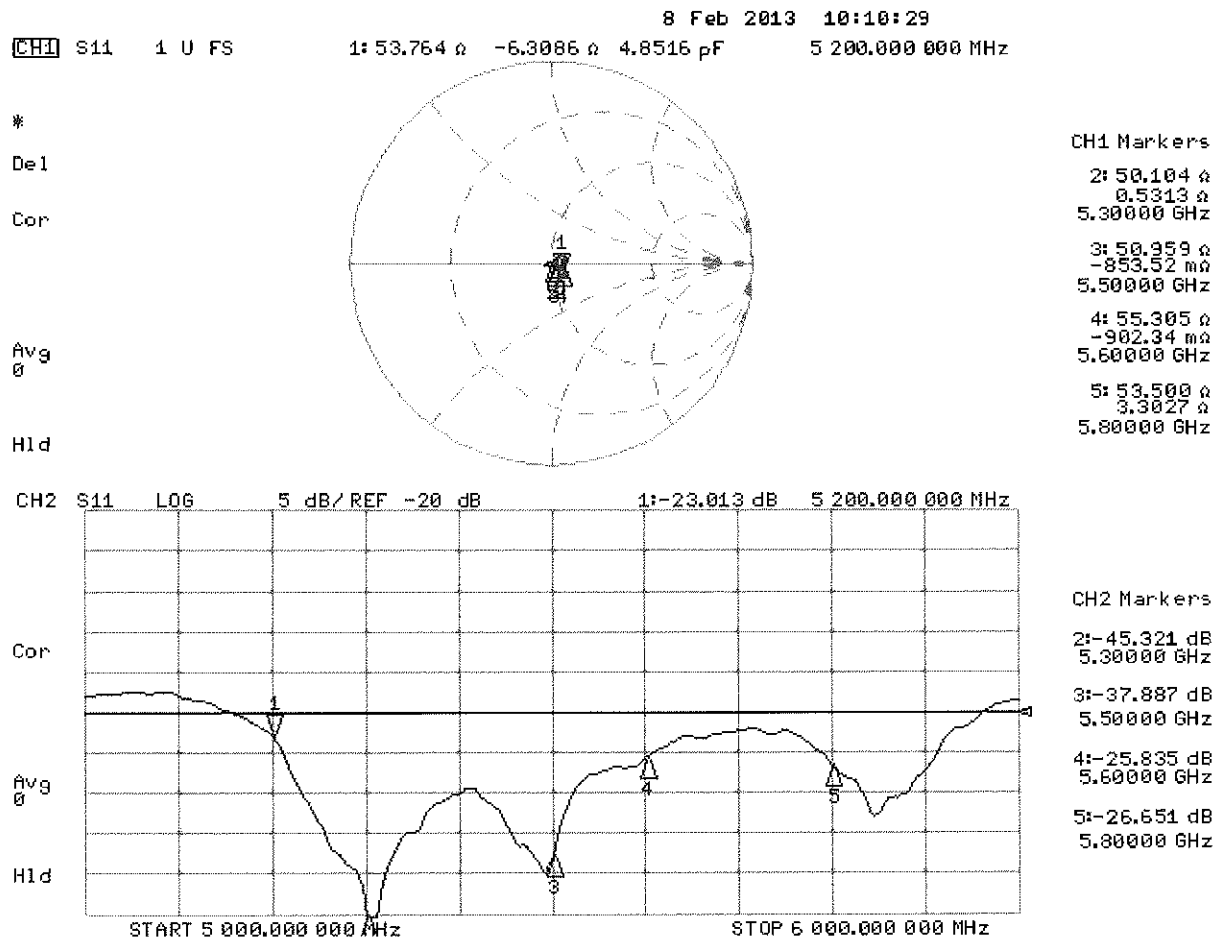
SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 18.8 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 14.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.36$ S/m; $\epsilon_r = 46.9$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 5.48$ S/m; $\epsilon_r = 46.7$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.71$ S/m; $\epsilon_r = 46.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.83$ S/m; $\epsilon_r = 46.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.12$ S/m; $\epsilon_r = 45.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 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: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Body Tissue/Pin=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 = 61.053 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 7.73 W/kg; SAR(10 g) = 2.17 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 = 60.021 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 32.1 W/kg

SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.18 W/kg

Maximum value of SAR (measured) = 18.5 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 = 59.894 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 35.3 W/kg

SAR(1 g) = 8.06 W/kg; SAR(10 g) = 2.24 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 = 59.730 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 36.8 W/kg

SAR(1 g) = 8.15 W/kg; SAR(10 g) = 2.26 W/kg

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

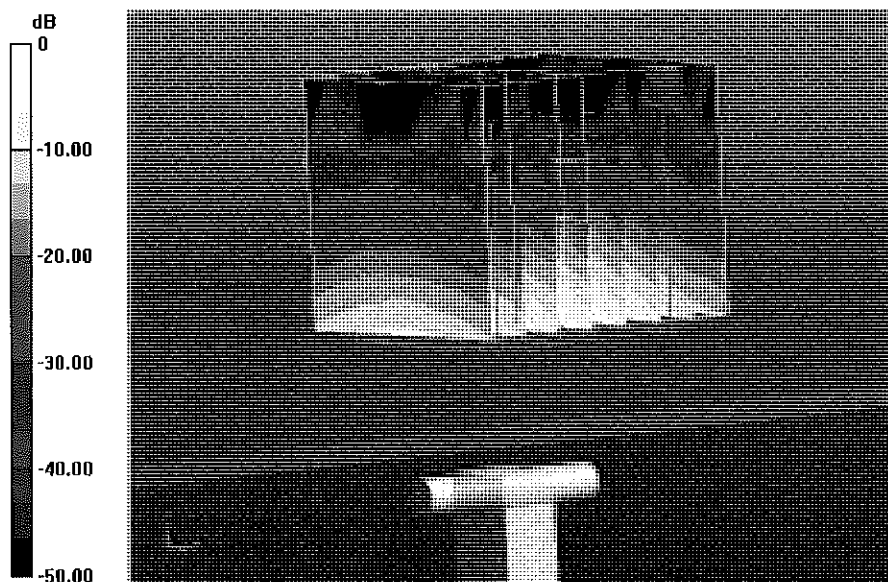
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 56.663 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 36.4 W/kg

SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.12 W/kg

Maximum value of SAR (measured) = 19.0 W/kg

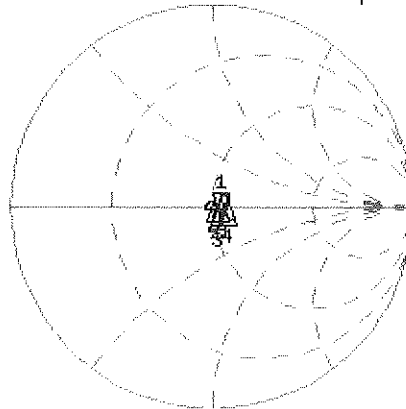


0 dB = 19.0 W/kg = 12.79 dBW/kg

Impedance Measurement Plot for Body TSL

14 Feb 2013 15:47:05
 CH1 S11 1 U FS 1: 53.672 Ω -4.7539 Ω 6.4382 pF 5 200.000 000 MHz

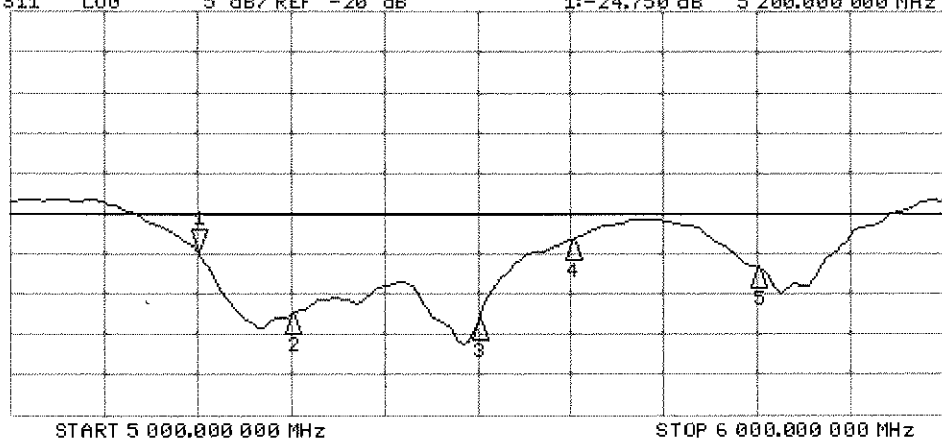
*
 Del
 Cor
 Avg
 16
 H1d



CH1 Markers
 2: 50.250 Ω
 2.3555 Ω
 5.30000 GHz
 3: 51.629 Ω
 -1.4824 Ω
 5.50000 GHz
 4: 57.389 Ω
 0.9180 Ω
 5.60000 GHz
 5: 53.543 Ω
 3.2441 Ω
 5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -24.750 dB 5 200.000 000 MHz

Cor
 Avg
 16
 H1d



CH2 Markers
 2: -32.508 dB
 5.30000 GHz
 3: -33.267 dB
 5.50000 GHz
 4: -23.183 dB
 5.60000 GHz
 5: -26.672 dB
 5.80000 GHz



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Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Client **PC Test**

Certificate No: **ES3-3287_Nov12**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3287**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

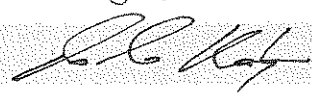
Calibration date: **November 15, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 
			Issued: November 16, 2012

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



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Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}**: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3287

Manufactured: June 7, 2010
Calibrated: November 15, 2012

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.31	1.25	1.25	$\pm 10.1 \%$
DCP (mV) ^B	102.9	103.6	101.6	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
0	CW	0.00	X	0.0	0.0	1.0	116.8	$\pm 3.5 \%$
			Y	0.0	0.0	1.0	118.5	
			Z	0.0	0.0	1.0	154.1	

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%.

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.40	6.40	6.40	0.20	2.54	± 12.0 %
835	41.5	0.90	6.17	6.17	6.17	0.34	1.68	± 12.0 %
1750	40.1	1.37	5.16	5.16	5.16	0.63	1.30	± 12.0 %
1900	40.0	1.40	4.96	4.96	4.96	0.48	1.55	± 12.0 %
2450	39.2	1.80	4.30	4.30	4.30	0.79	1.31	± 12.0 %
2600	39.0	1.96	4.19	4.19	4.19	0.80	1.31	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

Calibration Parameter Determined in Body Tissue Simulating Media

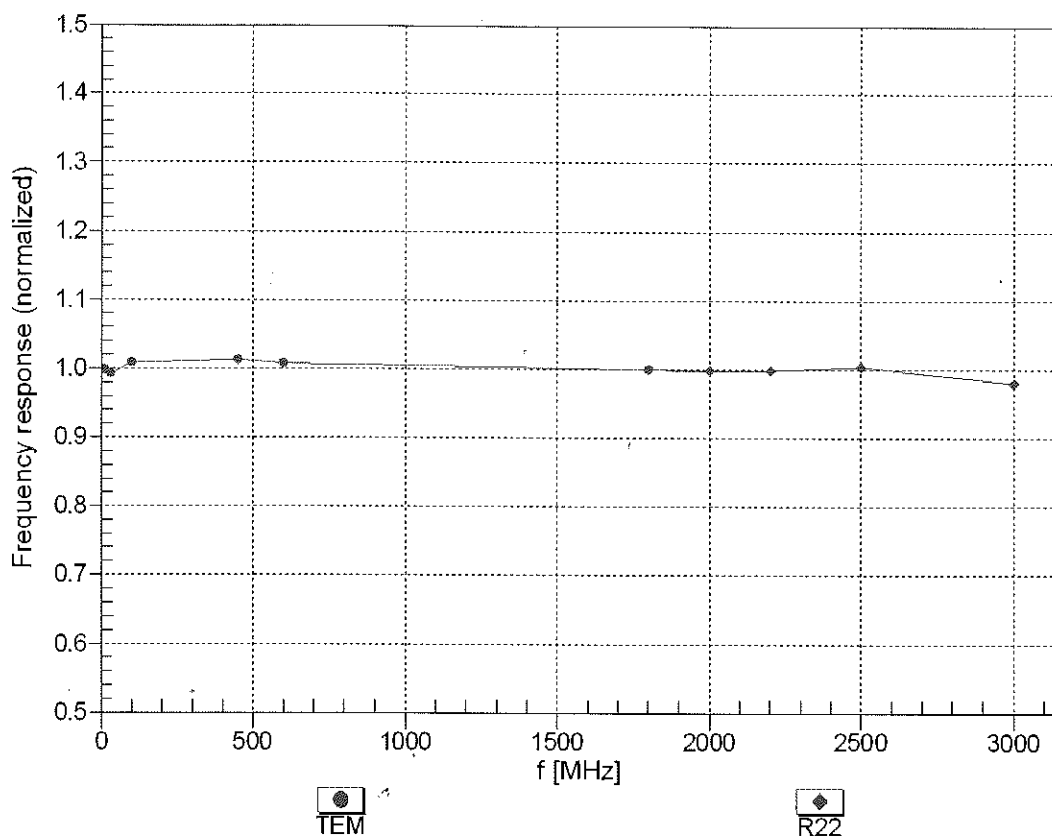
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.14	6.14	6.14	0.28	2.06	± 12.0 %
835	55.2	0.97	6.06	6.06	6.06	0.42	1.63	± 12.0 %
1750	53.4	1.49	4.86	4.86	4.86	0.43	1.64	± 12.0 %
1900	53.3	1.52	4.69	4.69	4.69	0.56	1.54	± 12.0 %
2450	52.7	1.95	4.29	4.29	4.29	0.80	1.02	± 12.0 %
2600	52.5	2.16	4.12	4.12	4.12	0.64	0.92	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

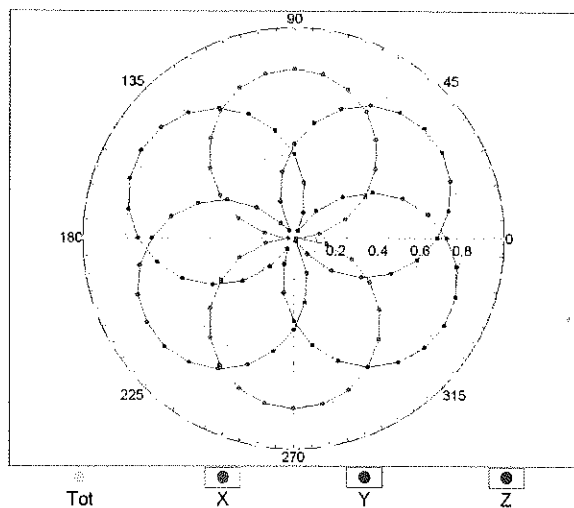
(TEM-Cell:ifi110 EXX, Waveguide: R22)



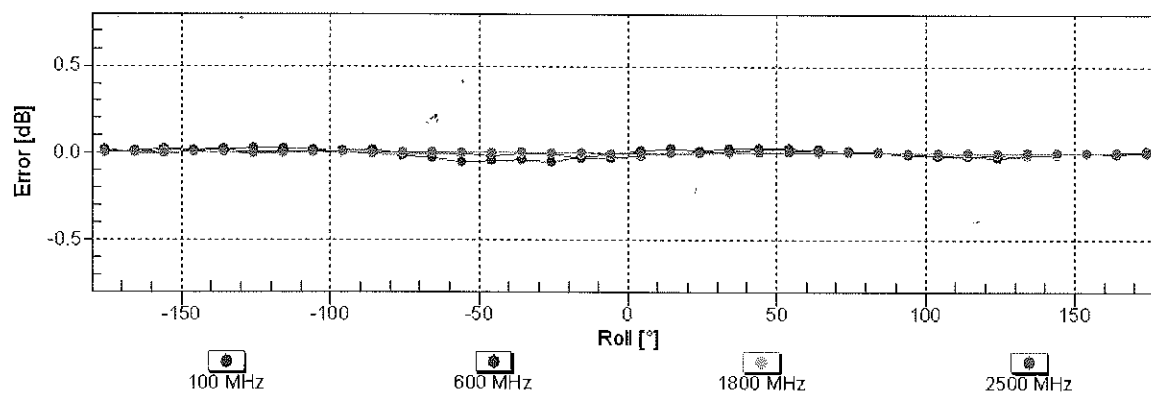
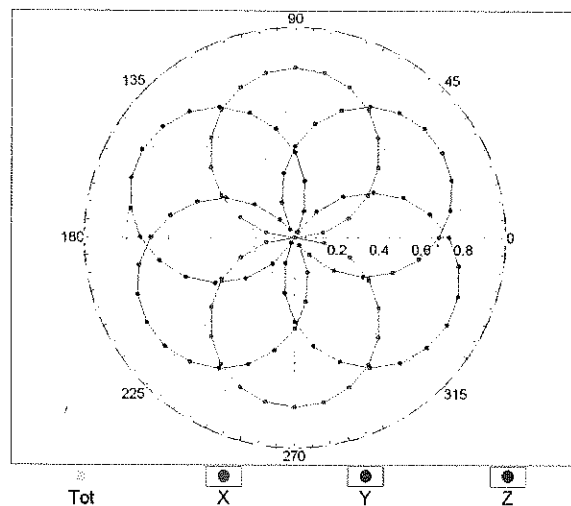
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz, TEM

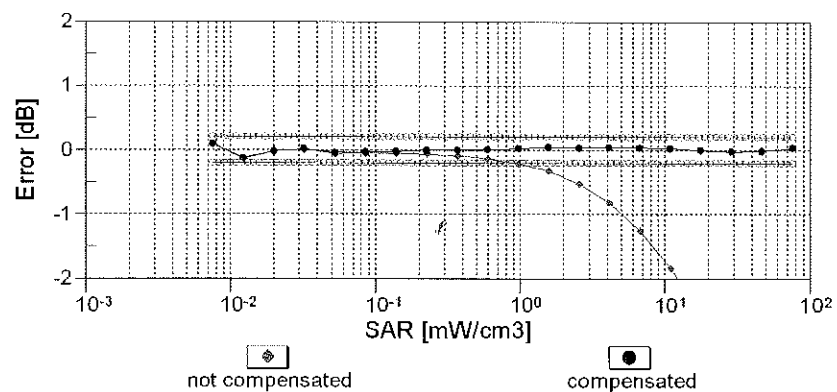
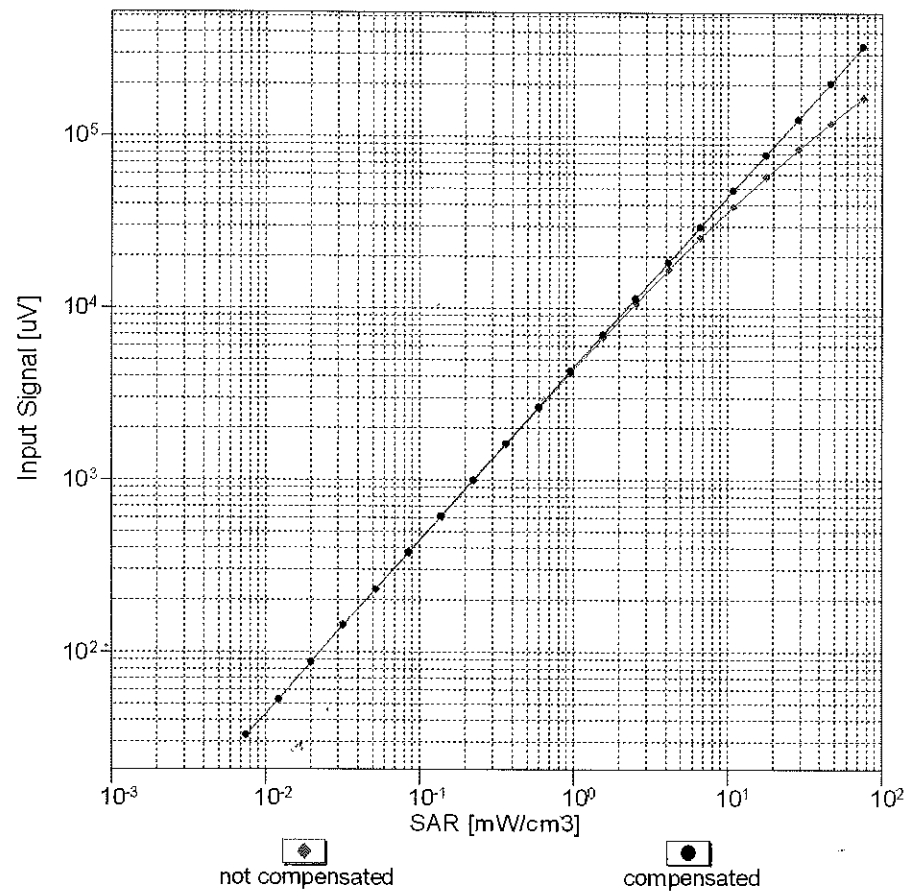


f=1800 MHz, R22



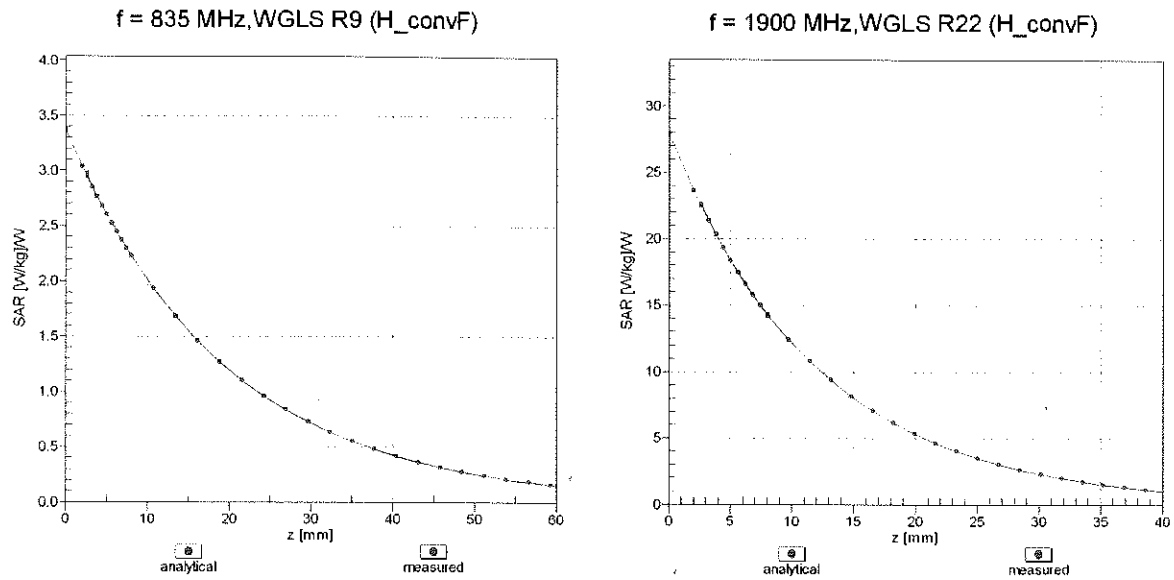
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f = 900 \text{ MHz}$)



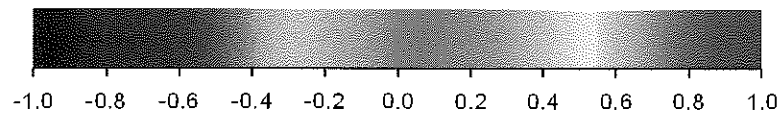
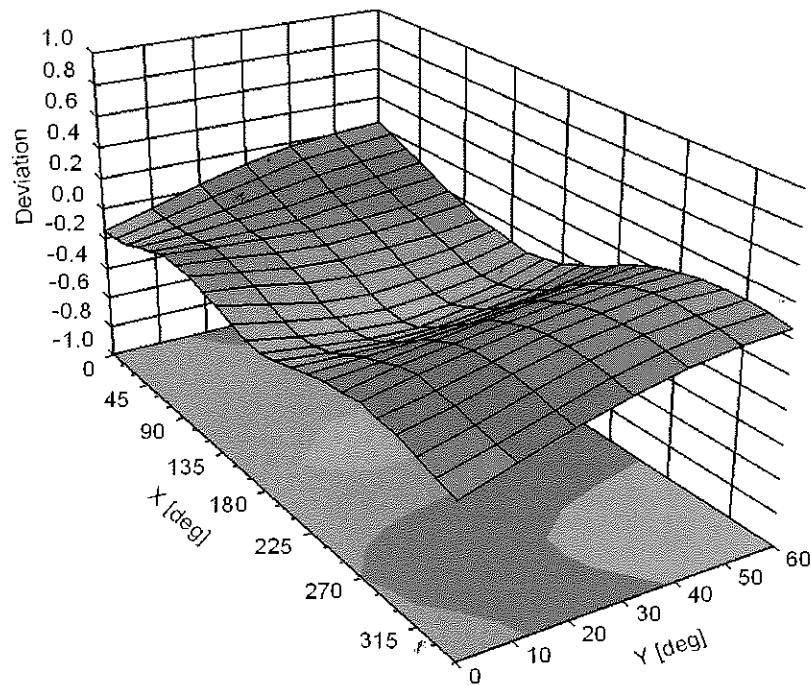
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-15.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3209_Mar13**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3209**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **March 15, 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)

✓ KOK
3/24/13

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Israe El-Naouq	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature
			Issued: March 15, 2013
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}; A, B, C, D** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3209

Manufactured: October 14, 2008
Calibrated: March 15, 2013

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.35	1.33	1.14	$\pm 10.1 \%$
DCP (mV) ^B	99.2	97.8	98.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	163.6	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		170.3	
		Z	0.0	0.0	1.0		158.7	

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%.

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.74	6.74	6.74	0.76	1.18	± 12.0 %
835	41.5	0.90	6.46	6.46	6.46	0.31	1.81	± 12.0 %
1750	40.1	1.37	5.39	5.39	5.39	0.80	1.21	± 12.0 %
1900	40.0	1.40	5.21	5.21	5.21	0.78	1.26	± 12.0 %
2450	39.2	1.80	4.57	4.57	4.57	0.65	1.43	± 12.0 %
2600	39.0	1.96	4.43	4.43	4.43	0.75	1.36	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Calibration Parameter Determined in Body Tissue Simulating Media

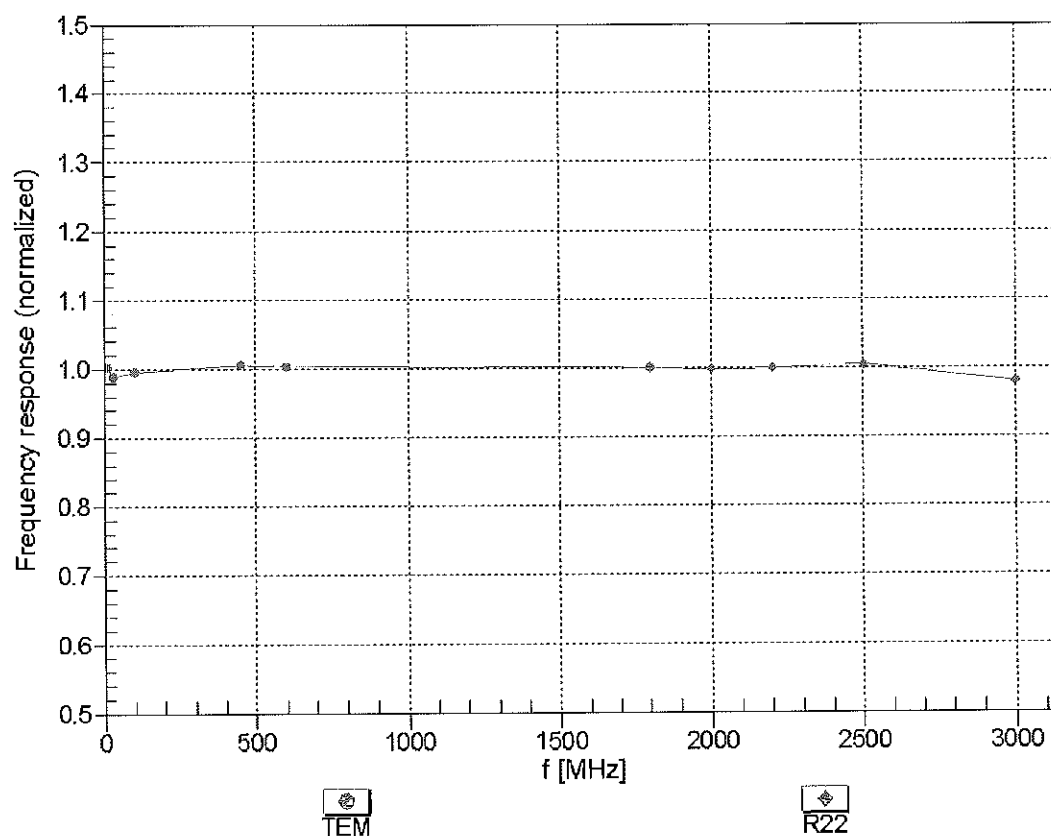
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.38	6.38	6.38	0.80	1.16	± 12.0 %
835	55.2	0.97	6.28	6.28	6.28	0.52	1.45	± 12.0 %
1750	53.4	1.49	5.03	5.03	5.03	0.58	1.45	± 12.0 %
1900	53.3	1.52	4.77	4.77	4.77	0.70	1.36	± 12.0 %
2450	52.7	1.95	4.34	4.34	4.34	0.80	1.15	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.80	1.00	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

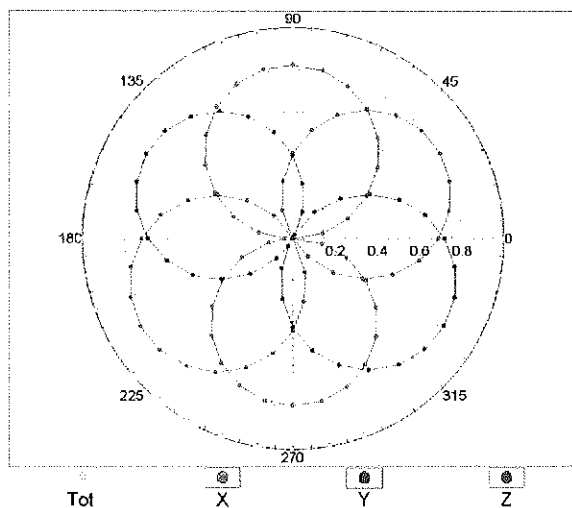
(TEM-Cell:ifi110 EXX, Waveguide: R22)



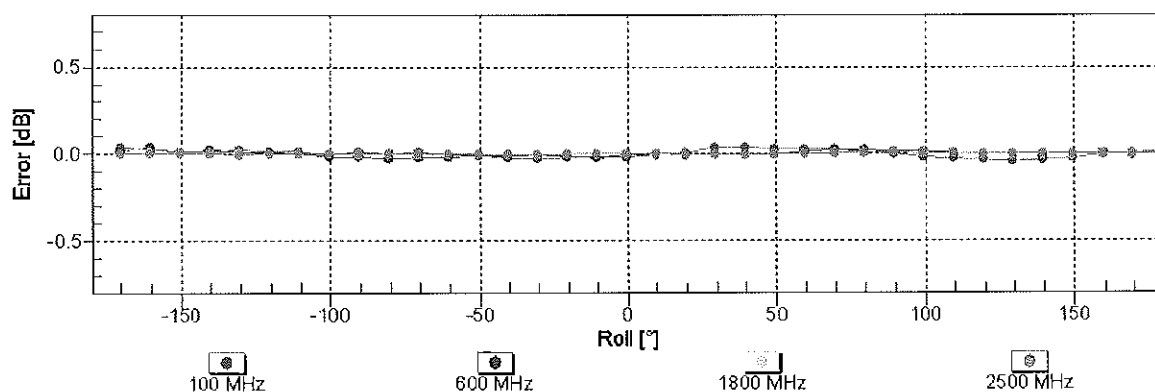
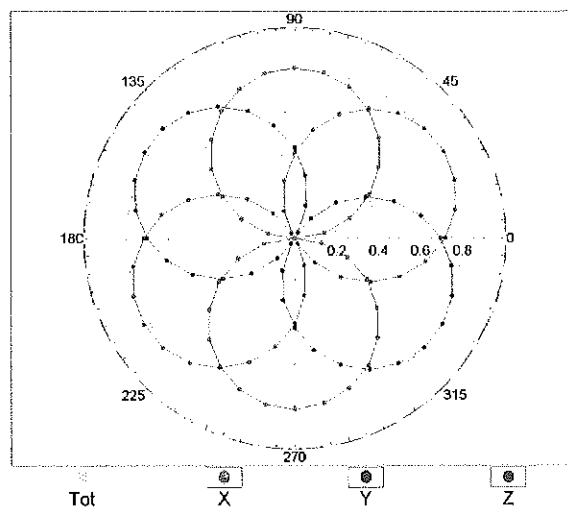
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz,TEM

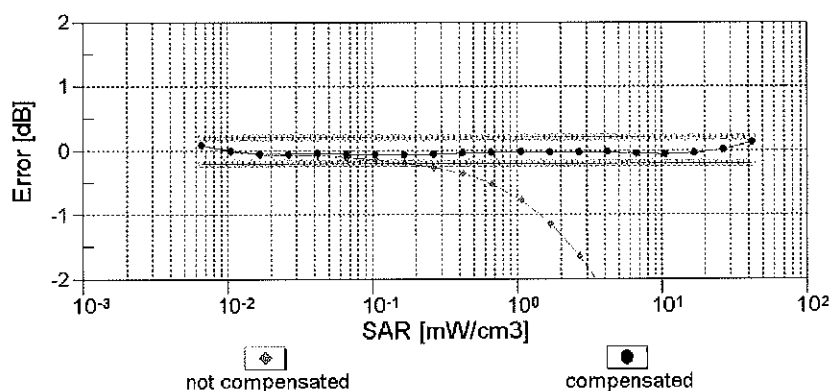
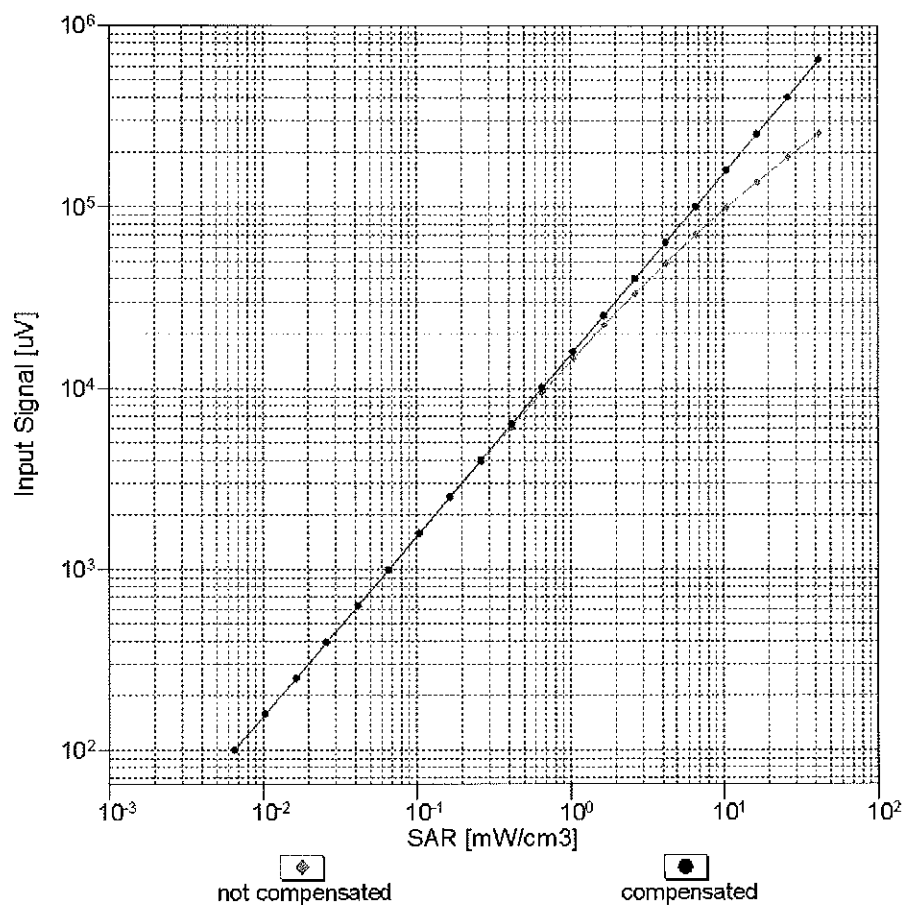


f=1800 MHz,R22



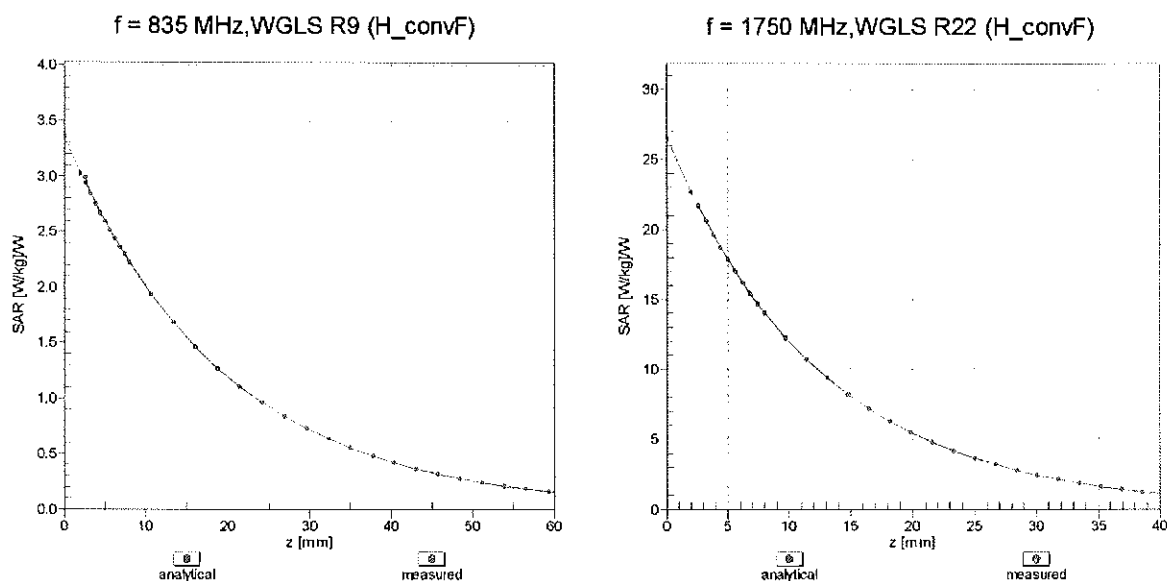
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



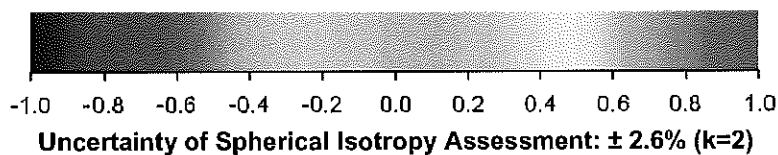
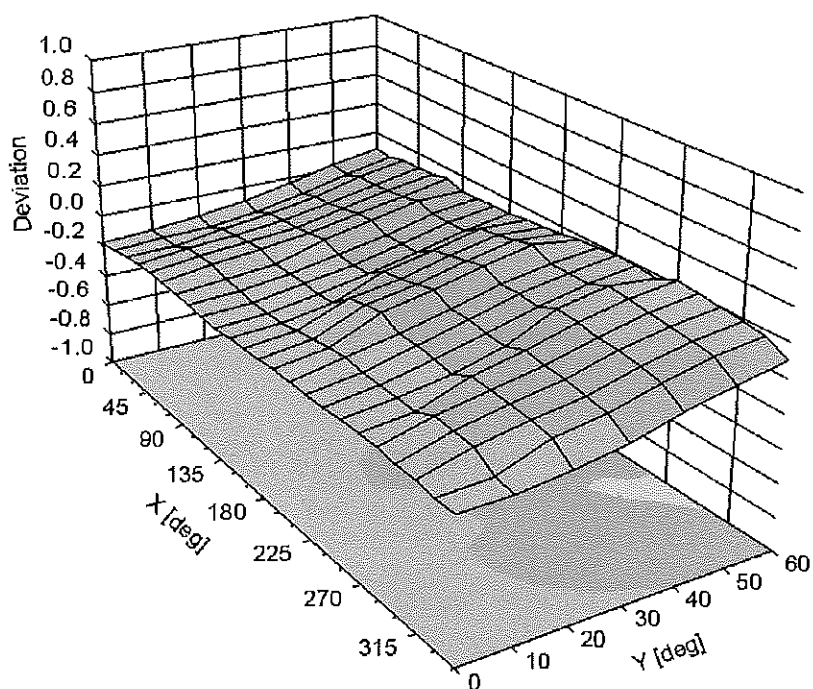
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-40.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm