SAR EVALUATION REPORT

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

Date of Testing:
07/02/13 - 07/19/13
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1307011138-R2.ZNF

FCC ID: **ZNFD803**

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

DUT Type: Portable Handset
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): LG-D803, LGD803, D803

Equipment Class	Band & Mode	Tx Frequency	Measured Conducted Power [dBm]	SAR		
				1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Wireless Router (W/kg)
PCE	GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	33.20	0.53	0.95	0.95
PCE	UMTS 850	826.40 - 846.60 MHz	23.70	0.36	0.51	0.51
PCE	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	31.14	0.19	0.64	1.01
PCE	UMTS 1900	1852.4 - 1907.6 MHz	24.02	0.26	1.01	1.20
PCE	LTE Band 17	706.5 - 713.5 MHz	23.35	0.22	0.30	0.31
PCE	LTE Band 4 (AWS)	1712.5 - 1752.5 MHz	23.92	0.19	0.83	0.83
PCE	LTE Band 7	2502.5 - 2567.5 MHz	23.56	0.21	1.22	1.22
DTS	2.4 GHz WLAN	2412 - 2462 MHz	15.96	0.37	0.10	0.10
DTS/NII	5.8 GHz WLAN	5745 - 5825 MHz	9.73	0.12	0.17	0.17
NII	5.2 GHz WLAN	5180 - 5240 MHz	10.65	< 0.1	< 0.1	
NII	5.3 GHz WLAN	5260 - 5320 MHz	10.73	< 0.1	< 0.1	
NII	5.5 GHz WLAN	5500 - 5700 MHz	10.57	< 0.1	0.11	
DSS/DTS	Bluetooth	2402 - 2480 MHz	10.82	N/A		
Simultaneous SAR per KDB 690783 D01v01r02:				0.91	1.50	1.39

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: 0Y1307011138-R2.ZNF) supersedes and replaces the previously issued test report on the same subject DUT for the same type of testing indicated. Please discard or destroy the previously issued tests report(s) and dispose of 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

ilac-MRA
ACCREDITED
TESTING LABORATORY
CERTIFICATE #2041.01

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

1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE 850	Voice/Data	824.20 - 848.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
LTE Band 17	Data	706.5 - 713.5 MHz
LTE Band 4 (AWS)	Data	1712.5 - 1752.5 MHz
LTE Band 7	Data	2502.5 - 2567.5 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

1.2 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v05r01.

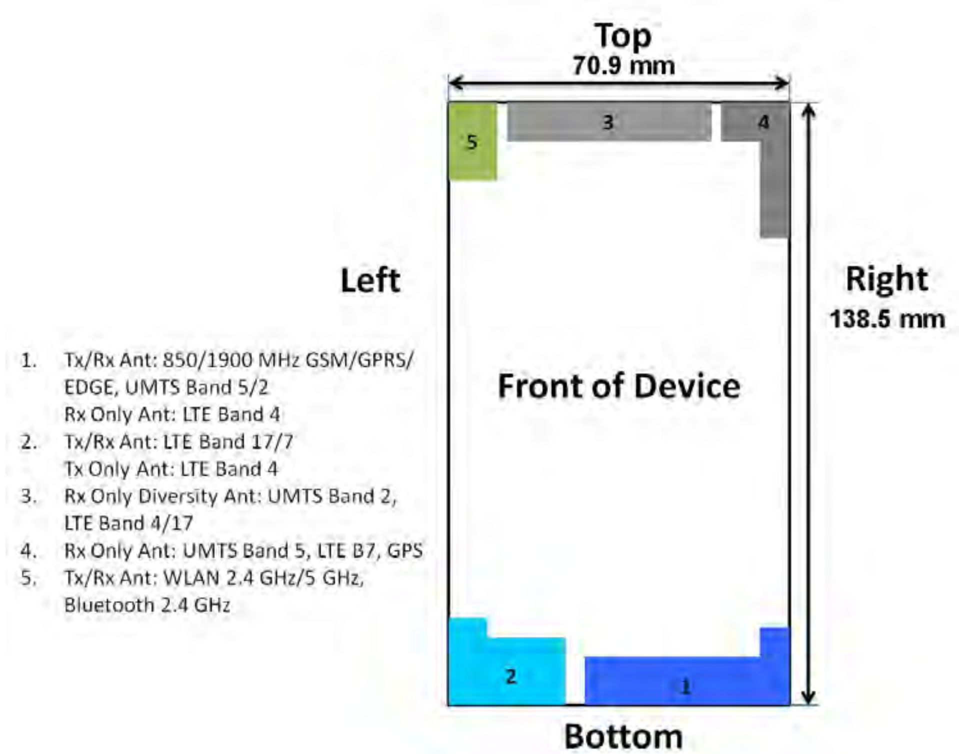
Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slot	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*
GSM/GPRS/EDGE 850	Maximum	**33.2**	**33.2**	**31.5**	**29.5**	**28.0**	**27.5**	**27.5**	**26.5**	**25.5**
	Nominal	**32.7**	**32.7**	**31.0**	**29.0**	**27.5**	**27.0**	**27.0**	**26.0**	**25.0**
GSM/GPRS/EDGE 1900	Maximum	**31.2**	**31.2**	**29.5**	**27.5**	**26.0**	**26.5**	**26.5**	**25.5**	**24.5**
	Nominal	**30.7**	**30.7**	**29.0**	**27.0**	**25.5**	**26.0**	**26.0**	**25.0**	**24.0**

Mode / Band		Modulated Average (dBm)			
		3GPP RMC	*3GPP HSDPA*	*3GPP HSUPA*	*3GPP DC-HSDPA*
UMTS Band 5 (850 MHz)	Maximum	**23.9**	**23.9**	**23.9**	**23.9**
	Nominal	**23.4**	**23.4**	**23.4**	**23.4**
UMTS Band 2 (1900 MHz)	Maximum	**24.2**	**24.2**	**24.2**	**24.2**
	Nominal	**23.7**	**23.7**	**23.7**	**23.7**

Mode / Band		Modulated Average (dBm)
LTE Band 17	Maximum	**23.7**
	Nominal	**23.2**
LTE Band 4 (AWS)	Maximum	**24.0**
	Nominal	**23.5**
LTE Band 7	Maximum	**23.7**
	Nominal	**23.2**

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	**16.0**
	Nominal	**15.0**
IEEE 802.11g (2.4 GHz)	Maximum	**13.0**
	Nominal	**12.0**
IEEE 802.11n (2.4 GHz)	Maximum	**12.0**
	Nominal	**11.0**
IEEE 802.11a (5 GHz)	Maximum	**11.0**
	Nominal	**10.0**
IEEE 802.11n (5 GHz)	Maximum	**11.0**
	Nominal	**10.0**
IEEE 802.11ac (5 GHz) (80 MHz)	Maximum	**10.0**
	Nominal	**9.0**
Bluetooth	Maximum	**11.0**
	Nominal	**10.0**
Bluetooth LE	Maximum	**5.5**
	Nominal	**4.0**

1.3 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
Wireless Router Sides for SAR Testing

Mode	Back	Front	Top	Bottom	Right	Left
GPRS 850	Yes	Yes	No	Yes	Yes	No
UMTS 850	Yes	Yes	No	Yes	Yes	No
GPRS 1900	Yes	Yes	No	Yes	Yes	No
UMTS 1900	Yes	Yes	No	Yes	Yes	No
LTE Band 17	Yes	Yes	No	Yes	No	Yes
LTE Band 4 (AWS)	Yes	Yes	No	Yes	No	Yes
LTE Band 7	Yes	Yes	No	Yes	No	Yes
2.4 GHz WLAN	Yes	Yes	Yes	No	No	Yes
5.8 GHz WLAN	Yes	Yes	Yes	No	No	Yes

Note:

1. 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 D06v01r01 guidance, page 2. When Hotspot is enabled, all 5 GHz bands are disabled. Therefore no 5 GHz WIFI Hotspot SAR Data was required.
2. 5 GHz Wifi Direct GO is supported in the 5.8 GHz band only. The manufacturer expects 5.8 GHz Wifi Direct GO may be used similar to wireless router usage. Therefore, 5.8 GHz Wifi Direct GO was evaluated for SAR similar to wireless router SAR procedures in FCC KDB Publication 941225.

1.4 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the specialized battery cover. The SAR tests were performed with the specialized battery cover.

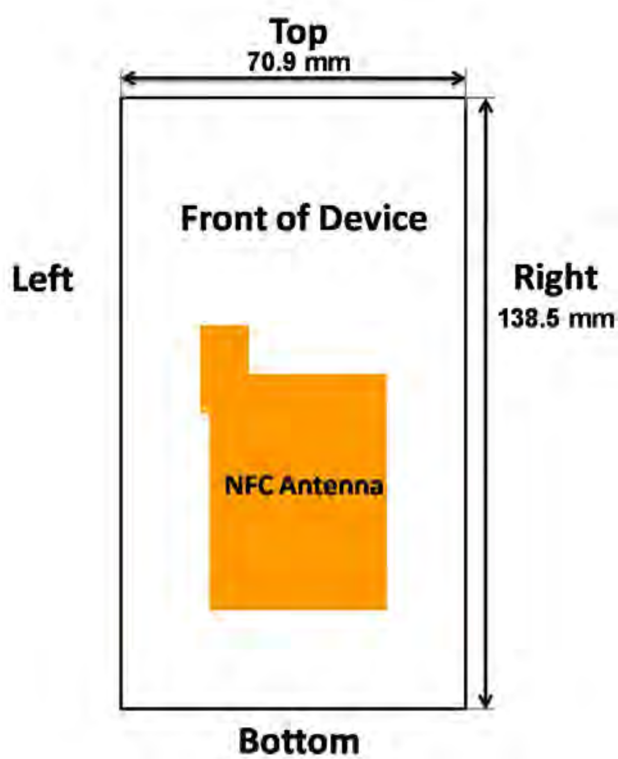


Figure 1-2
NFC Antenna Locations

1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v05r01, 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.

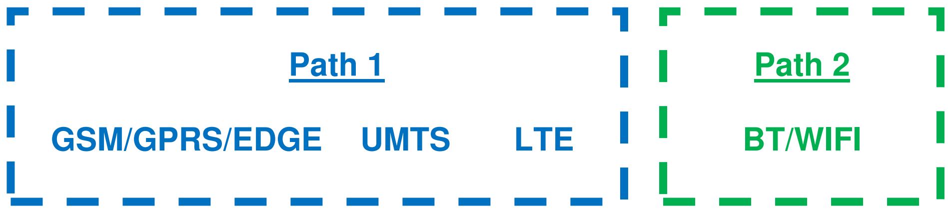


Figure 1-3
Simultaneous Transmission Paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v05r01 3) procedures.

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable TX Configration	Head SAR	Body Worn SAR	Wireless Router SAR	Note
1	GSM 850/1900 MHz Voice + WiFi 2.4Ghz	Yes	Yes	No	
2	GSM 850/1900 MHz Voice + WiFi 5Ghz	Yes	Yes	No	
3	GSM 850/1900 MHz Voice + Bluetooth 2.4Ghz	No	Yes	No	
4	GSM/GPRS/EDGE 850/1900 MHz Data + WiFi 2.4Ghz	Yes	Yes	Yes	
5	GSM/GPRS/EDGE 850/1900 MHz Data + WiFi 5.8Ghz	Yes	Yes	Yes	WIFI 5GHz Direct
6	UMTS Band 2/5 + WiFi 2.4Ghz	Yes	Yes	Yes	
7	UMTS Band 2/5 + WiFi 5.8Ghz	Yes	Yes	Yes	WIFI 5GHz Direct
8	UMTS Band 2/5 + Bluetooth 2.4Ghz	No	Yes	No	
9	LTE B17/4/7 + WiFi 2.4Ghz	Yes	Yes	Yes	
10	LTE B17/4/7 + WiFi 5.8Ghz	Yes	Yes	Yes	WIFI 5GHz Direct
11	LTE B17/4/7 + Bluetooth 2.4Ghz	No	Yes	No	
12	GSM/GPRS/EDGE 850/1900 MHz Data + WIFI 5.2/5.3/5.5 GHz	No	No	No	Not Supported by SW
13	LTE Band 17/4/7 + WIFI 5.2/5.3/5.5	No	No	No	Not Supported by SW

1. WiFi 2.4GHz supports Hotspot and WiFi-Direct (GO/GC)
2. WiFi 5Ghz supports WiFi-Direct. WiFi 5GHz does not support Hotspot.
   -> UNII 1 = WiFi direct GC only supported , UNII 2 = WiFi direct not supported , 5.7(ISM) = WiFi direct GC/GO supported
3. LTE, WCDMA, GPRS/EDGE support Hotspot.
4. VoIP is supported in LTE, WCDMA, GSM (e.g. 3rd part VoIP and VoLTE)
5. Bluetooth and WiFi cannot transmit simultaneously since they share the same chip.
6. GSM, WCDMA and LTE cannot transmit simultaneously since they share the same chip.

When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.

1.6 SAR Test Exclusions Applied

(A) WIFI/BT

The manufacturer expects Wifi Direct GO, supported in the 5.8 GHz band only, may be used similar to wireless router usage. Therefore, 5.8 GHz Wifi Direct GO was evaluated for SAR similar to wireless router SAR procedures in FCC KDB Publication 941225. Since Hotspot operations are not allowed by the chipset firmware using 5 GHz WIFI, only 2.4 GHz WIFI Hotspot SAR tests and combinations are additionally considered for SAR with respect to Wireless Router configurations according to FCC KDB 941225 D06v01r01.

Per FCC KDB 447498 D01v05r01, the SAR exclusion threshold for distances <50mm is defined by the following equation:

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

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth SAR was not required; $[(13/10)* \sqrt{2.441}] = 2.0 < 3.0$. 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.

This device supports IEEE 802.11ac with the following features:
a) Up to 80 MHz Bandwidth only
b) No aggregate channel configurations
c) 1 Tx antenna output
d) 256 QAM is supported

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

(B) Licensed Transmitter(s)

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

Per KDB Publication 941225 D03v01EDGE testing was excluded for SAR testing because the frame-averaged output powers were lower than the frame-averaged output powers for GPRS.

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

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 D05v02r02.

1.7 Power Reduction for SAR

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

1.8 Guidance Applied

- FCC OET Bulletin 65 Supplement C [June 2001]
- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (2G/3G/4G and Hotspot)
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05r01 (General SAR Guidance)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)
- April 2013 TCB Workshop Notes (IEEE 802.11ac)

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	Wireless Router Serial Number
GSM/GPRS/EDGE 850	2434-1	2434-1	2434-1
UMTS 850	2434-1	2434-2	2434-2
GSM/GPRS/EDGE 1900	2434-1	2434-1	2434-1
UMTS 1900	2434-1	2434-1	2434-1
LTE Band 17	5830-2	5830-1	5830-1
LTE Band 4 (AWS)	5830-1	5830-1	5830-1
LTE Band 7	5830-2	5830-1	5830-1
2.4 GHz WLAN	9434-2	9434-2	9434-2
5 GHz WLAN	9434-2	9434-2	9434-2

2 LTE INFORMATION

LTE Information			
FCC ID	**ZNFD803**		
Form Factor	Portable Handset		
Frequency Range of each LTE transmission band	LTE Band 17 (706.5 - 713.5 MHz)		
	LTE Band 4 (AWS) (1712.5 - 1752.5 MHz)		
	LTE Band 7 (2502.5 - 2567.5 MHz)		
Channel Bandwidths	LTE Band 17: 5 MHz, 10 MHz		
	LTE Band 4 (AWS): 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 7: 5 MHz, 10 MHz, 15 MHz, 20 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 17: 5 MHz	706.5 (23755)	710 (23790)	713.5 (23825)
LTE Band 17: 10 MHz	709 (23780)	710 (23790)	711 (23800)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	1732.5 (20175)	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715 (20000)	1732.5 (20175)	1750 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	1732.5 (20175)	1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720 (20050)	1732.5 (20175)	1745 (20300)
LTE Band 7: 5 MHz	2502.5 (20775)	2535 (21100)	2567.5 (21425)
LTE Band 7: 10 MHz	2505 (20800)	2535 (21100)	2565 (21400)
LTE Band 7: 15 MHz	2507.5 (20825)	2535 (21100)	2562.5 (21375)
LTE Band 7: 20 MHz	2510 (20850)	2535 (21100)	2560 (21350)
UE Category	3		
Modulations Supported in UL	QPSK, 16QAM		
LTE Voice available?	NO		
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		
Conducted power Table provided for 1RB (low, mid and high offset), 50% RB (low, mid, and high offset), and 100% RB	YES		

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/m^3)
E = Total RMS electric field strength (V/m)

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

4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure:

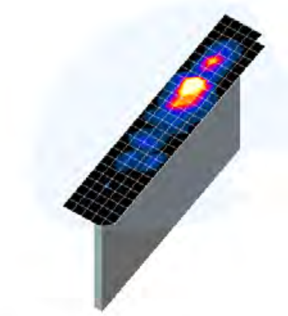


Figure 4-1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r01 (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 D01v01r01 (See Table 4-1). On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

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

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

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

Table 4-1
Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r01

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

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].

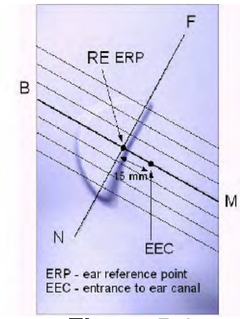


Figure 5-1
Close-Up Side view of ERP

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 than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at its top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.

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

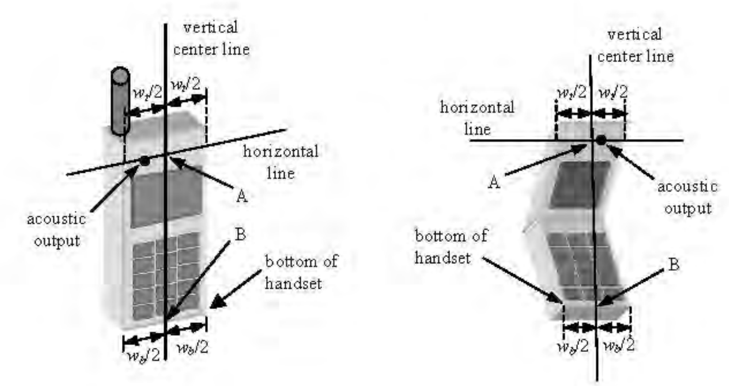


Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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 ε = 3 and loss tangent δ = 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 was respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the device contact with the ear, the device was rotated about the NF line until any point on the handset made contact with a phantom point below the ear (cheek) (See Figure 6-2).

6.3 Positioning for Ear / 15º Tilt

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

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

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

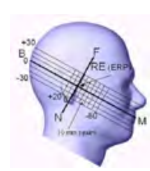


Figure 6-3
Side view w/ relevant markings

6.4 Body-Worn Accessory Configurations

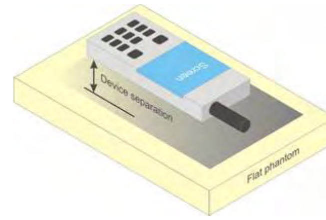


Figure 6-4
Sample Body-Worn Diagram

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6-4). Per FCC KDB Publication 648474 D04v01r01, 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 D01v05r01 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

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

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented.

Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

6.5 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.

6.6 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06v01r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v05r01 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.

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

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

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 D01v05r01, 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 UMTS

8.3.1 Output Power Verification

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

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

8.3.2 Head SAR Measurements for Handsets

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

8.3.3 Body SAR Measurements

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

8.3.4 SAR Measurements for Handsets with Rel 5 HSDPA

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

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

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

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 8 ⇔ $A_{hs} = \beta_{hs}/\beta_c = 30/15$ ⇔ $\beta_{hs} = 30/15 * \beta_c$.
Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and Δ_{NACK} = 8 (A_{hs} = 30/15) with $\beta_{hs} = 30/15 * \beta_c$, and Δ_{CQI} = 7 (A_{hs} = 24/15) with $\beta_{hs} = 24/15 * \beta_c$.
Note 3: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Figure 8-1
Table C.10.1.4 of TS 234.121-1

8.3.5 SAR Measurements for Handsets with Rel 6 HSUPA

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

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

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

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

8.3.6 SAR Measurement Conditions for DC-HSDPA

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

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

8.4 SAR Measurement Conditions for LTE

LTE modes were tested according to FCC KDB 941225 D05v02r02 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 D05v02r02:

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.

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 /ac transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v01r02 for more details.

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 then the default channels, these “required channels” were considered instead of the default channels for SAR testing. 802.11n modes and higher data rates for 802.11a/n were evaluated only if the respective mode was 0.25 dB or higher than the 802.11a mode. 802.11ac SAR was evaluated for highest 802.11a configuration in each 5 GHz band and each exposure condition. 802.11ac modes were additionally evaluated for SAR if the output power for the respective mode was more than 0.25 dB higher than powers of 802.11a modes.

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

9 RF CONDUCTED POWERS

9.1 GSM Conducted Powers

		Maximum Burst-Averaged Output Power								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	33.15	33.18	**31.47**	29.50	27.99	27.37	27.50	26.50	25.49
	190	33.20	33.20	**31.41**	29.50	27.91	27.31	27.40	26.48	25.37
	251	33.16	33.20	**31.19**	29.31	27.87	27.21	27.29	26.17	25.25
GSM 1900	512	31.20	31.20	**29.50**	27.46	25.97	26.39	26.49	25.50	24.50
	661	31.14	31.19	**29.50**	27.48	26.00	25.92	26.35	25.46	24.47
	810	31.18	31.20	**29.50**	27.48	25.99	25.87	26.34	25.48	24.42

		Calculated Maximum Frame-Averaged Output Power								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	24.12	24.15	**25.45**	25.24	24.98	18.34	21.48	22.24	22.48
	190	24.17	24.17	**25.39**	25.24	24.90	18.28	21.38	22.22	22.36
	251	24.13	24.17	**25.17**	25.05	24.86	18.18	21.27	21.91	22.24
GSM 1900	512	22.17	22.17	**23.48**	23.20	22.96	17.36	20.47	21.24	21.49
	661	22.11	22.16	**23.48**	23.22	22.99	16.89	20.33	21.20	21.46
	810	22.15	22.17	**23.48**	23.22	22.98	16.84	20.32	21.22	21.41

Note:

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

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

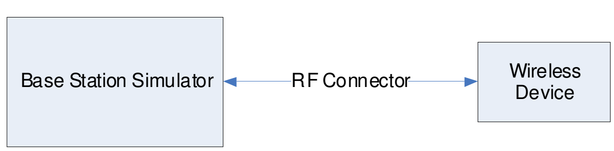


Figure 9-1
Power Measurement Setup

9.2 UMTS Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	23.73	23.70	23.85	24.02	23.99	23.72	-
99		12.2 kbps AMR	23.72	23.70	23.84	24.00	24.09	23.68	-
6	HSDPA	Subtest 1	23.74	23.77	23.90	24.18	24.05	23.78	0
6		Subtest 2	23.80	23.80	23.90	24.07	24.01	23.91	0
6		Subtest 3	23.22	23.21	23.40	23.50	23.54	23.59	0.5
6		Subtest 4	23.28	23.28	23.40	23.48	23.47	23.60	0.5
6	HSUPA	Subtest 1	23.50	23.44	23.61	23.67	23.87	23.36	0
6		Subtest 2	21.79	21.86	21.90	22.20	22.20	22.10	2
6		Subtest 3	22.81	22.43	22.70	23.09	23.09	22.92	1
6		Subtest 4	22.30	22.40	22.40	22.50	22.70	22.50	2
6		Subtest 5	23.02	23.08	22.99	23.55	23.22	23.77	0
8	DC-HSDPA	Subtest 1	23.70	23.72	23.51	24.18	24.17	23.97	0
8		Subtest 2	23.75	23.76	23.62	24.20	24.16	23.96	0
8		Subtest 3	23.29	23.44	23.23	23.77	23.74	23.72	0.5
8		Subtest 4	23.31	23.43	23.23	23.71	23.66	23.77	0.5

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

DC-HSDPA considerations

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

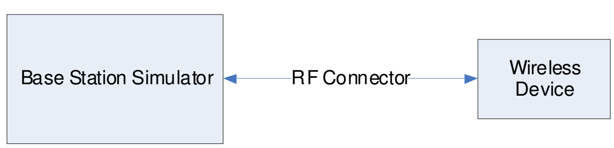


Figure 9-2
Power Measurement Setup

9.3 LTE Conducted Powers

9.3.1 LTE Band 17

Table 9-1
LTE Band 17 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	710.0	23790	10	QPSK	1	0	**23.35**	0	0
	710.0	23790	10	QPSK	1	25	23.27	0	0
	710.0	23790	10	QPSK	1	49	23.35	0	0
	710.0	23790	10	QPSK	25	0	22.10	1	0-1
	710.0	23790	10	QPSK	25	12	22.05	1	0-1
	710.0	23790	10	QPSK	25	25	**22.10**	1	0-1
	710.0	23790	10	QPSK	50	0	21.99	1	0-1
	710.0	23790	10	16QAM	1	0	21.89	1	0-1
	710.0	23790	10	16QAM	1	25	21.87	1	0-1
	710.0	23790	10	16QAM	1	49	21.96	1	0-1
	710.0	23790	10	16QAM	25	0	21.11	2	0-2
	710.0	23790	10	16QAM	25	12	21.06	2	0-2
	710.0	23790	10	16QAM	25	25	21.13	2	0-2
	710.0	23790	10	16QAM	50	0	20.92	2	0-2

Note: LTE Band 17 at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02r02, 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.

Table 9-2
LTE Band 17 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]
Mid	710.0	23790	5	QPSK	1	0	23.44	0	0
	710.0	23790	5	QPSK	1	12	23.34	0	0
	710.0	23790	5	QPSK	1	24	23.47	0	0
	710.0	23790	5	QPSK	12	0	22.01	1	0-1
	710.0	23790	5	QPSK	12	6	22.03	1	0-1
	710.0	23790	5	QPSK	12	13	22.09	1	0-1
	710.0	23790	5	QPSK	25	0	21.95	1	0-1
	710.0	23790	5	16-QAM	1	0	22.62	1	0-1
	710.0	23790	5	16-QAM	1	12	22.49	1	0-1
	710.0	23790	5	16-QAM	1	24	22.68	1	0-1
	710.0	23790	5	16-QAM	12	0	20.94	2	0-2
	710.0	23790	5	16-QAM	12	6	20.97	2	0-2
	710.0	23790	5	16-QAM	12	13	21.08	2	0-2
	710.0	23790	5	16-QAM	25	0	20.96	2	0-2

Note: LTE Band 17 at 5 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02r02, 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.

9.3.2 LTE Band 4 (AWS)

Table 9-3
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	1732.5	20175	20	QPSK	1	0	23.87	0	0
	1732.5	20175	20	QPSK	1	50	23.69	0	0
	1732.5	20175	20	QPSK	1	99	**23.92**	0	0
	1732.5	20175	20	QPSK	50	0	**22.45**	1	0-1
	1732.5	20175	20	QPSK	50	25	22.43	1	0-1
	1732.5	20175	20	QPSK	50	50	22.44	1	0-1
	1732.5	20175	20	QPSK	100	0	22.41	1	0-1
	1732.5	20175	20	16QAM	1	0	22.49	1	0-1
	1732.5	20175	20	16QAM	1	50	22.42	1	0-1
	1732.5	20175	20	16QAM	1	99	22.58	1	0-1
	1732.5	20175	20	16QAM	50	0	21.56	2	0-2
	1732.5	20175	20	16QAM	50	25	21.50	2	0-2
	1732.5	20175	20	16QAM	50	50	21.56	2	0-2
	1732.5	20175	20	16QAM	100	0	21.49	2	0-2

Note: LTE Band 4 (AWS) at 20 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02r02, 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.

Table 9-4
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1717.5	20025	15	QPSK	1	0	23.72	0	0
	1717.5	20025	15	QPSK	1	36	23.65	0	0
	1717.5	20025	15	QPSK	1	74	23.83	0	0
	1717.5	20025	15	QPSK	36	0	22.26	1	0-1
	1717.5	20025	15	QPSK	36	18	22.34	1	0-1
	1717.5	20025	15	QPSK	36	37	22.39	1	0-1
	1717.5	20025	15	QPSK	75	0	22.31	1	0-1
	1717.5	20025	15	16QAM	1	0	22.31	1	0-1
	1717.5	20025	15	16QAM	1	36	22.16	1	0-1
	1717.5	20025	15	16QAM	1	74	22.40	1	0-1
	1717.5	20025	15	16QAM	36	0	21.29	2	0-2
	1717.5	20025	15	16QAM	36	18	21.44	2	0-2
	1717.5	20025	15	16QAM	36	37	21.45	2	0-2
	1717.5	20025	15	16QAM	75	0	21.38	2	0-2
Mid	1732.5	20175	15	QPSK	1	0	23.74	0	0
	1732.5	20175	15	QPSK	1	36	23.65	0	0
	1732.5	20175	15	QPSK	1	74	23.71	0	0
	1732.5	20175	15	QPSK	36	0	22.44	1	0-1
	1732.5	20175	15	QPSK	36	18	22.44	1	0-1
	1732.5	20175	15	QPSK	36	37	22.46	1	0-1
	1732.5	20175	15	QPSK	75	0	22.40	1	0-1
	1732.5	20175	15	16QAM	1	0	22.91	1	0-1
	1732.5	20175	15	16QAM	1	36	22.86	1	0-1
	1732.5	20175	15	16QAM	1	74	22.91	1	0-1
	1732.5	20175	15	16QAM	36	0	21.60	2	0-2
	1732.5	20175	15	16QAM	36	18	21.55	2	0-2
	1732.5	20175	15	16QAM	36	37	21.53	2	0-2
	1732.5	20175	15	16QAM	75	0	21.45	2	0-2
High	1747.5	20325	15	QPSK	1	0	23.76	0	0
	1747.5	20325	15	QPSK	1	36	23.57	0	0
	1747.5	20325	15	QPSK	1	74	23.81	0	0
	1747.5	20325	15	QPSK	36	0	22.39	1	0-1
	1747.5	20325	15	QPSK	36	18	22.31	1	0-1
	1747.5	20325	15	QPSK	36	37	22.41	1	0-1
	1747.5	20325	15	QPSK	75	0	22.38	1	0-1
	1747.5	20325	15	16QAM	1	0	22.36	1	0-1
	1747.5	20325	15	16QAM	1	36	22.11	1	0-1
	1747.5	20325	15	16QAM	1	74	22.46	1	0-1
	1747.5	20325	15	16QAM	36	0	21.51	2	0-2
	1747.5	20325	15	16QAM	36	18	21.40	2	0-2
	1747.5	20325	15	16QAM	36	37	21.47	2	0-2
	1747.5	20325	15	16QAM	75	0	21.47	2	0-2

Table 9-5
LTE Band 4 (AWS) 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]
Low	1715	20000	10	QPSK	1	0	23.71	0	0
	1715	20000	10	QPSK	1	25	23.67	0	0
	1715	20000	10	QPSK	1	49	23.77	0	0
	1715	20000	10	QPSK	25	0	22.34	1	0-1
	1715	20000	10	QPSK	25	12	22.24	1	0-1
	1715	20000	10	QPSK	25	25	22.30	1	0-1
	1715	20000	10	QPSK	50	0	22.22	1	0-1
	1715	20000	10	16QAM	1	0	22.36	1	0-1
	1715	20000	10	16QAM	1	25	22.24	1	0-1
	1715	20000	10	16QAM	1	49	22.35	1	0-1
	1715	20000	10	16QAM	25	0	21.39	2	0-2
	1715	20000	10	16QAM	25	12	21.40	2	0-2
	1715	20000	10	16QAM	25	25	21.46	2	0-2
	1715	20000	10	16QAM	50	0	21.25	2	0-2
Mid	1732.5	20175	10	QPSK	1	0	23.79	0	0
	1732.5	20175	10	QPSK	1	25	23.66	0	0
	1732.5	20175	10	QPSK	1	49	23.76	0	0
	1732.5	20175	10	QPSK	25	0	22.45	1	0-1
	1732.5	20175	10	QPSK	25	12	22.37	1	0-1
	1732.5	20175	10	QPSK	25	25	22.40	1	0-1
	1732.5	20175	10	QPSK	50	0	22.31	1	0-1
	1732.5	20175	10	16QAM	1	0	22.42	1	0-1
	1732.5	20175	10	16QAM	1	25	22.29	1	0-1
	1732.5	20175	10	16QAM	1	49	22.39	1	0-1
	1732.5	20175	10	16QAM	25	0	21.50	2	0-2
	1732.5	20175	10	16QAM	25	12	21.50	2	0-2
	1732.5	20175	10	16QAM	25	25	21.46	2	0-2
	1732.5	20175	10	16QAM	50	0	21.42	2	0-2
High	1750	20350	10	QPSK	1	0	23.72	0	0
	1750	20350	10	QPSK	1	25	23.68	0	0
	1750	20350	10	QPSK	1	49	23.77	0	0
	1750	20350	10	QPSK	25	0	22.30	1	0-1
	1750	20350	10	QPSK	25	12	22.41	1	0-1
	1750	20350	10	QPSK	25	25	22.51	1	0-1
	1750	20350	10	QPSK	50	0	22.32	1	0-1
	1750	20350	10	16QAM	1	0	22.86	1	0-1
	1750	20350	10	16QAM	1	25	22.88	1	0-1
	1750	20350	10	16QAM	1	49	22.93	1	0-1
	1750	20350	10	16QAM	25	0	21.37	2	0-2
	1750	20350	10	16QAM	25	12	21.46	2	0-2
	1750	20350	10	16QAM	25	25	21.55	2	0-2
	1750	20350	10	16QAM	50	0	21.40	2	0-2

Table 9-6
LTE Band 4 (AWS) 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	1712.5	19975	5	QPSK	1	0	23.74	0	0
	1712.5	19975	5	QPSK	1	12	23.70	0	0
	1712.5	19975	5	QPSK	1	24	23.69	0	0
	1712.5	19975	5	QPSK	12	0	22.39	1	0-1
	1712.5	19975	5	QPSK	12	6	22.38	1	0-1
	1712.5	19975	5	QPSK	12	13	22.40	1	0-1
	1712.5	19975	5	QPSK	25	0	22.27	1	0-1
	1712.5	19975	5	16-QAM	1	0	22.56	1	0-1
	1712.5	19975	5	16-QAM	1	12	22.53	1	0-1
	1712.5	19975	5	16-QAM	1	24	22.53	1	0-1
	1712.5	19975	5	16-QAM	12	0	21.41	2	0-2
	1712.5	19975	5	16-QAM	12	6	21.42	2	0-2
	1712.5	19975	5	16-QAM	12	13	21.45	2	0-2
	1712.5	19975	5	16-QAM	25	0	21.34	2	0-2
Mid	1732.5	20175	5	QPSK	1	0	23.83	0	0
	1732.5	20175	5	QPSK	1	12	23.79	0	0
	1732.5	20175	5	QPSK	1	24	23.78	0	0
	1732.5	20175	5	QPSK	12	0	22.46	1	0-1
	1732.5	20175	5	QPSK	12	6	22.46	1	0-1
	1732.5	20175	5	QPSK	12	13	22.48	1	0-1
	1732.5	20175	5	QPSK	25	0	22.35	1	0-1
	1732.5	20175	5	16-QAM	1	0	22.37	1	0-1
	1732.5	20175	5	16-QAM	1	12	22.31	1	0-1
	1732.5	20175	5	16-QAM	1	24	22.31	1	0-1
	1732.5	20175	5	16-QAM	12	0	21.53	2	0-2
	1732.5	20175	5	16-QAM	12	6	21.49	2	0-2
	1732.5	20175	5	16-QAM	12	13	21.47	2	0-2
	1732.5	20175	5	16-QAM	25	0	21.47	2	0-2
High	1752.5	20375	5	QPSK	1	0	23.66	0	0
	1752.5	20375	5	QPSK	1	12	23.69	0	0
	1752.5	20375	5	QPSK	1	24	23.71	0	0
	1752.5	20375	5	QPSK	12	0	22.41	1	0-1
	1752.5	20375	5	QPSK	12	6	22.53	1	0-1
	1752.5	20375	5	QPSK	12	13	22.57	1	0-1
	1752.5	20375	5	QPSK	25	0	22.53	1	0-1
	1752.5	20375	5	16-QAM	1	0	22.32	1	0-1
	1752.5	20375	5	16-QAM	1	12	22.37	1	0-1
	1752.5	20375	5	16-QAM	1	24	22.32	1	0-1
	1752.5	20375	5	16-QAM	12	0	21.55	2	0-2
	1752.5	20375	5	16-QAM	12	6	21.64	2	0-2
	1752.5	20375	5	16-QAM	12	13	21.62	2	0-2
	1752.5	20375	5	16-QAM	25	0	21.53	2	0-2

9.3.3 LTE Band 7

Table 9-7
LTE Band 7 Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	2510	20850	20	QPSK	1	0	23.51	0	0
	2510	20850	20	QPSK	1	49	23.48	0	0
	2510	20850	20	QPSK	1	99	**23.56**	0	0
	2510	20850	20	QPSK	50	0	21.88	1	0-1
	2510	20850	20	QPSK	50	25	21.99	1	0-1
	2510	20850	20	QPSK	50	50	21.87	1	0-1
	2510	20850	20	QPSK	100	0	21.94	1	0-1
	2510	20850	20	16QAM	1	0	22.16	1	0-1
	2510	20850	20	16QAM	1	49	22.13	1	0-1
	2510	20850	20	16QAM	1	99	22.18	1	0-1
	2510	20850	20	16QAM	50	0	20.89	2	0-2
	2510	20850	20	16QAM	50	25	21.02	2	0-2
	2510	20850	20	16QAM	50	50	20.92	2	0-2
	2510	20850	20	16QAM	100	0	20.95	2	0-2
Mid	2535.0	21100	20	QPSK	1	0	23.30	0	0
	2535.0	21100	20	QPSK	1	49	23.23	0	0
	2535.0	21100	20	QPSK	1	99	23.38	0	0
	2535.0	21100	20	QPSK	50	0	21.92	1	0-1
	2535.0	21100	20	QPSK	50	25	21.83	1	0-1
	2535.0	21100	20	QPSK	50	50	21.90	1	0-1
	2535.0	21100	20	QPSK	100	0	21.95	1	0-1
	2535.0	21100	20	16QAM	1	0	22.08	1	0-1
	2535.0	21100	20	16QAM	1	49	22.02	1	0-1
	2535.0	21100	20	16QAM	1	99	22.17	1	0-1
	2535.0	21100	20	16QAM	50	0	20.84	2	0-2
	2535.0	21100	20	16QAM	50	25	20.85	2	0-2
	2535.0	21100	20	16QAM	50	50	20.89	2	0-2
	2535.0	21100	20	16QAM	100	0	20.90	2	0-2
High	2560	21350	20	QPSK	1	0	23.43	0	0
	2560	21350	20	QPSK	1	49	23.43	0	0
	2560	21350	20	QPSK	1	99	23.39	0	0
	2560	21350	20	QPSK	50	0	21.94	1	0-1
	2560	21350	20	QPSK	50	25	22.00	1	0-1
	2560	21350	20	QPSK	50	50	**22.02**	1	0-1
	2560	21350	20	QPSK	100	0	22.01	1	0-1
	2560	21350	20	16QAM	1	0	22.35	1	0-1
	2560	21350	20	16QAM	1	49	22.44	1	0-1
	2560	21350	20	16QAM	1	99	22.39	1	0-1
	2560	21350	20	16QAM	50	0	20.86	2	0-2
	2560	21350	20	16QAM	50	25	20.91	2	0-2
	2560	21350	20	16QAM	50	50	21.07	2	0-2
	2560	21350	20	16QAM	100	0	20.92	2	0-2

Table 9-8
LTE Band 7 Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	2507.5	20825	15	QPSK	1	0	23.39	0	0
	2507.5	20825	15	QPSK	1	36	23.34	0	0
	2507.5	20825	15	QPSK	1	74	23.28	0	0
	2507.5	20825	15	QPSK	36	0	21.88	1	0-1
	2507.5	20825	15	QPSK	36	18	21.92	1	0-1
	2507.5	20825	15	QPSK	36	37	21.89	1	0-1
	2507.5	20825	15	QPSK	75	0	21.87	1	0-1
	2507.5	20825	15	16QAM	1	0	22.54	1	0-1
	2507.5	20825	15	16QAM	1	36	22.43	1	0-1
	2507.5	20825	15	16QAM	1	74	22.46	1	0-1
	2507.5	20825	15	16QAM	36	0	20.96	2	0-2
	2507.5	20825	15	16QAM	36	18	21.00	2	0-2
	2507.5	20825	15	16QAM	36	37	21.02	2	0-2
	2507.5	20825	15	16QAM	75	0	20.85	2	0-2
Mid	2535.0	21100	15	QPSK	1	0	23.38	0	0
	2535.0	21100	15	QPSK	1	36	23.30	0	0
	2535.0	21100	15	QPSK	1	74	23.39	0	0
	2535.0	21100	15	QPSK	36	0	21.89	1	0-1
	2535.0	21100	15	QPSK	36	18	21.91	1	0-1
	2535.0	21100	15	QPSK	36	37	21.91	1	0-1
	2535.0	21100	15	QPSK	75	0	21.81	1	0-1
	2535.0	21100	15	16QAM	1	0	21.97	1	0-1
	2535.0	21100	15	16QAM	1	36	21.86	1	0-1
	2535.0	21100	15	16QAM	1	74	22.01	1	0-1
	2535.0	21100	15	16QAM	36	0	20.87	2	0-2
	2535.0	21100	15	16QAM	36	18	20.84	2	0-2
	2535.0	21100	15	16QAM	36	37	20.97	2	0-2
	2535.0	21100	15	16QAM	75	0	20.86	2	0-2
High	2562.5	21375	15	QPSK	1	0	23.48	0	0
	2562.5	21375	15	QPSK	1	36	23.53	0	0
	2562.5	21375	15	QPSK	1	74	23.31	0	0
	2562.5	21375	15	QPSK	36	0	21.90	1	0-1
	2562.5	21375	15	QPSK	36	18	22.02	1	0-1
	2562.5	21375	15	QPSK	36	37	22.01	1	0-1
	2562.5	21375	15	QPSK	75	0	21.92	1	0-1
	2562.5	21375	15	16QAM	1	0	22.17	1	0-1
	2562.5	21375	15	16QAM	1	36	22.31	1	0-1
	2562.5	21375	15	16QAM	1	74	22.14	1	0-1
	2562.5	21375	15	16QAM	36	0	20.91	2	0-2
	2562.5	21375	15	16QAM	36	18	21.06	2	0-2
	2562.5	21375	15	16QAM	36	37	21.07	2	0-2
	2562.5	21375	15	16QAM	75	0	20.88	2	0-2

Table 9-9
LTE Band 7 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]
Low	2505	20800	10	QPSK	1	0	23.41	0	0
	2505	20800	10	QPSK	1	25	23.30	0	0
	2505	20800	10	QPSK	1	49	23.33	0	0
	2505	20800	10	QPSK	25	0	22.01	1	0-1
	2505	20800	10	QPSK	25	12	21.92	1	0-1
	2505	20800	10	QPSK	25	25	21.97	1	0-1
	2505	20800	10	QPSK	50	0	21.85	1	0-1
	2505	20800	10	16QAM	1	0	22.59	1	0-1
	2505	20800	10	16QAM	1	25	22.44	1	0-1
	2505	20800	10	16QAM	1	49	22.55	1	0-1
	2505	20800	10	16QAM	25	0	20.97	2	0-2
	2505	20800	10	16QAM	25	12	20.94	2	0-2
	2505	20800	10	16QAM	25	25	20.95	2	0-2
	2505	20800	10	16QAM	50	0	20.84	2	0-2
Mid	2535.0	21100	10	QPSK	1	0	23.37	0	0
	2535.0	21100	10	QPSK	1	25	23.33	0	0
	2535.0	21100	10	QPSK	1	49	23.39	0	0
	2535.0	21100	10	QPSK	25	0	21.95	1	0-1
	2535.0	21100	10	QPSK	25	12	21.92	1	0-1
	2535.0	21100	10	QPSK	25	25	21.87	1	0-1
	2535.0	21100	10	QPSK	50	0	21.81	1	0-1
	2535.0	21100	10	16QAM	1	0	21.93	1	0-1
	2535.0	21100	10	16QAM	1	25	21.86	1	0-1
	2535.0	21100	10	16QAM	1	49	21.92	1	0-1
	2535.0	21100	10	16QAM	25	0	20.95	2	0-2
	2535.0	21100	10	16QAM	25	12	20.95	2	0-2
	2535.0	21100	10	16QAM	25	25	20.97	2	0-2
	2535.0	21100	10	16QAM	50	0	20.72	2	0-2
High	2565	21400	10	QPSK	1	0	23.31	0	0
	2565	21400	10	QPSK	1	25	23.34	0	0
	2565	21400	10	QPSK	1	49	23.31	0	0
	2565	21400	10	QPSK	25	0	22.04	1	0-1
	2565	21400	10	QPSK	25	12	22.05	1	0-1
	2565	21400	10	QPSK	25	25	22.04	1	0-1
	2565	21400	10	QPSK	50	0	21.91	1	0-1
	2565	21400	10	16QAM	1	0	21.92	1	0-1
	2565	21400	10	16QAM	1	25	21.97	1	0-1
	2565	21400	10	16QAM	1	49	21.94	1	0-1
	2565	21400	10	16QAM	25	0	21.06	2	0-2
	2565	21400	10	16QAM	25	12	21.13	2	0-2
	2565	21400	10	16QAM	25	25	21.14	2	0-2
	2565	21400	10	16QAM	50	0	20.99	2	0-2

Table 9-10
LTE Band 7 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	2502.5	20775	5	QPSK	1	0	23.45	0	0
	2502.5	20775	5	QPSK	1	12	23.35	0	0
	2502.5	20775	5	QPSK	1	24	23.37	0	0
	2502.5	20775	5	QPSK	12	0	22.09	1	0-1
	2502.5	20775	5	QPSK	12	6	22.11	1	0-1
	2502.5	20775	5	QPSK	12	13	22.09	1	0-1
	2502.5	20775	5	QPSK	25	0	21.95	1	0-1
	2502.5	20775	5	16-QAM	1	0	22.30	1	0-1
	2502.5	20775	5	16-QAM	1	12	22.19	1	0-1
	2502.5	20775	5	16-QAM	1	24	22.21	1	0-1
	2502.5	20775	5	16-QAM	12	0	21.06	2	0-2
	2502.5	20775	5	16-QAM	12	6	21.08	2	0-2
	2502.5	20775	5	16-QAM	12	13	21.14	2	0-2
	2502.5	20775	5	16-QAM	25	0	20.98	2	0-2
Mid	2535.0	21100	5	QPSK	1	0	23.37	0	0
	2535.0	21100	5	QPSK	1	12	23.31	0	0
	2535.0	21100	5	QPSK	1	24	23.33	0	0
	2535.0	21100	5	QPSK	12	0	22.04	1	0-1
	2535.0	21100	5	QPSK	12	6	21.93	1	0-1
	2535.0	21100	5	QPSK	12	13	21.95	1	0-1
	2535.0	21100	5	QPSK	25	0	21.92	1	0-1
	2535.0	21100	5	16-QAM	1	0	21.88	1	0-1
	2535.0	21100	5	16-QAM	1	12	21.76	1	0-1
	2535.0	21100	5	16-QAM	1	24	21.85	1	0-1
	2535.0	21100	5	16-QAM	12	0	20.99	2	0-2
	2535.0	21100	5	16-QAM	12	6	20.92	2	0-2
	2535.0	21100	5	16-QAM	12	13	20.85	2	0-2
	2535.0	21100	5	16-QAM	25	0	20.79	2	0-2
High	2567.5	21425	5	QPSK	1	0	23.34	0	0
	2567.5	21425	5	QPSK	1	12	23.28	0	0
	2567.5	21425	5	QPSK	1	24	23.27	0	0
	2567.5	21425	5	QPSK	12	0	22.11	1	0-1
	2567.5	21425	5	QPSK	12	6	22.12	1	0-1
	2567.5	21425	5	QPSK	12	13	22.05	1	0-1
	2567.5	21425	5	QPSK	25	0	22.01	1	0-1
	2567.5	21425	5	16-QAM	1	0	21.97	1	0-1
	2567.5	21425	5	16-QAM	1	12	21.87	1	0-1
	2567.5	21425	5	16-QAM	1	24	21.98	1	0-1
	2567.5	21425	5	16-QAM	12	0	21.21	2	0-2
	2567.5	21425	5	16-QAM	12	6	21.17	2	0-2
	2567.5	21425	5	16-QAM	12	13	21.21	2	0-2
	2567.5	21425	5	16-QAM	25	0	21.05	2	0-2

9.4 WLAN Conducted Powers

Table 9-11
IEEE 802.11b Average RF Power

Mode	Freq [MHz]	Channel	802.11b (2.4 GHz) Conducted Power [dBm] Data Rate [Mbps] 1	2	5.5	11
802.11b	2412	1*	15.58	15.55	15.54	15.62
802.11b	2437	6*	**15.96**	15.89	15.95	15.97
802.11b	2462	11*	15.66	15.59	15.66	15.67

Table 9-12
IEEE 802.11g Average RF Power

Mode	Freq [MHz]	Channel	802.11g (2.4 GHz) Conducted Power [dBm] Data Rate [Mbps] 6	9	12	18	24	36	48	54
802.11g	2412	1	12.05	12.05	12.09	11.97	12.10	12.04	12.14	12.03
802.11g	2437	6	12.33	12.30	12.32	12.38	12.33	12.22	12.44	12.36
802.11g	2462	11	12.06	12.23	12.07	12.13	12.04	12.08	12.29	12.09

Table 9-13
IEEE 802.11n Average RF Power

Mode	Freq [MHz]	Channel	802.11n (2.4 GHz) Conducted Power [dBm] Data Rate [Mbps] 6.5	13	20	26	39	52	58	65
802.11n	2412	1	10.83	10.78	10.60	10.75	10.94	10.75	10.92	10.87
802.11n	2437	6	11.04	11.10	11.27	11.18	11.15	11.11	11.27	11.29
802.11n	2462	11	10.84	10.74	10.99	10.67	10.81	10.86	10.90	10.93

Table 9-14
IEEE 802.11a Average RF Power

Mode	Freq [MHz]	Channel	802.11a (5GHz) Conducted Power [dBm] Data Rate [Mbps] 6	9	12	18	24	36	48	54
802.11a	5180	36*	10.52	10.58	10.67	10.59	10.69	10.64	10.67	10.63
802.11a	5200	40	**10.65**	10.87	10.80	10.89	10.79	10.81	10.86	10.41
802.11a	5220	44	10.50	10.61	10.68	10.54	10.61	10.54	10.54	10.36
802.11a	5240	48*	10.48	10.42	10.46	10.45	10.45	10.48	10.49	10.25
802.11a	5260	52*	10.58	10.79	10.61	10.73	10.74	10.70	10.89	10.50
802.11a	5280	56	**10.73**	10.76	10.76	10.70	10.70	10.65	10.80	10.55
802.11a	5300	60	10.64	10.62	10.72	10.72	10.61	10.57	10.68	10.47
802.11a	5320	64*	10.66	10.65	10.62	10.65	10.60	10.52	10.60	10.43
802.11a	5500	100	**10.57**	10.53	10.58	10.66	10.53	10.51	10.54	10.25
802.11a	5520	104*	10.44	10.40	10.56	10.46	10.49	10.32	10.43	10.29
802.11a	5540	108	10.44	10.34	10.39	10.38	10.30	10.24	10.42	9.94
802.11a	5560	112	9.94	9.92	9.97	9.92	10.02	9.82	10.05	9.85
802.11a	5580	116*	10.11	10.12	10.29	10.16	10.06	10.09	10.22	9.98
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	9.89	9.87	9.94	9.84	9.81	9.91	9.93	9.71
802.11a	5680	136*	9.74	9.80	9.84	9.85	9.74	9.71	10.02	9.62
802.11a	5700	140	9.63	9.75	9.71	9.69	9.66	9.73	9.89	9.45
802.11a	5720	144	9.68	9.71	9.75	9.70	9.62	9.63	9.64	9.72
802.11a	5745	149*	9.63	9.84	9.84	9.76	9.73	9.60	9.71	9.48
802.11a	5765	153	9.66	9.58	9.64	9.71	9.58	9.64	9.54	9.59
802.11a	5785	157*	9.20	9.58	9.50	9.60	9.18	9.70	9.85	9.64
802.11a	5805	161*	**9.73**	9.69	9.72	9.24	9.36	9.44	9.56	9.42
802.11a	5825	165	9.44	9.45	9.50	9.57	9.67	9.49	9.70	9.34

Per FCC KDB Publication 443999 D01v01 and RSS-210 A9.2(3), transmission on channels which overlap the 5600-5650 MHz is prohibited as a client. This device does not transmit any beacons or initiate any transmissions in 5.3 and 5.5 GHz Band.

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

Table 9-15
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	10.57	10.60	10.54	10.51	10.47	10.47	10.42	10.46
802.11n	5200	40	10.54	10.46	10.40	10.47	10.43	10.30	10.39	10.34
802.11n	5220	44	10.41	10.43	10.48	10.35	10.27	10.27	10.35	10.29
802.11n	5240	48	10.26	10.30	10.41	10.26	10.33	10.22	10.30	10.27
802.11n	5260	52	10.77	10.62	10.68	10.64	10.60	10.62	10.60	10.62
802.11n	5280	56	10.57	10.62	10.53	10.69	10.65	10.41	10.58	10.49
802.11n	5300	60	10.52	10.52	10.53	10.53	10.52	10.51	10.49	10.43
802.11n	5320	64	10.49	10.58	10.48	10.40	10.50	10.38	10.45	10.45
802.11n	5500	100	10.36	10.29	10.33	10.43	10.42	10.28	10.43	10.38
802.11n	5520	104	10.47	10.31	10.40	10.36	10.29	10.28	10.28	10.33
802.11n	5540	108	10.31	10.35	10.37	10.27	10.36	10.33	10.32	10.31
802.11n	5560	112	10.25	10.29	10.24	10.30	10.26	10.23	10.20	10.16
802.11n	5580	116	10.19	10.26	10.14	10.15	10.19	10.19	10.20	10.11
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	9.90	9.89	9.91	9.95	9.80	9.89	9.77	9.80
802.11n	5680	136	9.82	9.81	9.75	9.82	9.74	9.83	9.73	9.72
802.11n	5700	140	9.72	9.79	9.82	9.73	9.72	9.78	9.72	9.72
802.11n	5720	144	9.76	9.72	9.78	9.71	9.64	9.69	9.66	9.67
802.11n	5745	149	9.76	9.67	9.65	9.83	9.83	9.70	9.73	9.71
802.11n	5765	153	9.78	9.71	9.66	9.51	9.64	9.61	9.56	9.50
802.11n	5785	157	9.63	9.69	9.83	9.74	9.52	9.55	9.61	9.53
802.11n	5805	161	9.64	9.53	9.48	9.58	9.53	9.54	9.48	9.54
802.11n	5825	165	9.47	9.51	9.49	9.48	9.40	9.34	9.34	9.42

Table 9-16
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	10.68	10.39	10.38	10.61	10.42	10.66	10.36	10.38
802.11n	5230	46	10.65	10.19	10.54	10.41	9.95	10.41	10.57	10.54
802.11n	5270	54	10.94	10.56	10.71	10.98	10.75	10.62	10.98	10.97
802.11n	5310	62	10.59	10.40	10.80	10.89	10.37	10.82	10.51	10.35
802.11n	5510	102	10.62	10.43	10.57	10.48	10.49	10.40	10.43	10.36
802.11n	5550	110	10.78	10.47	10.45	10.42	10.33	10.57	10.27	10.26
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	10.11	10.07	9.89	10.14	9.82	9.86	10.13	9.76
802.11n	5710	142	10.01	10.06	10.00	9.97	9.97	9.96	10.03	10.00
802.11n	5755	151	9.31	9.08	9.25	9.41	9.39	9.30	9.39	9.25
802.11n	5795	159	9.89	9.31	9.19	9.23	9.29	9.83	9.60	9.79

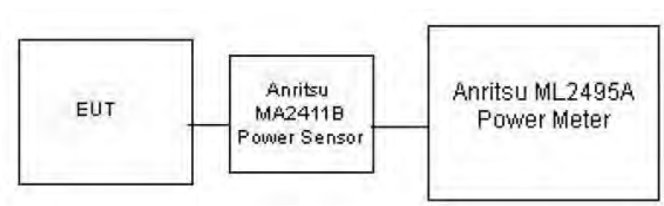


Figure 9-3
Power Measurement Setup for Bandwidths < 50 MHz

Table 9-17
IEEE 802.11ac Average RF Power – 80 MHz Bandwidth

Mode	Freq [MHz]	Channel	80MHz BW 802.11ac (5GHz) Conducted Power [dBm]									
			Data Rate [Mbps]									
			29.3	58.5	87.8	117	175.5	234	263.3	292.5	351	390
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	MCS8	MCS9
802.11ac	5210	42	**9.75**	9.73	9.63	9.68	9.74	9.69	9.84	9.69	9.69	9.59
802.11ac	5290	58	**9.70**	9.54	9.60	9.50	9.63	9.52	9.60	9.58	9.50	9.58
802.11ac	5530	106	**9.83**	9.80	9.73	9.72	9.70	9.82	9.95	9.78	9.72	9.70
802.11ac	5690	138	9.15	9.13	9.05	9.07	9.14	9.10	9.02	9.06	9.11	9.05
802.11ac	5775	155	**9.04**	8.94	8.95	8.98	9.01	8.99	9.02	9.05	8.96	8.84

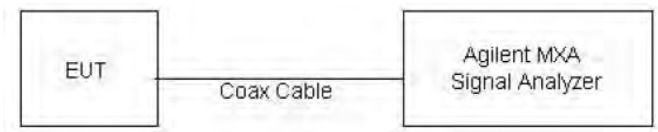


Figure 9-4
Power Measurement Setup for Bandwidths > 50 MHz

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. The data in the above tables was rounded up to 2 decimal places and is therefore less than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
- Full SAR tests for all IEEE 802.11ac configurations were not required because the average output power was not more than 0.25 dB higher than IEEE 802.11a mode. IEEE 802.11ac was evaluated for the highest IEEE 802.11a position in each 5 GHz band and exposure condition.
- When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is <1.6 W/kg and the reported 1g averaged SAR is <0.8 W/kg, SAR testing on other channels is not required. Otherwise, the other default (or corresponding required) test channels were additionally tested using the lowest data rate.
- The bolded data rate and channel above were tested for SAR.

10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
Measured Tissue Properties – Head

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C°)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	%dev σ	%dev ε
07/17/2013	750H	21.6	710	0.885	41.298	0.887	42.113	***-0.23%***	***-1.94%***
			725	0.898	41.120	0.888	42.033	***1.13%***	***-2.17%***
			740	0.914	40.909	0.889	41.953	***2.81%***	***-2.49%***
			755	0.927	40.662	0.891	41.876	***4.04%***	***-2.90%***
07/17/2013	835H	23.2	820	0.897	40.509	0.898	41.571	***-0.11%***	***-2.55%***
			835	0.911	40.322	0.900	41.500	***1.22%***	***-2.84%***
			850	0.926	40.134	0.916	41.500	***1.09%***	***-3.29%***
07/11/2013	1750H	23.4	1710	1.326	39.223	1.348	40.136	***-1.63%***	***-2.27%***
			1750	1.367	39.046	1.370	40.100	***-0.22%***	***-2.63%***
			1790	1.408	38.860	1.394	40.020	***1.00%***	***-2.90%***
07/15/2013	1900H	23.4	1850	1.332	40.096	1.400	40.000	***-4.86%***	***0.24%***
			1880	1.365	39.987	1.400	40.000	***-2.50%***	***-0.03%***
			1910	1.398	39.883	1.400	40.000	***-0.14%***	***-0.29%***
07/11/2013	2450H	24.2	2401	1.813	38.475	1.758	39.298	***3.13%***	***-2.09%***
			2450	1.870	38.283	1.800	39.200	***3.89%***	***-2.34%***
			2499	1.925	38.090	1.852	39.135	***3.94%***	***-2.67%***
07/18/2013	2450H-2600B	24.0	2401	1.790	38.700	1.758	39.298	***1.82%***	***-1.52%***
			2450	1.846	38.495	1.800	39.200	***2.56%***	***-1.80%***
			2499	1.902	38.290	1.852	39.135	***2.70%***	***-2.16%***
			2500	1.903	38.276	1.853	39.133	***2.70%***	***-2.19%***
			2550	1.962	38.070	1.907	39.067	***2.88%***	***-2.55%***
			2600	2.018	37.879	1.960	39.000	***2.96%***	***-2.87%***
07/08/2013	5200H-5800H	23.1	5200	4.468	35.069	4.660	36.000	***-4.12%***	***-2.59%***
			5220	4.485	35.044	4.680	35.980	***-4.17%***	***-2.60%***
			5280	4.545	34.956	4.740	35.920	***-4.11%***	***-2.68%***
			5300	4.565	34.928	4.760	35.900	***-4.10%***	***-2.71%***
			5500	4.760	34.630	4.965	35.650	***-4.13%***	***-2.86%***
			5520	4.783	34.606	4.986	35.620	***-4.07%***	***-2.85%***
			5540	4.804	34.574	5.007	35.590	***-4.05%***	***-2.85%***
			5765	5.039	34.263	5.235	35.335	***-3.74%***	***-3.03%***
			5785	5.057	34.238	5.255	35.315	***-3.77%***	***-3.05%***
			5800	5.075	34.216	5.270	35.300	***-3.70%***	***-3.07%***
			5805	5.080	34.210	5.275	35.295	***-3.70%***	***-3.07%***

Table 10-2
Measured Tissue Properties – Body

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C°)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
07/14/2013	750B	22.8	710	0.928	55.352	0.960	55.687	*-3.33%*	*-0.60%*
			725	0.942	55.179	0.961	55.629	*-1.98%*	*-0.81%*
			740	0.956	55.024	0.963	55.570	*-0.73%*	*-0.98%*
			755	0.970	54.886	0.964	55.512	*0.62%*	*-1.13%*
07/11/2013	835B	22.9	820	0.992	55.754	0.969	55.258	*2.37%*	*0.90%*
			835	1.007	55.598	0.970	55.200	*3.81%*	*0.72%*
			850	1.022	55.451	0.988	55.154	*3.44%*	*0.54%*
07/19/2013	835B	23.0	820	0.983	54.534	0.969	55.258	*1.44%*	*-1.31%*
			835	0.998	54.368	0.970	55.200	*2.89%*	*-1.51%*
			850	1.012	54.214	0.988	55.154	*2.43%*	*-1.70%*
07/11/2013	1750B	22.8	1710	1.477	52.518	1.460	53.540	*1.16%*	*-1.91%*
			1750	1.522	52.353	1.490	53.430	*2.15%*	*-2.02%*
			1790	1.570	52.176	1.510	53.330	*3.97%*	*-2.16%*
07/08/2013	1900B	22.6	1850	1.482	54.208	1.520	53.300	*-2.50%*	*1.70%*
			1880	1.511	54.125	1.520	53.300	*-0.59%*	*1.55%*
			1910	1.553	54.032	1.520	53.300	*2.17%*	*1.37%*
07/15/2013	1900B	23.3	1850	1.466	52.752	1.520	53.300	*-3.55%*	*-1.03%*
			1880	1.510	52.658	1.520	53.300	*-0.66%*	*-1.20%*
			1910	1.543	52.667	1.520	53.300	*1.51%*	*-1.19%*
07/02/2013	2450B	22.2	2401	1.955	50.578	1.903	52.765	*2.73%*	*-4.14%*
			2450	2.034	50.510	1.950	52.700	*4.31%*	*-4.16%*
			2499	2.104	50.305	2.019	52.638	*4.21%*	*-4.43%*
07/19/2013	2450B-2600B	23.8	2401	1.932	51.474	1.903	52.765	*1.52%*	*-2.45%*
			2450	1.998	51.321	1.950	52.700	*2.46%*	*-2.62%*
			2499	2.064	51.156	2.019	52.638	*2.23%*	*-2.82%*
			2500	2.066	51.152	2.021	52.636	*2.23%*	*-2.82%*
			2550	2.139	50.953	2.092	52.573	*2.25%*	*-3.08%*
			2600	2.211	50.761	2.163	52.509	*2.22%*	*-3.33%*
07/08/2013	5200B-5800B	22.3	5200	5.215	46.814	5.299	49.014	*-1.59%*	*-4.49%*
			5220	5.257	46.901	5.323	48.987	*-1.24%*	*-4.26%*
			5280	5.384	46.690	5.393	48.879	*-0.17%*	*-4.48%*
			5300	5.366	46.619	5.416	48.851	*-0.92%*	*-4.57%*
			5500	5.721	46.329	5.650	48.580	*1.26%*	*-4.63%*
			5520	5.763	46.291	5.673	48.553	*1.59%*	*-4.66%*
			5540	5.797	46.274	5.696	48.526	*1.77%*	*-4.64%*
			5765	6.146	46.109	5.959	48.220	*3.14%*	*-4.38%*
			5785	6.186	46.222	5.982	48.242	*3.41%*	*-4.19%*
			5800	6.218	46.037	6.000	48.200	*3.63%*	*-4.49%*
			5805	6.229	46.011	6.005	48.166	*3.73%*	*-4.47%*

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.

10.2 Test System Verification

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

Table 10-3
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	$Deviation_{1g}$ (%)
C	750	HEAD	07/17/2013	21.0	21.6	0.100	1054	3022	0.807	8.500	8.070	-5.06%
E	835	HEAD	07/17/2013	24.3	23.5	0.100	4d132	3920	0.975	9.660	9.750	0.93%
E	1750	HEAD	07/11/2013	23.8	23.2	0.100	1051	3920	3.740	36.500	37.400	2.47%
C	1900	HEAD	07/15/2013	22.1	22.5	0.100	5d080	3022	3.950	39.400	39.500	0.25%
C	2450	HEAD	07/11/2013	24.4	24.2	0.100	719	3022	5.160	52.700	51.600	-2.09%
C	2450	HEAD	07/18/2013	23.0	23.5	0.100	719	3022	5.620	52.700	56.200	6.64%
C	2600	HEAD	07/18/2013	23.0	23.5	0.100	1004	3022	6.220	58.200	62.200	6.87%
E	5200	HEAD	07/08/2013	24.4	23.1	0.040	1120	3920	3.030	76.000	75.750	-0.33%
E	5300	HEAD	07/08/2013	24.4	23.1	0.040	1120	3920	2.970	78.700	74.250	-5.65%
E	5500	HEAD	07/08/2013	24.4	23.2	0.040	1120	3920	2.980	80.100	74.500	-6.99%
E	5800	HEAD	07/08/2013	24.5	23.2	0.040	1120	3920	2.980	74.900	74.500	-0.53%
G	750	BODY	07/14/2013	24.5	22.8	0.100	1003	3209	0.848	8.830	8.480	-3.96%
G	835	BODY	07/11/2013	24.5	22.9	0.100	4d132	3209	0.964	9.360	9.640	2.99%
G	835	BODY	07/19/2013	24.5	23.5	0.100	4d026	3209	0.974	9.580	9.740	1.67%
E	1750	BODY	07/11/2013	23.9	23.1	0.100	1051	3920	3.890	37.800	38.900	2.91%
B	1900	BODY	07/08/2013	23.2	22.8	0.100	5d080	3287	4.250	40.300	42.500	5.46%
B	1900	BODY	07/15/2013	23.5	23.1	0.100	5d080	3287	3.990	40.300	39.900	-0.99%
B	2450	BODY	07/02/2013	23.5	22.7	0.100	719	3287	5.180	51.600	51.800	0.39%
E	2450	BODY	07/19/2013	24.4	23.9	0.100	797	3920	5.140	49.600	51.400	3.63%
E	2600	BODY	07/19/2013	24.3	23.9	0.100	1004	3920	5.740	57.500	57.400	-0.17%
A	5200	BODY	07/08/2013	24.4	23.2	0.100	1057	3589	7.160	75.500	71.600	-5.17%
A	5300	BODY	07/08/2013	24.4	23.2	0.100	1057	3589	7.870	75.300	78.700	4.52%
A	5500	BODY	07/08/2013	24.4	23.2	0.100	1057	3589	8.080	80.800	80.800	0.00%
A	5800	BODY	07/08/2013	24.5	23.4	0.100	1057	3589	7.330	75.100	73.300	-2.40%

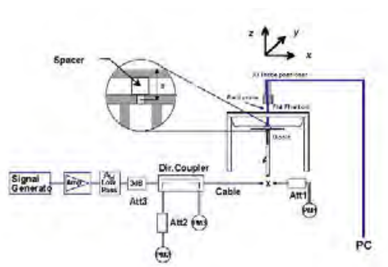


Figure 10-1
System Verification Setup Diagram

Figure 10-2
System Verification Setup Photo

11 SAR DATA SUMMARY

11.1 Standalone Head SAR Data

Table 11-1
GSM 850 Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	# Time Slots	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM850	GSM	33.2	33.20	0.08	Right	Cheek	2434-1	1	1:8.3	0.331	1.000	0.331	
836.60	190	GSM850	GSM	33.2	33.20	-0.02	Right	Tilt	2434-1	1	1:8.3	0.199	1.000	0.199	
836.60	190	GSM850	GSM	33.2	33.20	0.00	Left	Cheek	2434-1	1	1:8.3	0.275	1.000	0.275	
836.60	190	GSM850	GSM	33.2	33.20	0.00	Left	Tilt	2434-1	1	1:8.3	0.201	1.000	0.201	
836.60	190	GSM850	GPRS	31.5	31.41	-0.03	Right	Cheek	2434-1	2	1:4.15	0.521	1.021	0.532	A1
836.60	190	GSM850	GPRS	31.5	31.41	-0.08	Right	Tilt	2434-1	2	1:4.15	0.305	1.021	0.311	
836.60	190	GSM850	GPRS	31.5	31.41	-0.07	Left	Cheek	2434-1	2	1:4.15	0.409	1.021	0.418	
836.60	190	GSM850	GPRS	31.5	31.41	-0.02	Left	Tilt	2434-1	2	1:4.15	0.272	1.021	0.278	
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 11-2
UMTS 850 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	23.9	23.70	0.02	Right	Cheek	2434-1	1:1	0.340	1.047	0.356	A2
836.60	4183	UMTS 850	RMC	23.9	23.70	-0.03	Right	Tilt	2434-1	1:1	0.191	1.047	0.200	
836.60	4183	UMTS 850	RMC	23.9	23.70	-0.01	Left	Cheek	2434-1	1:1	0.245	1.047	0.257	
836.60	4183	UMTS 850	RMC	23.9	23.70	0.00	Left	Tilt	2434-1	1:1	0.166	1.047	0.174	
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
GSM 1900 Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	# Time Slots	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
1880.00	661	GSM1900	GSM	31.2	31.14	0.01	Right	Cheek	2434-1	1	1:8.3	0.141	1.014	0.143	
1880.00	661	GSM1900	GSM	31.2	31.14	-0.04	Right	Tilt	2434-1	1	1:8.3	0.066	1.014	0.067	
1880.00	661	GSM1900	GSM	31.2	31.14	0.01	Left	Cheek	2434-1	1	1:8.3	0.125	1.014	0.127	
1880.00	661	GSM1900	GSM	31.2	31.14	0.00	Left	Tilt	2434-1	1	1:8.3	0.069	1.014	0.070	
1880.00	661	GSM1900	GPRS	29.5	29.50	-0.04	Right	Cheek	2434-1	2	1:4.15	0.194	1.000	0.194	A3
1880.00	661	GSM1900	GPRS	29.5	29.50	0.01	Right	Tilt	2434-1	2	1:4.15	0.095	1.000	0.095	
1850.20	512	GSM1900	GPRS	29.5	29.50	-0.13	Left	Cheek	2434-1	2	1:4.15	0.187	1.000	0.187	
1880.00	661	GSM1900	GPRS	29.5	29.50	0.00	Left	Tilt	2434-1	2	1:4.15	0.102	1.000	0.102	
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 11-4
UMTS 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	24.2	23.99	-0.03	Right	Cheek	2434-1	1:1	0.243	1.050	0.255	A4
1880.00	9400	UMTS 1900	RMC	24.2	23.99	0.02	Right	Tilt	2434-1	1:1	0.120	1.050	0.126	
1880.00	9400	UMTS 1900	RMC	24.2	23.99	-0.13	Left	Cheek	2434-1	1:1	0.238	1.050	0.250	
1880.00	9400	UMTS 1900	RMC	24.2	23.99	0.01	Left	Tilt	2434-1	1:1	0.125	1.050	0.131	
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
LTE Band 17 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)	
710.00	23790	Mid	LTE Band 17	10	23.7	23.35	-0.02	0	Right	Cheek	QPSK	1	0	5830-2	1:1	0.146	1.084	0.158	
710.00	23790	Mid	LTE Band 17	10	22.7	22.10	0.12	1	Right	Cheek	QPSK	25	25	5830-2	1:1	0.065	1.148	0.075	
710.00	23790	Mid	LTE Band 17	10	23.7	23.35	0.03	0	Right	Tilt	QPSK	1	0	5830-2	1:1	0.087	1.084	0.094	
710.00	23790	Mid	LTE Band 17	10	22.7	22.10	0.21	1	Right	Tilt	QPSK	25	25	5830-2	1:1	0.036	1.148	0.041	
710.00	23790	Mid	LTE Band 17	10	23.7	23.35	0.05	0	Left	Cheek	QPSK	1	0	5830-2	1:1	0.201	1.084	0.218	A5
710.00	23790	Mid	LTE Band 17	10	22.7	22.10	0.02	1	Left	Cheek	QPSK	25	25	5830-2	1:1	0.085	1.148	0.098	
710.00	23790	Mid	LTE Band 17	10	23.7	23.35	0.11	0	Left	Tilt	QPSK	1	0	5830-2	1:1	0.105	1.084	0.114	
710.00	23790	Mid	LTE Band 17	10	22.7	22.10	0.14	1	Left	Tilt	QPSK	25	25	5830-2	1:1	0.044	1.148	0.051	
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 11-6
LTE Band 4 (AWS) 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)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.92	0.05	0	Right	Cheek	QPSK	1	99	5830-1	1:1	0.189	1.019	0.193	A6
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.45	-0.02	1	Right	Cheek	QPSK	50	0	5830-1	1:1	0.149	1.135	0.169	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.92	0.16	0	Right	Tilt	QPSK	1	99	5830-1	1:1	0.089	1.019	0.091	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.45	-0.02	1	Right	Tilt	QPSK	50	0	5830-1	1:1	0.087	1.135	0.099	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.92	0.02	0	Left	Cheek	QPSK	1	99	5830-1	1:1	0.151	1.019	0.154	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.45	0.04	1	Left	Cheek	QPSK	50	0	5830-1	1:1	0.158	1.135	0.179	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.92	-0.06	0	Left	Tilt	QPSK	1	99	5830-1	1:1	0.076	1.019	0.077	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.45	0.16	1	Left	Tilt	QPSK	50	0	5830-1	1:1	0.070	1.135	0.079	
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 11-7
LTE Band 7 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)	
2510.00	20850	Low	LTE Band 7	20	23.7	23.56	0.06	0	Right	Cheek	QPSK	1	99	5830-2	1:1	0.118	1.033	0.122	
2560.00	21350	High	LTE Band 7	20	22.7	22.02	0.14	1	Right	Cheek	QPSK	50	50	5830-2	1:1	0.081	1.169	0.095	
2510.00	20850	Low	LTE Band 7	20	23.7	23.56	-0.21	0	Right	Tilt	QPSK	1	99	5830-2	1:1	0.157	1.033	0.162	
2560.00	21350	High	LTE Band 7	20	22.7	22.02	-0.14	1	Right	Tilt	QPSK	50	50	5830-2	1:1	0.111	1.169	0.130	
2510.00	20850	Low	LTE Band 7	20	23.7	23.56	0.10	0	Left	Cheek	QPSK	1	99	5830-2	1:1	0.201	1.033	0.208	A7
2560.00	21350	High	LTE Band 7	20	22.7	22.02	0.09	1	Left	Cheek	QPSK	50	50	5830-2	1:1	0.125	1.169	0.146	
2510.00	20850	Low	LTE Band 7	20	23.7	23.56	0.04	0	Left	Tilt	QPSK	1	99	5830-2	1:1	0.105	1.033	0.108	
2560.00	21350	High	LTE Band 7	20	22.7	22.02	0.07	1	Left	Tilt	QPSK	50	50	5830-2	1:1	0.073	1.169	0.085	
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 11-8
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	16.0	15.96	-0.13	Right	Cheek	9434-2	1	1:1	0.371	1.009	0.374	A8
2437	6	IEEE 802.11b	DSSS	16.0	15.96	0.16	Right	Tilt	9434-2	1	1:1	0.257	1.009	0.259	
2437	6	IEEE 802.11b	DSSS	16.0	15.96	-0.07	Left	Cheek	9434-2	1	1:1	0.204	1.009	0.206	
2437	6	IEEE 802.11b	DSSS	16.0	15.96	0.02	Left	Tilt	9434-2	1	1:1	0.175	1.009	0.177	
5805	161	IEEE 802.11a	OFDM	11.0	9.73	0.15	Right	Cheek	9434-2	6	1:1	0.087	1.340	0.117	A9
5775	155	IEEE 802.11ac	OFDM	10.0	9.04	0.13	Right	Cheek	9434-2	29.3	1:1	0.064	1.247	0.080	
5805	161	IEEE 802.11a	OFDM	11.0	9.73	-0.20	Right	Tilt	9434-2	6	1:1	0.052	1.340	0.070	
5805	161	IEEE 802.11a	OFDM	11.0	9.73	0.14	Left	Cheek	9434-2	6	1:1	0.044	1.340	0.059	
5805	161	IEEE 802.11a	OFDM	11.0	9.73	0.12	Left	Tilt	9434-2	6	1:1	0.042	1.340	0.056	
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 11-9
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)	
5200	40	IEEE 802.11a	OFDM	11.0	10.65	0.19	Right	Cheek	9434-2	6	1:1	0.086	1.084	0.093	A10
5210	42	IEEE 802.11ac	OFDM	10.0	9.75	0.13	Right	Cheek	9434-2	29.3	1:1	0.053	1.059	0.056	
5200	40	IEEE 802.11a	OFDM	11.0	10.65	0.15	Right	Tilt	9434-2	6	1:1	0.067	1.084	0.073	
5200	40	IEEE 802.11a	OFDM	11.0	10.65	0.17	Left	Cheek	9434-2	6	1:1	0.034	1.084	0.037	
5200	40	IEEE 802.11a	OFDM	11.0	10.65	-0.18	Left	Tilt	9434-2	6	1:1	0.039	1.084	0.042	
5280	56	IEEE 802.11a	OFDM	11.0	10.73	0.18	Right	Cheek	9434-2	6	1:1	0.078	1.064	0.083	
5290	58	IEEE 802.11ac	OFDM	10.0	9.70	0.13	Right	Cheek	9434-2	29.3	1:1	0.051	1.072	0.055	
5280	56	IEEE 802.11a	OFDM	11.0	10.73	-0.14	Right	Tilt	9434-2	6	1:1	0.069	1.064	0.073	
5280	56	IEEE 802.11a	OFDM	11.0	10.73	0.12	Left	Cheek	9434-2	6	1:1	0.036	1.064	0.038	
5280	56	IEEE 802.11a	OFDM	11.0	10.73	0.14	Left	Tilt	9434-2	6	1:1	0.037	1.064	0.039	
5500	100	IEEE 802.11a	OFDM	11.0	10.57	0.14	Right	Cheek	9434-2	6	1:1	0.071	1.104	0.078	
5530	106	IEEE 802.11ac	OFDM	10.0	9.83	0.15	Right	Cheek	9434-2	29.3	1:1	0.048	1.040	0.050	
5500	100	IEEE 802.11a	OFDM	11.0	10.57	0.19	Right	Tilt	9434-2	6	1:1	0.056	1.104	0.062	
5500	100	IEEE 802.11a	OFDM	11.0	10.57	0.17	Left	Cheek	9434-2	6	1:1	0.029	1.104	0.032	
5500	100	IEEE 802.11a	OFDM	11.0	10.57	0.14	Left	Tilt	9434-2	6	1:1	0.031	1.104	0.034	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram								

11.2 Standalone Body-Worn SAR Data

Table 11-10
GSM/UMTS Body-Worn SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of Time Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.2	33.20	-0.03	10 mm	2434-1	1	1:8.3	back	0.638	1.000	0.638	
824.20	128	GSM 850	GPRS	31.5	31.47	-0.07	10 mm	2434-1	2	1:4.15	back	0.845	1.007	0.851	
836.60	190	GSM 850	GPRS	31.5	31.41	-0.05	10 mm	2434-1	2	1:4.15	back	0.919	1.021	0.938	
848.80	251	GSM 850	GPRS	31.5	31.19	0.01	10 mm	2434-1	2	1:4.15	back	0.848	1.074	0.911	
836.60	190	GSM 850	GPRS	31.5	31.41	-0.11	10 mm	2434-1	2	1:4.15	back	0.927	1.021	0.946	A11
836.60	4183	UMTS 850	RMC	23.9	23.70	-0.04	10 mm	2434-2	N/A	1:1	back	0.490	1.047	0.513	A12
1880.00	661	GSM 1900	GSM	31.2	31.14	0.08	10 mm	2434-1	1	1:8.3	back	0.411	1.014	0.417	
1880.00	661	GSM 1900	GPRS	29.5	29.50	-0.01	10 mm	2434-1	2	1:4.15	back	0.641	1.000	0.641	A13
1852.40	9262	UMTS 1900	RMC	24.2	24.02	0.16	10 mm	2434-1	N/A	1:1	back	0.972	1.042	1.013	A15
1880.00	9400	UMTS 1900	RMC	24.2	23.99	0.15	10 mm	2434-1	N/A	1:1	back	0.855	1.050	0.898	
1907.60	9538	UMTS 1900	RMC	24.2	23.72	0.12	10 mm	2434-1	N/A	1:1	back	0.610	1.117	0.681	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

Note: Blue entry represents repeatability measurement.

Table 11-11
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 #
MHz	Ch.															(W/kg)		(W/kg)	
710.00	23790	Mid	LTE Band 17	10	23.7	23.35	-0.04	0	5830-1	QPSK	1	0	10 mm	back	1:1	0.272	1.084	0.295	A17
710.00	23790	Mid	LTE Band 17	10	22.7	22.10	0.05	1	5830-1	QPSK	25	25	10 mm	back	1:1	0.106	1.148	0.122	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.92	-0.05	0	5830-1	QPSK	1	99	10 mm	back	1:1	0.810	1.019	0.825	A19
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.45	-0.09	1	5830-1	QPSK	50	0	10 mm	back	1:1	0.634	1.135	0.720	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.41	0.00	1	5830-1	QPSK	100	0	10 mm	back	1:1	0.595	1.146	0.682	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.92	0.00	0	5830-1	QPSK	1	99	10 mm	back	1:1	0.691	1.019	0.704	
2510.00	20850	Low	LTE Band 7	20	23.7	23.56	0.00	0	5830-1	QPSK	1	99	10 mm	back	1:1	0.812	1.033	0.839	
2535.00	21100	Mid	LTE Band 7	20	23.7	23.38	-0.02	0	5830-1	QPSK	1	99	10 mm	back	1:1	0.935	1.076	1.006	
2560.00	21350	High	LTE Band 7	20	23.7	23.43	-0.06	0	5830-1	QPSK	1	49	10 mm	back	1:1	1.090	1.064	1.160	
2560.00	21350	High	LTE Band 7	20	23.7	23.43	-0.16	0	5830-1	QPSK	1	49	10 mm	back*	1:1	0.870	1.064	0.926	
2510.00	20850	Low	LTE Band 7	20	22.7	21.99	0.06	1	5830-1	QPSK	50	25	10 mm	back	1:1	0.456	1.178	0.537	
2535.00	21100	Mid	LTE Band 7	20	22.7	21.92	-0.06	1	5830-1	QPSK	50	0	10 mm	back	1:1	0.693	1.197	0.830	
2560.00	21350	High	LTE Band 7	20	22.7	22.02	0.05	1	5830-1	QPSK	50	50	10 mm	back	1:1	0.799	1.169	0.934	
2560.00	21350	High	LTE Band 7	20	22.7	22.01	-0.12	1	5830-1	QPSK	100	0	10 mm	back	1:1	0.795	1.172	0.932	
2510.00	20850	Low	LTE Band 7	20	23.7	23.56	-0.01	0	5830-1	QPSK	1	99	10 mm	back	1:1	0.782	1.033	0.808	
2560.00	21350	High	LTE Band 7	20	23.7	23.43	-0.01	0	5830-1	QPSK	1	49	10 mm	back	1:1	1.150	1.064	1.224	A20
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram										

Note:
1. Blue entries represent repeatability measurements.
2. (*) Indicates SAR test performed with headphones

Table 11-12
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	16.0	15.96	0.12	10 mm	9434-2	1	back	1:1	0.100	1.009	0.101	A21
5805	161	IEEE 802.11a	OFDM	11.0	9.73	-0.04	10 mm	9434-2	6	back	1:1	0.124	1.340	0.166	A22
5775	155	IEEE 802.11ac	OFDM	10.0	9.04	0.12	10 mm	9434-2	29.3	back	1:1	0.063	1.247	0.079	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

Table 11-13
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)	
5200	40	IEEE 802.11a	OFDM	11.0	10.65	0.16	10 mm	9434-2	6	back	1:1	0.063	1.084	0.068	
5210	42	IEEE 802.11ac	OFDM	10.0	9.75	0.14	10 mm	9434-2	29.3	back	1:1	0.037	1.059	0.039	
5280	56	IEEE 802.11a	OFDM	11.0	10.73	0.18	10 mm	9434-2	6	back	1:1	0.084	1.064	0.089	
5290	58	IEEE 802.11ac	OFDM	10.0	9.70	0.19	10 mm	9434-2	29.3	back	1:1	0.043	1.072	0.046	
5500	100	IEEE 802.11a	OFDM	11.0	10.57	0.16	10 mm	9434-2	6	back	1:1	0.100	1.104	0.110	A23
5530	106	IEEE 802.11ac	OFDM	10.0	9.83	0.17	10 mm	9434-2	29.3	back	1:1	0.060	1.040	0.062	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

11.3 Standalone Wireless Router SAR Data

Table 11-14
GPRS Hotspot SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of GPRS Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
824.20	128	GSM 850	GPRS	31.5	31.47	-0.07	10 mm	2434-1	2	1:4.15	back	0.845	1.007	0.851	
836.60	190	GSM 850	GPRS	31.5	31.41	-0.05	10 mm	2434-1	2	1:4.15	back	0.919	1.021	0.938	
848.80	251	GSM 850	GPRS	31.5	31.19	0.01	10 mm	2434-1	2	1:4.15	back	0.848	1.074	0.911	
836.60	190	GSM 850	GPRS	31.5	31.41	-0.06	10 mm	2434-1	2	1:4.15	front	0.655	1.021	0.669	
836.60	190	GSM 850	GPRS	31.5	31.41	-0.02	10 mm	2434-1	2	1:4.15	bottom	0.357	1.021	0.364	
824.20	128	GSM 850	GPRS	31.5	31.47	0.07	10 mm	2434-1	2	1:4.15	right	0.842	1.007	0.848	
836.60	190	GSM 850	GPRS	31.5	31.41	0.01	10 mm	2434-1	2	1:4.15	right	0.812	1.021	0.829	
848.80	251	GSM 850	GPRS	31.5	31.19	-0.17	10 mm	2434-1	2	1:4.15	right	0.743	1.074	0.798	
836.60	190	GSM 850	GPRS	31.5	31.41	-0.11	10 mm	2434-1	2	1:4.15	back	0.927	1.021	0.946	A11
1880.00	661	GSM 1900	GPRS	29.5	29.50	-0.01	10 mm	2434-1	2	1:4.15	back	0.641	1.000	0.641	
1880.00	661	GSM 1900	GPRS	29.5	29.50	-0.15	10 mm	2434-1	2	1:4.15	front	0.368	1.000	0.368	
1850.20	512	GSM 1900	GPRS	29.5	29.50	0.16	10 mm	2434-1	2	1:4.15	bottom	1.010	1.000	1.010	A14
1880.00	661	GSM 1900	GPRS	29.5	29.50	0.02	10 mm	2434-1	2	1:4.15	bottom	0.899	1.000	0.899	
1909.80	810	GSM 1900	GPRS	29.5	29.50	-0.18	10 mm	2434-1	2	1:4.15	bottom	0.756	1.000	0.756	
1880.00	661	GSM 1900	GPRS	29.5	29.50	-0.13	10 mm	2434-1	2	1:4.15	right	0.237	1.000	0.237	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

Note: Blue entry represents repeatability measurement.

Table 11-15
UMTS 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)	
836.60	4183	UMTS 850	RMC	23.9	23.70	-0.04	10 mm	2434-2	1:1	back	0.490	1.047	0.513	A13
836.60	4183	UMTS 850	RMC	23.9	23.70	-0.01	10 mm	2434-2	1:1	front	0.334	1.047	0.350	
836.60	4183	UMTS 850	RMC	23.9	23.70	0.11	10 mm	2434-2	1:1	bottom	0.174	1.047	0.182	
836.60	4183	UMTS 850	RMC	23.9	23.70	-0.01	10 mm	2434-2	1:1	right	0.435	1.047	0.455	
1852.40	9262	UMTS 1900	RMC	24.2	24.02	0.16	10 mm	2434-1	1:1	back	0.972	1.042	1.013	
1880.00	9400	UMTS 1900	RMC	24.2	23.99	0.15	10 mm	2434-1	1:1	back	0.855	1.050	0.898	
1907.60	9538	UMTS 1900	RMC	24.2	23.72	0.12	10 mm	2434-1	1:1	back	0.610	1.117	0.681	
1880.00	9400	UMTS 1900	RMC	24.2	23.99	-0.12	10 mm	2434-1	1:1	front	0.682	1.050	0.716	
1852.40	9262	UMTS 1900	RMC	24.2	24.02	-0.14	10 mm	2434-1	1:1	bottom	1.120	1.042	1.167	
1880.00	9400	UMTS 1900	RMC	24.2	23.99	-0.05	10 mm	2434-1	1:1	bottom	0.927	1.050	0.973	
1907.60	9538	UMTS 1900	RMC	24.2	23.72	-0.08	10 mm	2434-1	1:1	bottom	0.666	1.117	0.744	
1880.00	9400	UMTS 1900	RMC	24.2	23.99	-0.04	10 mm	2434-1	1:1	right	0.269	1.050	0.282	
1852.40	9262	UMTS 1900	RMC	24.2	24.02	-0.01	10 mm	2434-1	1:1	bottom	1.150	1.042	1.198	A16
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram							

Note: Blue entry represents repeatability measurement.

Table 11-16
LTE Band 17 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)	
710.00	23790	Mid	LTE Band 17	10	23.7	23.35	-0.04	0	5830-1	QPSK	1	0	10 mm	back	1:1	0.272	1.084	0.295	A17
710.00	23790	Mid	LTE Band 17	10	22.7	22.10	0.05	1	5830-1	QPSK	25	25	10 mm	back	1:1	0.106	1.148	0.122	
710.00	23790	Mid	LTE Band 17	10	23.7	23.35	0.05	0	5830-1	QPSK	1	0	10 mm	front	1:1	0.179	1.084	0.194	
710.00	23790	Mid	LTE Band 17	10	22.7	22.10	0.07	1	5830-1	QPSK	25	25	10 mm	front	1:1	0.074	1.148	0.085	
710.00	23790	Mid	LTE Band 17	10	23.7	23.35	-0.08	0	5830-1	QPSK	1	0	10 mm	bottom	1:1	0.242	1.084	0.262	
710.00	23790	Mid	LTE Band 17	10	22.7	22.10	0.03	1	5830-1	QPSK	25	25	10 mm	bottom	1:1	0.108	1.148	0.124	
710.00	23790	Mid	LTE Band 17	10	23.7	23.35	0.09	0	5830-1	QPSK	1	0	10 mm	left	1:1	0.281	1.084	0.305	A18
710.00	23790	Mid	LTE Band 17	10	22.7	22.10	0.07	1	5830-1	QPSK	25	25	10 mm	left	1:1	0.120	1.148	0.138	
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 11-17
LTE Band 4 (AWS) 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)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.92	-0.05	0	5830-1	QPSK	1	99	10 mm	back	1:1	0.810	1.019	0.825	A19
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.45	-0.09	1	5830-1	QPSK	50	0	10 mm	back	1:1	0.634	1.135	0.720	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.41	0.00	1	5830-1	QPSK	100	0	10 mm	back	1:1	0.595	1.146	0.682	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.92	0.00	0	5830-1	QPSK	1	99	10 mm	front	1:1	0.338	1.019	0.344	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.45	0.01	1	5830-1	QPSK	50	0	10 mm	front	1:1	0.293	1.135	0.333	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.92	0.01	0	5830-1	QPSK	1	99	10 mm	bottom	1:1	0.519	1.019	0.529	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.45	-0.06	1	5830-1	QPSK	50	0	10 mm	bottom	1:1	0.430	1.135	0.488	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.92	0.01	0	5830-1	QPSK	1	99	10 mm	left	1:1	0.462	1.019	0.471	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.45	0.09	1	5830-1	QPSK	50	0	10 mm	left	1:1	0.408	1.135	0.463	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.92	0.00	0	5830-1	QPSK	1	99	10 mm	back	1:1	0.691	1.019	0.704	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram										

Note: Blue entry represents repeatability measurement.

Table 11-18
LTE Band 7 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)	
2510.00	20850	Low	LTE Band 7	20	23.7	23.56	0.00	0	5830-1	QPSK	1	99	10 mm	back	1:1	0.812	1.033	0.839	
2535.00	21100	Mid	LTE Band 7	20	23.7	23.38	-0.02	0	5830-1	QPSK	1	99	10 mm	back	1:1	0.935	1.076	1.006	
2560.00	21350	High	LTE Band 7	20	23.7	23.43	-0.06	0	5830-1	QPSK	1	49	10 mm	back	1:1	1.090	1.064	1.160	
2510.00	20850	Low	LTE Band 7	20	22.7	21.99	0.06	1	5830-1	QPSK	50	25	10 mm	back	1:1	0.456	1.178	0.537	
2535.00	21100	Mid	LTE Band 7	20	22.7	21.92	-0.06	1	5830-1	QPSK	50	0	10 mm	back	1:1	0.693	1.197	0.830	
2560.00	21350	High	LTE Band 7	20	22.7	22.02	0.05	1	5830-1	QPSK	50	50	10 mm	back	1:1	0.799	1.169	0.934	
2560.00	21350	High	LTE Band 7	20	22.7	22.01	-0.12	1	5830-1	QPSK	100	0	10 mm	back	1:1	0.795	1.172	0.932	
2510.00	20850	Low	LTE Band 7	20	23.7	23.56	-0.06	0	5830-1	QPSK	1	99	10 mm	front	1:1	0.217	1.033	0.224	
2560.00	21350	High	LTE Band 7	20	22.7	22.02	-0.08	1	5830-1	QPSK	50	50	10 mm	front	1:1	0.181	1.169	0.212	
2510.00	20850	Low	LTE Band 7	20	23.7	23.56	0.09	0	5830-1	QPSK	1	99	10 mm	bottom	1:1	0.248	1.033	0.256	
2560.00	21350	High	LTE Band 7	20	22.7	22.02	0.05	1	5830-1	QPSK	50	50	10 mm	bottom	1:1	0.225	1.169	0.263	
2510.00	20850	Low	LTE Band 7	20	23.7	23.56	0.01	0	5830-1	QPSK	1	99	10 mm	left	1:1	0.515	1.033	0.532	
2560.00	21350	High	LTE Band 7	20	22.7	22.02	0.02	1	5830-1	QPSK	50	50	10 mm	left	1:1	0.516	1.169	0.603	
2510.00	20850	Low	LTE Band 7	20	23.7	23.56	-0.01	0	5830-1	QPSK	1	99	10 mm	back	1:1	0.782	1.033	0.808	
2560.00	21350	High	LTE Band 7	20	23.7	23.43	-0.01	0	5830-1	QPSK	1	49	10 mm	back	1:1	1.150	1.064	1.224	A20
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

Note: Blue entry represent repeatability measurements.

Table 11-19
Wireless Router 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	16.0	15.96	0.12	10 mm	9434-2	1	back	1:1	0.100	1.009	0.101	A21
2437	6	IEEE 802.11b	DSSS	16.0	15.96	0.01	10 mm	9434-2	1	front	1:1	0.079	1.009	0.080	
2437	6	IEEE 802.11b	DSSS	16.0	15.96	-0.21	10 mm	9434-2	1	top	1:1	0.079	1.009	0.080	
2437	6	IEEE 802.11b	DSSS	16.0	15.96	-0.13	10 mm	9434-2	1	left	1:1	0.048	1.009	0.048	
5805	161	IEEE 802.11a	OFDM	11.0	9.73	-0.04	10 mm	9434-2	6	back	1:1	0.124	1.340	0.166	A22
5775	155	IEEE 802.11ac	OFDM	10.0	9.04	0.14	10 mm	9434-2	29.3	back	1:1	0.063	1.247	0.079	
5805	161	IEEE 802.11a	OFDM	11.0	9.73	0.12	10 mm	9434-2	6	front	1:1	0.000	1.340	0.000	
5805	161	IEEE 802.11a	OFDM	11.0	9.73	0.16	10 mm	9434-2	6	top	1:1	0.044	1.340	0.059	
5805	161	IEEE 802.11a	OFDM	11.0	9.73	-0.13	10 mm	9434-2	6	left	1:1	0.080	1.340	0.107	
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 D01v05r01.
2. Liquid tissue depth was at least 15.0 cm for all frequencies.
3. 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.
4. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05r01.
5. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
6. Per FCC KDB Publication 648474 D04v01r01, body-worn SAR was evaluated without a headset connected to the device. When the standalone reported SAR was ≥ 1.2 W/kg, additional SAR evaluations using a headset cable were required.
7. Per FCC KDB 865664 D01v01r01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 13 for variability analysis.
8. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v01r01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.5 for more details).

GSM/GPRS Test Notes:

1. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
2. This device supports GSM VOIP in the head and body-worn configurations; therefore GPRS was additionally evaluated for head and body-worn compliance.
3. Justification for reduced test configurations per KDB Publication 941225 D03v01: The source-based time-averaged output power was evaluated for all multi-slot operations. The multi-slot configuration with the highest frame averaged output power was evaluated for SAR.
4. Per FCC KDB Publication 447498 D01v05r01, when the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≥ 0.8 W/kg then testing at the other channels are not required for such test configuration(s). Since the maximum output power variation across the required test channels was ≤ ½ dB, middle channel was the default channel used.

UMTS Notes:

1. UMTS mode in Body SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v02. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.
2. Per FCC KDB Publication 447498 D01v05r01, when the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). Since the maximum output power variation across the required test channels was ≤ ½ dB, middle channel was the default channel used.

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. Per April 2013 TCB Workshop notes, full SAR tests for all IEEE 802.11ac configurations were not required because the average output power was not more than 0.25 dB higher than IEEE 802.11a mode. IEEE 802.11ac was evaluated for the highest IEEE 802.11a configuration in each 5 GHz band and exposure condition.
4. When wireless router is enables, all 5 GHz bands are disabled. 5.8 GHz WIFI was evaluated according to the wireless router SAR procedures because the manufacturer expects that WIFI Direct GO may be used in a manner similar to a wireless router. WIFI Direct GO is not supported by 5.2-5.7 GHz WIFI.
5. This device can operate in the 2.4 GHz and 5.8 GHz bands using WIFI Direct GO capability. The manufacturer expects 5.8 GHz Wifi Direct GO may be used similar to wireless router usage. Therefore, 5.8 GHz Wifi Direct GO was evaluated for SAR similar to wireless router SAR procedures in FCC KDB Publication 941225.
6. WIFI transmission was verified using an uncalibrated spectrum analyzer.
7. Since the maximum extrapolated peak SAR of the zoom scan for the maximum output channel was <1.6 W/kg and the reported 1g averaged SAR was <0.8 W/kg, SAR testing on other default channels was not required.

12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05r01 are applicable to handsets with built-in unlicensed transmitters such as 802.11a/b/g/n/ac and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

12.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05r01 IV.C.1.iii, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05r01 4.3.2 2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

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

Table 12-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2441	11.00	10	**0.271**

Note: Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. Per KDB Publication 447498 D01v05r01, the maximum power of the channel was rounded to the nearest mW before calculation.

12.3 Head SAR Simultaneous Transmission Analysis

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

Simult Tx	Configuration	GSM 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.331	0.374	**0.705**
	Right Tilt	0.199	0.259	0.458
	Left Cheek	0.275	0.206	0.481
	Left Tilt	0.201	0.177	0.378

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.532	0.374	**0.906**
	Right Tilt	0.311	0.259	0.570
	Left Cheek	0.418	0.206	0.624
	Left Tilt	0.278	0.177	0.455

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.356	0.374	**0.730**
	Right Tilt	0.200	0.259	0.459
	Left Cheek	0.257	0.206	0.463
	Left Tilt	0.174	0.177	0.351

Simult Tx	Configuration	GSM 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.143	0.374	**0.517**
	Right Tilt	0.067	0.259	0.326
	Left Cheek	0.127	0.206	0.333
	Left Tilt	0.070	0.177	0.247

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.194	0.374	**0.568**
	Right Tilt	0.095	0.259	0.354
	Left Cheek	0.187	0.206	0.393
	Left Tilt	0.102	0.177	0.279

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.255	0.374	**0.629**
	Right Tilt	0.126	0.259	0.385
	Left Cheek	0.250	0.206	0.456
	Left Tilt	0.131	0.177	0.308

Simult Tx	Configuration	LTE Band 17 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.158	0.374	**0.532**
	Right Tilt	0.094	0.259	0.353
	Left Cheek	0.218	0.206	0.424
	Left Tilt	0.114	0.177	0.291

Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.193	0.374	**0.567**
	Right Tilt	0.099	0.259	0.358
	Left Cheek	0.179	0.206	0.385
	Left Tilt	0.079	0.177	0.256

Simult Tx	Configuration	LTE Band 7 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.122	0.374	**0.496**
	Right Tilt	0.162	0.259	0.421
	Left Cheek	0.208	0.206	0.414
	Left Tilt	0.108	0.177	0.285

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

Simult Tx	Configuration	GSM 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.331	0.117	**0.448**
	Right Tilt	0.199	0.073	0.272
	Left Cheek	0.275	0.059	0.334
	Left Tilt	0.201	0.056	0.257

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.532	0.117	**0.649**
	Right Tilt	0.311	0.073	0.384
	Left Cheek	0.418	0.059	0.477
	Left Tilt	0.278	0.056	0.334

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.356	0.117	**0.473**
	Right Tilt	0.200	0.073	0.273
	Left Cheek	0.257	0.059	0.316
	Left Tilt	0.174	0.056	0.230

Simult Tx	Configuration	GSM 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.143	0.117	**0.260**
	Right Tilt	0.067	0.073	0.140
	Left Cheek	0.127	0.059	0.186
	Left Tilt	0.070	0.056	0.126

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.194	0.117	**0.311**
	Right Tilt	0.095	0.073	0.168
	Left Cheek	0.187	0.059	0.246
	Left Tilt	0.102	0.056	0.158

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.255	0.117	**0.372**
	Right Tilt	0.126	0.073	0.199
	Left Cheek	0.250	0.059	0.309
	Left Tilt	0.131	0.056	0.187

Simult Tx	Configuration	LTE Band 17 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.158	0.117	0.275
	Right Tilt	0.094	0.073	0.167
	Left Cheek	0.218	0.059	**0.277**
	Left Tilt	0.114	0.056	0.170

Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.193	0.117	**0.310**
	Right Tilt	0.099	0.073	0.172
	Left Cheek	0.179	0.059	0.238
	Left Tilt	0.079	0.056	0.135

Simult Tx	Configuration	LTE Band 7 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.122	0.117	0.239
	Right Tilt	0.162	0.073	0.235
	Left Cheek	0.208	0.059	**0.267**
	Left Tilt	0.108	0.056	0.164

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 Direct capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

12.4 Body-Worn Simultaneous Transmission Analysis

Table 12-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 10 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.638	0.101	0.739
Back Side	GPRS 850	0.946	0.101	1.047
Back Side	UMTS 850	0.513	0.101	0.614
Back Side	GSM 1900	0.417	0.101	0.518
Back Side	GPRS 1900	0.641	0.101	0.742
Back Side	UMTS 1900	1.013	0.101	1.114
Back Side	LTE Band 17	0.295	0.101	0.396
Back Side	LTE Band 4 (AWS)	0.825	0.101	0.926
Back Side	LTE Band 7	1.224	0.101	**1.325**

Table 12-5
Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 10 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.638	0.166	0.804
Back Side	GPRS 850	0.946	0.166	1.112
Back Side	UMTS 850	0.513	0.166	0.679
Back Side	GSM 1900	0.417	0.166	0.583
Back Side	GPRS 1900	0.641	0.166	0.807
Back Side	UMTS 1900	1.013	0.166	1.179
Back Side	LTE Band 17	0.295	0.166	0.461
Back Side	LTE Band 4 (AWS)	0.825	0.166	0.991
Back Side	LTE Band 7	1.224	0.166	**1.390**

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 Direct 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 10 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.638	0.271	0.909
Back Side	GPRS 850	0.946	0.271	1.217
Back Side	UMTS 850	0.513	0.271	0.784
Back Side	GSM 1900	0.417	0.271	0.688
Back Side	GPRS 1900	0.641	0.271	0.912
Back Side	UMTS 1900	1.013	0.271	1.284
Back Side	LTE Band 17	0.295	0.271	0.566
Back Side	LTE Band 4 (AWS)	0.825	0.271	1.096
Back Side	LTE Band 7	1.224	0.271	**1.495**

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.

12.5 WIFI Direct SAR Simultaneous Transmission Analysis

Per FCC KDB Publication 941225 D06v01r01, 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	GPRS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.946	0.101	**1.047**
	Front	0.669	0.080	0.749
	Top	-	0.080	0.080
	Bottom	0.364	-	0.364
	Right	0.848	-	0.848
	Left	-	0.048	0.048

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.513	0.101	**0.614**
	Front	0.350	0.080	0.430
	Top	-	0.080	0.080
	Bottom	0.182	-	0.182
	Right	0.455	-	0.455
	Left	-	0.048	0.048

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.641	0.101	0.742
	Front	0.368	0.080	0.448
	Top	-	0.080	0.080
	Bottom	1.010	-	**1.010**
	Right	0.237	-	0.237
	Left	-	0.048	0.048

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	1.013	0.101	1.114
	Front	0.716	0.080	0.796
	Top	-	0.080	0.080
	Bottom	1.198	-	**1.198**
	Right	0.282	-	0.282
	Left	-	0.048	0.048

Simult Tx	Configuration	LTE Band 17 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.295	0.101	**0.396**
	Front	0.194	0.080	0.274
	Top	-	0.080	0.080
	Bottom	0.262	-	0.262
	Right	-	-	0.000
	Left	0.305	0.048	0.353

Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.825	0.101	**0.926**
	Front	0.344	0.080	0.424
	Top	-	0.080	0.080
	Bottom	0.529	-	0.529
	Right	-	-	0.000
	Left	0.471	0.048	0.519

Simult Tx	Configuration	LTE Band 7 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	1.224	0.101	**1.325**
	Front	0.224	0.080	0.304
	Top	-	0.080	0.080
	Bottom	0.263	-	0.263
	Right	-	-	0.000
	Left	0.603	0.048	0.651

Table 12-8
Simultaneous Transmission Scenario (5 GHz WIFI Direct at 1.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.946	0.166	**1.112**
	Front	0.669	0.000	0.669
	Top	-	0.059	0.059
	Bottom	0.364	-	0.364
	Right	0.848	-	0.848
	Left	-	0.107	0.107

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.513	0.166	**0.679**
	Front	0.350	0.000	0.350
	Top	-	0.059	0.059
	Bottom	0.182	-	0.182
	Right	0.455	-	0.455
	Left	-	0.107	0.107

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.641	0.166	0.807
	Front	0.368	0.000	0.368
	Top	-	0.059	0.059
	Bottom	1.010	-	**1.010**
	Right	0.237	-	0.237
	Left	-	0.107	0.107

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	1.013	0.166	1.179
	Front	0.716	0.000	0.716
	Top	-	0.059	0.059
	Bottom	1.198	-	**1.198**
	Right	0.282	-	0.282
	Left	-	0.107	0.107

Simult Tx	Configuration	LTE Band 17 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.295	0.166	**0.461**
	Front	0.194	0.000	0.194
	Top	-	0.059	0.059
	Bottom	0.262	-	0.262
	Right	-	-	0.000
	Left	0.305	0.107	0.412

Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.825	0.166	**0.991**
	Front	0.344	0.000	0.344
	Top	-	0.059	0.059
	Bottom	0.529	-	0.529
	Right	-	-	0.000
	Left	0.471	0.107	0.578

Simult Tx	Configuration	LTE Band 7 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	1.224	0.166	**1.390**
	Front	0.224	0.000	0.224
	Top	-	0.059	0.059
	Bottom	0.263	-	0.263
	Right	-	-	0.000
	Left	0.603	0.107	0.710

12.6 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v05r01.

13 SAR MEASUREMENT VARIABILITY

13.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r01, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2) A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

Table 13-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS														
Band	FREQUENCY		Mode	Service	# of Time Slots	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.						(W/kg)	(W/kg)		(W/kg)		(W/kg)	
835	836.60	190	GSM 850	GPRS	2	back	10 mm	0.919	0.927	1.01	N/A	N/A	N/A	N/A
1750	1732.50	20175	LTE Band 4 (AWS)	QPSK, 1 RB, 99 RB Offset	N/A	back	10 mm	0.810	0.691	1.17	N/A	N/A	N/A	N/A
1900	1852.40	9262	UMTS 1900	RMC	N/A	bottom	10 mm	1.120	1.150	1.03	N/A	N/A	N/A	N/A
2450	2510.00	20850	LTE Band 7	QPSK, 1 RB, 99 RB Offset	N/A	back	10 mm	0.812	0.782	1.04	N/A	N/A	N/A	N/A
2600	2560.00	21350	LTE Band 7	QPSK, 1 RB, 49 RB Offset	N/A	back	10 mm	1.090	1.150	1.06	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram						

13.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664 D01v01r01, the extended measurement uncertainty analysis per IEEE 1528-2003 was not required.

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	2904A00579
Amplifier Research	5S1G4	5W, 800MHz-4.2GHz	CBT	N/A	CBT	21910
Anritsu	ML2495A	Power Meter	10/11/2012	Annual	10/11/2013	1039008
Anritsu	ML2438A	Power Meter	2/14/2013	Annual	2/14/2014	98150041
Anritsu	MA2481A	Power Sensor	2/14/2013	Annual	2/14/2014	5318
Anritsu	MA2481A	Power Sensor	2/14/2013	Annual	2/14/2014	5821
Anritsu	MA2411B	Pulse Power Sensor	12/5/2012	Annual	12/5/2013	1126066
Anritsu	MA2411B	Pulse Power Sensor	12/4/2012	Annual	12/4/2013	1207364
Anritsu	MT8820C	Radio Communication Analyzer	6/28/2013	Annual	6/28/2014	6201240328
Anritsu	MT8820C	Radio Communication Tester	11/6/2012	Annual	11/6/2013	6200901190
Anritsu	MA24106A	USB Power Sensor	12/7/2012	Annual	12/7/2013	1244512
Anritsu	MA24106A	USB Power Sensor	12/7/2012	Annual	12/7/2013	1244515
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
Control Company	4353	Long Stem Thermometer	9/25/2012	Biennial	9/25/2014	122539615
Control Company	36934-158	Wall-Mounted Thermometer	1/4/2012	Biennial	1/4/2014	122014488
Fisher Scientific	15-078J	Long Stem Thermometer	10/30/2012	Biennial	10/30/2014	122626059
Fisher Scientific	15-077-960	Thermometer	11/6/2012	Biennial	11/6/2014	122640025
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	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
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	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	5/3/2013	Annual	5/3/2014	836371/0079
Rohde & Schwarz	NRVD	Dual Channel Power Meter	10/12/2012	Biennial	10/12/2014	101695
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	2/8/2013	Annual	2/8/2014	101699
Rohde & Schwarz	CMW500	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	SMIQ03B	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
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	D835V2	835 MHz SAR Dipole	8/23/2012	Annual	8/23/2013	4d026
SPEAG	D835V2	835 MHz SAR Dipole	1/7/2013	Annual	1/7/2014	4d132
SPEAG	D1750V2	1750 MHz SAR Dipole	4/30/2013	Annual	4/30/2014	1051
SPEAG	D1900V2	1900 MHz SAR Dipole	7/20/2012	Annual	7/20/2013	5d080
SPEAG	D2450V2	2450 MHz SAR Dipole	8/23/2012	Annual	8/23/2013	719
SPEAG	D2450V2	2450 MHz SAR Dipole	1/8/2013	Annual	1/8/2014	797
SPEAG	D2600V2	2600 MHz SAR Dipole	5/2/2013	Annual	5/2/2014	1004
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	DAE4	Dasy Data Acquisition Electronics	2/6/2013	Annual	2/6/2014	649
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/17/2013	Annual	1/17/2014	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/24/2012	Annual	8/24/2013	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/13/2012	Annual	11/13/2013	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/8/2013	Annual	3/8/2014	1334
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/14/2013	Annual	5/14/2014	1070
SPEAG	DAK-3.5	Dielectric Assessment Kit	12/11/2012	Annual	12/11/2013	1091
SPEAG	ES3DV2	SAR Probe	8/28/2012	Annual	8/28/2013	3022
SPEAG	ES3DV3	SAR Probe	3/15/2013	Annual	3/15/2014	3209
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
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/17/2013	Annual	4/17/2014	B010177
VWR	23226-658	Long Stem Thermometer	3/30/2012	Biennial	3/30/2014	122179874
VWR	62344-925	Mini-Thermometer	10/24/2011	Biennial	10/24/2013	111886443
VWR	36934-158	Wall-Mounted Thermometer	9/30/2011	Biennial	9/30/2013	111859332

Note:

- All equipment was used within its calibration period.
- 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.

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	299
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				24.2	23.5	

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

Applicable for frequencies up to 6 GHz.

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

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

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]

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APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 2434-1

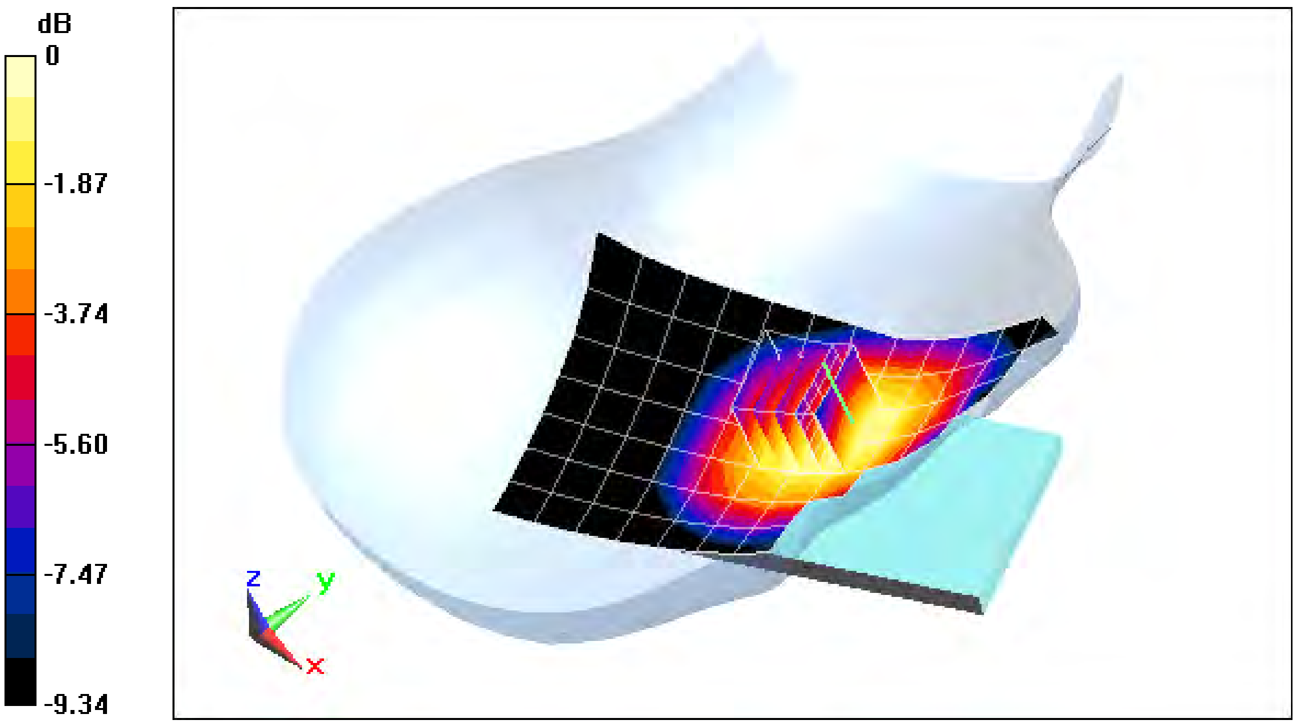
Communication System: GSM GPRS; 2 Tx slots; Frequency: 836.6 MHz; Duty Cycle: 1:4.15
Medium: 835 Head, Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.913 S/m; ε_r = 40.302; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-17-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.5°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 V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: GPRS 850, Right Head, Cheek, Mid.ch, 2 Tx slots

Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.249 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.671 W/kg
SAR(1 g) = 0.521 W/kg



0 dB = 0.535 W/kg = -2.72 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 2434-1

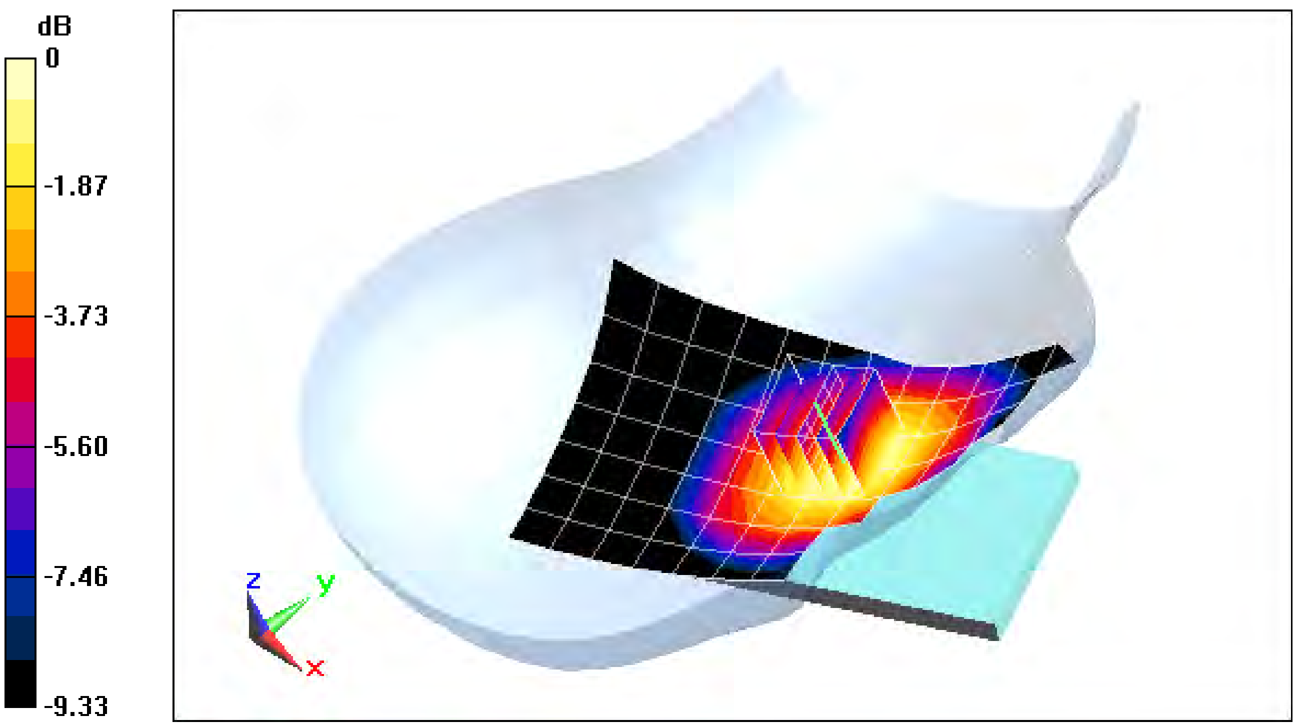
Communication System: UMTS850; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Head, Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.913 S/m; ε_r = 40.302; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-17-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.5°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 V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.301 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.441 W/kg
SAR(1 g) = 0.340 W/kg



0 dB = 0.355 W/kg = -4.50 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 2434-1

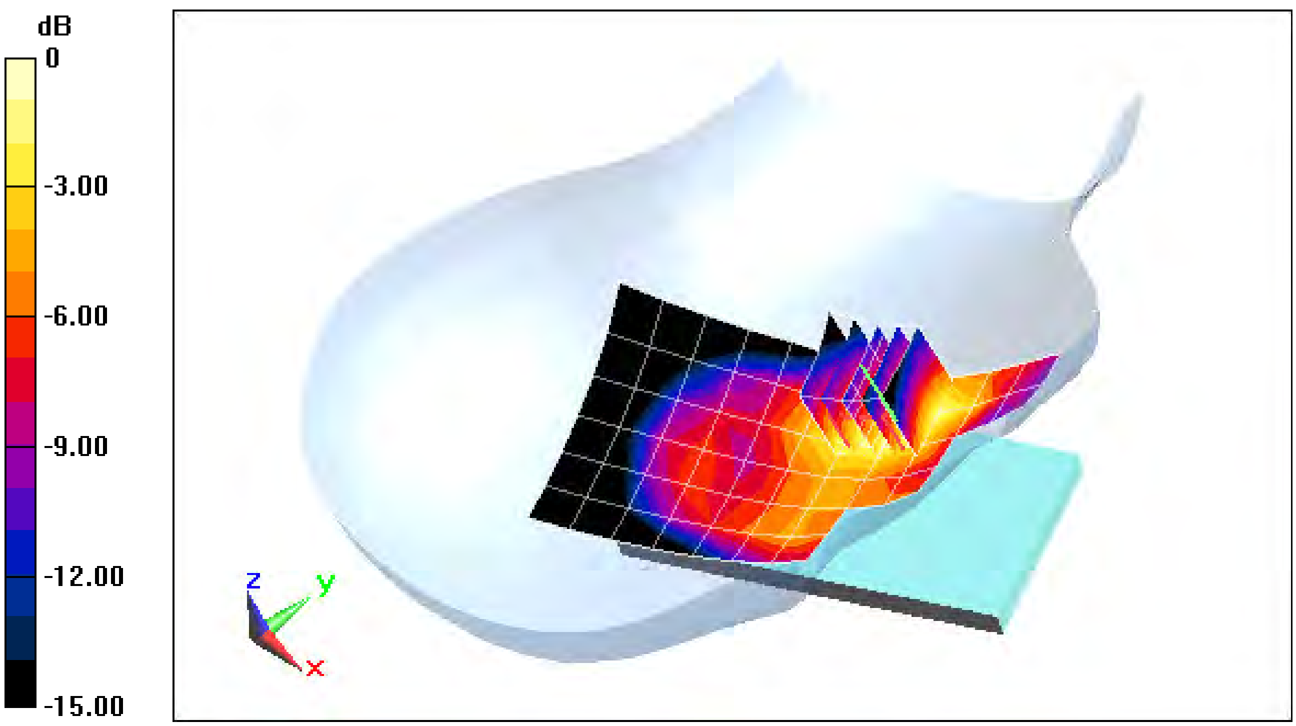
Communication System: GSM1900 GPRS; 2 Tx slots; Frequency: 1880 MHz; Duty Cycle: 1:4.15
Medium: 1900 Head, Medium parameters used:
f = 1880 MHz; σ = 1.365 S/m; ε_r = 39.987; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-15-2013; Ambient Temp: 22.1°C; Tissue Temp: 22.5°C

Probe: ES3DV2 - SN3022; ConvF(4.86, 4.86, 4.86); Calibrated: 8/28/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1403
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: GPRS 1900, Right Head, Cheek, Mid.ch, 2 Tx Slots

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.647 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.303 W/kg
SAR(1 g) = 0.194 W/kg



0 dB = 0.213 W/kg = -6.72 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 2434-1

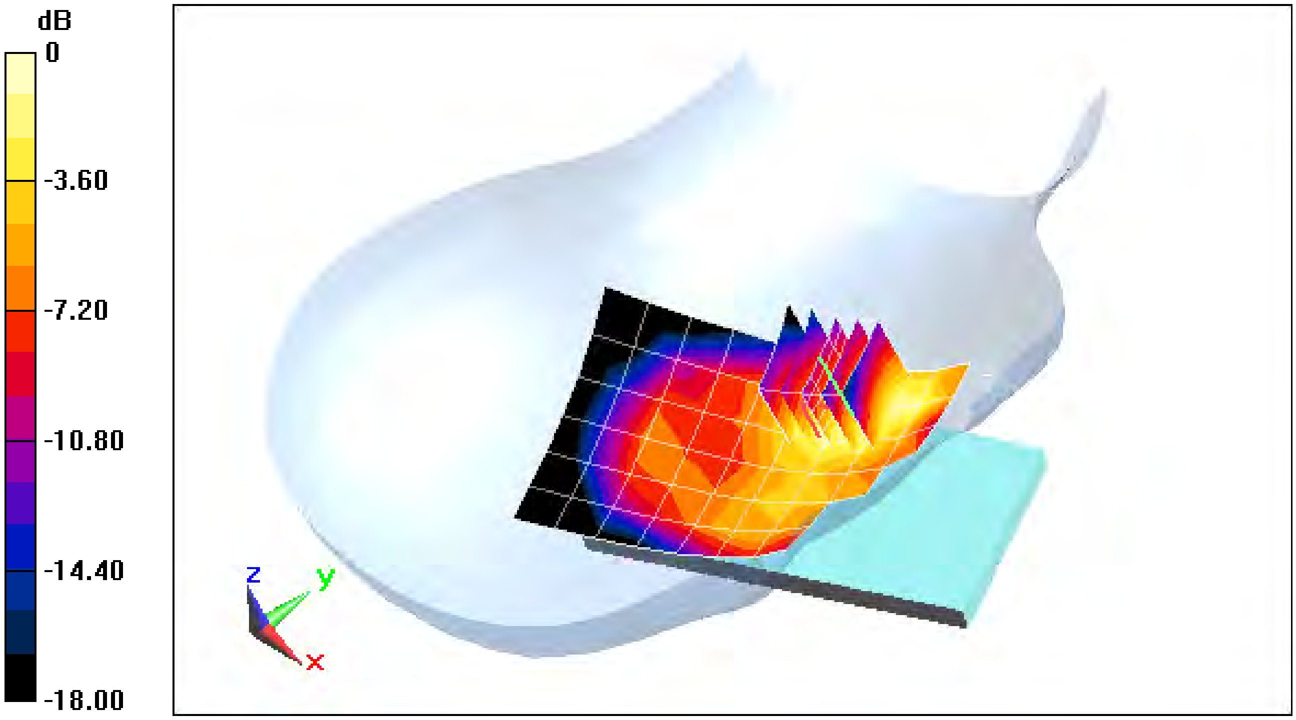
Communication System: UMTS1900; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Head, Medium parameters used:
f = 1880 MHz; σ = 1.365 S/m; ε_r = 39.987; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-15-2013; Ambient Temp: 22.1°C; Tissue Temp: 22.5°C

Probe: ES3DV2 - SN3022; ConvF(4.86, 4.86, 4.86); Calibrated: 8/28/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1403
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.763 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.367 W/kg
SAR(1 g) = 0.243 W/kg



0 dB = 0.264 W/kg = -5.78 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 5830-2

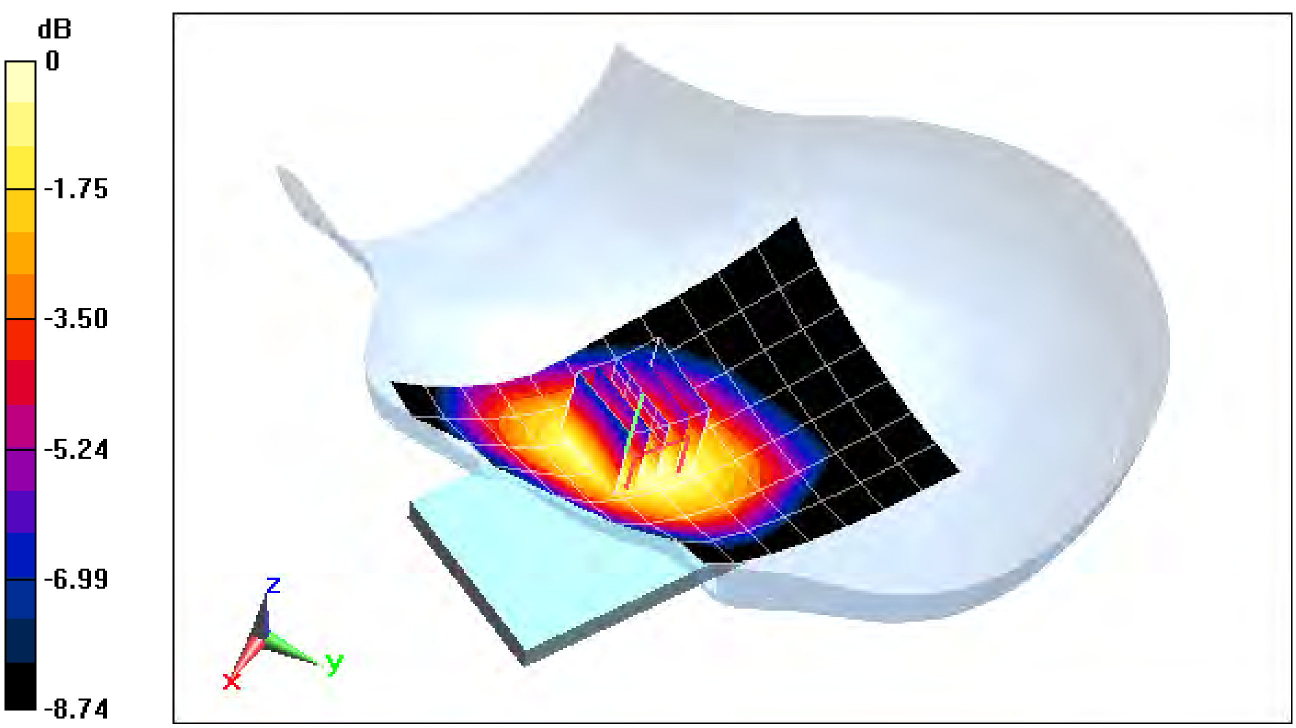
Communication System: LTE BAND 17; Frequency: 710 MHz; Duty Cycle: 1:1
Medium: 750 Head, Medium parameters used:
f = 710 MHz; σ = 0.885 S/m; ε_r = 41.298; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 07-17-2013; Ambient Temp: 21.0°C; Tissue Temp: 21.6°C

Probe: ES3DV2 - SN3022; ConvF(6.3, 6.3, 6.3); Calibrated: 8/28/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: LTE Band 17, Left Head, Cheek, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.158 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 0.244 W/kg
SAR(1 g) = 0.201 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 5830-1

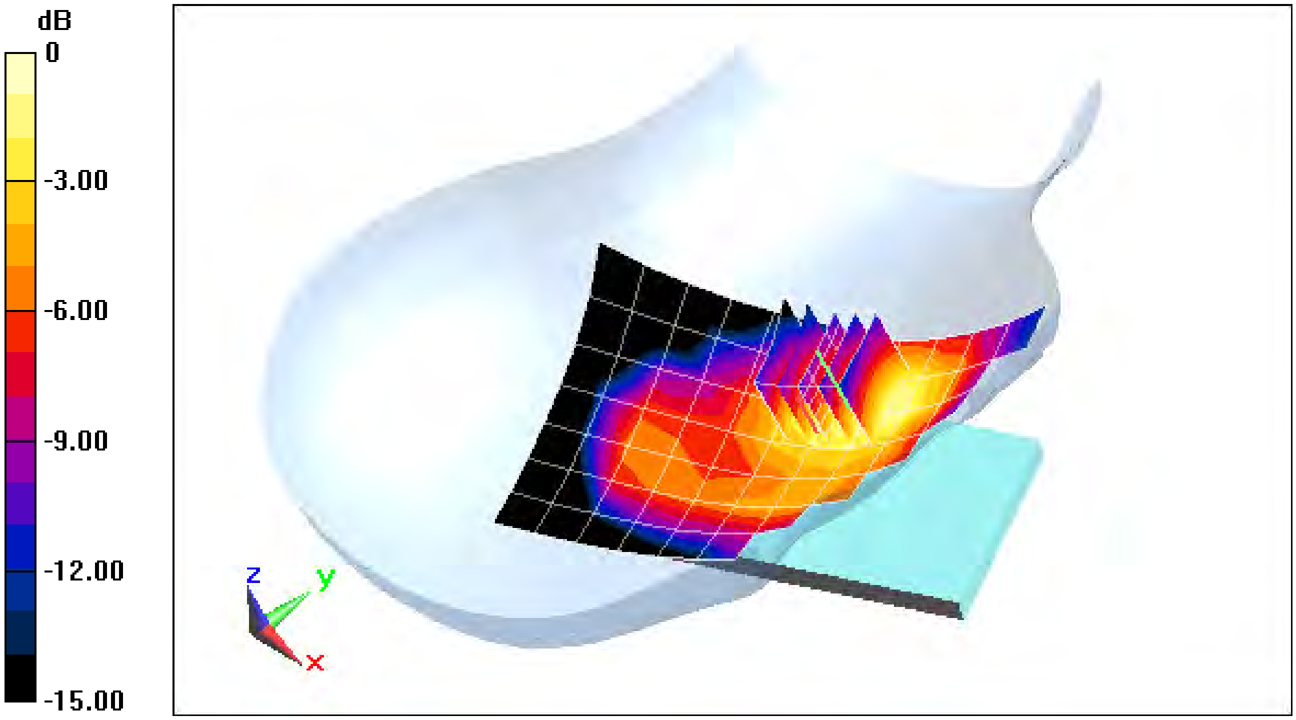
Communication System: LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Head, Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.349 S/m; ε_r = 39.123; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-11-2013; Ambient Temp: 23.8°C; Tissue Temp: 23.2°C

Probe: EX3DV4 - SN3920; ConvF(7.97, 7.97, 7.97); 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: LTE Band 4 (AWS), Right Head, Cheek, Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 99 RB Offset

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.842 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 0.284 W/kg
SAR(1 g) = 0.189 W/kg



0 dB = 0.202 W/kg = -6.95 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 5830-2

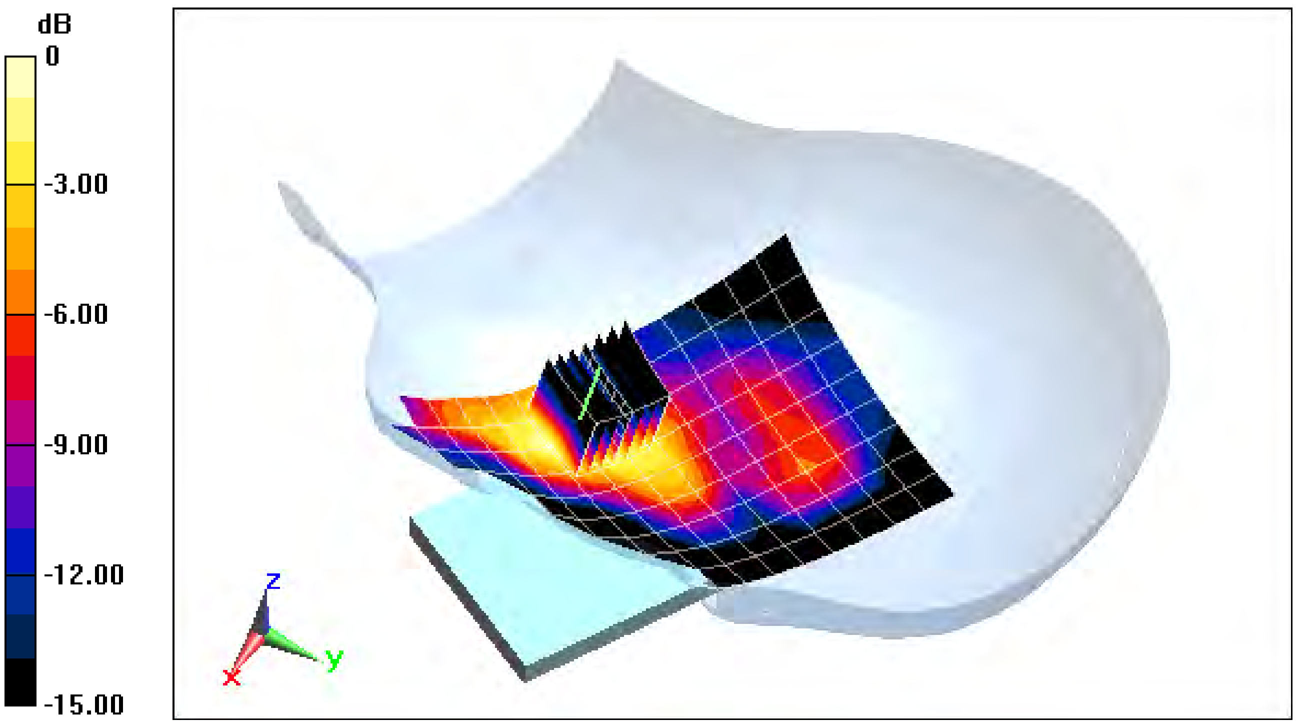
Communication System: LTE BAND 7; Frequency: 2510 MHz; Duty Cycle: 1:1
Medium: 2600 Head, Medium parameters used (interpolated):
f = 2510 MHz; σ = 1.915 S/m; ε_r = 38.235; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 07-18-2013; Ambient Temp: 23.0°C; Tissue Temp: 23.5°C

Probe: ES3DV2 - SN3022; ConvF(4.23, 4.23, 4.23); Calibrated: 8/28/2012;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1403
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: LTE Band 7, Left Head, Cheek, Low.ch,
20 MHz Bandwidth, QPSK, 1 RB, 99 RB Offset

Area Scan (10x17x1): Measurement grid: dx=12mm, dy=12
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 11.539 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.401 W/kg
SAR(1 g) = 0.201 W/kg



0 dB = 0.252 W/kg = -5.99 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 9434-2

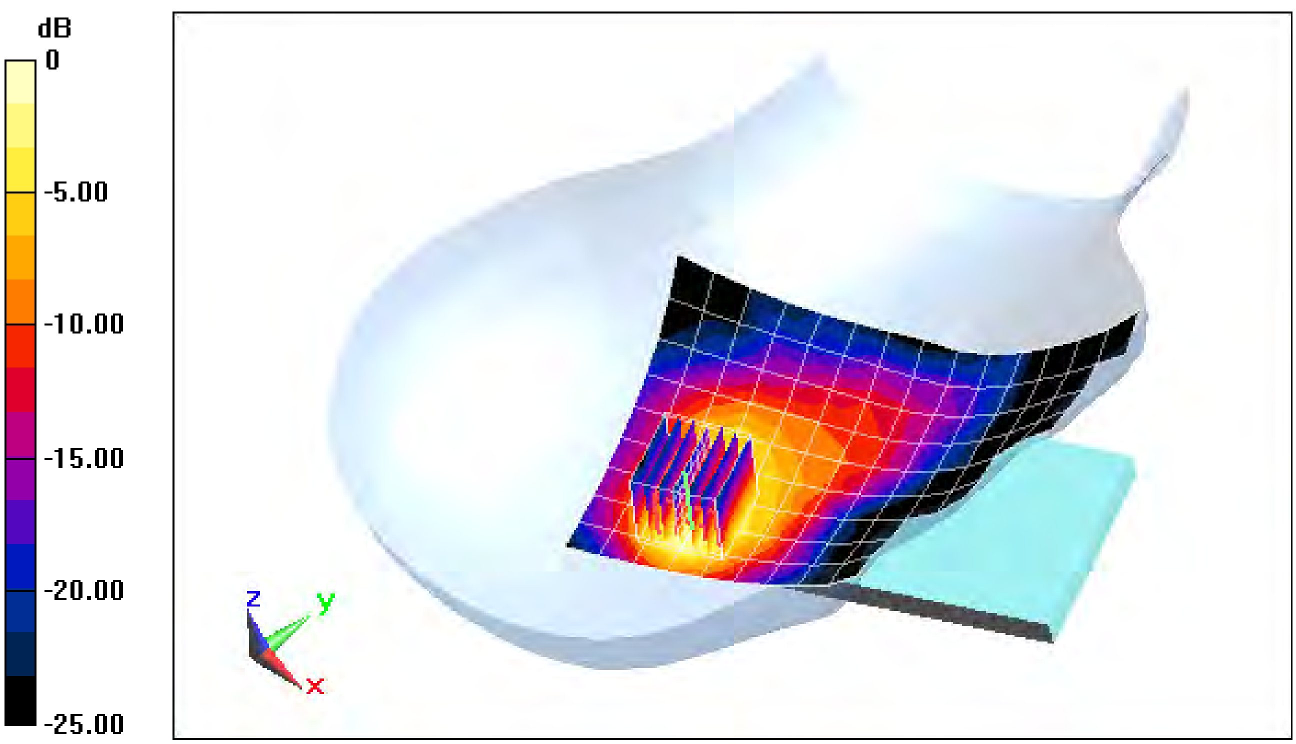
Communication System: IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: 2450 Head, Medium parameters used (interpolated):
$f = 2437$ MHz; $\sigma = 1.855$ S/m; $\varepsilon_r = 38.334$; $\rho = 1000$ kg/m^3
Phantom section: Right Section

Test Date: 07-11-2013; Ambient Temp: 24.4°C; Tissue Temp: 24.2°C

Probe: ES3DV2 - SN3022; ConvF(4.23, 4.23, 4.23); Calibrated: 8/28/2012;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1403
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (10x17x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 15.263 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 0.853 W/kg
SAR(1 g) = 0.371 W/kg



0 dB = 0.500 W/kg = -3.01 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 9434-2

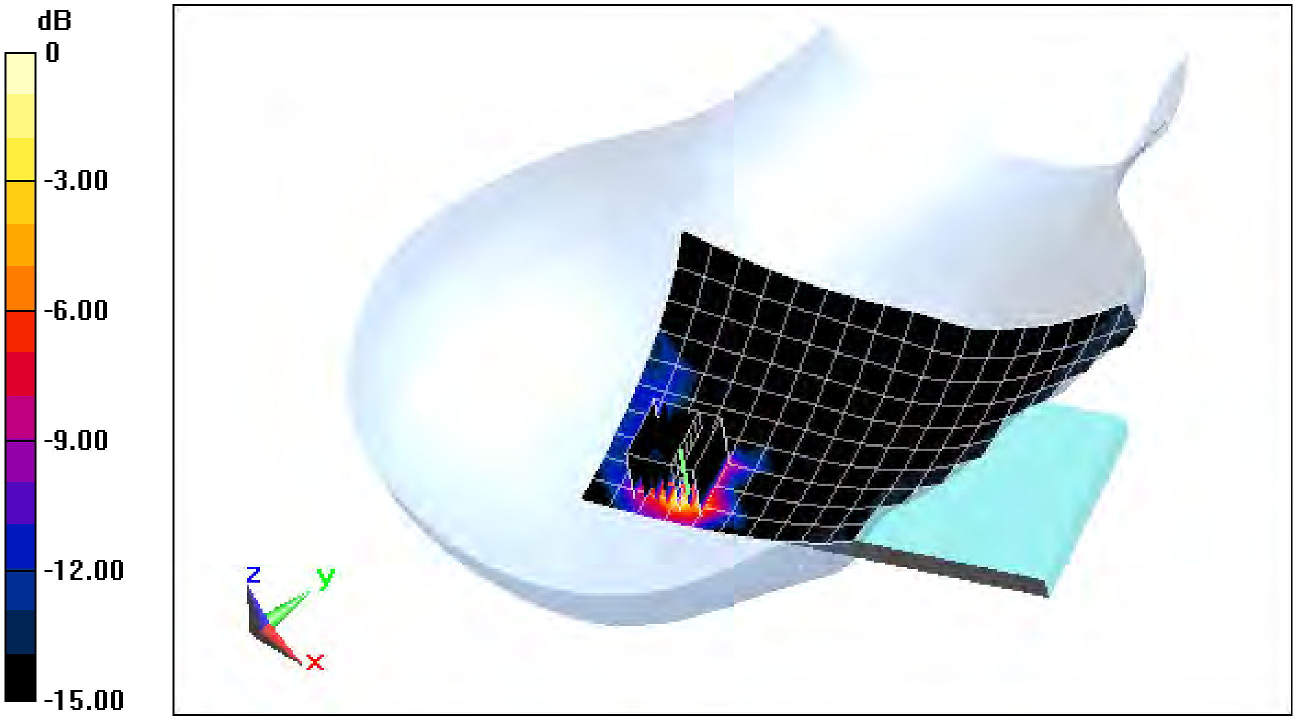
Communication System: IEEE 802.11a; Frequency: 5805 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5805 MHz; σ = 5.08 S/m; ε_r = 34.21; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-08-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.2°C

Probe: EX3DV4 - SN3920; ConvF(4.02, 4.02, 4.02); 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, Right Head, Cheek, Ch 161, 6 Mbps

Area Scan (11x21x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 4.188 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 0.347 W/kg
SAR(1 g) = 0.087 W/kg



0 dB = 0.220 W/kg = -6.58 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 9434-2

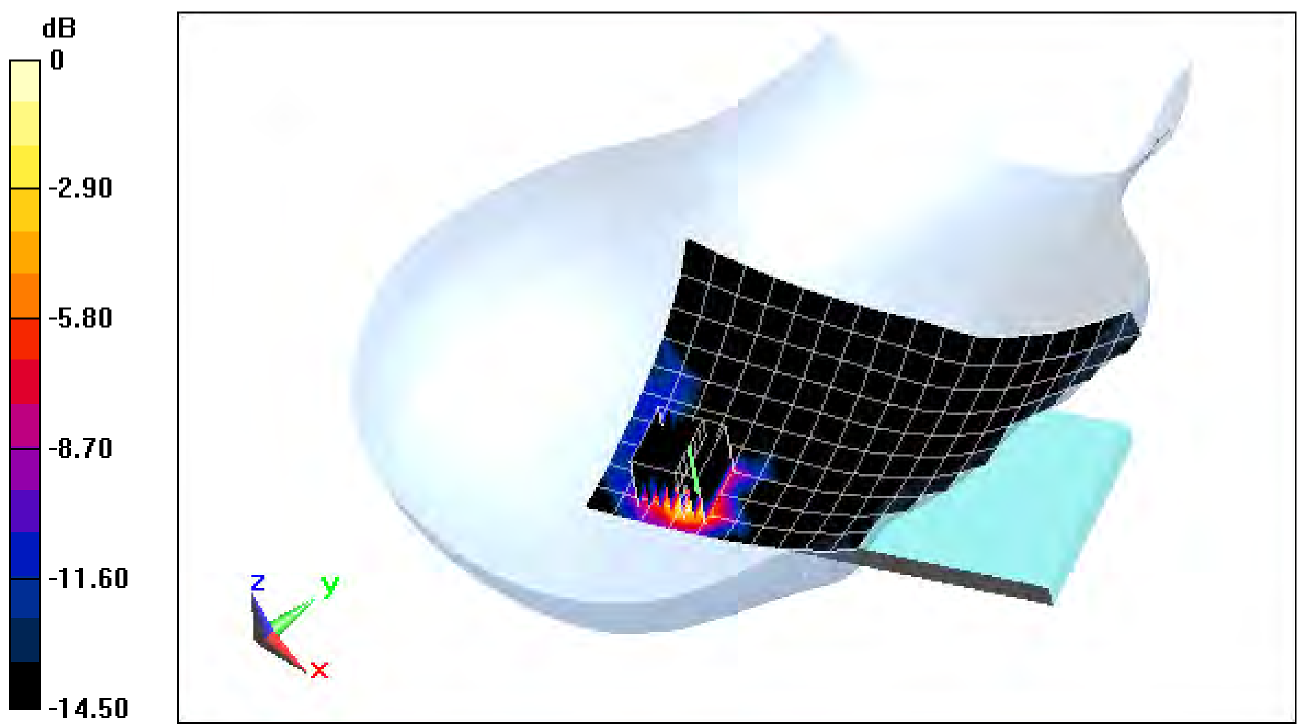
Communication System: IEEE 802.11a; Frequency: 5200 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5200 MHz; σ = 4.468 S/m; ε_r = 35.069; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-08-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.1°C

Probe: EX3DV4 - SN3920; ConvF(4.87, 4.87, 4.87); 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, 5.2 GHz, Right Head, Cheek, Ch 40, 6 Mbps

Area Scan (11x21x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 4.205 V/m; Power Drift = 0.19 dB
Peak SAR (extrapolated) = 0.329 W/kg
SAR(1 g) = 0.086 W/kg



0 dB = 0.197 W/kg = -7.06 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 2434-1

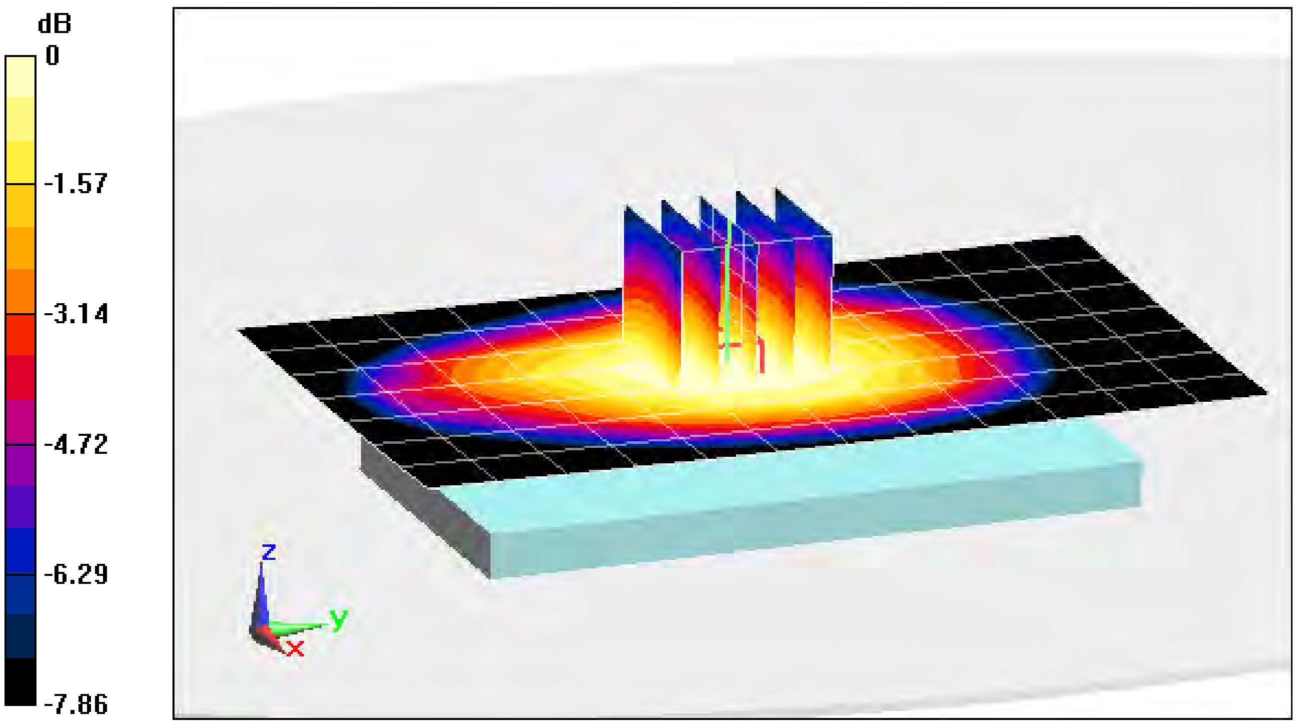
Communication System: GSM GPRS; 2 Tx slots; Frequency: 836.6 MHz; Duty Cycle: 1:4.15
Medium: 835 Body, Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.999 S/m; ε_r = 54.352; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-19-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.5°C

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

Mode: GPRS 850, Body SAR, Back Side, Mid.ch, 2 Tx Slots

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.610 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 1.14 W/kg
SAR(1 g) = 0.927 W/kg



0 dB = 0.968 W/kg = -0.14 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 2434-2

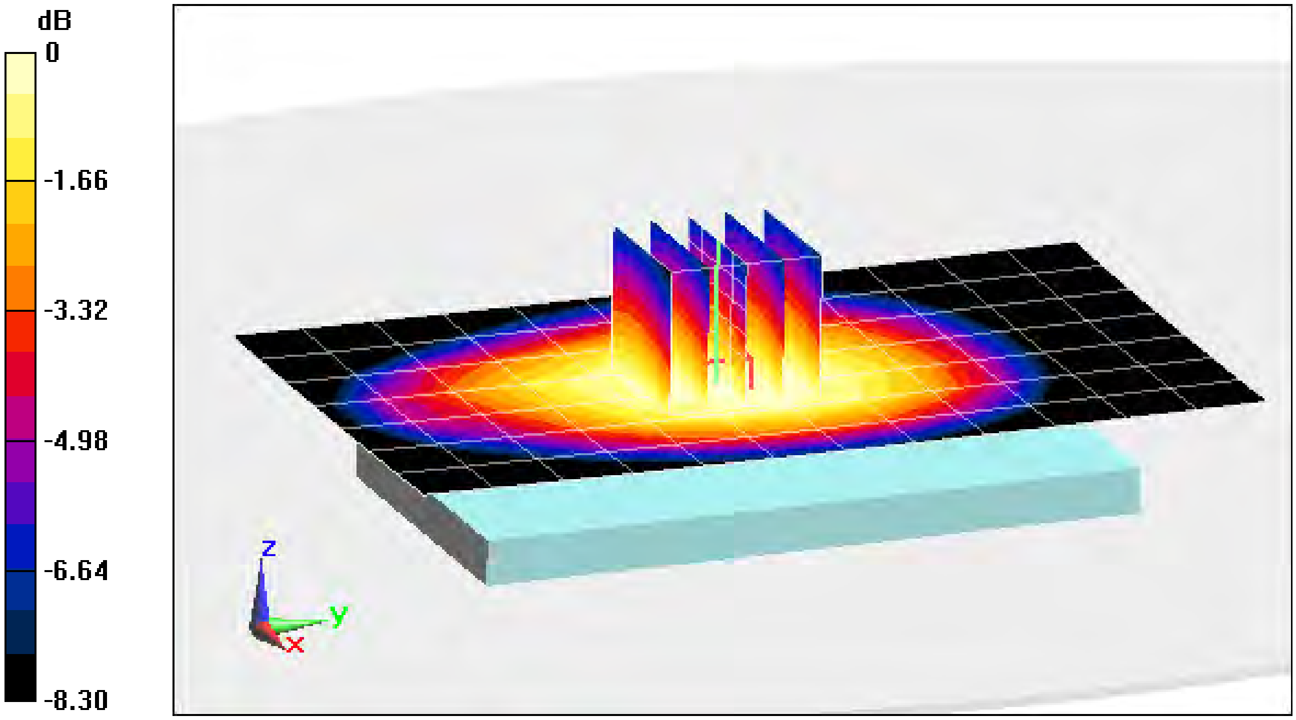
Communication System: UMTS850; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Body, Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.009 S/m; ε_r = 55.582; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-11-2013; Ambient Temp: 24.5°C; Tissue Temp: 22.9°C

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

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

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.756 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.606 W/kg
SAR(1 g) = 0.490 W/kg



0 dB = 0.513 W/kg = -2.90 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 2434-1

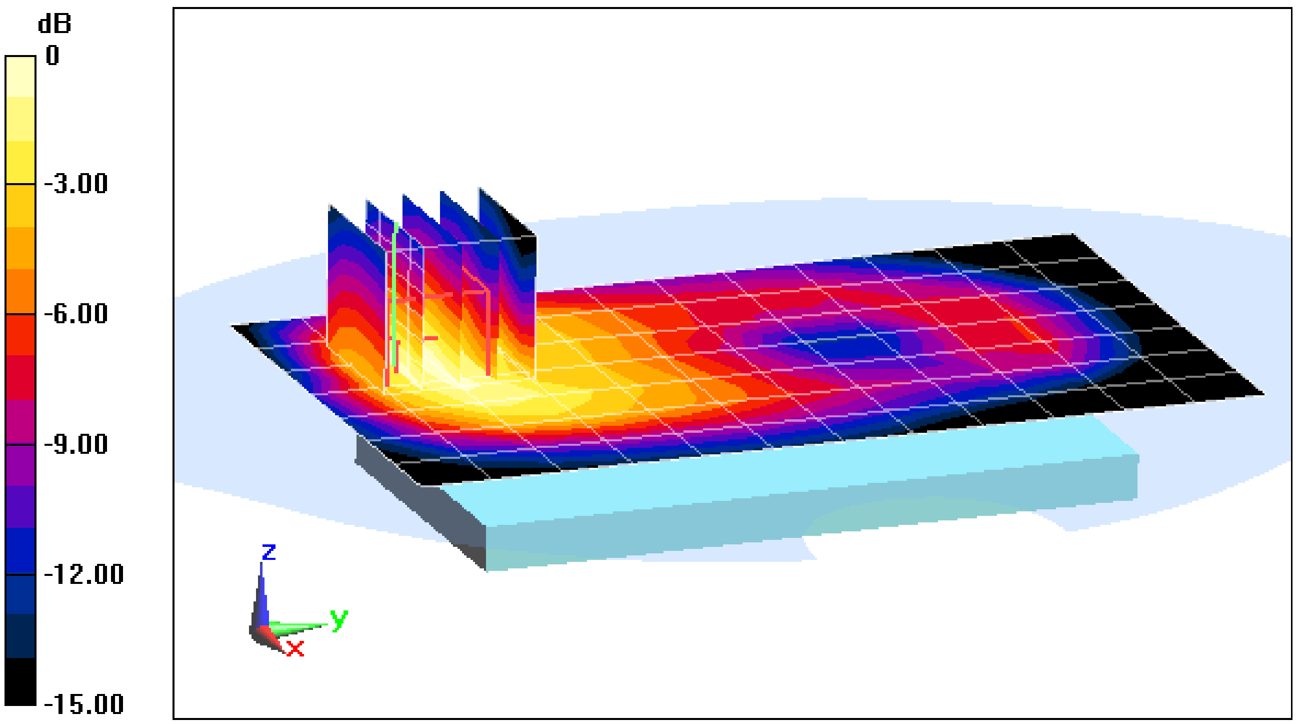
Communication System: GSM1900 GPRS; 2 Tx slots; Frequency: 1880 MHz; Duty Cycle: 1:4.15
Medium: 1900 Body, Medium parameters used:
f = 1880 MHz; σ = 1.511 S/m; ε_r = 54.125; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 23.2°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3287; ConvF(4.69, 4.69, 4.69); Calibrated: 11/15/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/13/2012
Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: GPRS 1900, Body SAR, Back Side, Mid.ch, 2 Tx Slots

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.313 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.06 W/kg
SAR(1 g) = 0.641 W/kg



0 dB = 0.650 W/kg = -1.87 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 2434-1

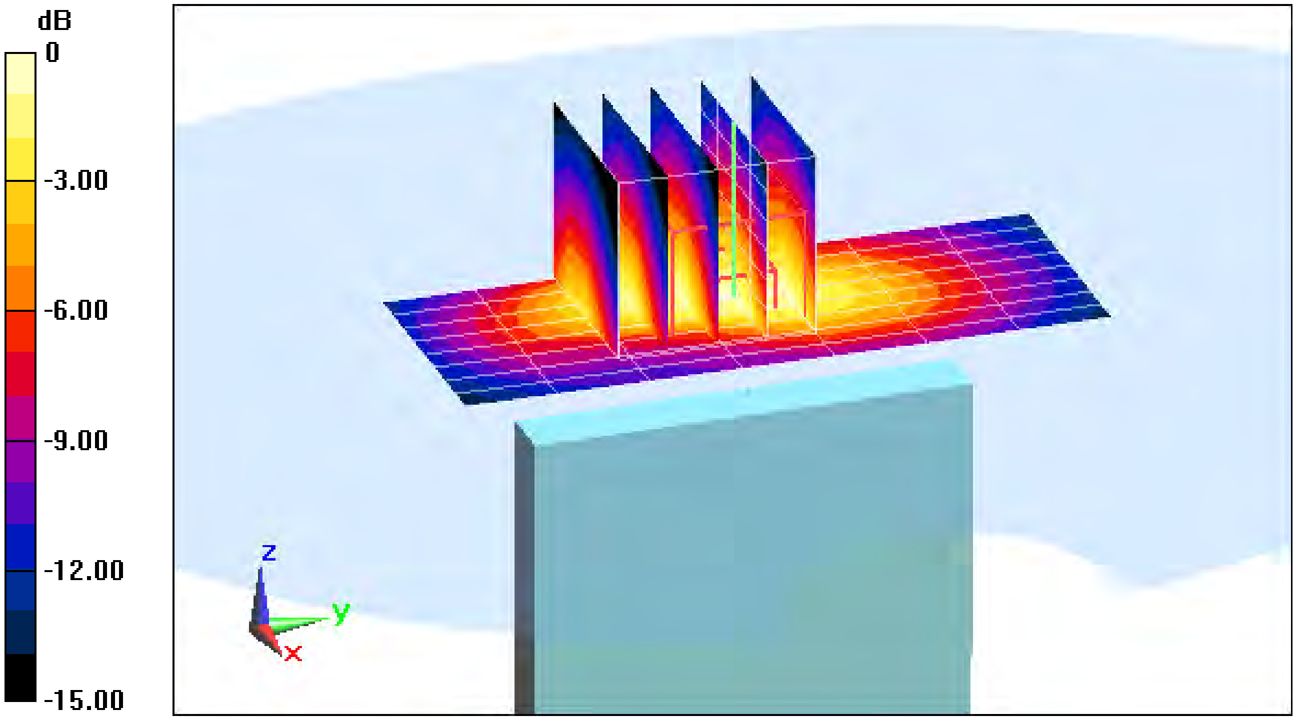
Communication System: GSM1900 GPRS; 2 Tx slots; Frequency: 1850.2 MHz; Duty Cycle: 1:4.15
Medium: 1900 Body, Medium parameters used (interpolated):
f = 1850.2 MHz; σ = 1.482 S/m; ε_r = 54.207; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 23.2°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3287; ConvF(4.69, 4.69, 4.69); Calibrated: 11/15/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/13/2012
Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: GPRS 1900, Body SAR, Bottom Edge, Low.ch, 2 Tx Slots

Area Scan (9x8x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.949 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 1.63 W/kg
SAR(1 g) = 1.01 W/kg



0 dB = 1.13 W/kg = 0.53 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 2434-1

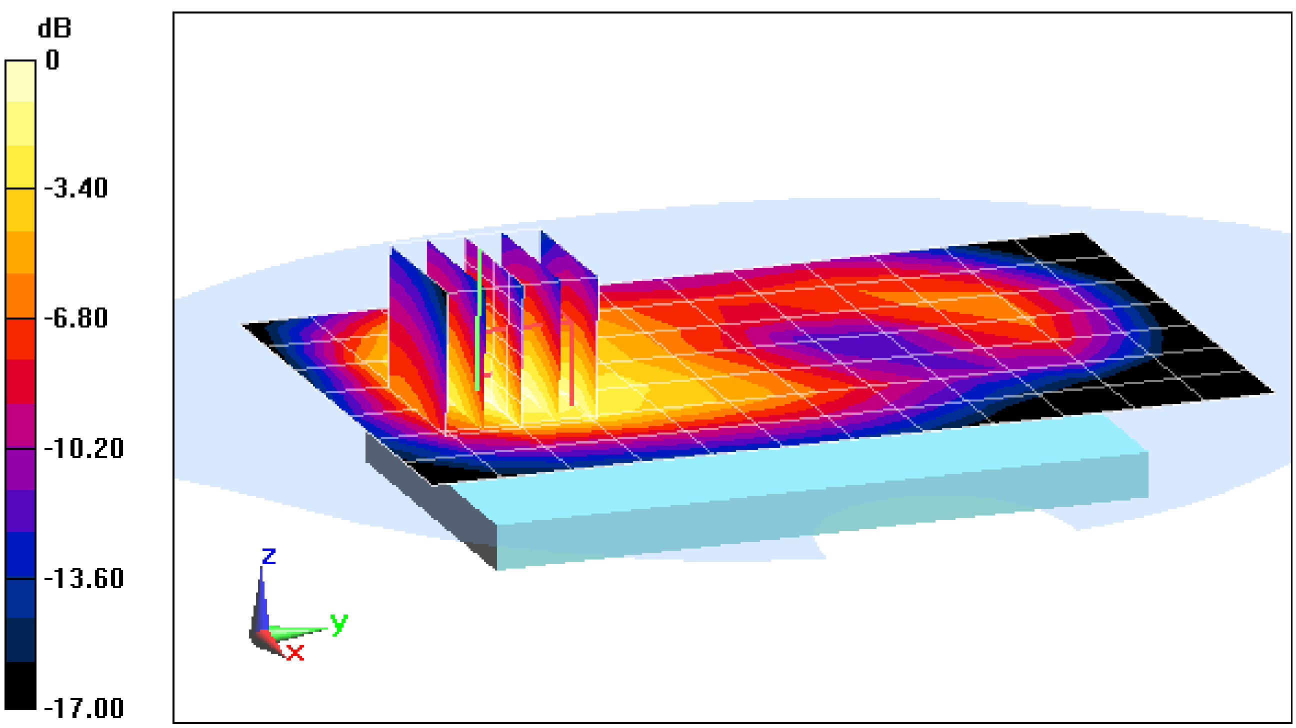
Communication System: UMTS1900; Frequency: 1852.4 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used (interpolated):
f = 1852.4 MHz; σ = 1.484 S/m; ε_r = 54.201; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 23.2°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3287; ConvF(4.69, 4.69, 4.69); Calibrated: 11/15/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/13/2012
Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: UMTS 1900, Body SAR, Back Side, Low.ch

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.124 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 1.49 W/kg
SAR(1 g) = 0.972 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 2434-1

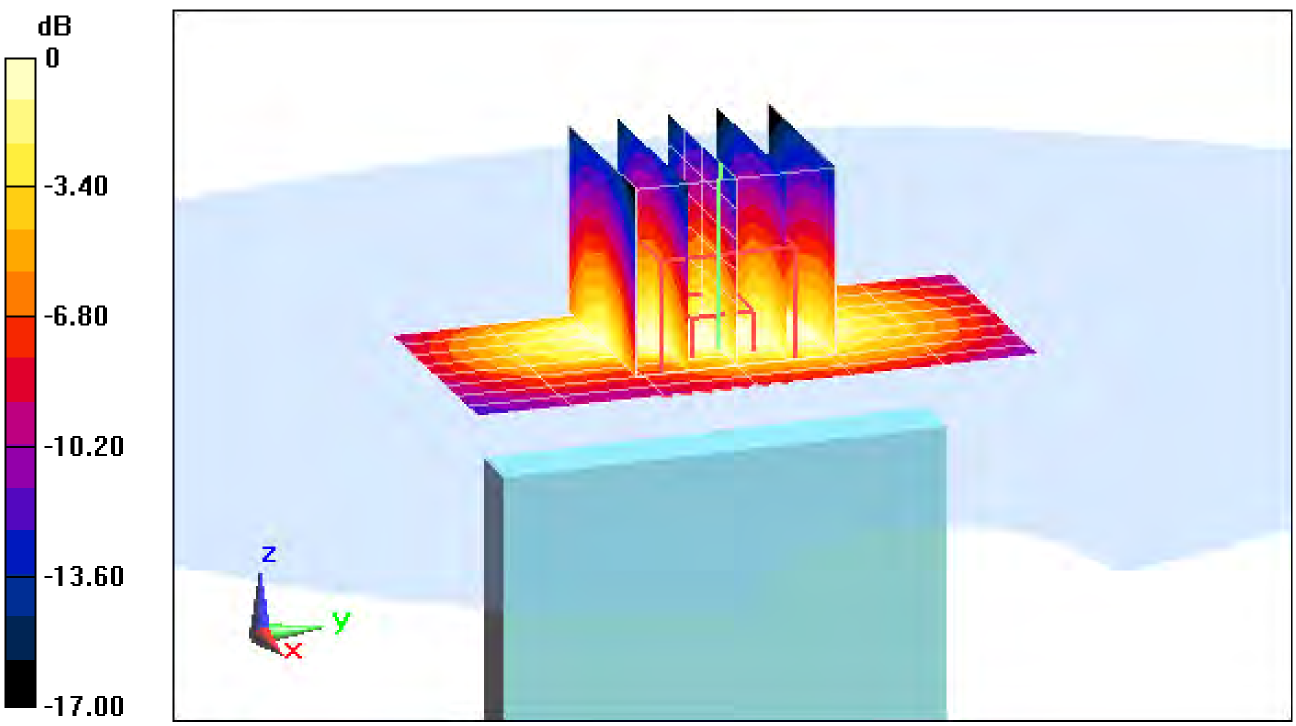
Communication System: UMTS1900; Frequency: 1852.4 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used (interpolated):
$f = 1852.4$ MHz; $\sigma = 1.47$ S/m; $\varepsilon_r = 52.744$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-15-2013; Ambient Temp: 23.5°C; Tissue Temp: 23.1°C

Probe: ES3DV3 - SN3287; ConvF(4.69, 4.69, 4.69); Calibrated: 11/15/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/13/2012
Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (9x7x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 29.394 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.93 W/kg
SAR(1 g) = 1.15 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 5830-1

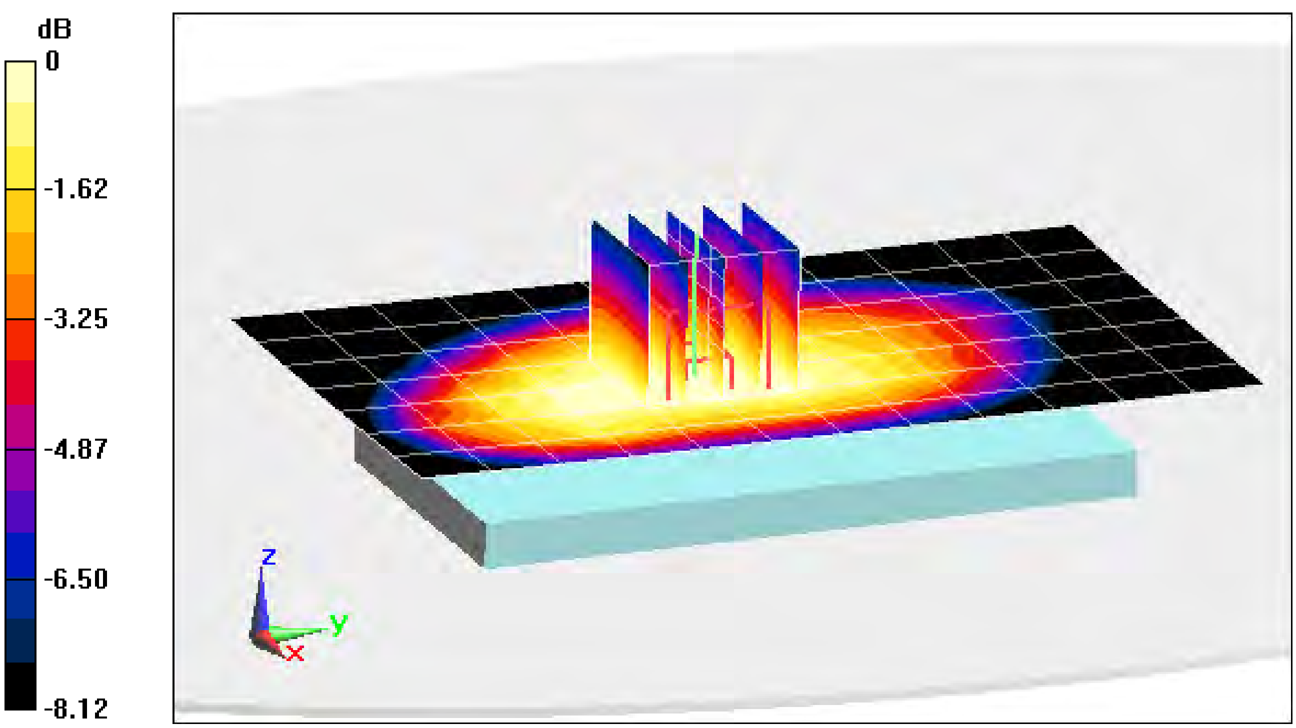
Communication System: LTE Band 17; Frequency: 710 MHz; Duty Cycle: 1:1
Medium: 750 Body, Medium parameters used:
f = 710 MHz; σ = 0.928 S/m; ε_r = 55.352; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-14-2013; Ambient Temp: 24.5°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3209; ConvF(6.38, 6.38, 6.38); 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 17, Body SAR, Back Side, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.773 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.344 W/kg
SAR(1 g) = 0.272 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 5830-1

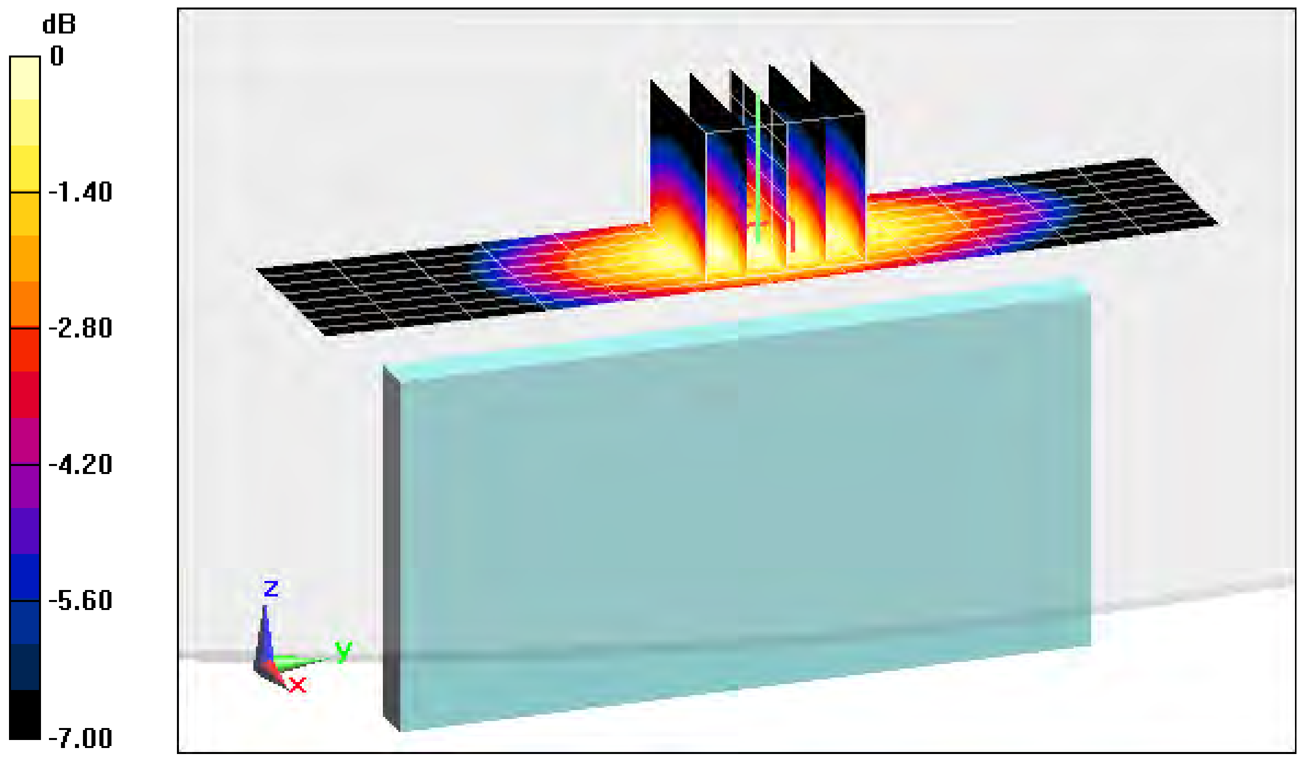
Communication System: LTE Band 17; Frequency: 710 MHz; Duty Cycle: 1:1
Medium: 750 Body, Medium parameters used:
f = 710 MHz; σ = 0.928 S/m; ε_r = 55.352; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-14-2013; Ambient Temp: 24.5°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3209; ConvF(6.38, 6.38, 6.38); 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 17, Body SAR, Left Edge, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

Area Scan (9x13x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.140 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.391 W/kg
SAR(1 g) = 0.281 W/kg



0 dB = 0.466 W/kg = -3.32 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 5830-1

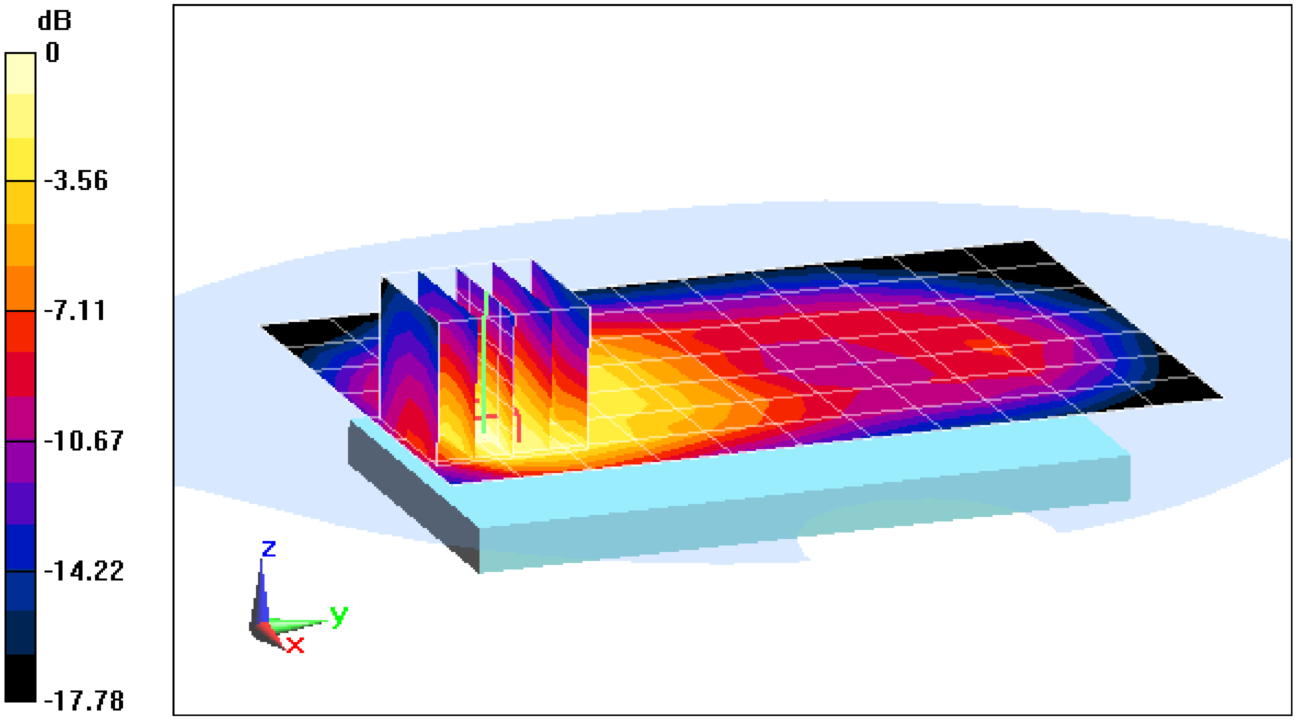
Communication System: LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Body, Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.502 S/m; ε_r = 52.425; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-11-2013; Ambient Temp: 23.9°C; Tissue Temp: 23.1°C

Probe: EX3DV4 - SN3920; ConvF(7.59, 7.59, 7.59); 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 4 (AWS), Body SAR, Back Side, Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 99 RB Offset

Area Scan (8x12x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.042 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 1.41 W/kg
SAR(1 g) = 0.810 W/kg



0 dB = 0.936 W/kg = -0.29 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 5830-1

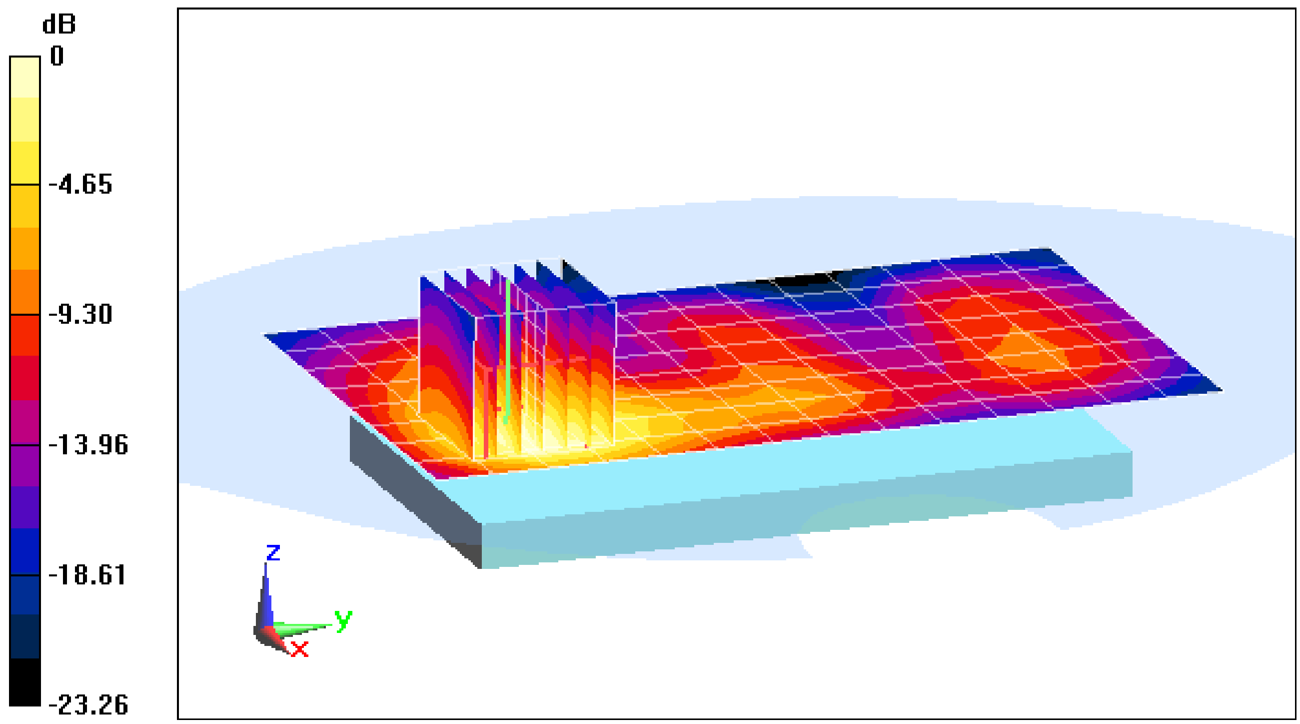
Communication System: LTE Band 7; Frequency: 2560 MHz; Duty Cycle: 1:1
Medium: 2600 Body, Medium parameters used (interpolated):
f = 2560 MHz; σ = 2.153 S/m; ε_r = 50.915; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-19-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.9°C

Probe: EX3DV4 - SN3920; ConvF(6.73, 6.73, 6.73); Calibrated: 2/27/2013;
Sensor-Surface: 3mm (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 7, Body SAR, Back side, High.ch,
20 MHz Bandwidth, QPSK, 1 RB, 49 RB Offset

Area Scan (9x15x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 24.531 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 2.19 W/kg
SAR(1 g) = 1.15 W/kg



0 dB = 1.29 W/kg = 1.11 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 9434-2

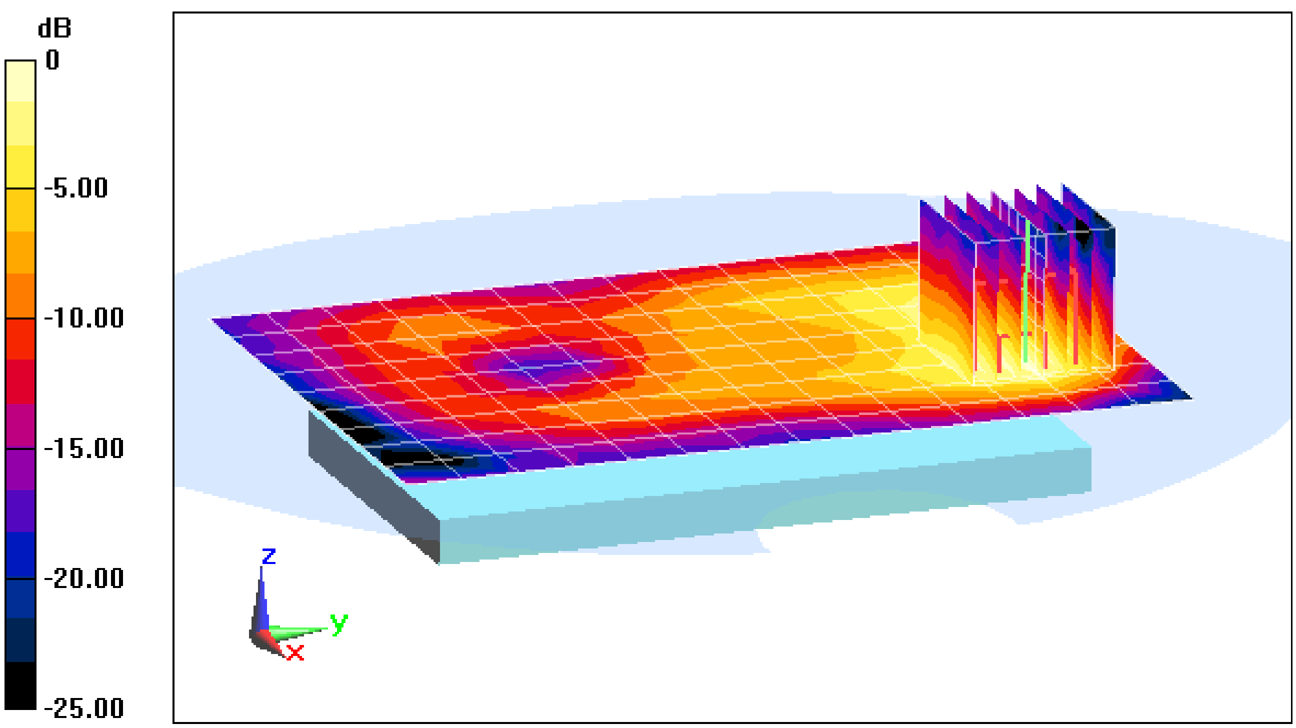
Communication System: IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: 2450 Body, Medium parameters used (interpolated):
$f = 2437$ MHz; $\sigma = 2.013$ S/m; $\varepsilon_r = 50.528$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-02-2013; Ambient Temp: 23.5°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3287; ConvF(4.29, 4.29, 4.29); Calibrated: 11/15/2012;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/13/2012
Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626
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 = 7.326 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 0.232 W/kg
SAR(1 g) = 0.100 W/kg



0 dB = 0.128 W/kg = -8.93 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 9434-2

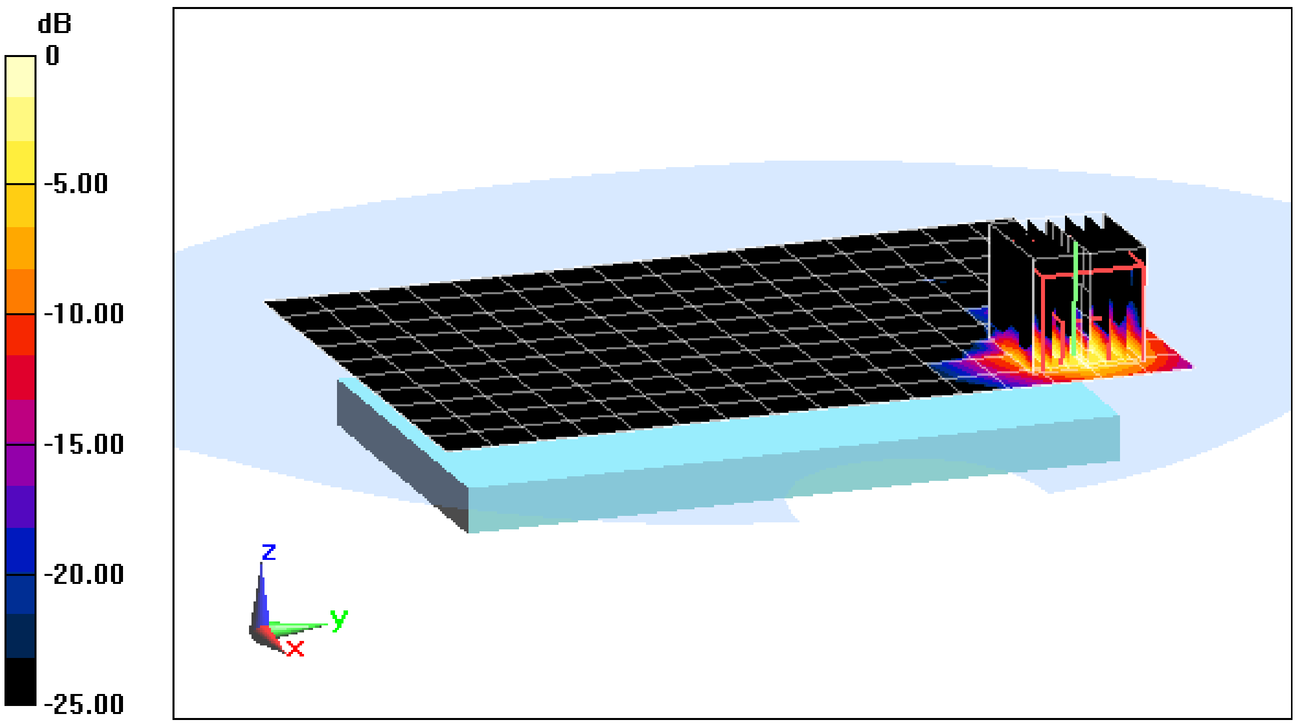
Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5805 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5805 MHz; σ = 6.229 S/m; ε_r = 46.011; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.4°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 161, 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 = 4.563 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.571 W/kg
SAR(1 g) = 0.124 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFD803; Type: Portable Handset; Serial: 9434-2

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5500 MHz; σ = 5.721 S/m; ε_r = 46.329; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

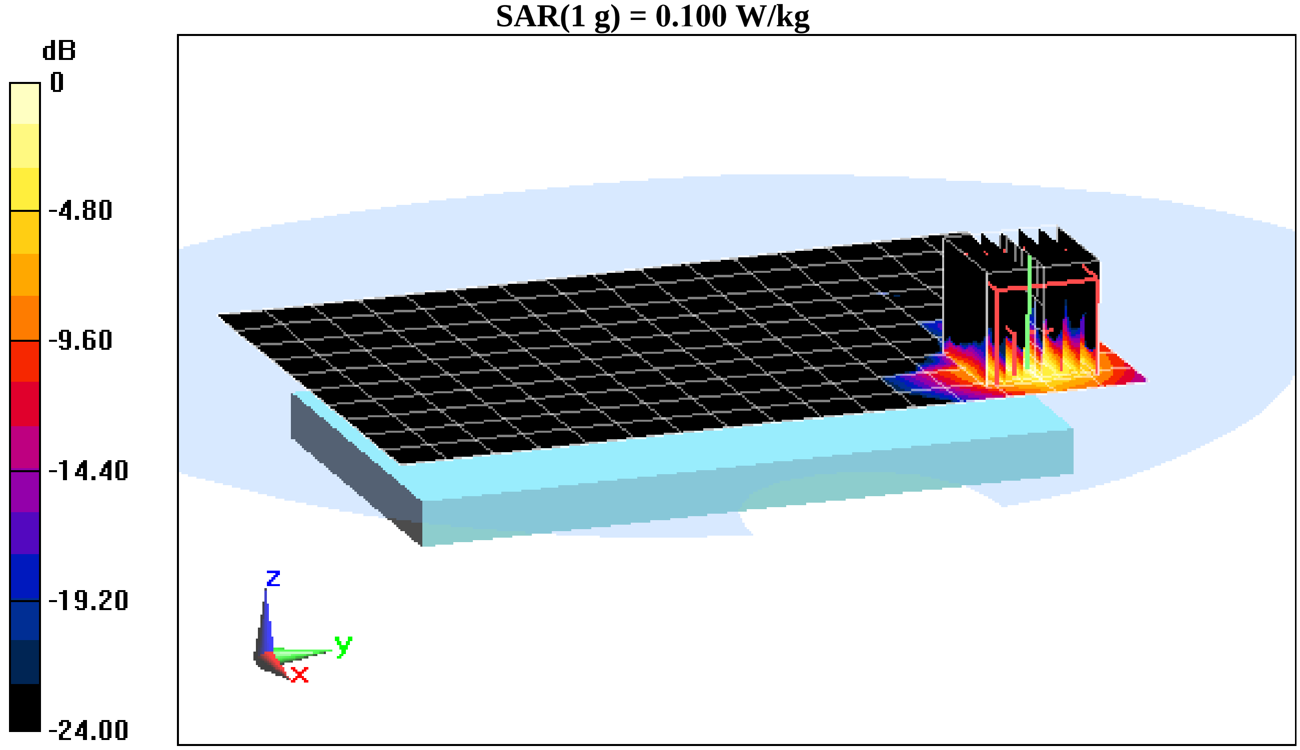
Test Date: 07-08-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.2°C

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

Mode: IEEE 802.11a, 5.5 GHz, Body SAR, Ch 100, 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 = 4.291 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 0.457 W/kg

SAR(1 g) = 0.100 W/kg



0 dB = 0.276 W/kg = -5.59 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 MHz; $\sigma = 0.923$ S/m; $\varepsilon_r = 40.744$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-17-2013; Ambient Temp: 21.0°C; Tissue Temp: 21.6°C

Probe: ES3DV2 - SN3022; ConvF(6.3, 6.3, 6.3); Calibrated: 8/28/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

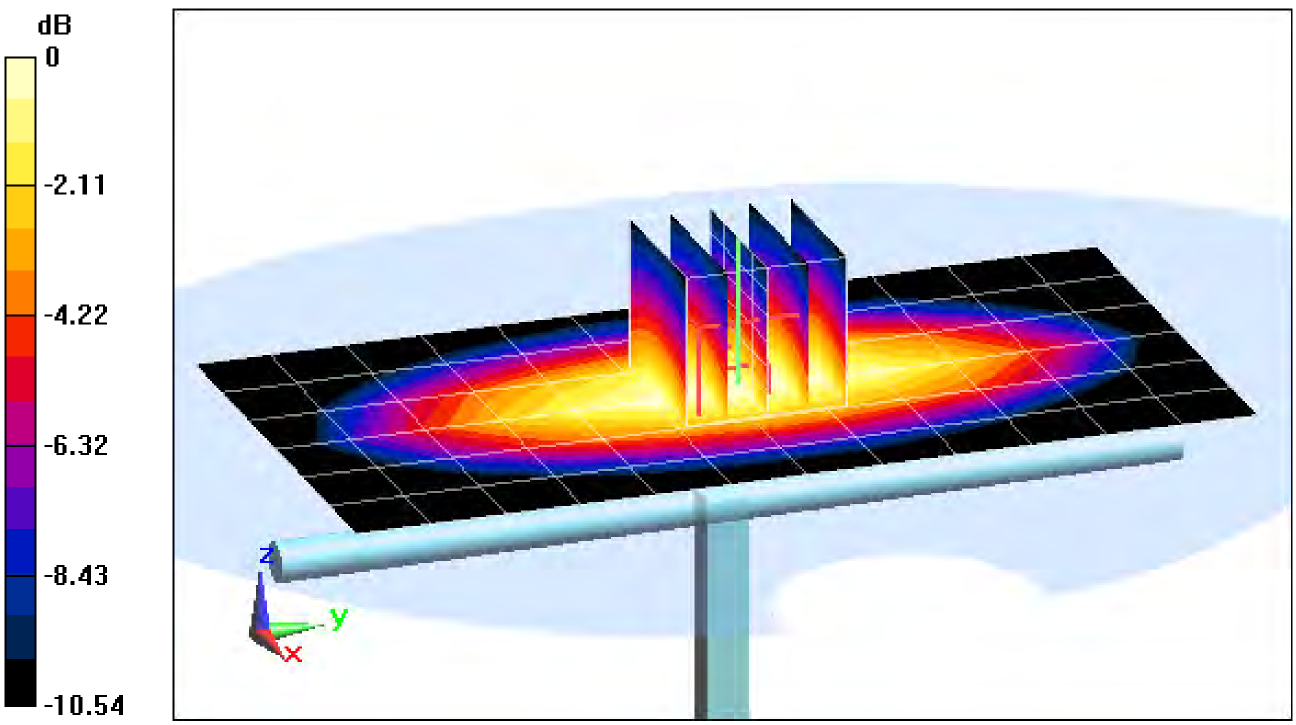
750 MHz System Verification

Area Scan (7x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.17 W/kg

SAR(1 g) = 0.807 W/kg

Deviation = -5.06%



0 dB = 0.871 W/kg = -0.60 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

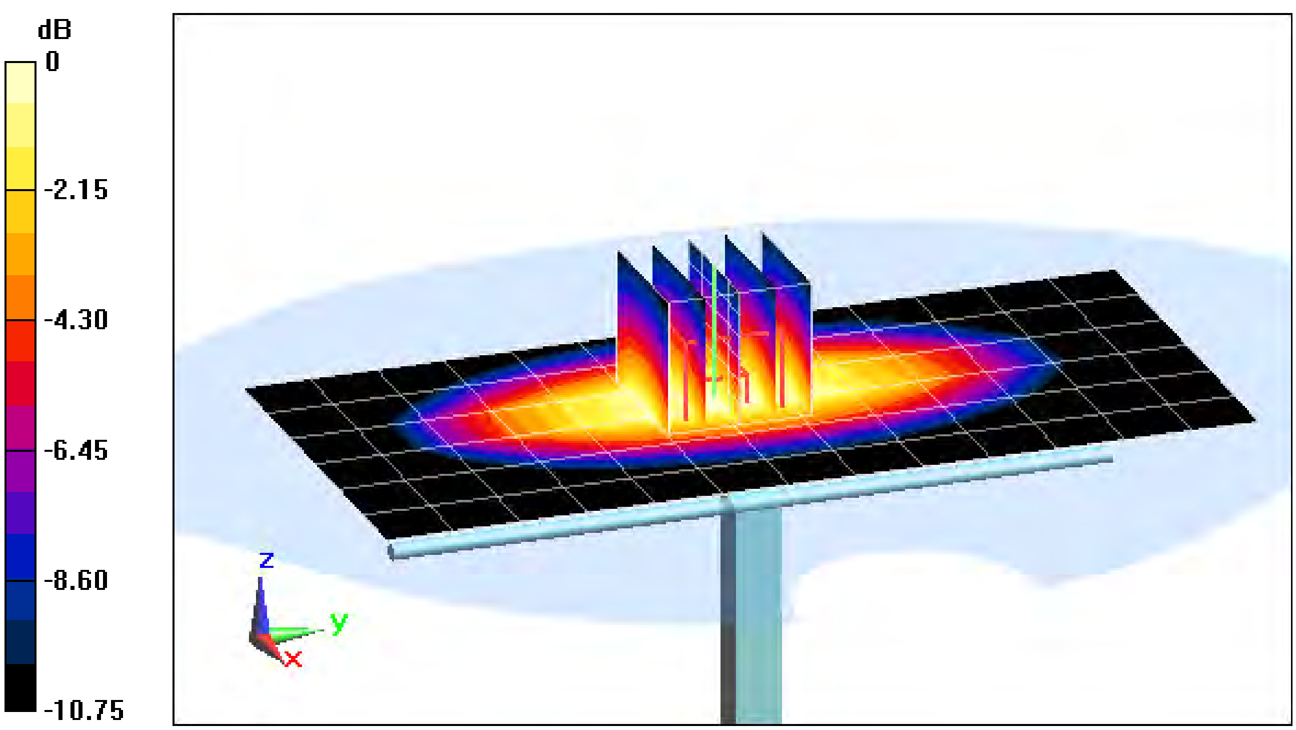
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Head, Medium parameters used:
f = 835 MHz; σ = 0.911 S/m; ε_r = 40.322; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-17-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.5°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 V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 1.48 W/kg
SAR(1 g) = 0.975 W/kg
Deviation = 0.93%



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1051

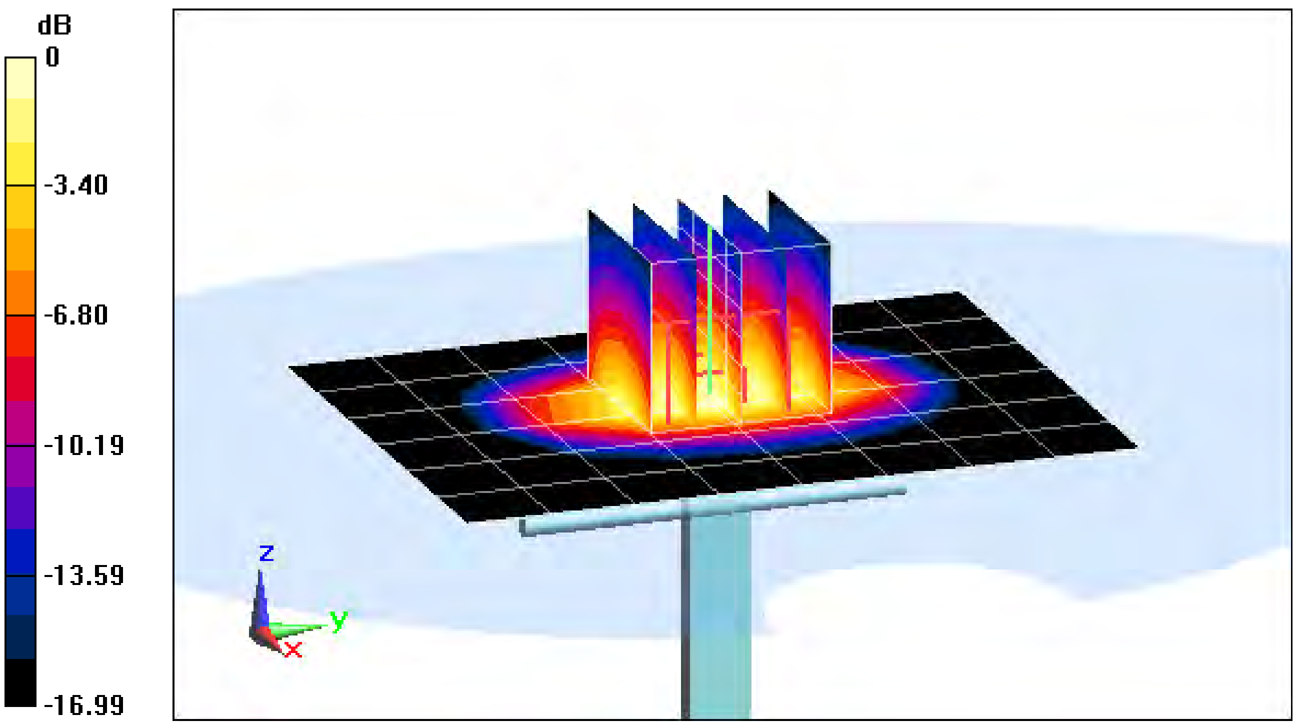
Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Head, Medium parameters used:
f = 1750 MHz; σ = 1.367 S/m; ε_r = 39.046; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-11-2013; Ambient Temp: 23.8°C; Tissue Temp: 23.2°C

Probe: EX3DV4 - SN3920; ConvF(7.97, 7.97, 7.97); 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)

1750 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 6.78 W/kg
SAR(1 g) = 3.74 W/kg
Deviation = 2.47%



0 dB = 4.17 W/kg = 6.20 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

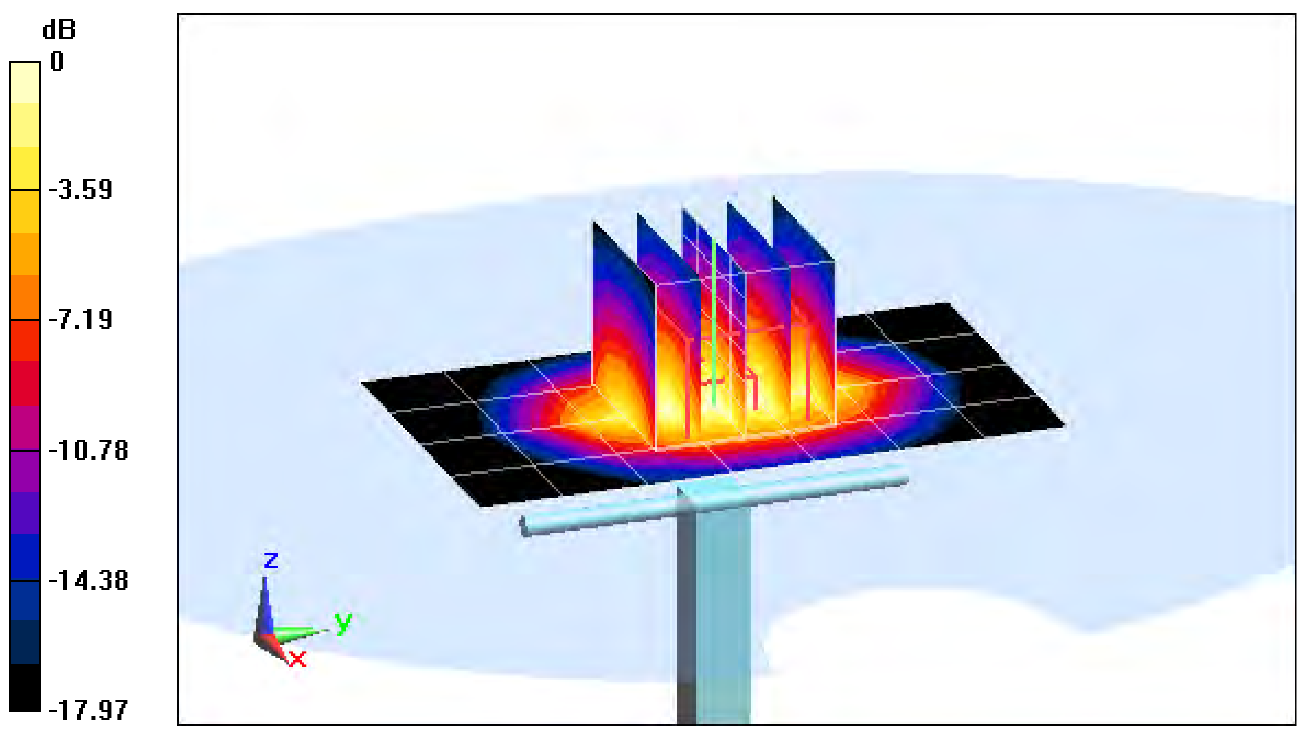
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Head, Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.387 S/m; ε_r = 39.918; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-15-2013; Ambient Temp: 22.1°C; Tissue Temp: 22.5°C

Probe: ES3DV2 - SN3022; ConvF(4.86, 4.86, 4.86); Calibrated: 8/28/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1403
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (5x8x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 7.20 W/kg
SAR(1 g) = 3.95 W/kg
Deviation = 0.25%



0 dB = 4.41 W/kg = 6.44 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

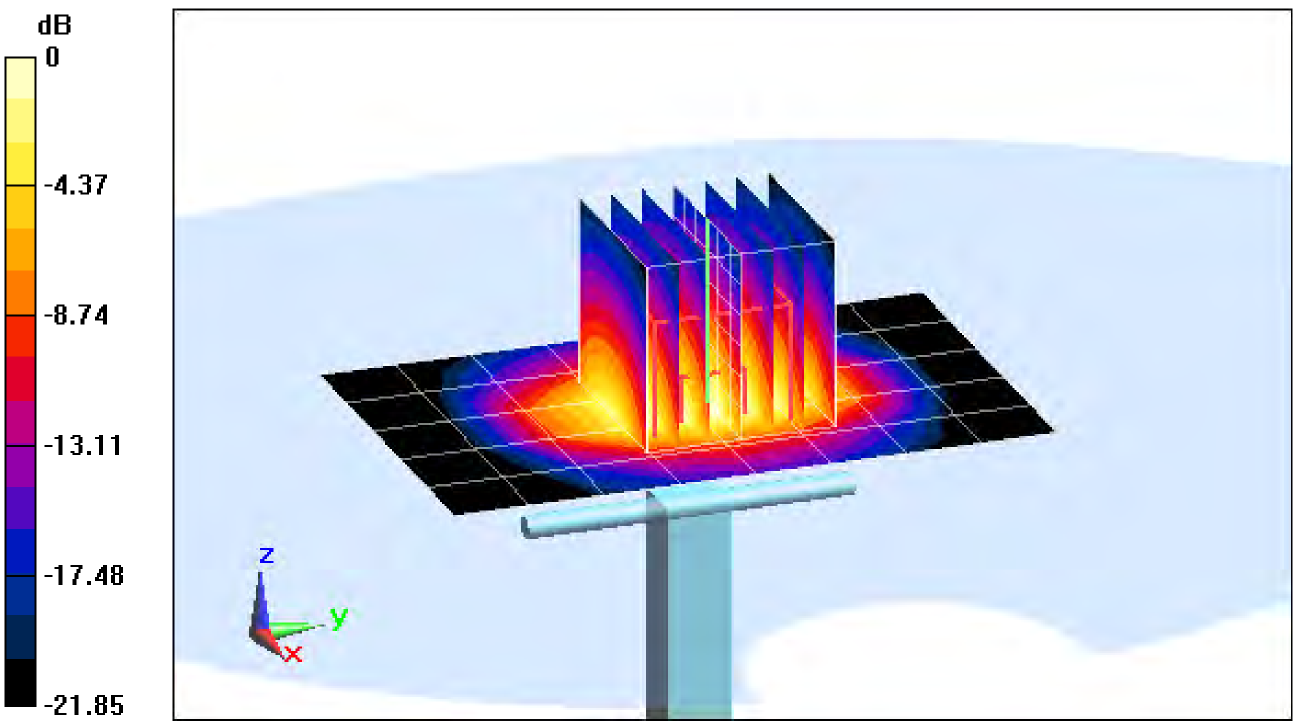
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Head, Medium parameters used:
f = 2450 MHz; σ = 1.87 S/m; ε_r = 38.283; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-11-2013; Ambient Temp: 24.4°C; Tissue Temp: 24.2°C

Probe: ES3DV2 - SN3022; ConvF(4.23, 4.23, 4.23); Calibrated: 8/28/2012;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1403
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

2450 MHz System Verification

Area Scan (6x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 10.7 W/kg
SAR(1 g) = 5.16 W/kg
Deviation = -2.09%



0 dB = 6.69 W/kg = 8.25 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

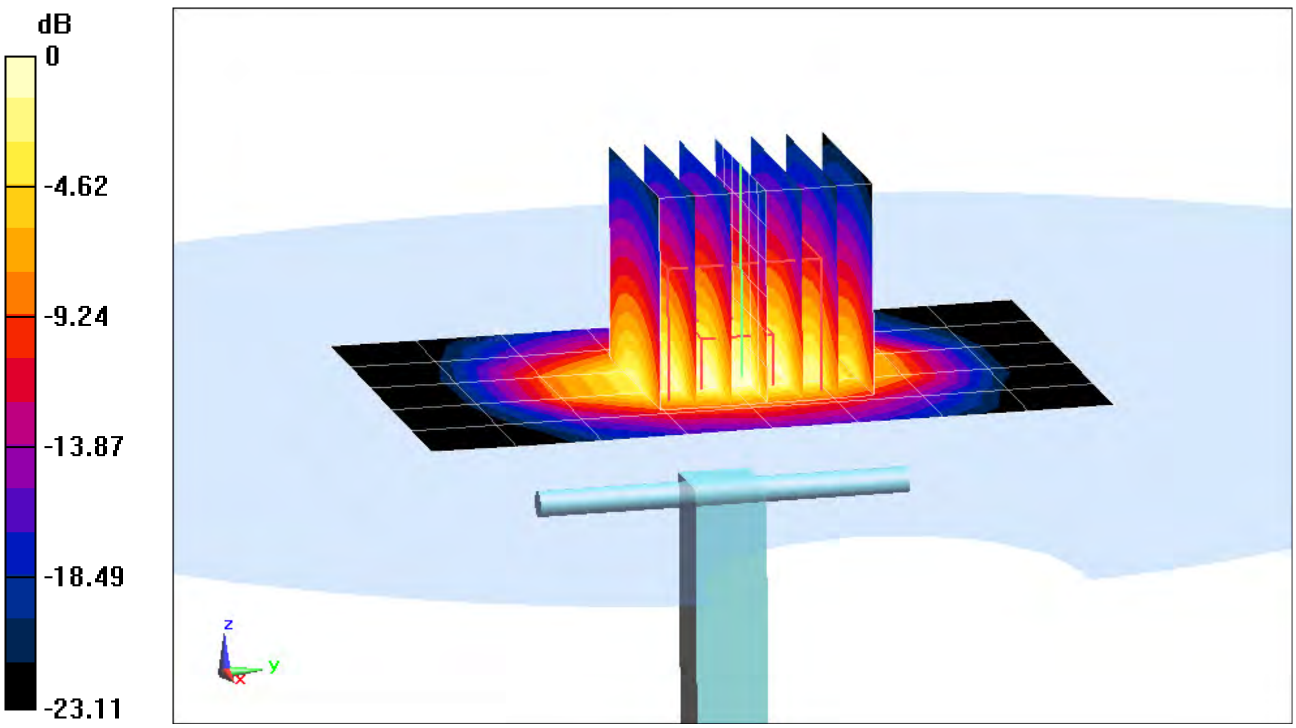
Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used:
f = 2450 MHz; $\sigma = 1.846$ S/m; $\varepsilon_r = 38.495$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-18-2013; Ambient Temp: 23.0°C; Tissue Temp: 23.5°C

Probe: ES3DV2 - SN3022; ConvF(4.23, 4.23, 4.23); Calibrated: 8/28/2012;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1403
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) = 12.1 W/kg
SAR(1 g) = 5.62 W/kg
Deviation = 6.64%



0 dB = 7.31 W/kg = 8.64 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1004

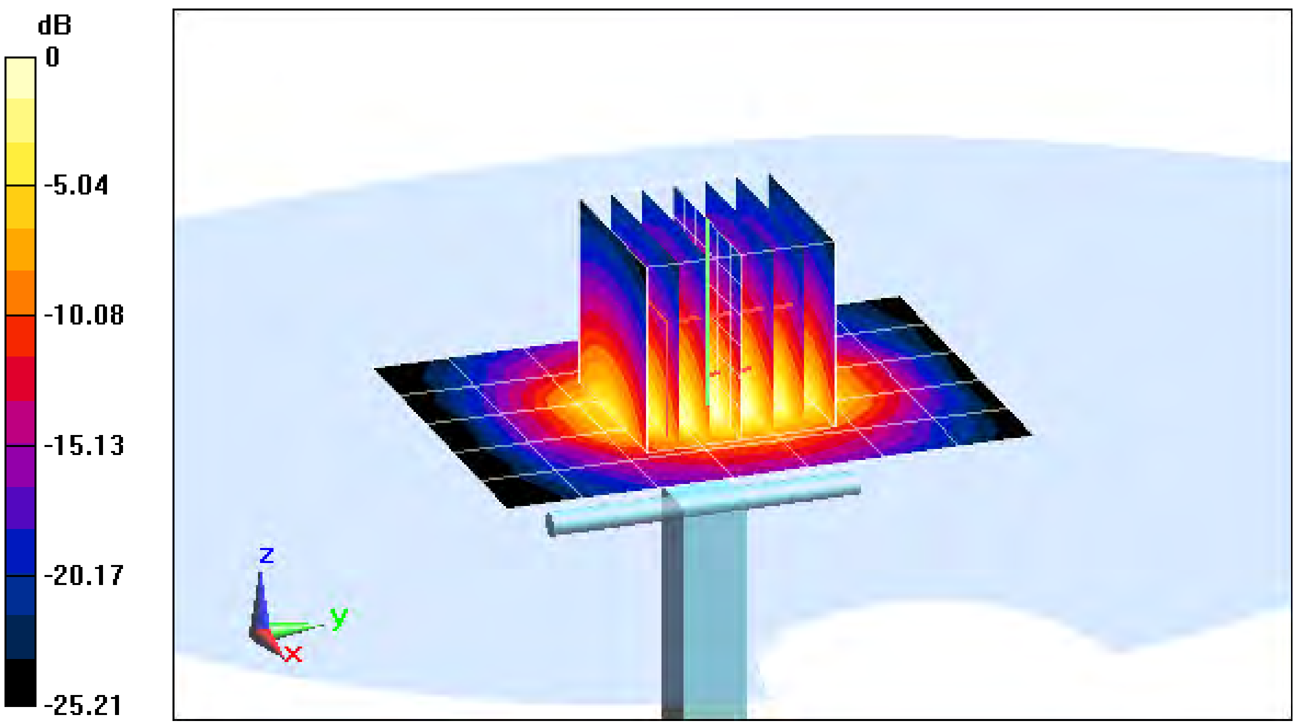
Communication System: CW; Frequency: 2600 MHz; Duty Cycle: 1:1
Medium: 2600 Head, Medium parameters used:
f = 2600 MHz; σ = 2.018 S/m; ε_r = 37.879; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-18-2013; Ambient Temp: 23.0°C; Tissue Temp: 23.5°C

Probe: ES3DV2 - SN3022; ConvF(4.1, 4.1, 4.1); Calibrated: 8/28/2012;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1403
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

2600 MHz System Verification

Area Scan (6x8x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 14.3 W/kg
SAR(1 g) = 6.22 W/kg
Deviation = 6.87%



0 dB = 8.26 W/kg = 9.17 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

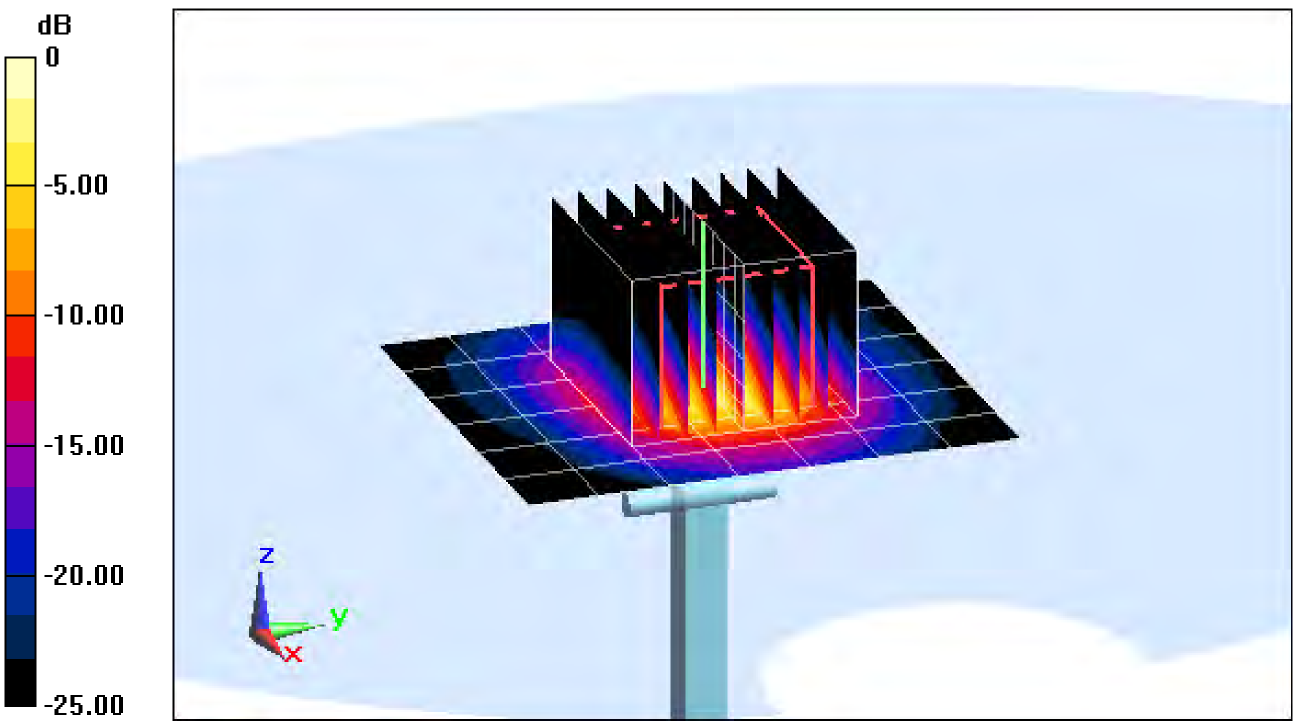
Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5200 MHz; σ = 4.468 S/m; ε_r = 35.069; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.1°C

Probe: EX3DV4 - SN3920; ConvF(4.87, 4.87, 4.87); 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 (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 = 16.0 dBm (40 mW)
Peak SAR (extrapolated) = 12.1 W/kg
SAR(1 g) = 3.03 W/kg
Deviation = -0.33%



0 dB = 7.55 W/kg = 8.78 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

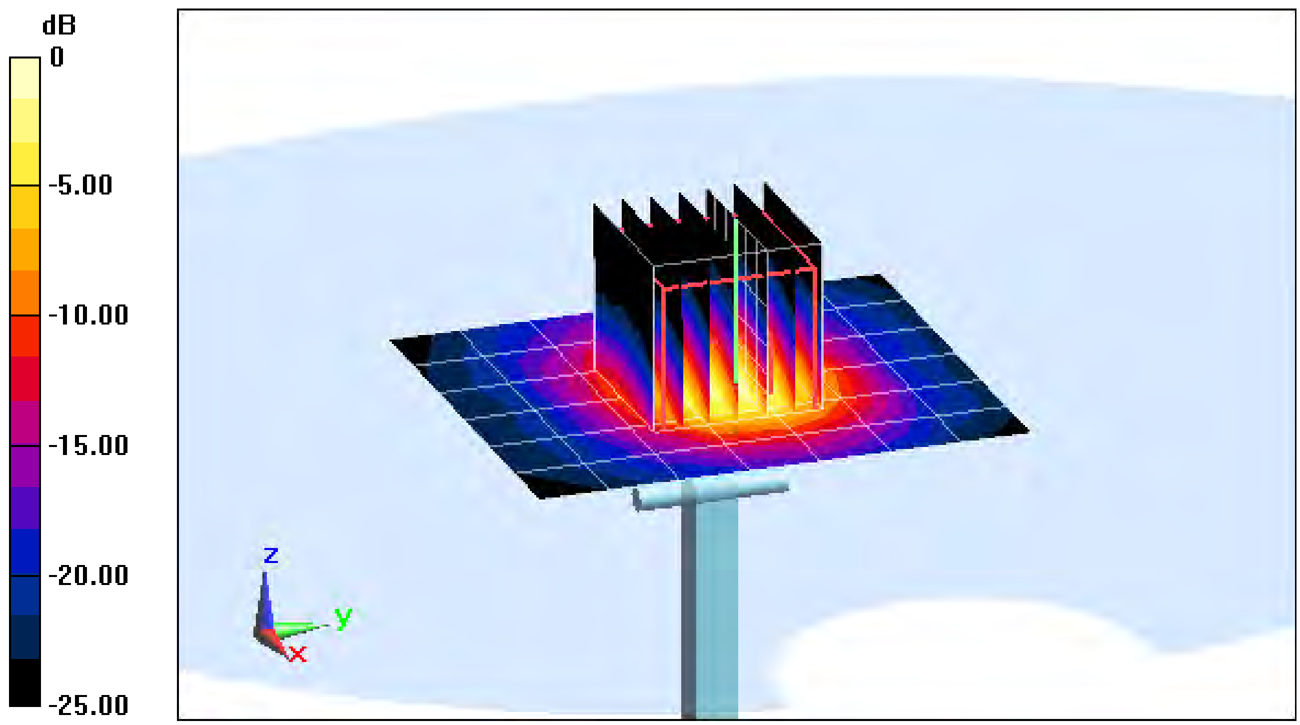
Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5300 MHz; σ = 4.565 S/m; ε_r = 34.928; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.1°C

Probe: EX3DV4 - SN3920; ConvF(4.73, 4.73, 4.73); 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 (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 16.0 dBm (40 mW)
Peak SAR (extrapolated) = 12.0 W/kg
SAR(1 g) = 2.97 W/kg
Deviation = -5.65%



0 dB = 5.86 W/kg = 7.68 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

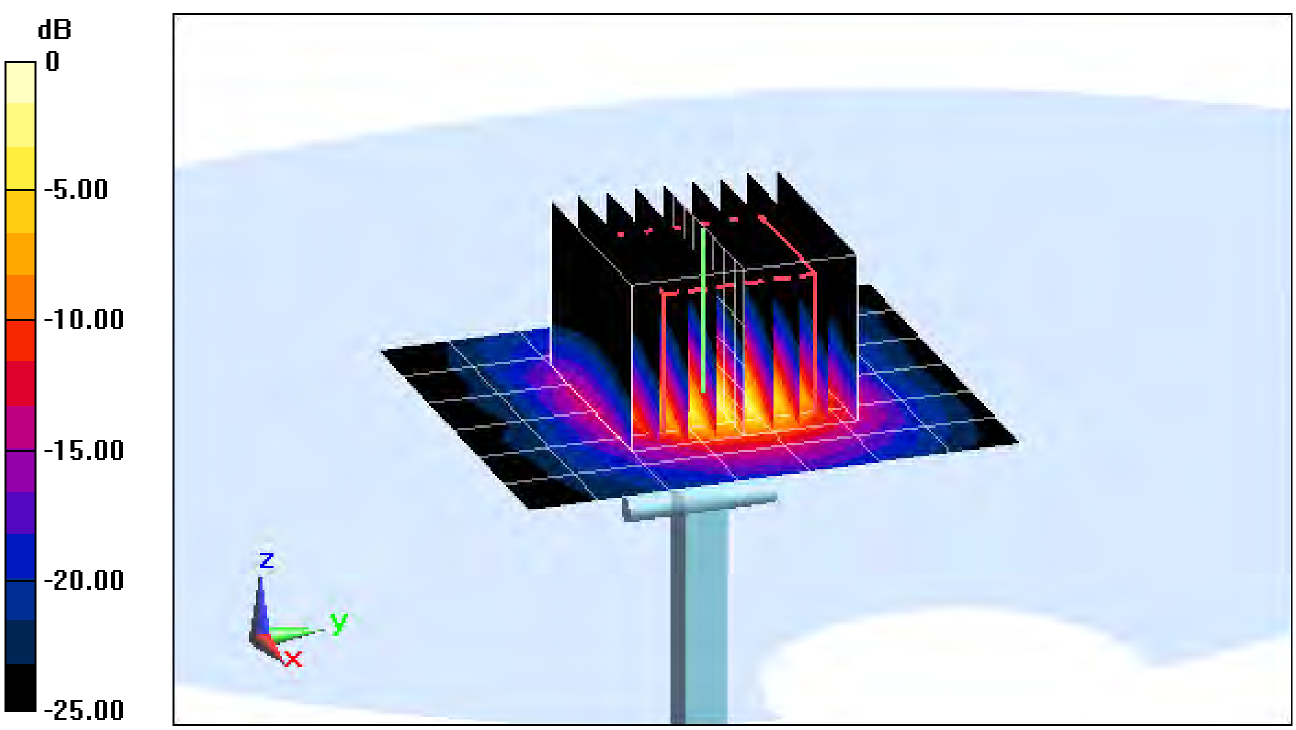
Communication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5500 MHz; σ = 4.76 S/m; ε_r = 34.63; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.2°C

Probe: EX3DV4 - SN3920; ConvF(4.52, 4.52, 4.52); 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 (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 = 16.0 dBm (40 mW)
Peak SAR (extrapolated) = 12.2 W/kg
SAR(1 g) = 2.98 W/kg
Deviation = -6.99%



0 dB = 7.54 W/kg = 8.77 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

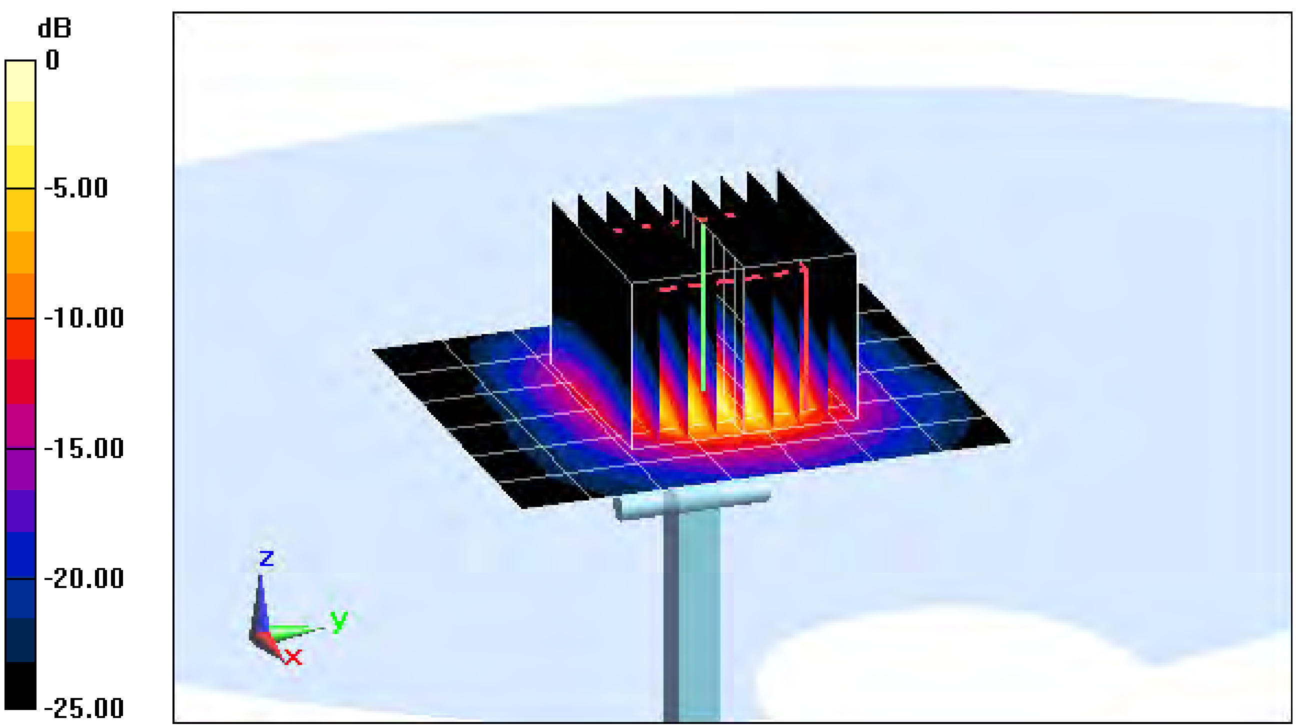
Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5800 MHz; σ = 5.075 S/m; ε_r = 34.216; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.2°C

Probe: EX3DV4 - SN3920; ConvF(4.02, 4.02, 4.02); 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 (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 = 16.0 dBm (40 mW)
Peak SAR (extrapolated) = 12.5 W/kg
SAR(1 g) = 2.98 W/kg
Deviation = -0.53%



0 dB = 7.63 W/kg = 8.83 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

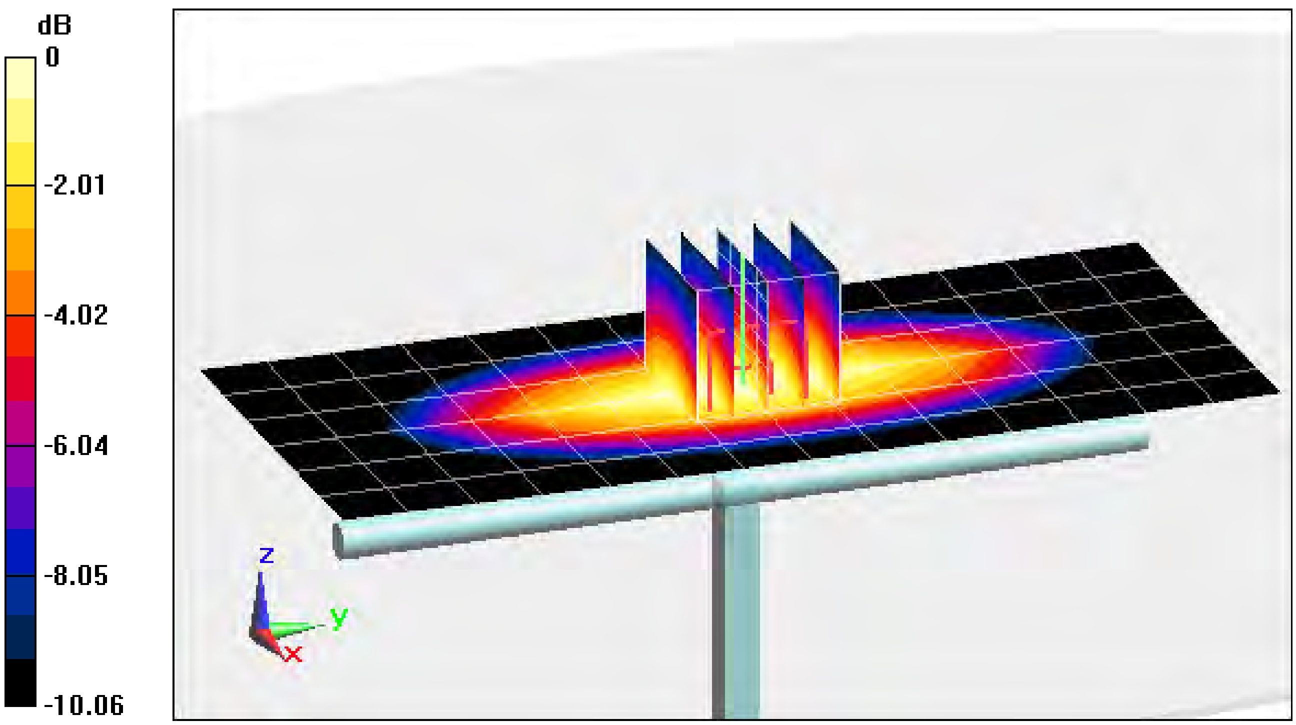
Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium: 750 Body, Medium parameters used (interpolated):
f = 750 MHz; σ = 0.965 S/m; ε_r = 54.932; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-14-2013; Ambient Temp: 24.5°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3209; ConvF(6.38, 6.38, 6.38); 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)

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) = 0.848 W/kg
Deviation = -3.96%



0 dB = 0.914 W/kg = -0.39 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

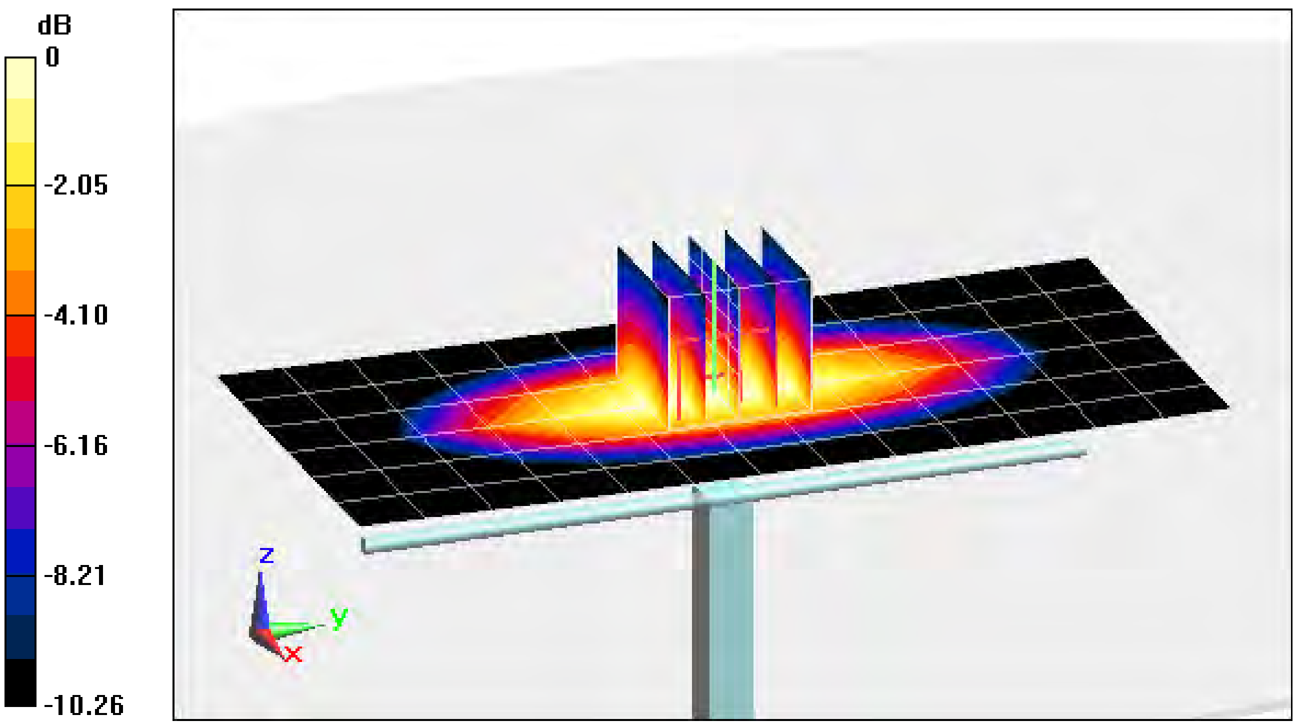
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Body, Medium parameters used:
f = 835 MHz; σ = 1.007 S/m; ε_r = 55.598; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-11-2013; Ambient Temp: 24.5°C; Tissue Temp: 22.9°C

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

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 1.40 W/kg
SAR(1 g) = 0.964 W/kg
Deviation = 2.99%



0 dB = 1.04 W/kg = 0.17 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

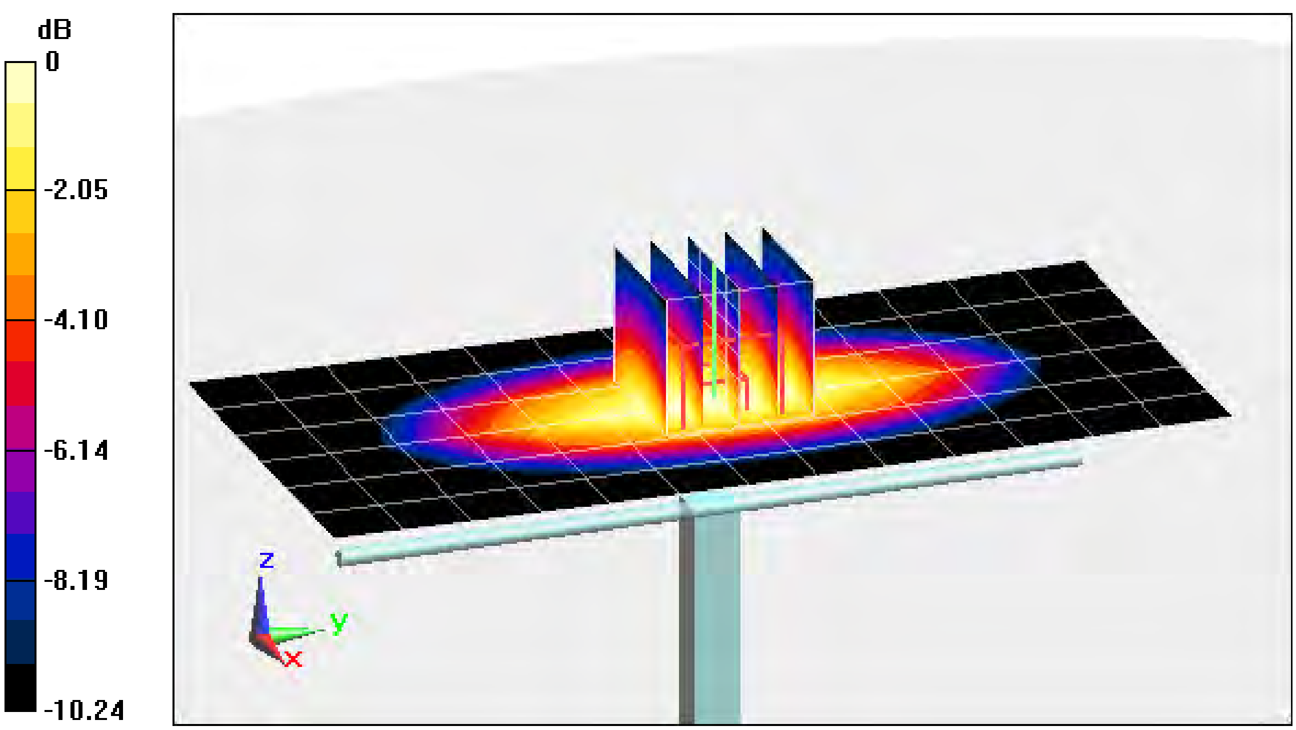
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Body, Medium parameters used:
f = 835 MHz; $\sigma = 0.998$ S/m; $\varepsilon_r = 54.368$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-19-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.5°C

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

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 1.41 W/kg
SAR(1 g) = 0.974 W/kg
Deviation = 1.67%



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1051

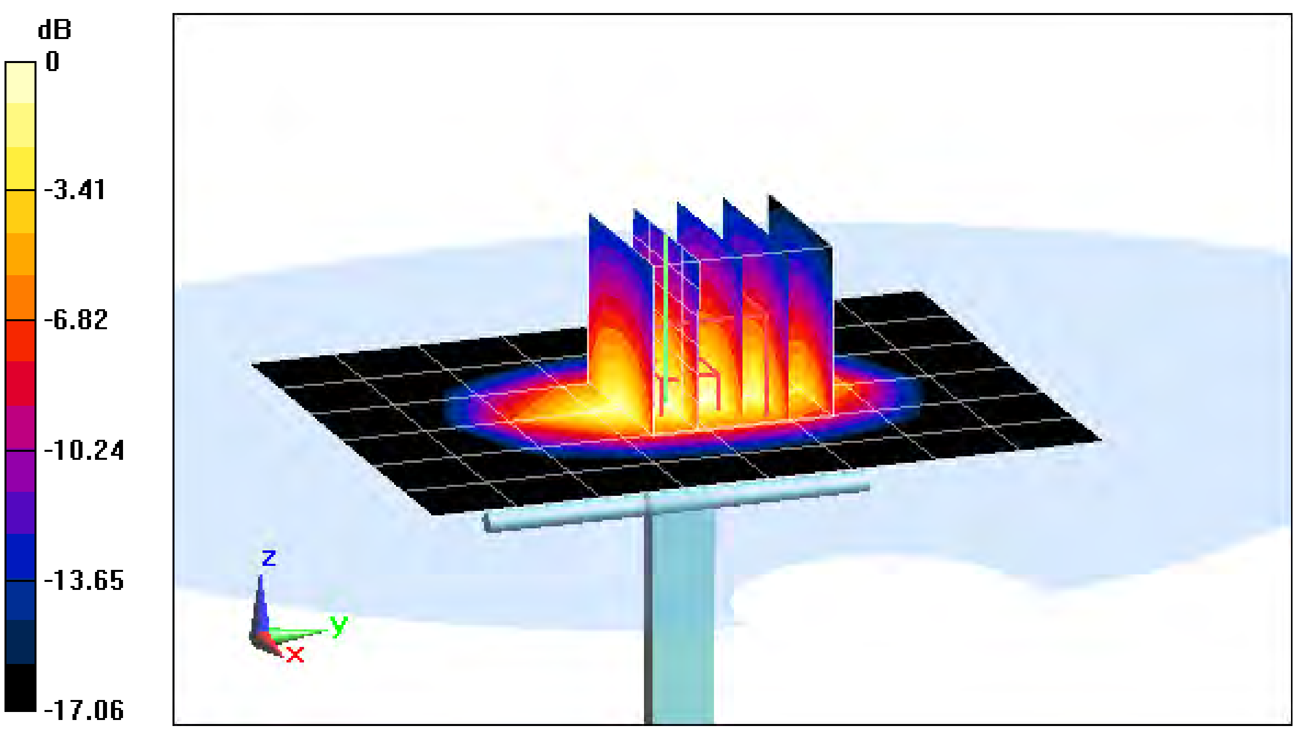
Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Body, Medium parameters used:
f = 1750 MHz; σ = 1.522 S/m; ε_r = 52.353; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-11-2013; Ambient Temp: 23.9°C; Tissue Temp: 23.1°C

Probe: EX3DV4 - SN3920; ConvF(7.59, 7.59, 7.59); 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)

1750 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 6.95 W/kg
SAR(1 g) = 3.89 W/kg
Deviation = 2.91%



0 dB = 4.31 W/kg = 6.34 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

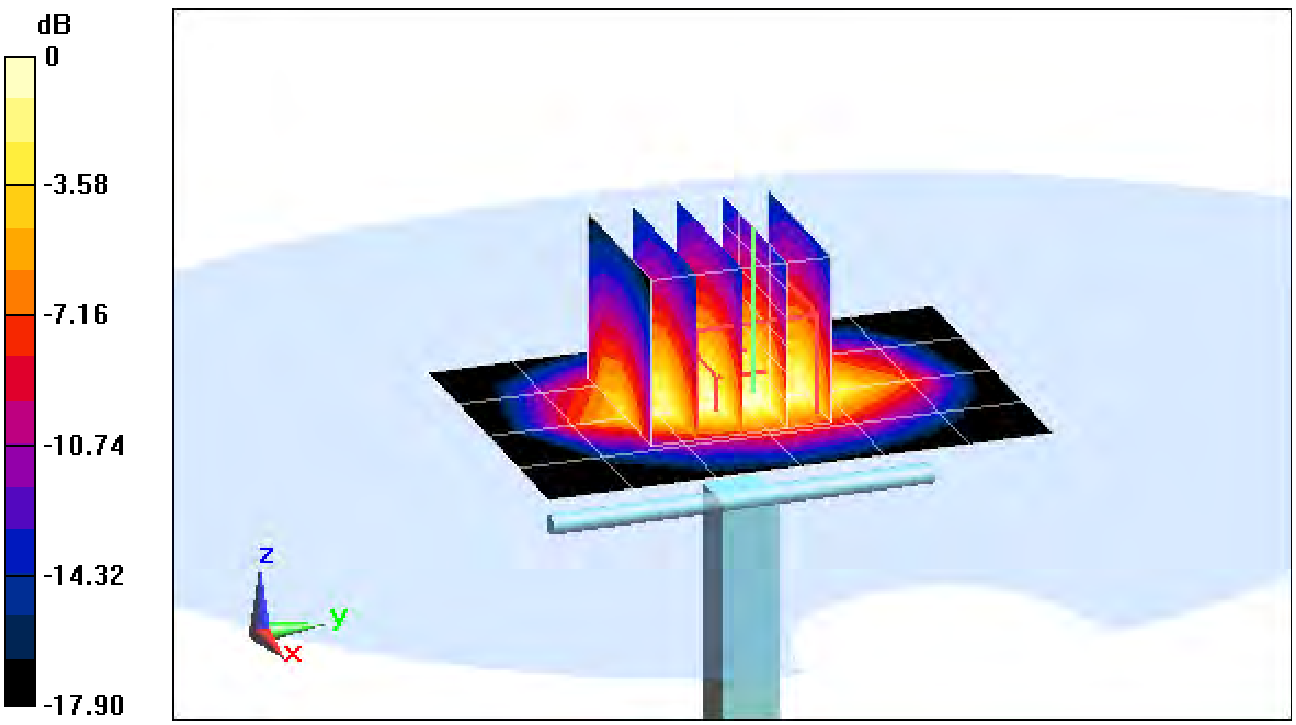
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.539 S/m; ε_r = 54.063; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 23.2°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3287; ConvF(4.69, 4.69, 4.69); Calibrated: 11/15/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/13/2012
Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 7.53 W/kg
SAR(1 g) = 4.25 W/kg
Deviation = 5.46%



0 dB = 4.66 W/kg = 6.68 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

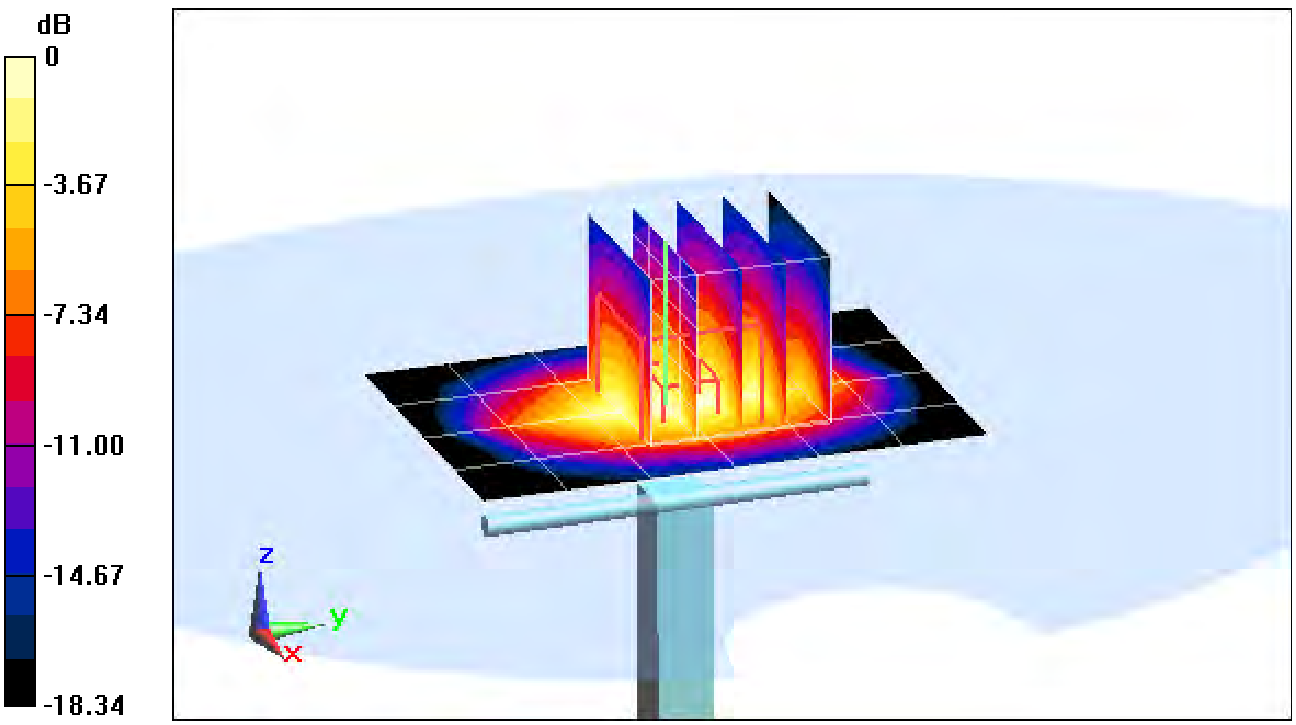
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used (interpolated):
$f = 1900$ MHz; $\sigma = 1.532$ S/m; $\varepsilon_r = 52.664$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-15-2013; Ambient Temp: 23.5°C; Tissue Temp: 23.1°C

Probe: ES3DV3 - SN3287; ConvF(4.69, 4.69, 4.69); Calibrated: 11/15/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/13/2012
Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 7.09 W/kg
SAR(1 g) = 3.99 W/kg
Deviation = -0.99%



0 dB = 4.47 W/kg = 6.50 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

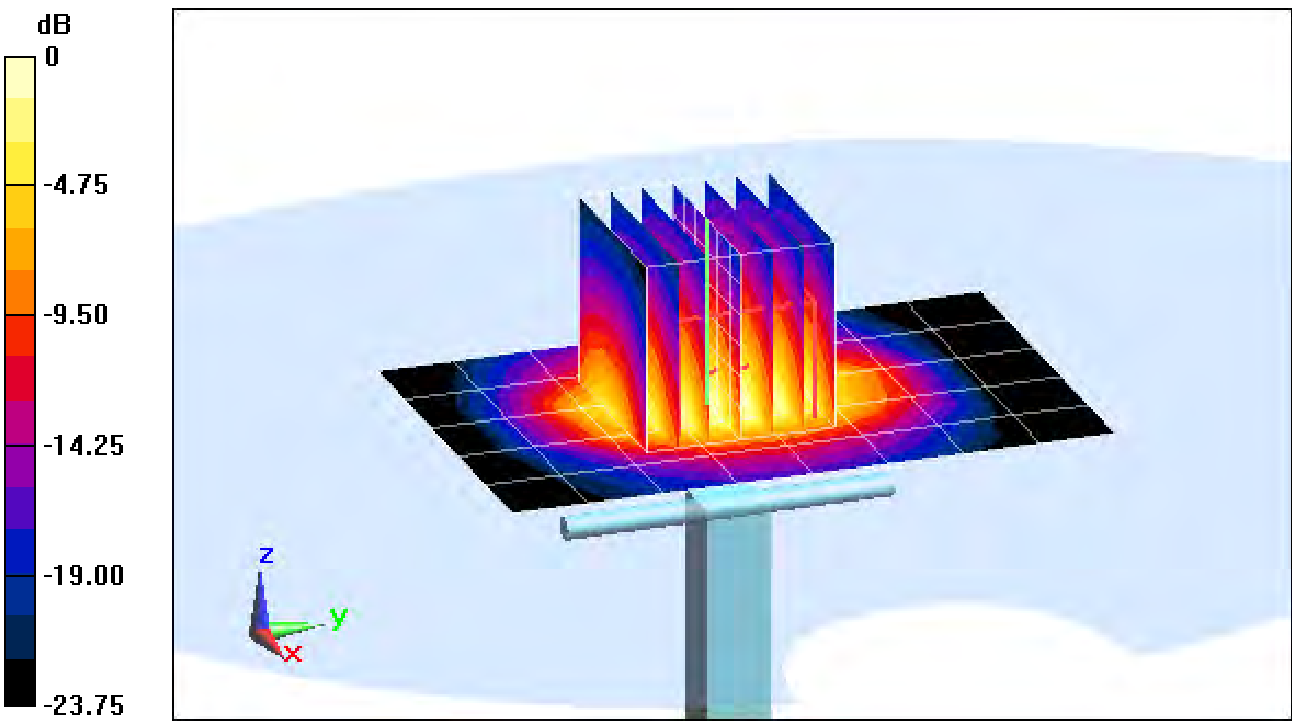
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Body, Medium parameters used:
f = 2450 MHz; σ = 2.034 S/m; ε_r = 50.51; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-02-2013; Ambient Temp: 23.5°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3287; ConvF(4.29, 4.29, 4.29); Calibrated: 11/15/2012;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/13/2012
Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

2450 MHz System Verification

Area Scan (6x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 11.4 W/kg
SAR(1 g) = 5.18 W/kg
Deviation = 0.39%



0 dB = 6.71 W/kg = 8.27 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

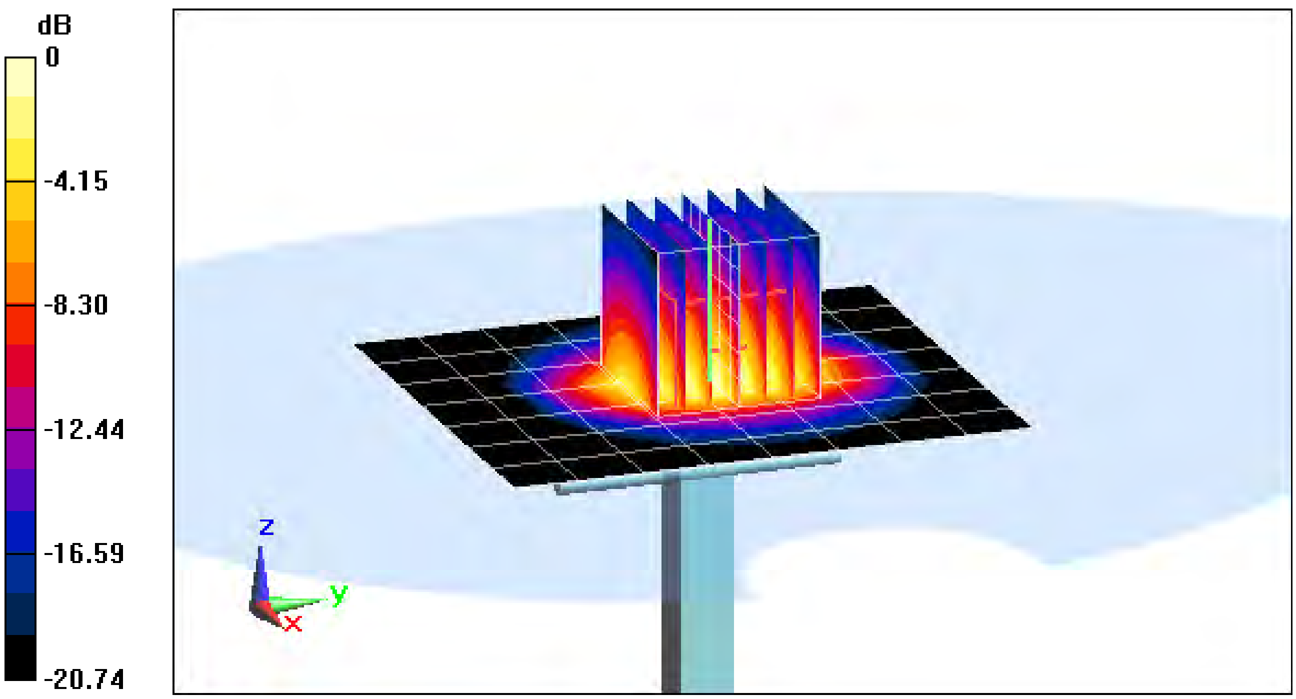
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Body, Medium parameters used:
f = 2450 MHz; σ = 1.998 S/m; ε_r = 51.321; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-19-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.9°C

Probe: EX3DV4 - SN3920; ConvF(7.07, 7.07, 7.07); Calibrated: 2/27/2013;
Sensor-Surface: 3mm (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)

2450 MHz System Verification

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 10.3 W/kg
SAR(1 g) = 5.14 W/kg
Deviation = 3.63%



0 dB = 6.67 W/kg = 8.24 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1004

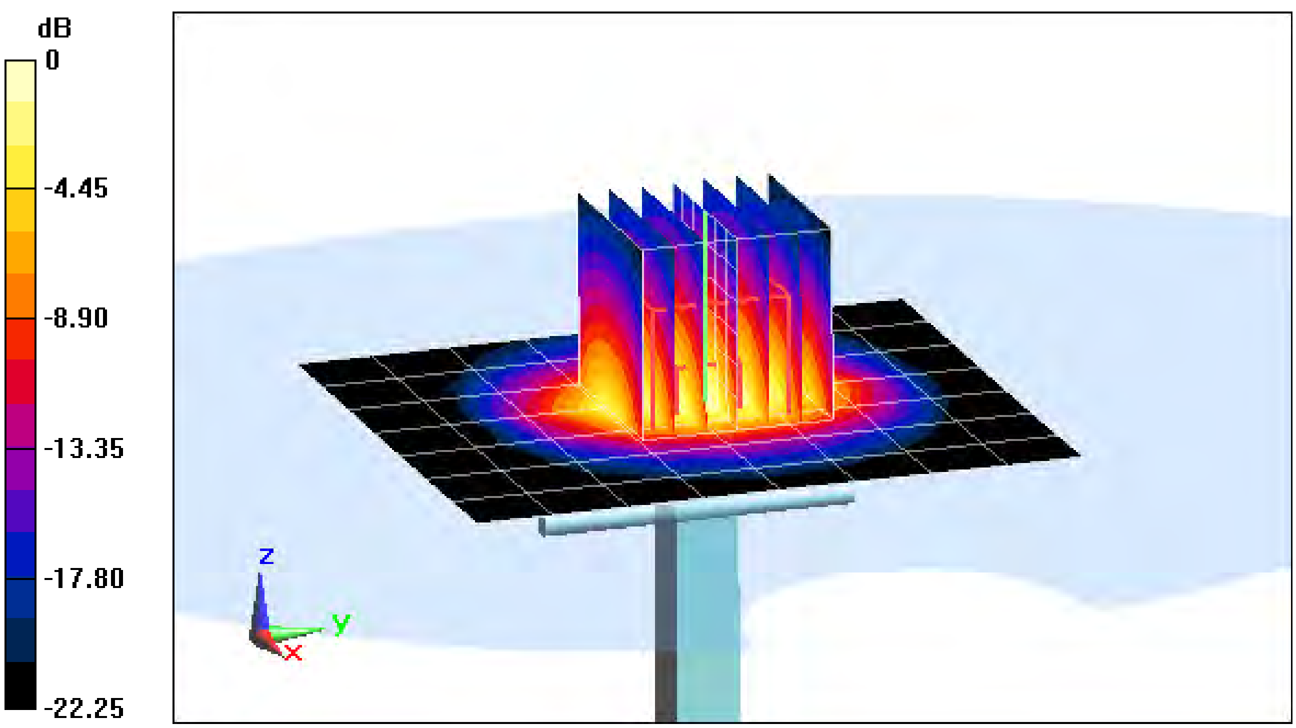
Communication System: CW; Frequency: 2600 MHz; Duty Cycle: 1:1
Medium: 2600 Body, Medium parameters used:
$f = 2600$ MHz; $\sigma = 2.211$ S/m; $\varepsilon_r = 50.761$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-19-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.9°C

Probe: EX3DV4 - SN3920; ConvF(6.73, 6.73, 6.73); Calibrated: 2/27/2013;
Sensor-Surface: 3mm (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)

2600 MHz System Verification

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 11.9 W/kg
SAR(1 g) = 5.74 W/kg
Deviation = -0.17%



0 dB = 7.56 W/kg = 8.79 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

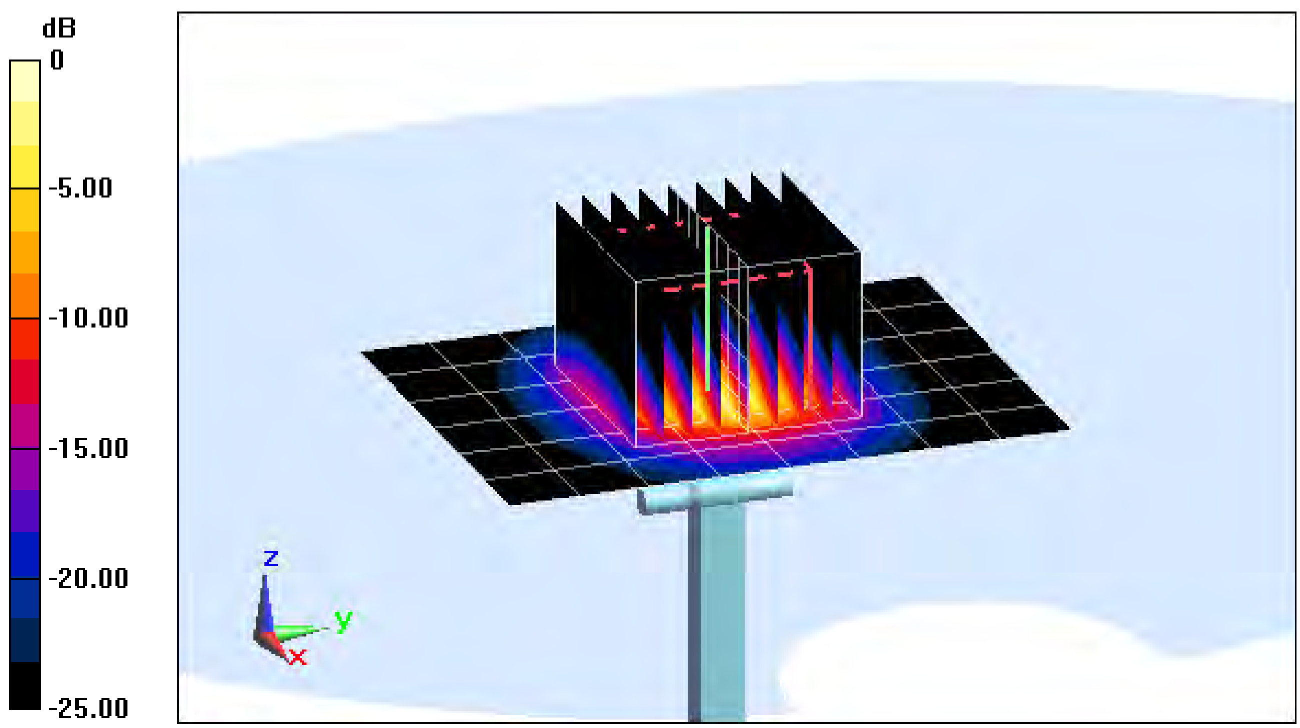
Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5200 MHz; σ = 5.215 S/m; ε_r = 46.814; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.2°C

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

5200 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 28.5 W/kg
SAR(1 g) = 7.16 W/kg
Deviation = -5.17%



0 dB = 17.5 W/kg = 12.43 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

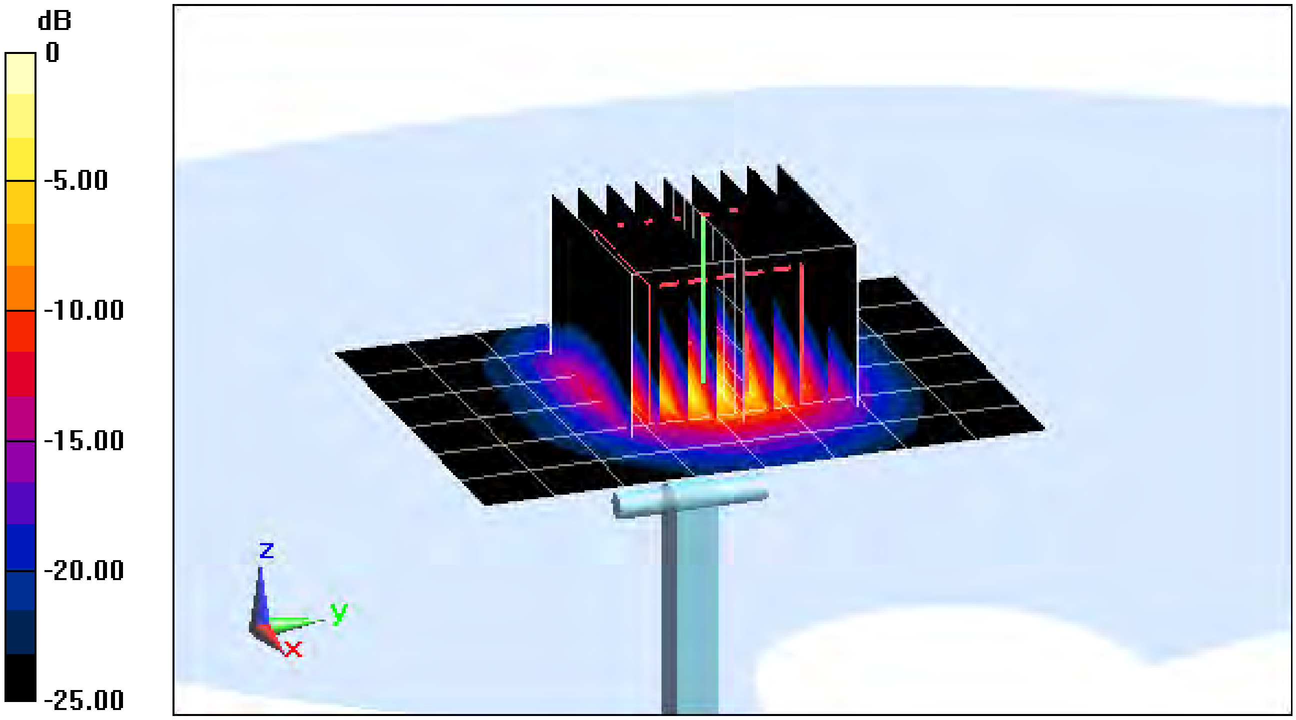
Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
$f = 5300$ MHz; $\sigma = 5.366$ S/m; $\varepsilon_r = 46.619$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.2°C

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

5300 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 32.6 W/kg
SAR(1 g) = 7.87 W/kg
Deviation = 4.52%



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

PCTEST ENGINEERING LABORATORY, INC.

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

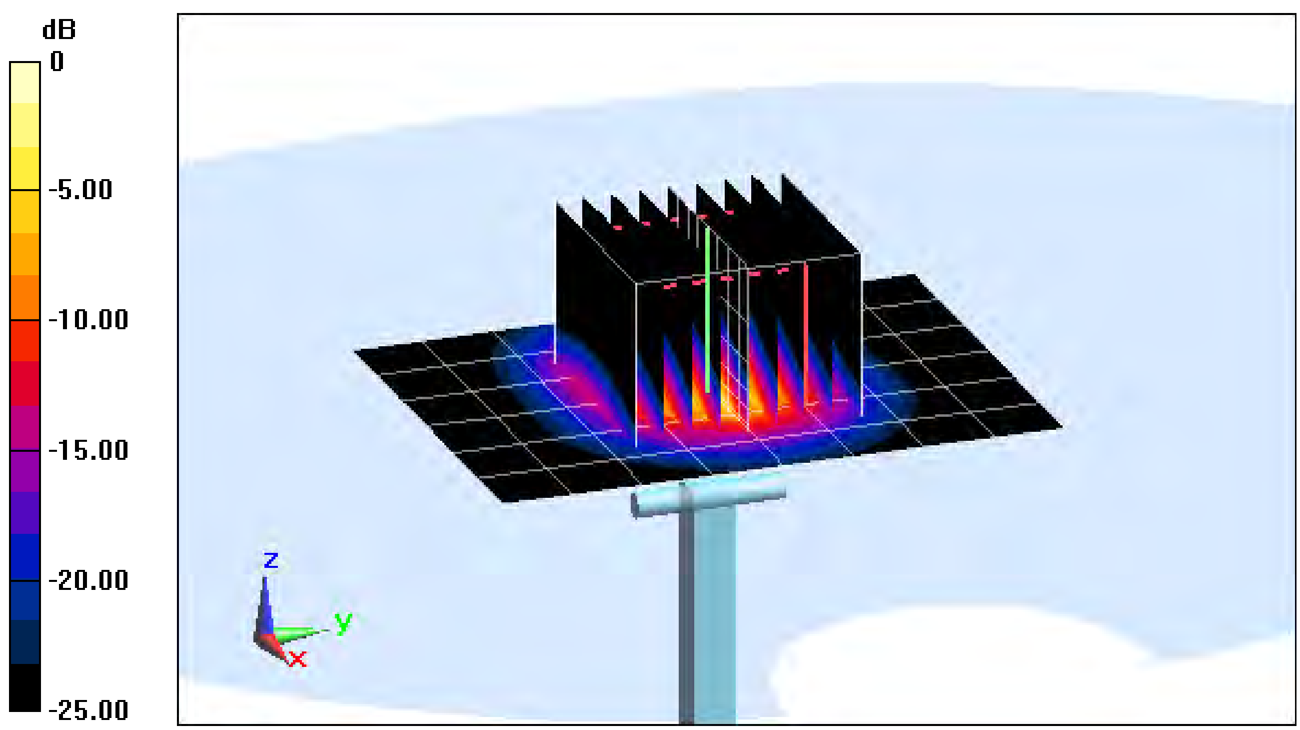
Communication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
$f = 5500$ MHz; $\sigma = 5.721$ S/m; $\varepsilon_r = 46.329$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.2°C

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

5500 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 39.0 W/kg
SAR(1 g) = 8.08 W/kg
Deviation = 0.00%



0 dB = 21.4 W/kg = 13.30 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

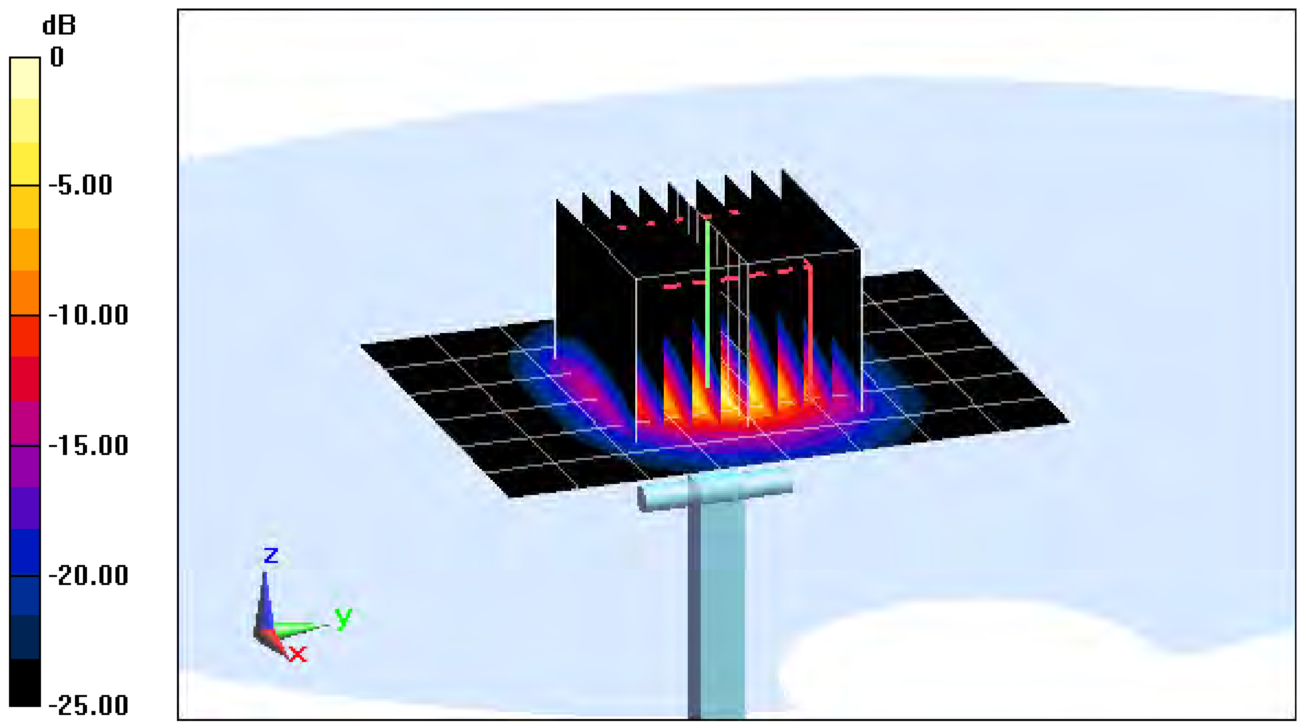
Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5800 MHz; σ = 6.218 S/m; ε_r = 46.037; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.4°C

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

5800 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 31.7 W/kg
SAR(1 g) = 7.33 W/kg
Deviation = -2.40%



0 dB = 18.7 W/kg = 12.72 dBW/kg

APPENDIX C: PROBE CALIBRATION

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

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

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

Accreditation No.: SCS 108

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	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: March 18, 2013

80880

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	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 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 ± 0.2) °C	41.1 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.50 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.55 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

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

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.72 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.48 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.75 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.7 Ω - 2.7 jΩ
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

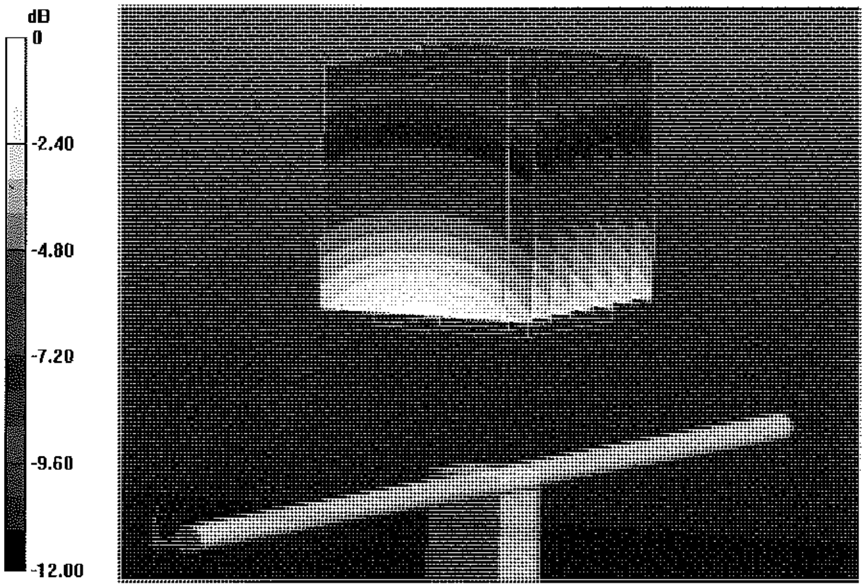
Communication System: CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; $\sigma = 0.92$ S/m; $\varepsilon_r = 41.1$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.28, 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)

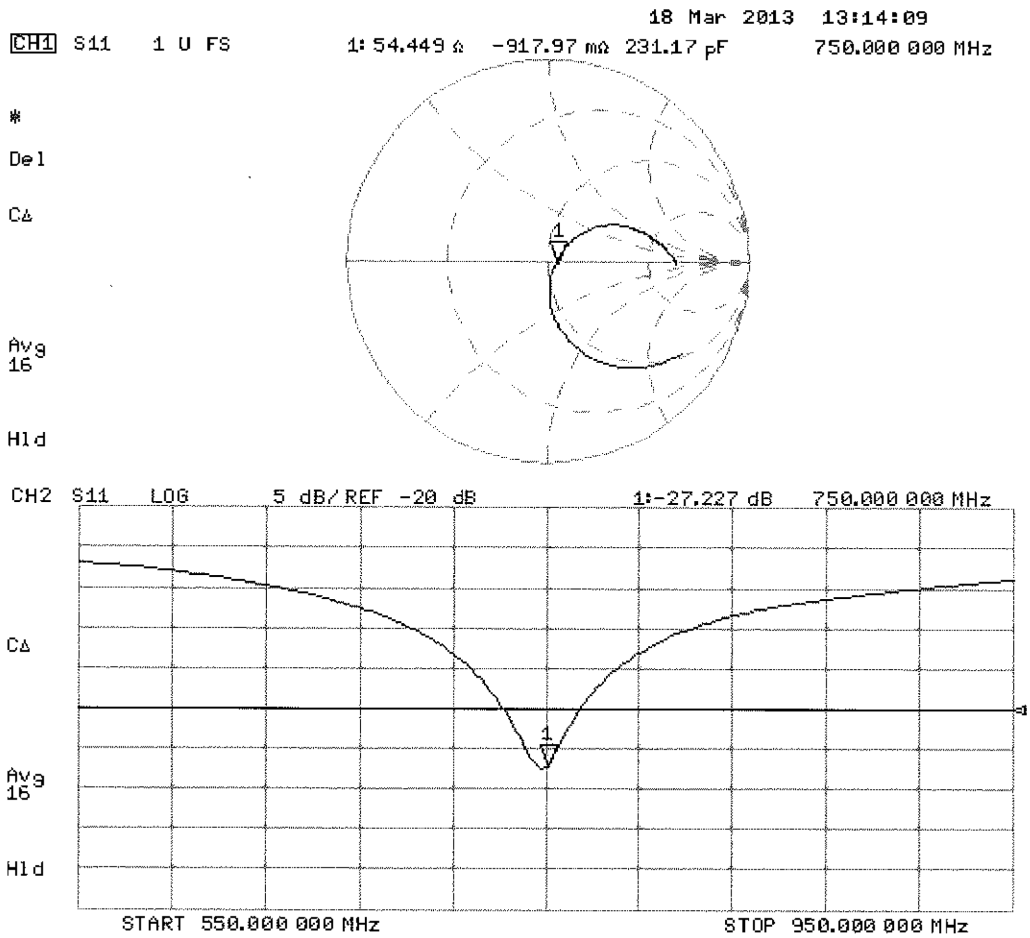
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

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



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

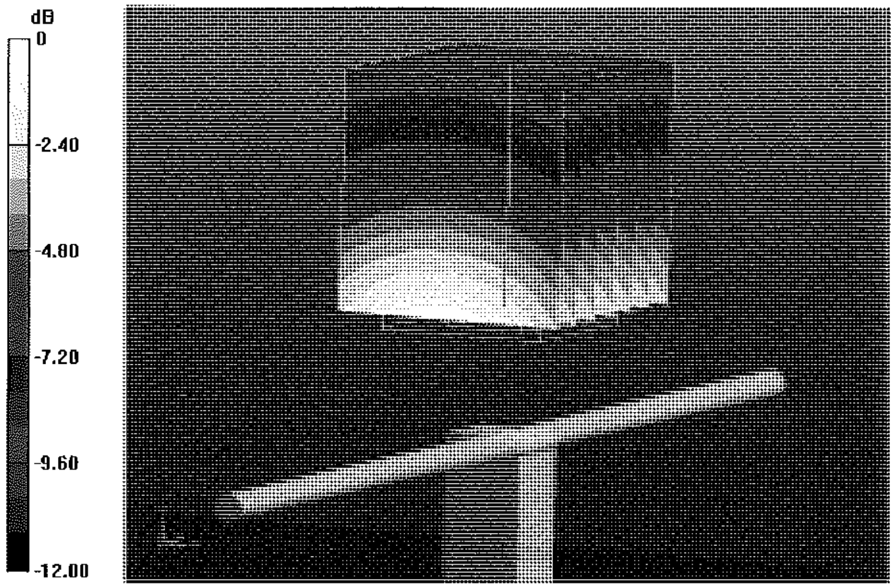
Communication System: CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 1 S/m; ε_r = 54.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.11, 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)

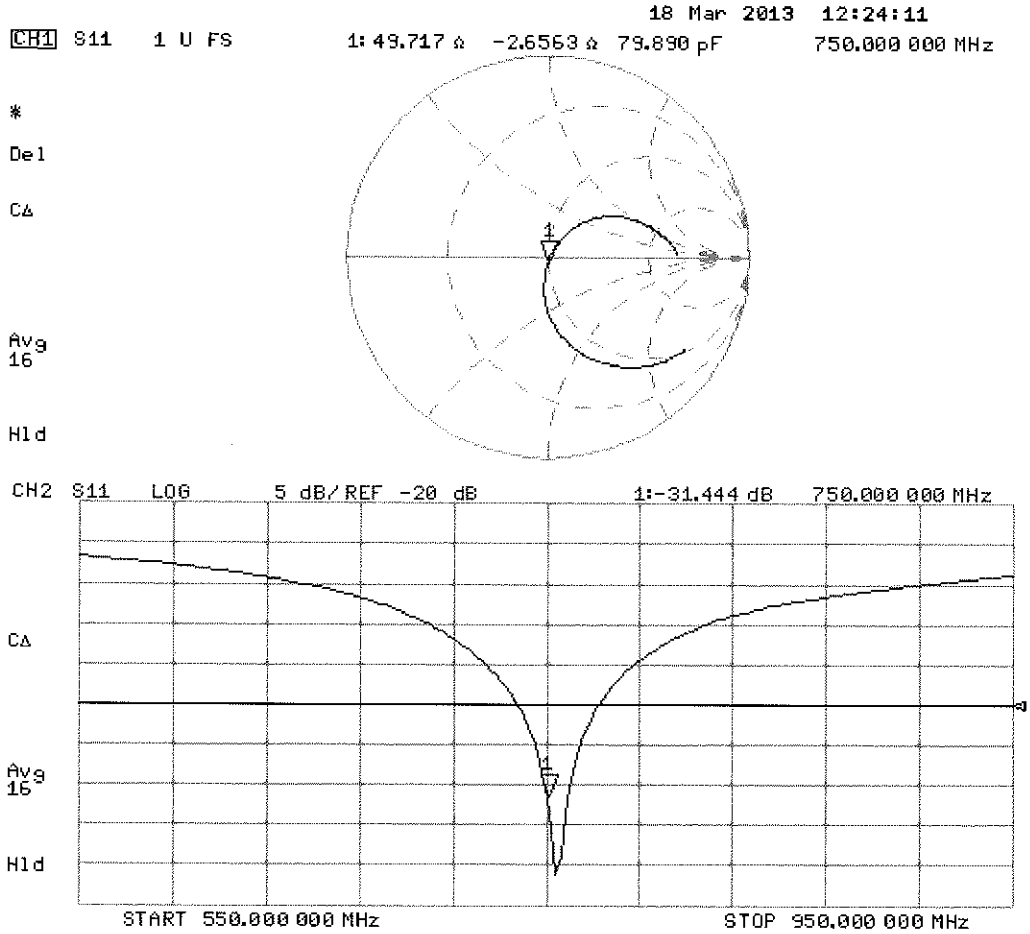
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

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



0 dB = 2.61 W/kg = 4.17 dBW/kg

Impedance Measurement Plot for Body TSL



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

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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D835V2-4d132_Jan13

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d132
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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

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

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

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

Issued: January 8, 2013

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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S Swiss Calibration Service

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.0 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.66 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.29 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.7 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.38 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.36 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.20 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.2 Ω + 1.3 jΩ
Return Loss	- 27.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.8 Ω - 1.3 jΩ
Return Loss	- 34.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.391 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 22, 2011

DASY5 Validation Report for Head TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

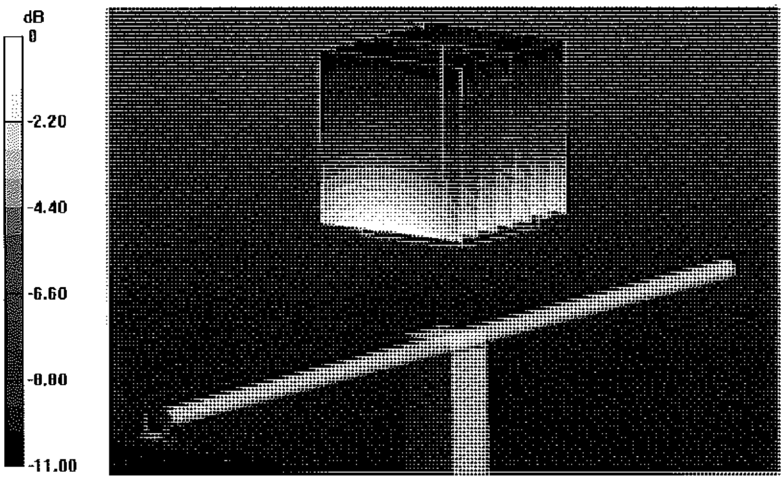
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.92 S/m; ε_r = 42; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); 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)

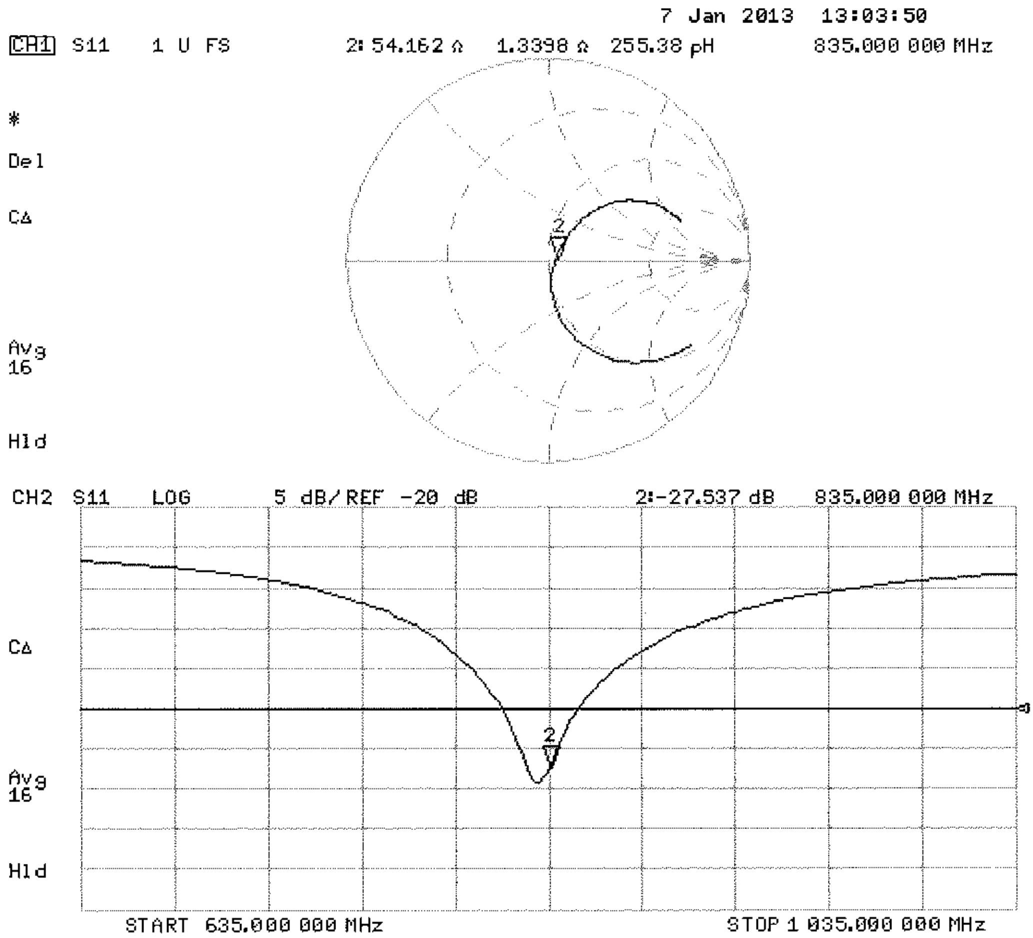
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.542 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 3.71 W/kg
SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.59 W/kg
Maximum value of SAR (measured) = 2.88 W/kg



0 dB = 2.88 W/kg = 4.59 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

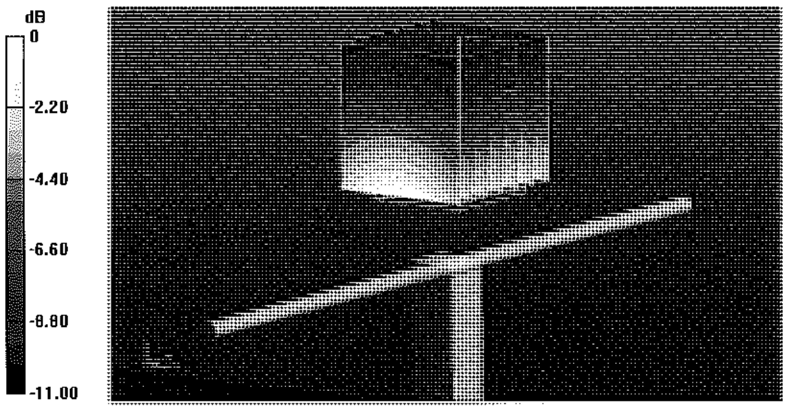
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma = 0.99$ S/m; $\varepsilon_r = 54.7$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); 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)

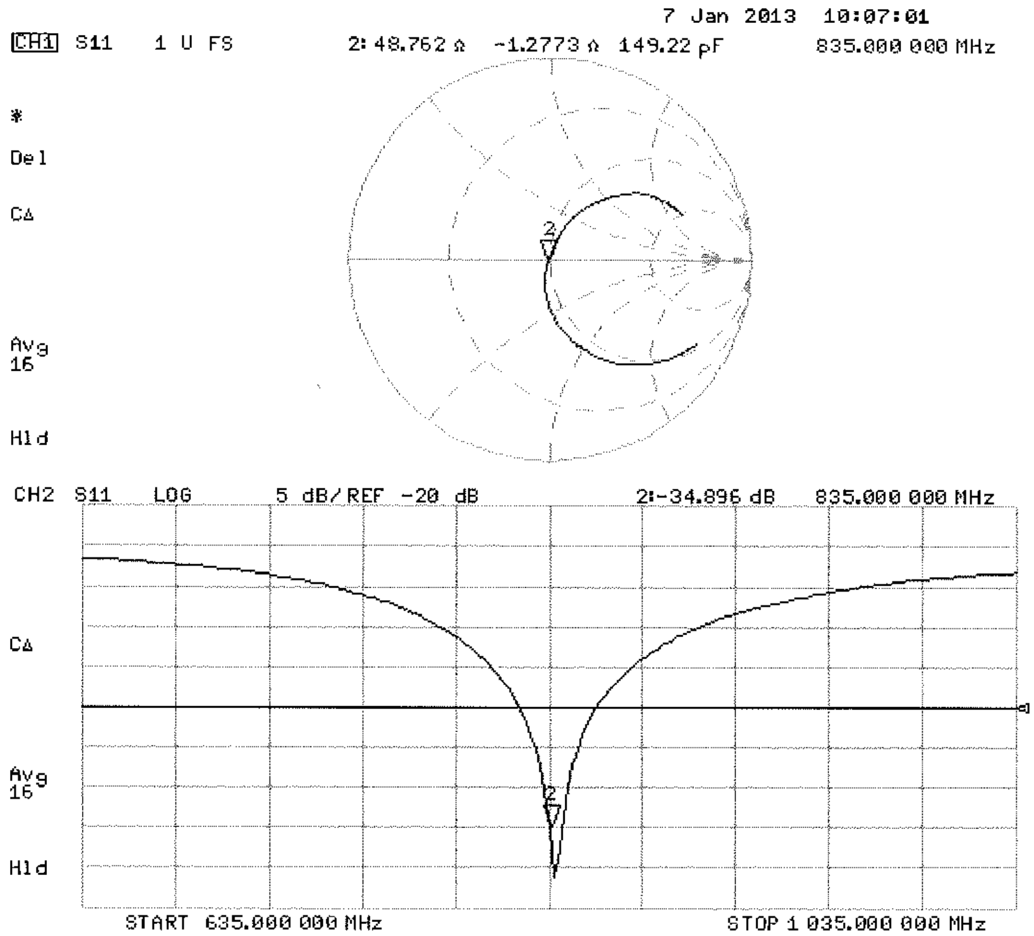
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.512 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 3.47 W/kg
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.57 W/kg
Maximum value of SAR (measured) = 2.77 W/kg



0 dB = 2.77 W/kg = 4.42 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D1750V2-1051_Apr13

CALIBRATION CERTIFICATE

Object	D1750V2 - SN: 1051
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 30, 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: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

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

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 30, 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	V52.8.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.1 ± 6 %	1.33 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**36.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.83 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.5 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.8 ± 6 %	1.50 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.55 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**37.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.4 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9 Ω + 0.3 jΩ
Return Loss	- 40.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.0 Ω + 0.4 jΩ
Return Loss	- 30.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.222 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	February 19, 2010

DASY5 Validation Report for Head TSL

Date: 30.04.2013

Test Laboratory: SPEAG, Zurich, Switzerland

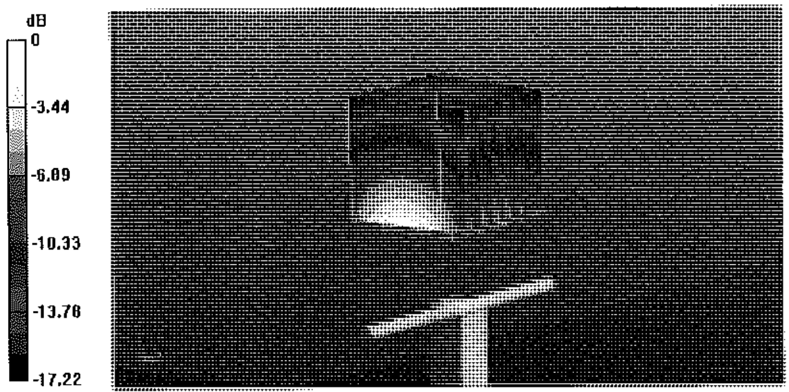
DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1051

Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; $\sigma = 1.33$ S/m; $\varepsilon_r = 39.1$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

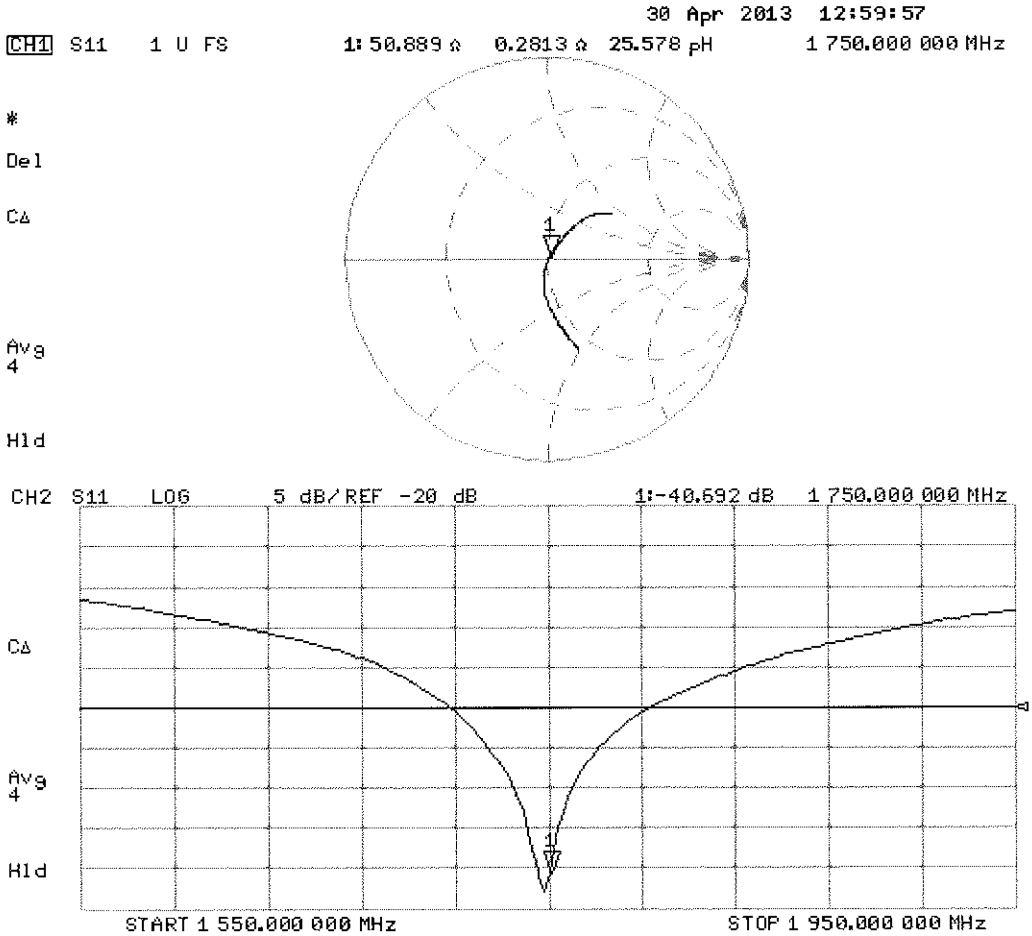
- Probe: ES3DV3 - SN3205; ConvF(5.18, 5.18, 5.18); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (8x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.104 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 16.0 W/kg
SAR(1 g) = 9.01 W/kg; SAR(10 g) = 4.83 W/kg
Maximum value of SAR (measured) = 11.3 W/kg



0 dB = 11.3 W/kg = 10.53 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 30.04.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1051

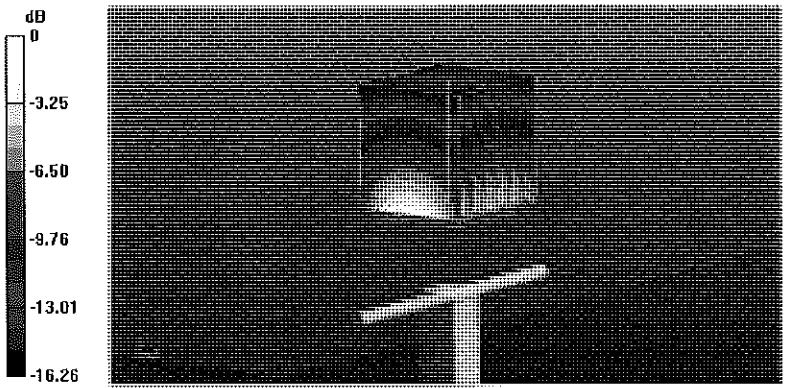
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.5 S/m; ε_r = 51.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.83, 4.83, 4.83); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

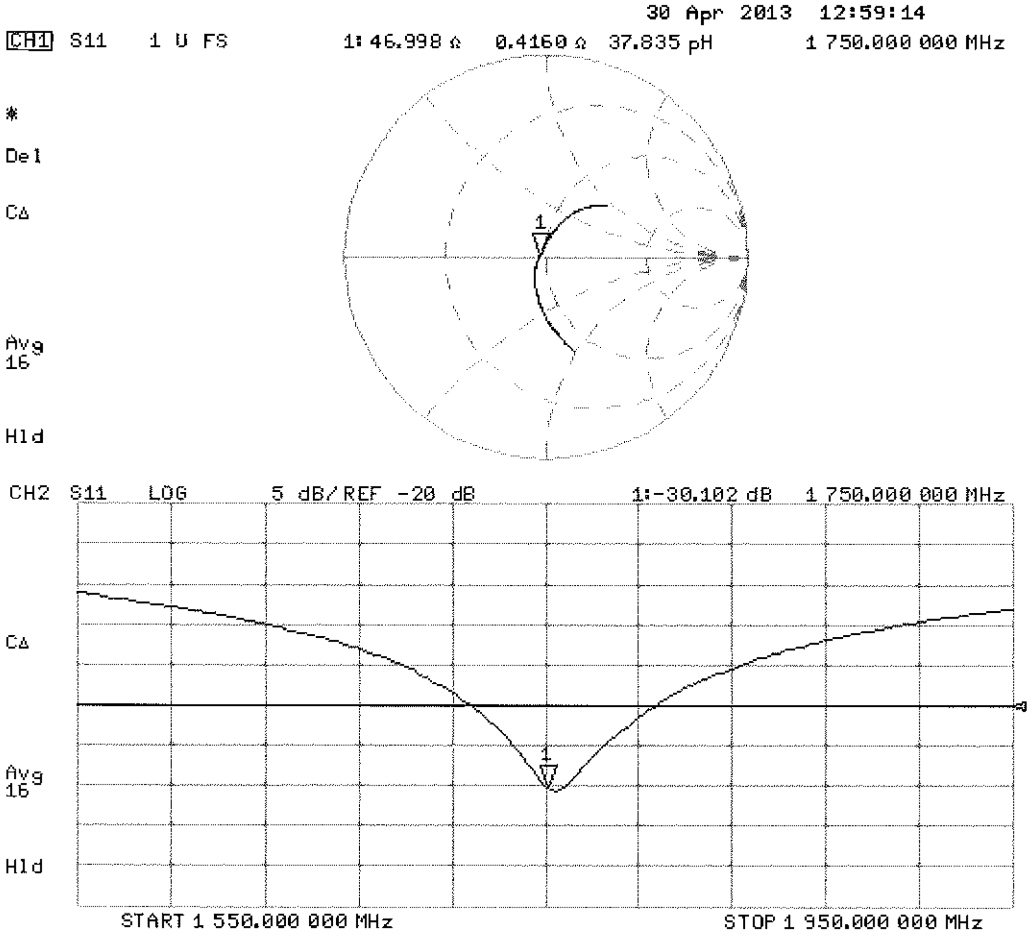
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.473 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 16.4 W/kg
SAR(1 g) = 9.55 W/kg; SAR(10 g) = 5.13 W/kg
Maximum value of SAR (measured) = 12.0 W/kg



0 dB = 12.0 W/kg = 10.79 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D1900V2-5d080_Jul12

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d080
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 20, 2012

✓ KOK 8/13/12

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 20, 2012

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	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.9 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.78 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**39.4 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.17 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**20.8 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.6 ± 6 %	1.52 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**40.3 mW / g ± 17.0 % (k=2)**

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9 Ω + 5.7 jΩ
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.9 Ω + 6.0 jΩ
Return Loss	- 23.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.191 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 28, 2006

DASY5 Validation Report for Head TSL

Date: 20.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

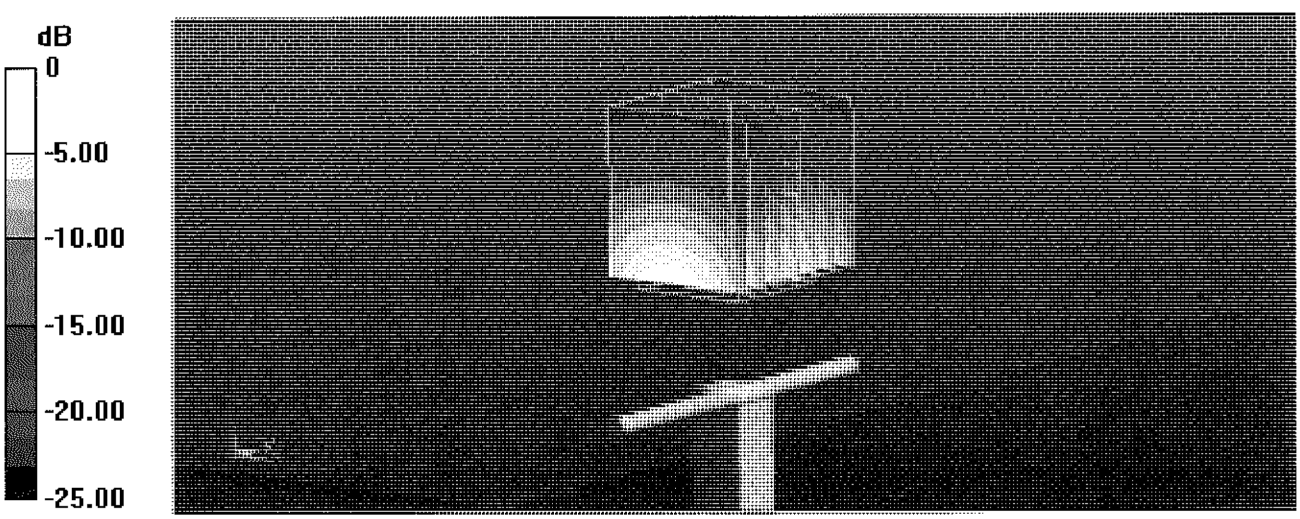
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d080

Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma = 1.38$ mho/m; $\varepsilon_r = 39.9$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

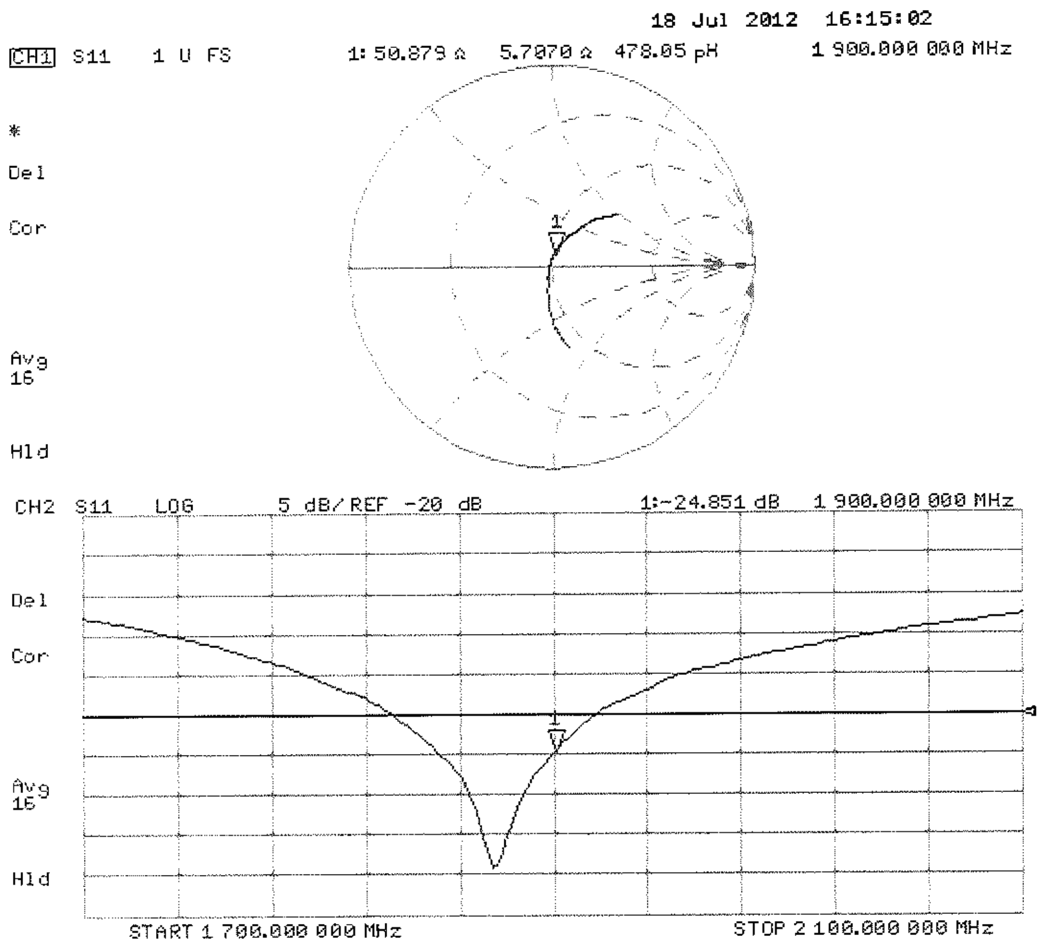
- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 97.586 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 17.454 mW/g
SAR(1 g) = 9.78 mW/g; SAR(10 g) = 5.17 mW/g
Maximum value of SAR (measured) = 12.2 mW/g



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 20.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

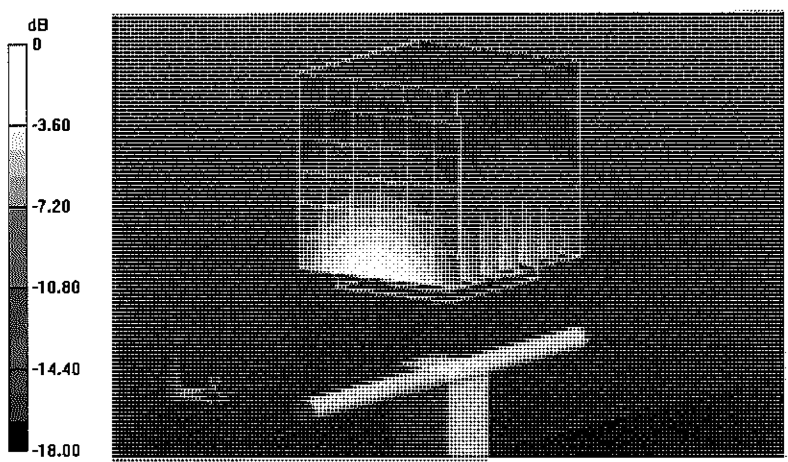
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.52 mho/m; ε_r = 52.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

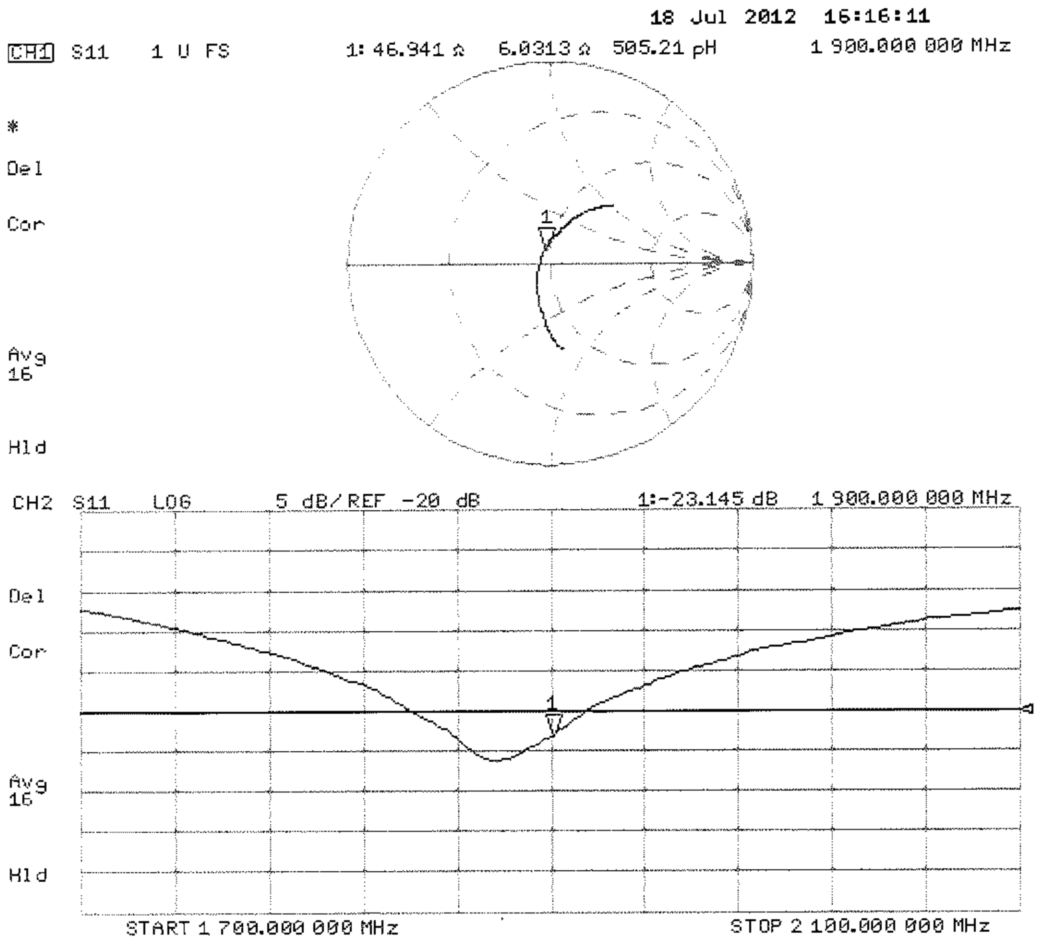
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.688 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 17.552 mW/g
SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.35 mW/g
Maximum value of SAR (measured) = 12.8 mW/g



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

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client PC Test

Certificate No: D2450V2-719_Aug12

CALIBRATION CERTIFICATE

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

✓ KOK 9/17/12

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

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

Issued: August 23, 2012

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

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

SAR result with Head TSL

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

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

Body TSL parameters

The following parameters and calculations were applied.

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

SAR result with Body TSL

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

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

Appendix

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.150 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

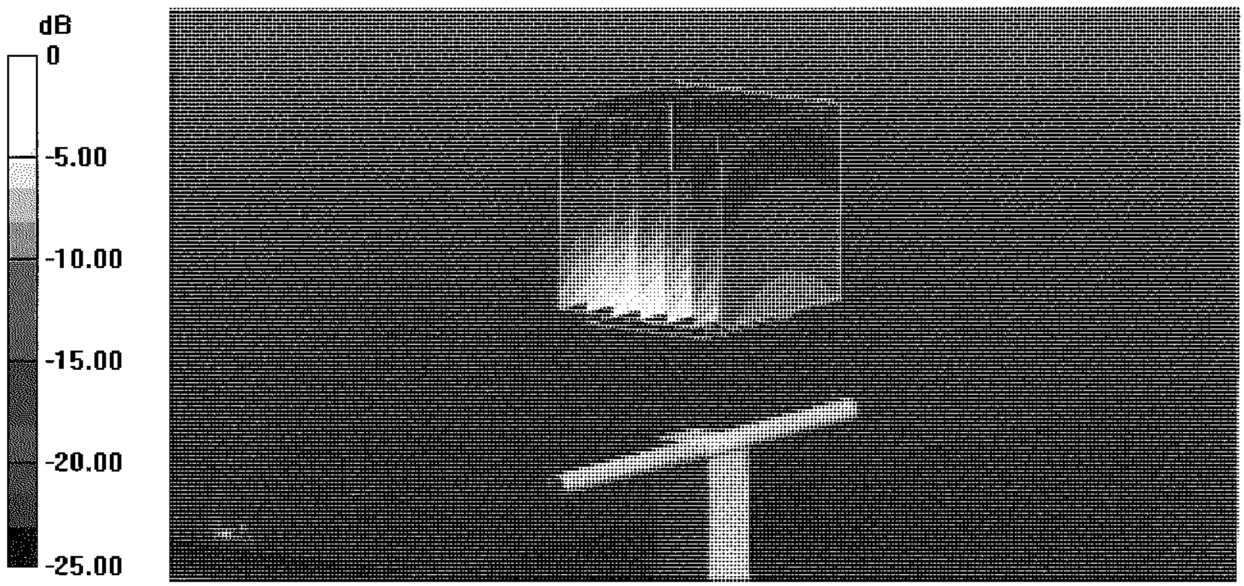
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.81 mho/m; ε_r = 39.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

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

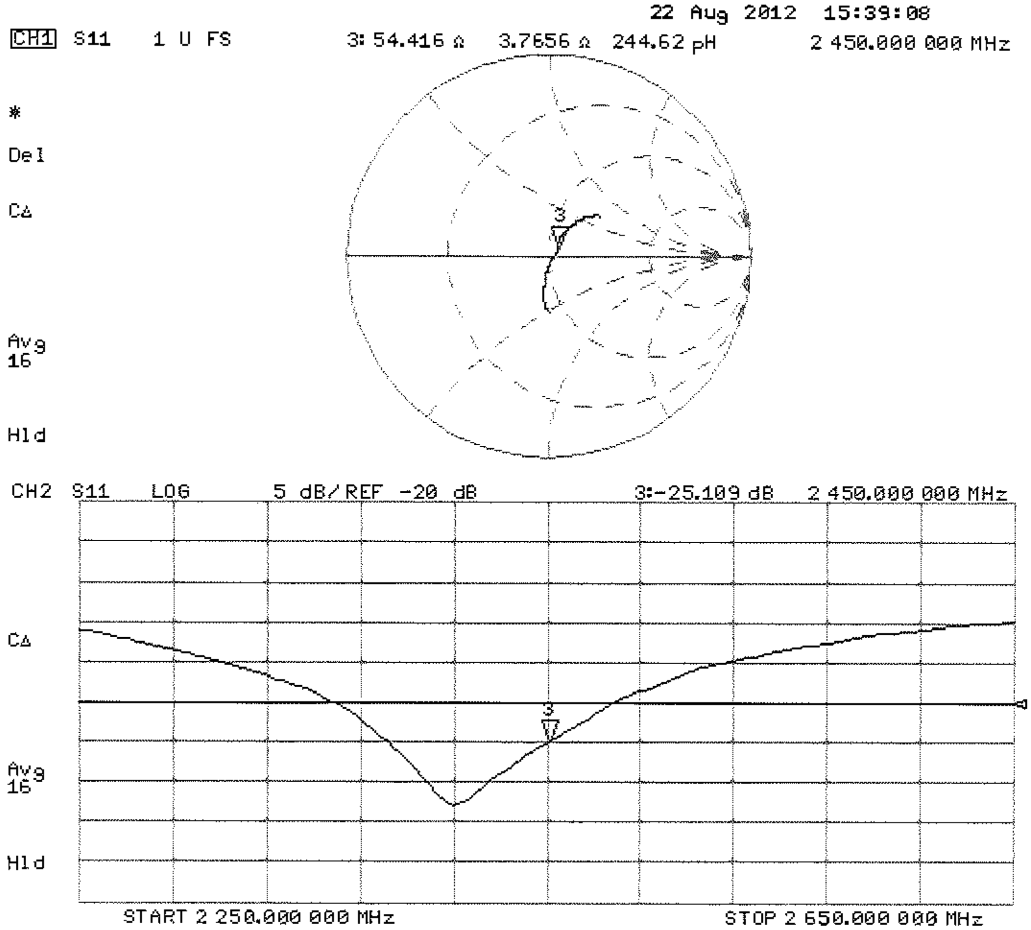
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 22.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

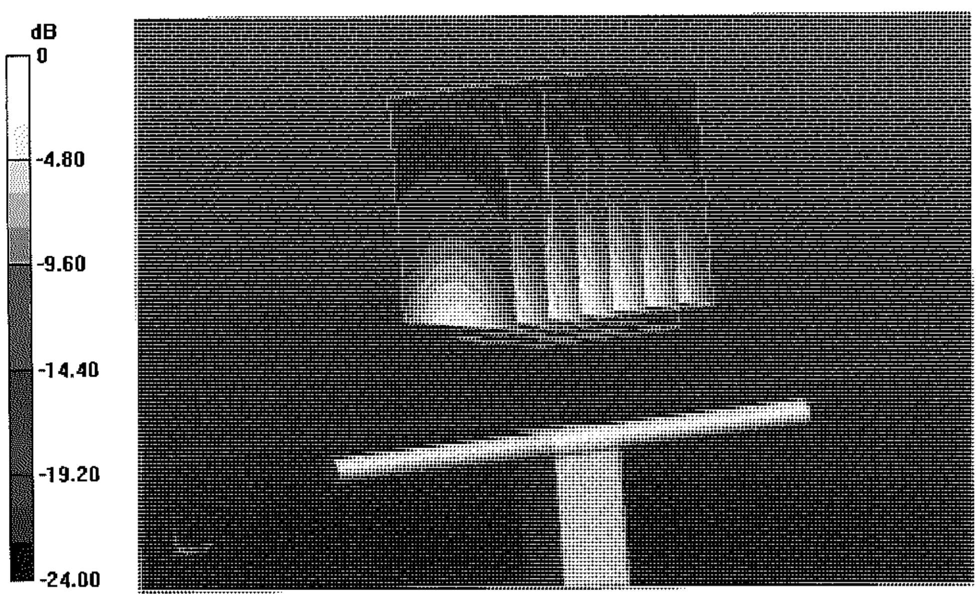
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.99 mho/m; ε_r = 51.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

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

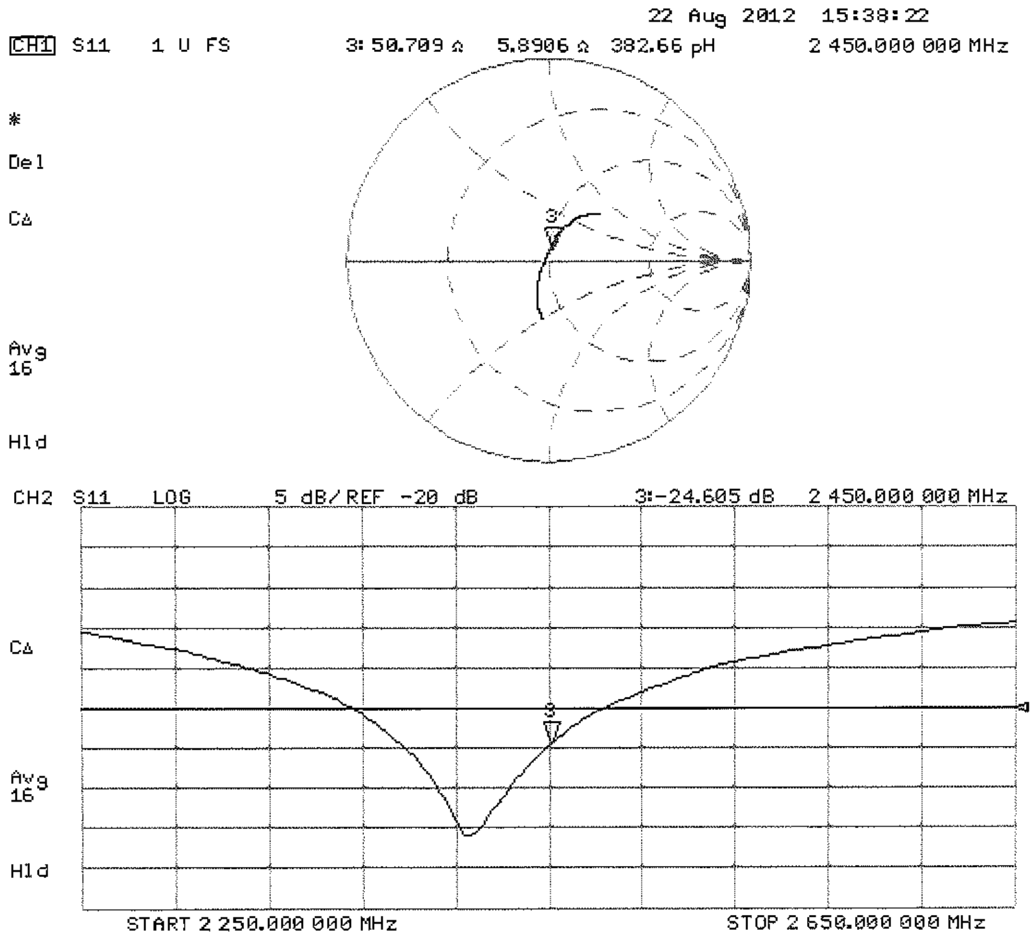
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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



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

Impedance Measurement Plot for Body TSL



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C **Service suisse d'étalonnage**
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Swiss Calibration Service

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D2600V2-1004_May13

CALIBRATION CERTIFICATE

Object	D2600V2 - SN: 1004
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 02, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
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

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 2, 2013

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.2 ± 6 %	1.99 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**58.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**26.0 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.8 ± 6 %	2.20 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	14.6 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**57.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**25.5 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.0 Ω - 4.3 jΩ
Return Loss	- 27.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.7 Ω - 2.9 jΩ
Return Loss	- 26.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 23, 2006

DASY5 Validation Report for Head TSL

Date: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1004

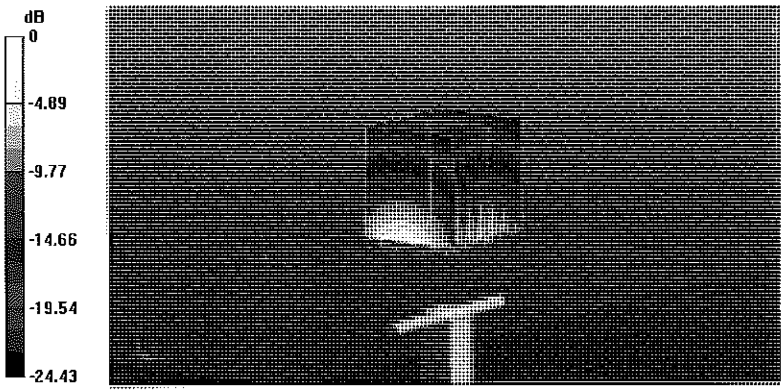
Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; σ = 1.99 S/m; ε_r = 37.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

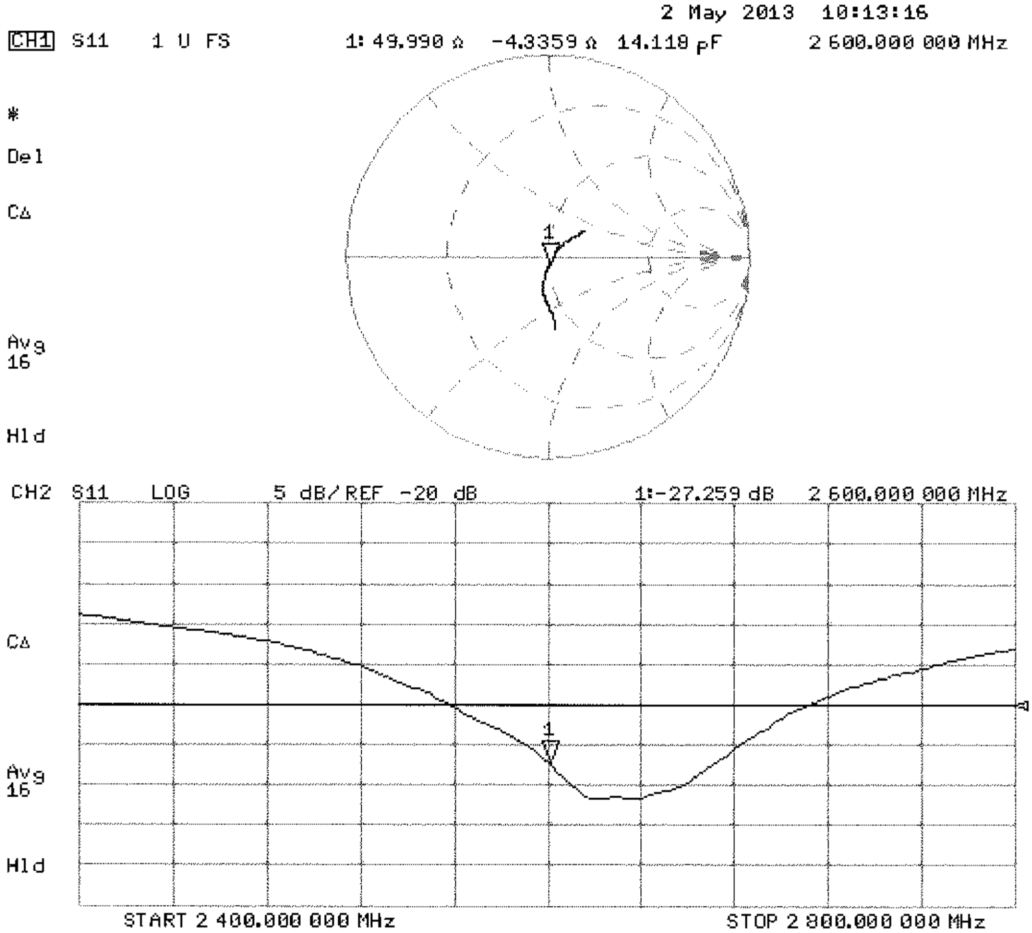
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.3 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 31.9 W/kg
SAR(1 g) = 14.8 W/kg; SAR(10 g) = 6.57 W/kg
Maximum value of SAR (measured) = 19.0 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 25.04.2013

Test Laboratory: SPEAG, Zurich, Switzerland

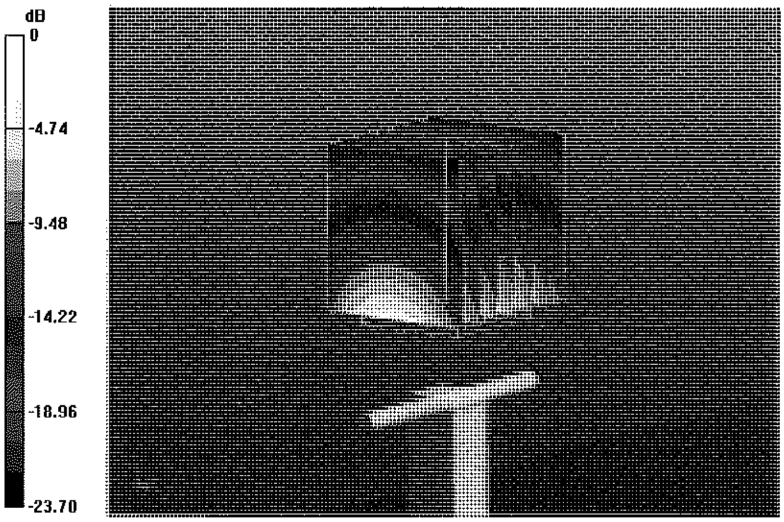
DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1004

Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; $\sigma = 2.2$ S/m; $\varepsilon_r = 50.8$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

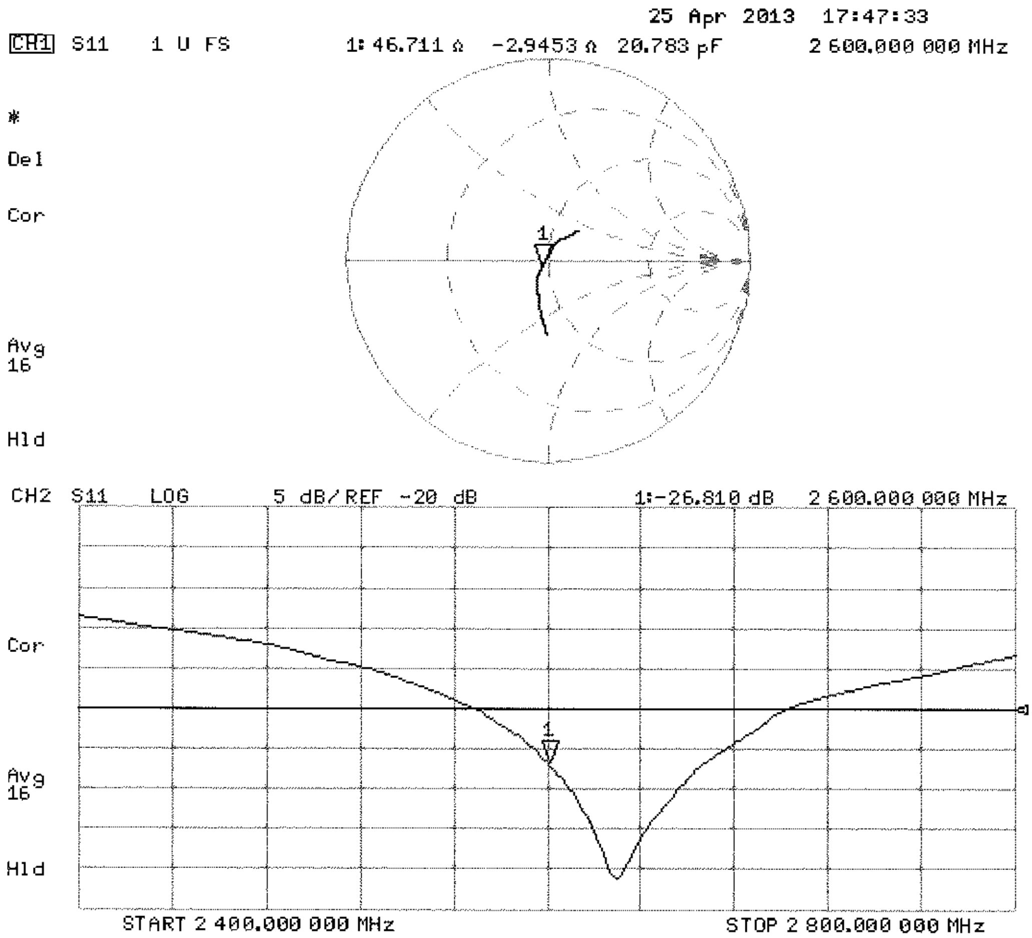
- Probe: ES3DV3 - SN3205; ConvF(4.32, 4.32, 4.32); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn909; Calibrated: 11.09.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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 = 96.605 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 32.0 W/kg
SAR(1 g) = 14.6 W/kg; SAR(10 g) = 6.43 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 Body TSL



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Accredited by the Swiss Accreditation Service (SAS)
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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

✓ KDK 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 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

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

Issued: February 14, 2013

Glossary:

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

Calibration is Performed According to the Following Standards:

a) 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 ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.47 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.67 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**76.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 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 cm^3 (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 cm^3 (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 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	2.29 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 cm^3 (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 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 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 cm^3 (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 cm^3 (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 cm^3 (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 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 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 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.75 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**76.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.18 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 cm^3 (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 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.1 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 cm^3 (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 cm^3 (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 cm^3 (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 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.9 W/kg ± 19.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	53.8 Ω - 6.3 jΩ
Return Loss	- 23.0 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	50.1 Ω + 0.5 jΩ
Return Loss	- 45.3 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.0 Ω - 0.9 jΩ
Return Loss	- 37.9 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	55.3 Ω - 0.9 jΩ
Return Loss	- 25.8 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	53.5 Ω + 3.3 jΩ
Return Loss	- 26.7 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	53.7 Ω - 4.8 jΩ
Return Loss	- 24.8 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	50.2 Ω + 2.4 jΩ
Return Loss	- 32.5 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	51.6 Ω - 1.5 jΩ
Return Loss	- 33.3 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	57.4 Ω + 0.9 jΩ
Return Loss	- 23.2 dB

Antenna Parameters with Body TSL at 5800 MHz

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.206 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 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; σ = 4.47 S/m; ε_r = 34.7; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 4.57 S/m; ε_r = 34.5; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.74 S/m; ε_r = 34.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.83 S/m; ε_r = 34.1; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.05 S/m; ε_r = 33.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 28.12.2012, ConvF(5.1, 5.1, 5.1); Calibrated: 28.12.2012, ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.76, 4.76, 4.76); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

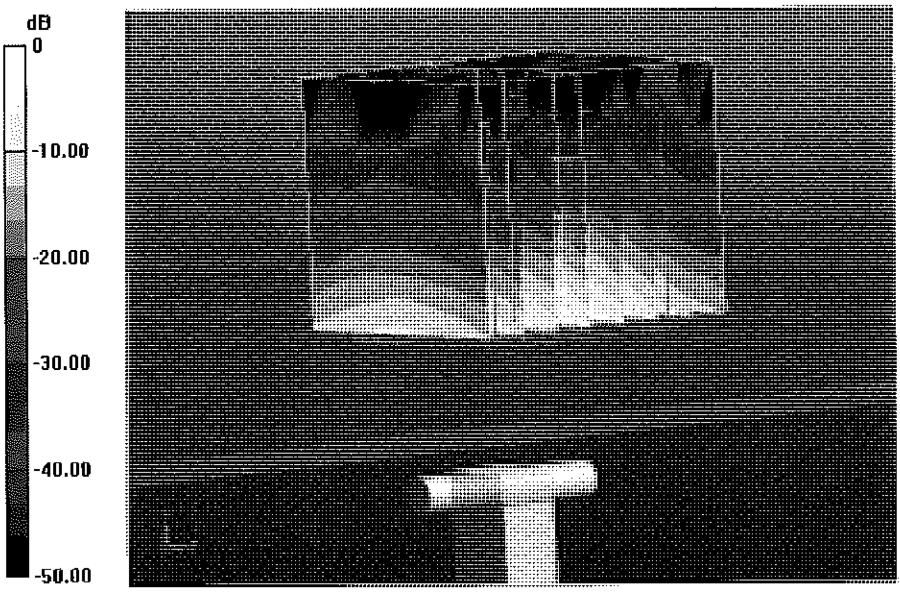
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.561 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 28.8 W/kg
SAR(1 g) = 7.67 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (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

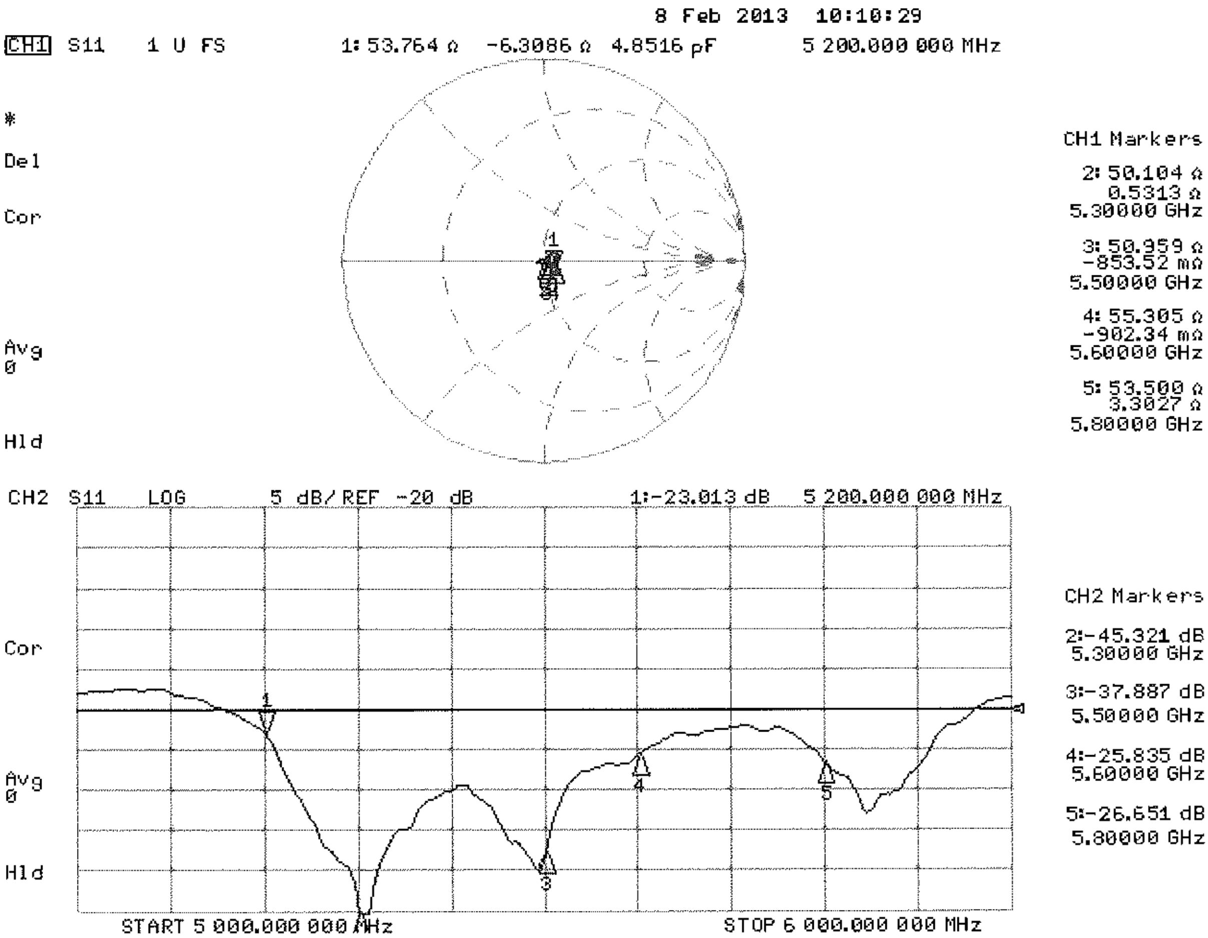
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.540 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 33.3 W/kg
SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.28 W/kg
Maximum value of SAR (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; σ = 5.36 S/m; ε_r = 46.9; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 5.48 S/m; ε_r = 46.7; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 5.71 S/m; ε_r = 46.3; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 5.83 S/m; ε_r = 46.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.12 S/m; ε_r = 45.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.67, 4.67, 4.67); Calibrated: 28.12.2012, ConvF(4.43, 4.43, 4.43); Calibrated: 28.12.2012, ConvF(4.22, 4.22, 4.22); Calibrated: 28.12.2012, ConvF(4.38, 4.38, 4.38); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

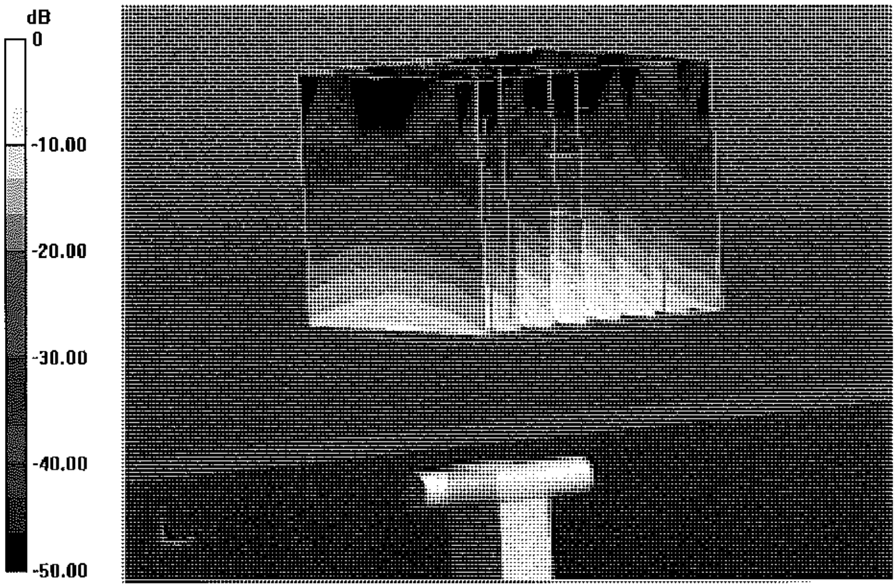
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.053 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 31.1 W/kg
SAR(1 g) = 7.73 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (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

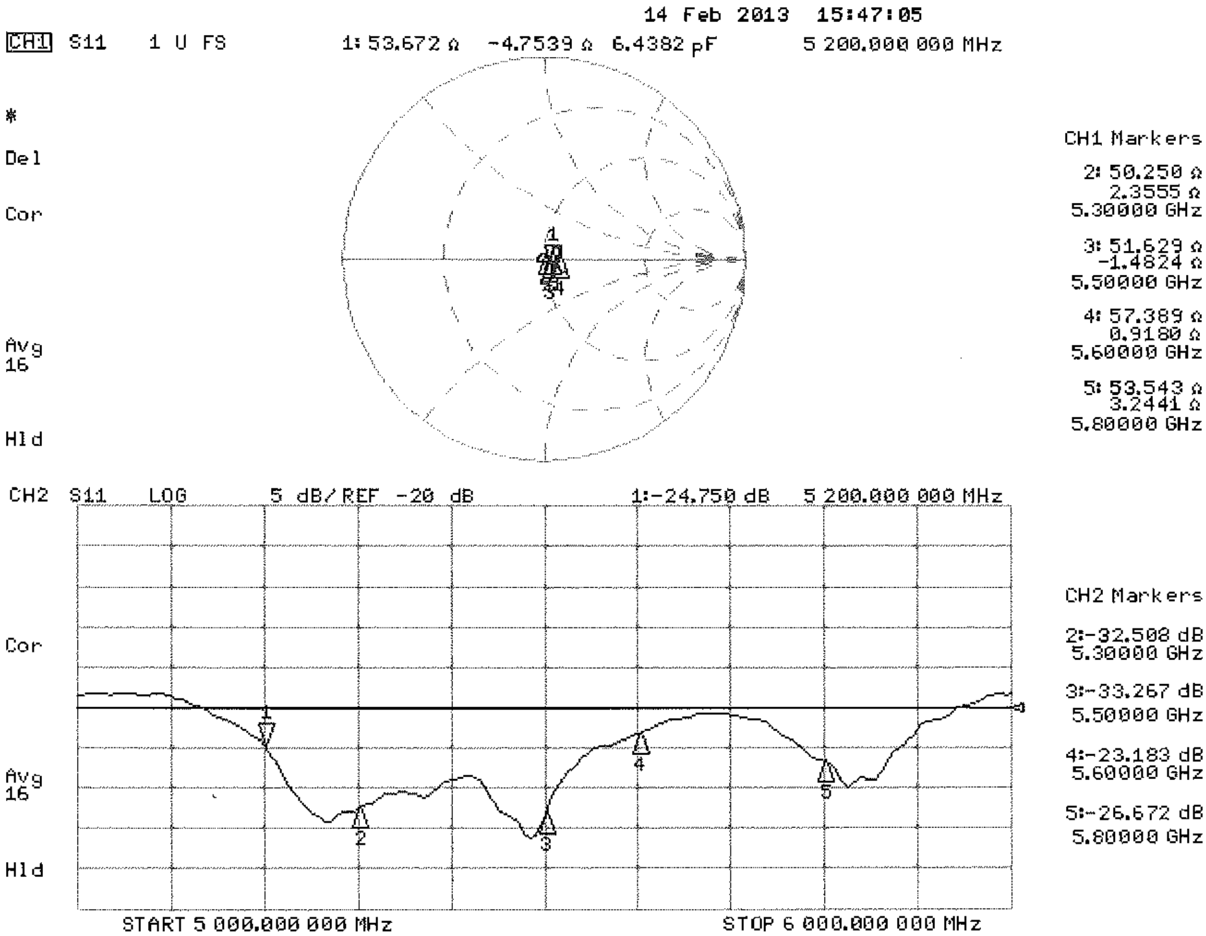
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 59.730 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 36.8 W/kg
SAR(1 g) = 8.15 W/kg; SAR(10 g) = 2.26 W/kg
Maximum value of SAR (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



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Accreditation No.: SCS 108

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

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

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

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

Issued: January 8, 2013

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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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	V52.8.4
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 ± 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 ± 0.2) °C	41.4 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.46 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.51 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.8 ± 6 %	0.97 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.83 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.48 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.87 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	56.1 Ω - 0.2 jΩ
Return Loss	- 24.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω - 3.5 jΩ
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

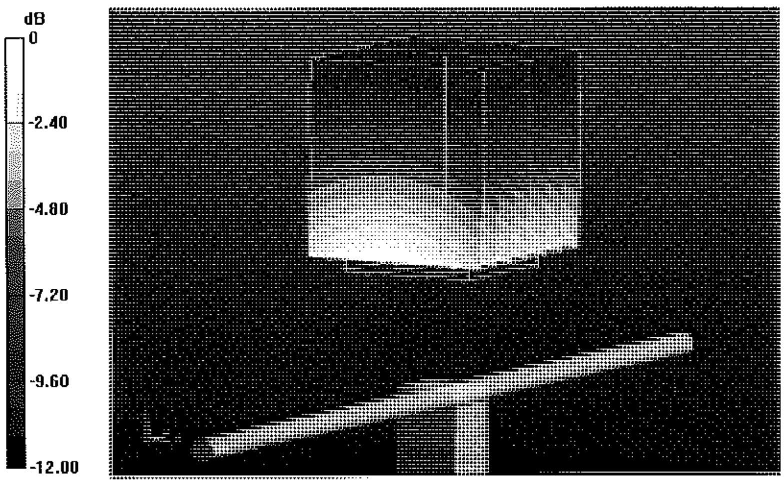
Communication System: CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; $\sigma = 0.89$ S/m; $\varepsilon_r = 41.4$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(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)

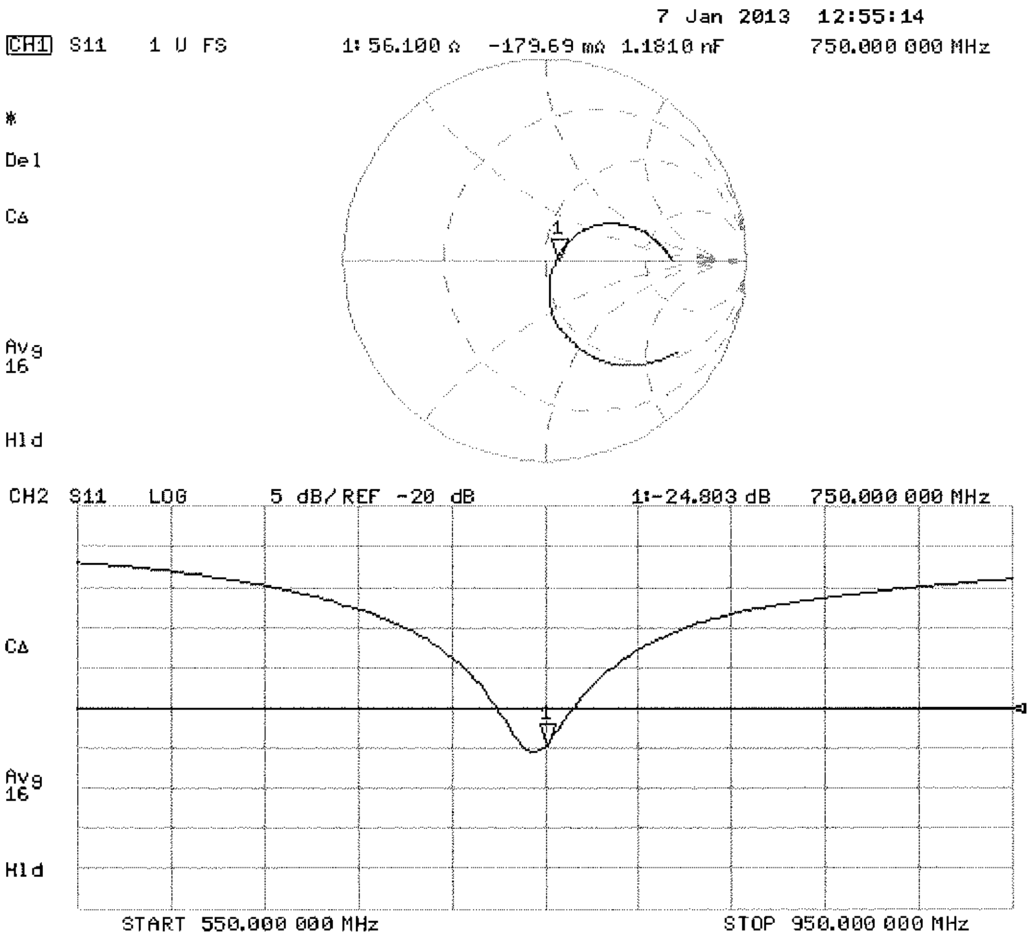
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

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



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

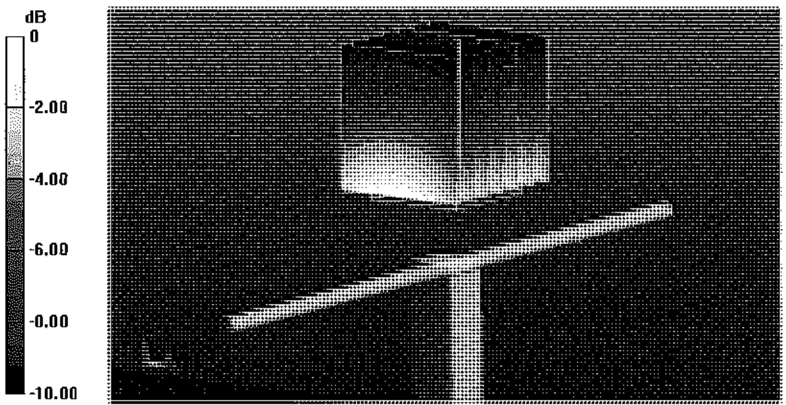
Communication System: CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; $\sigma = 0.97$ S/m; $\varepsilon_r = 54.8$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.11, 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)

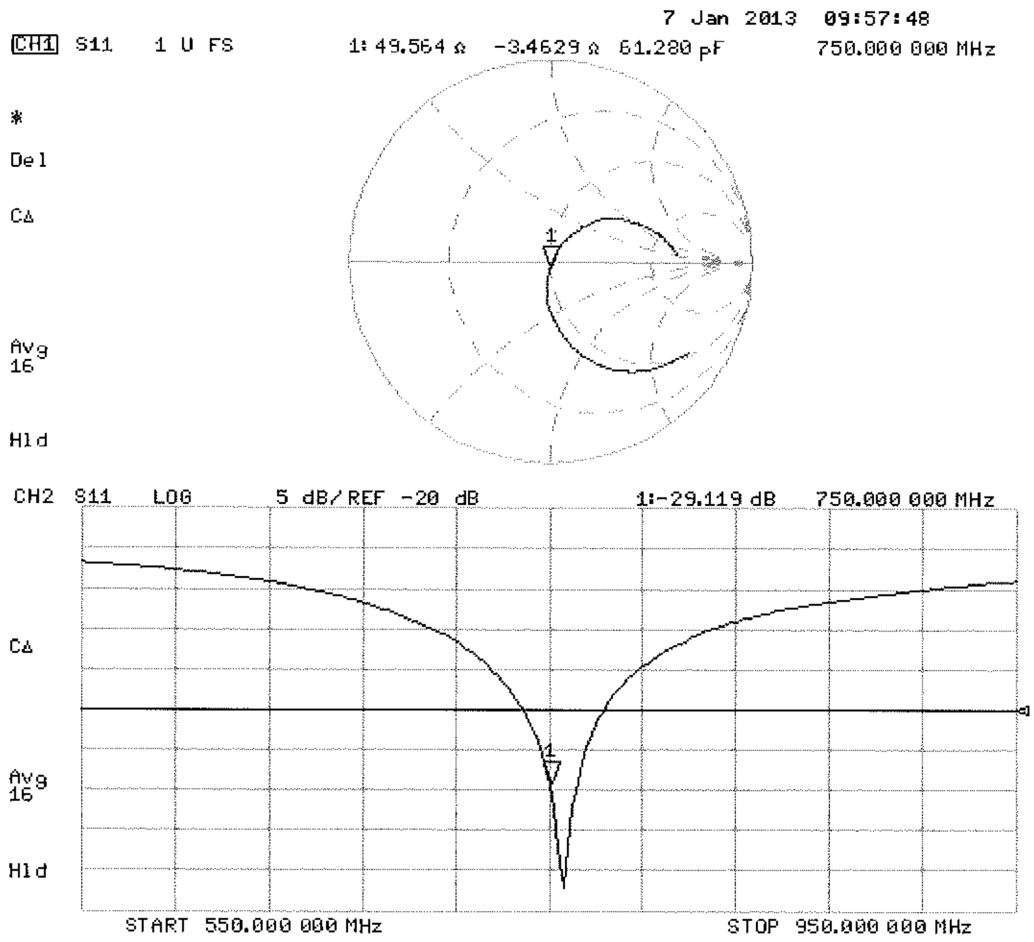
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

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



0 dB = 2.57 W/kg = 4.10 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D835V2-4d026_Aug12

CALIBRATION CERTIFICATE

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

KOK 9/17/12

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

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

Issued: August 23, 2012

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

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

SAR result with Head TSL

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

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

Body TSL parameters

The following parameters and calculations were applied.

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

SAR result with Body TSL

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

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

Appendix

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.389 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 17, 2004

DASY5 Validation Report for Head TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

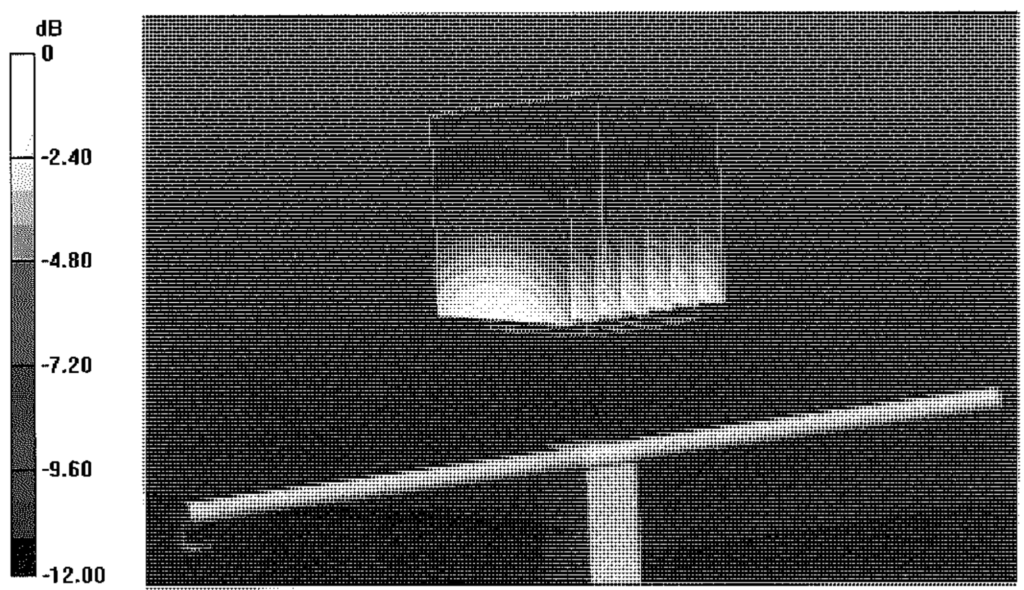
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d026

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

DASY52 Configuration:

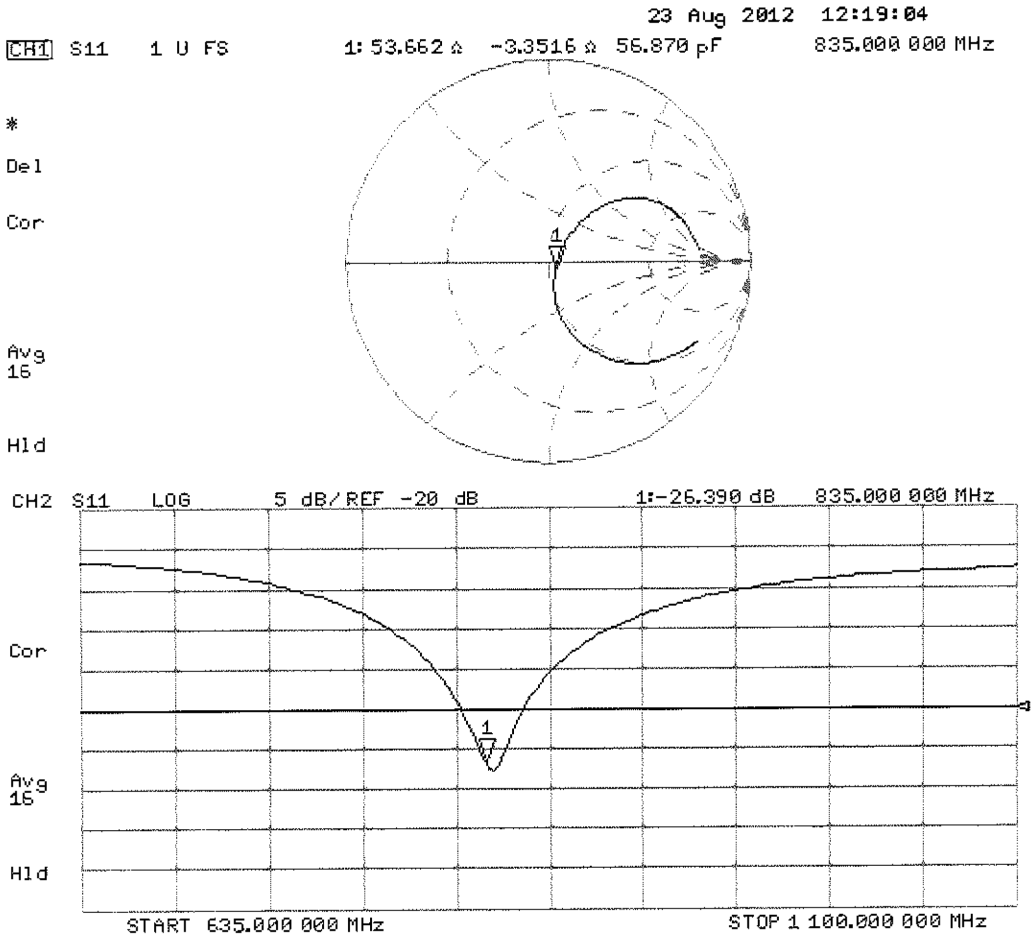
- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

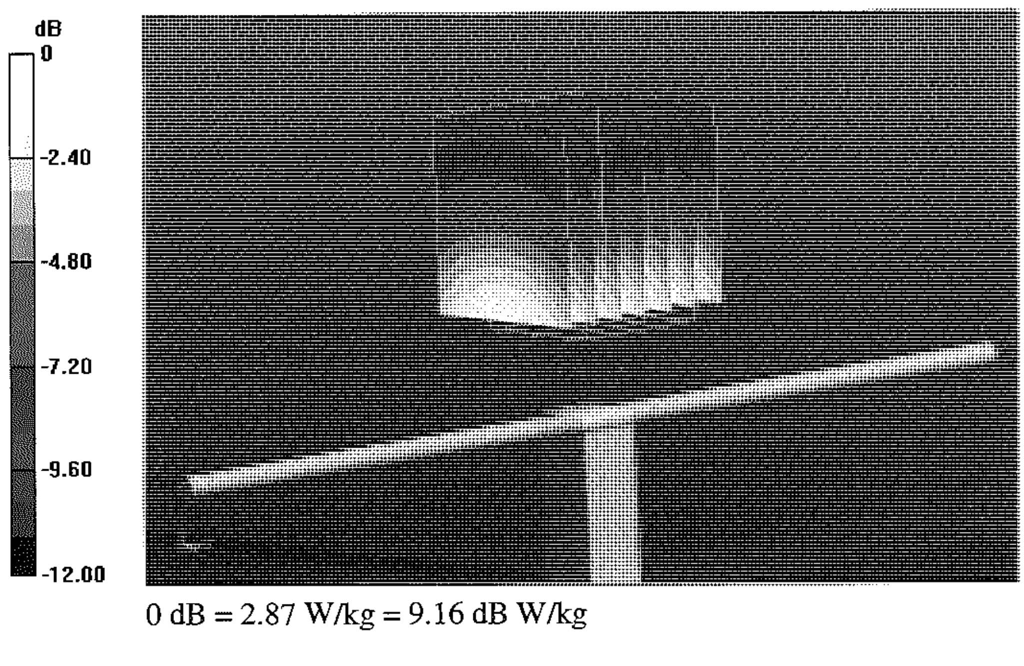
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d026

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

DASY52 Configuration:

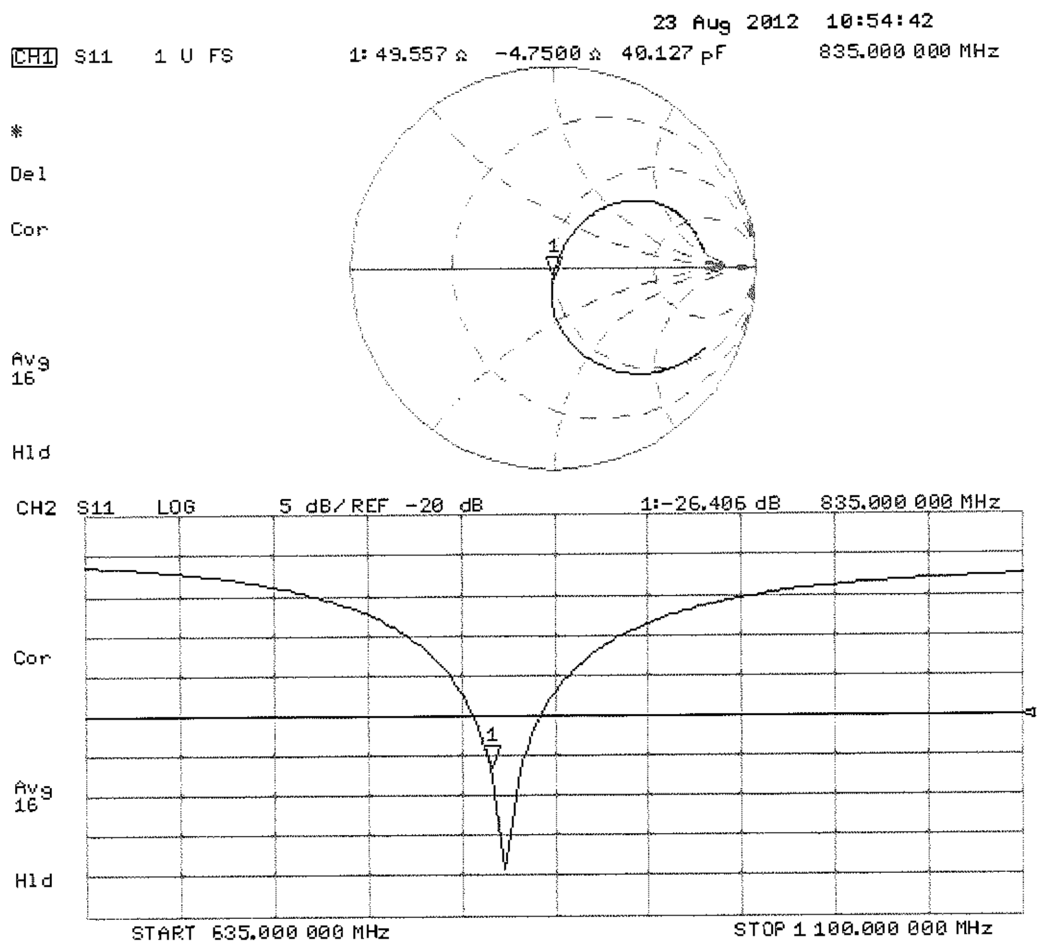
- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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



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

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D2450V2-797_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 ± 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	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 8, 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	V52.8.4
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 ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.9 ± 6 %	1.85 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.5 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.5 ± 6 %	2.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**49.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.88 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.2 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.3 Ω + 3.1 jΩ
Return Loss	- 27.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.1 Ω + 4.9 jΩ
Return Loss	- 26.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 24, 2006

DASY5 Validation Report for Head TSL

Date: 08.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

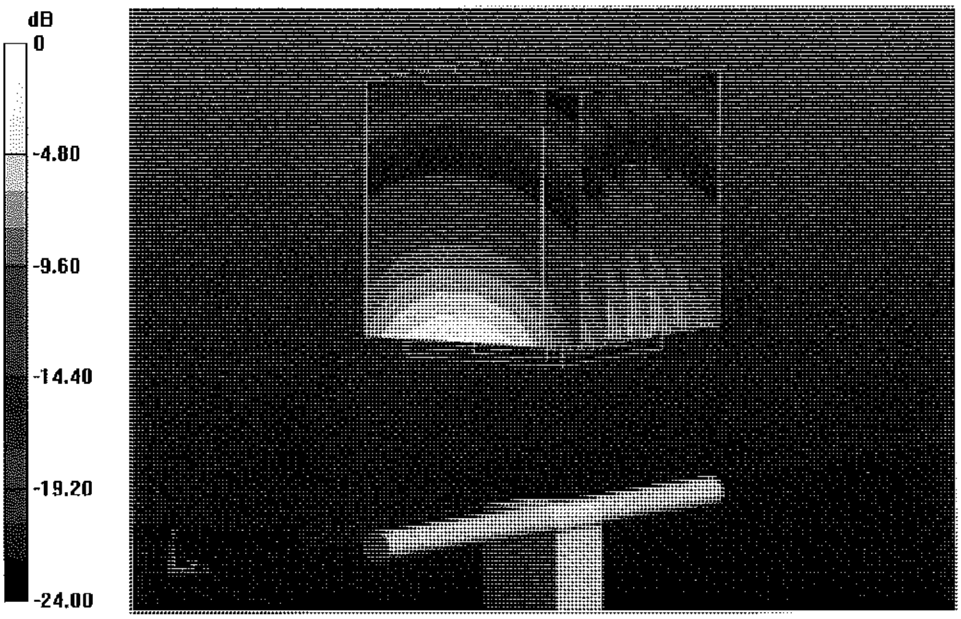
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.85 S/m; ε_r = 37.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(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)

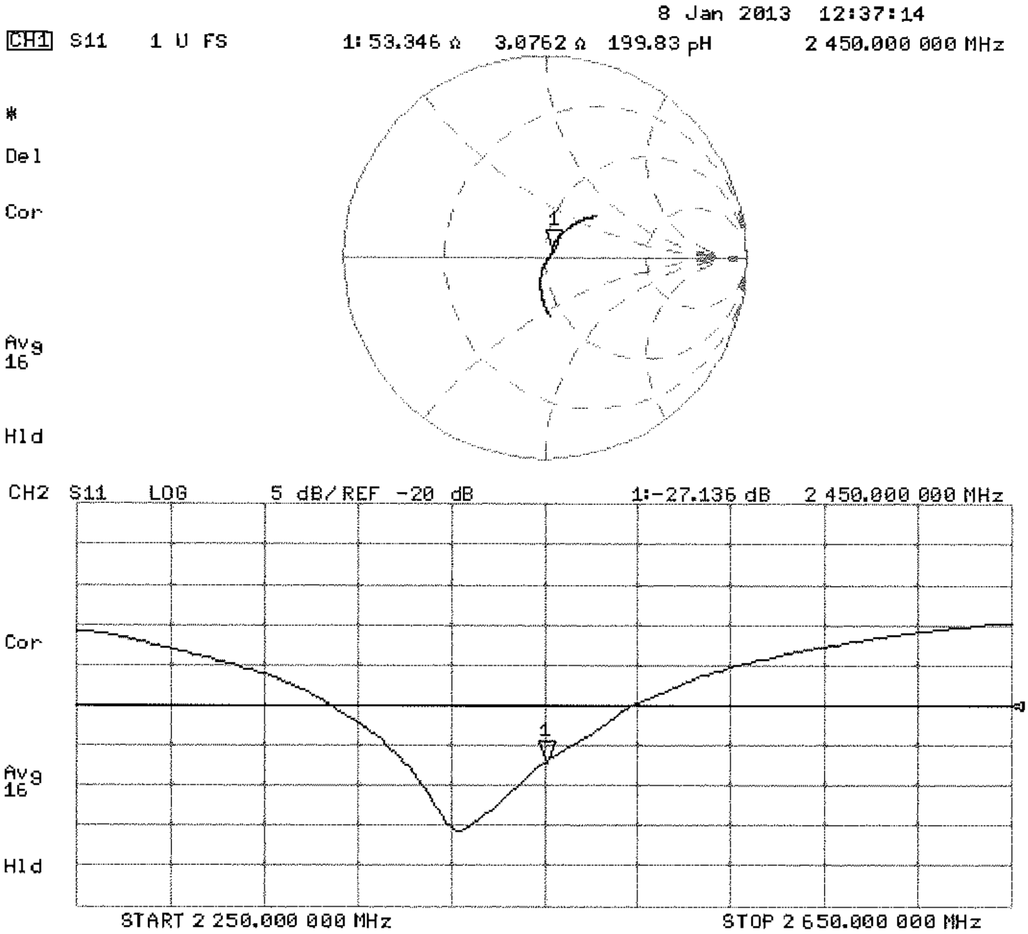
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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



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

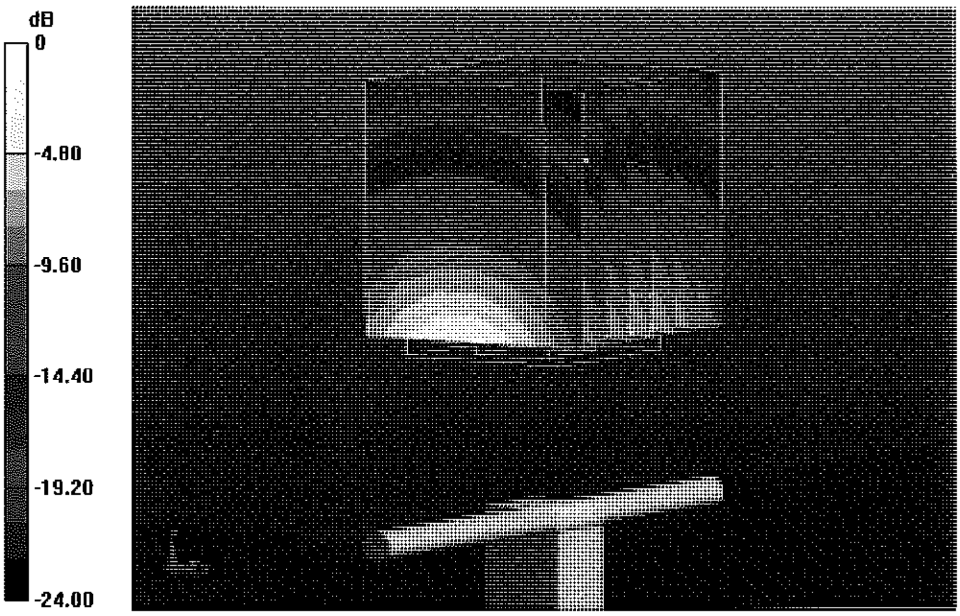
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma = 2.01$ S/m; $\varepsilon_r = 50.5$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 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)

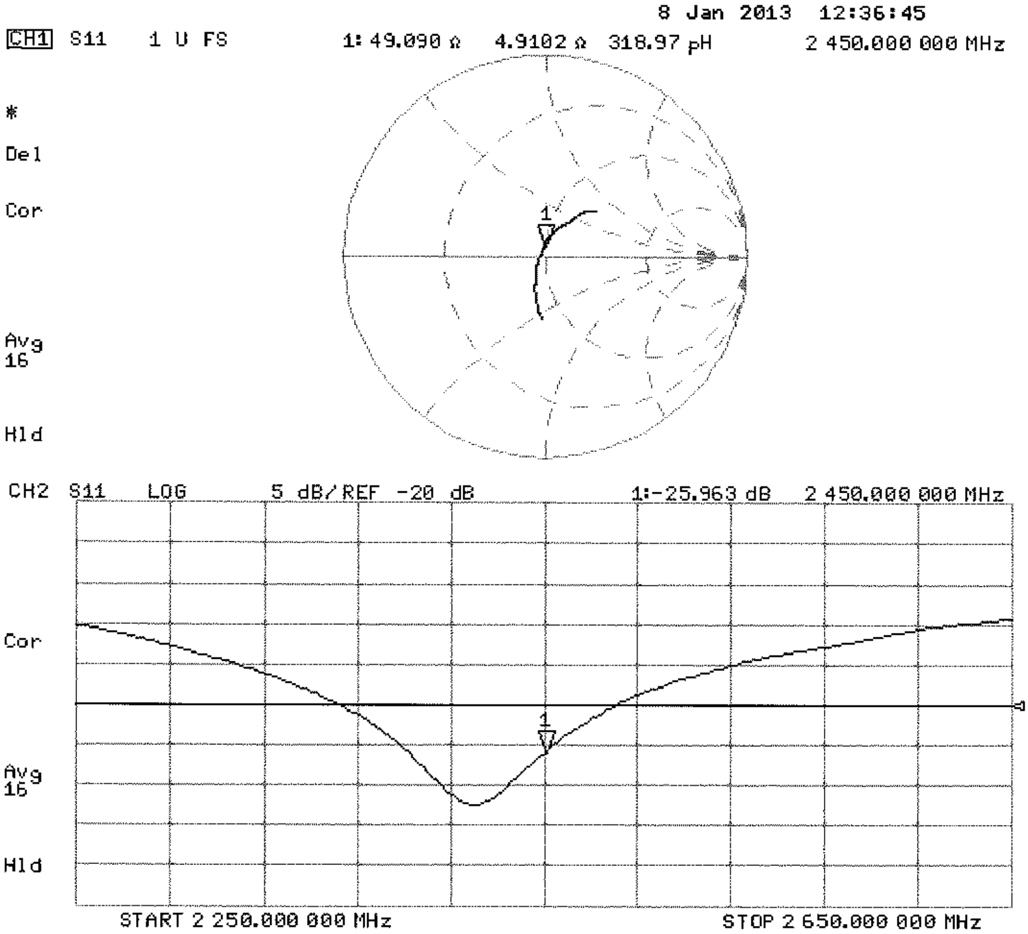
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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



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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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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 1/28/13

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 ± 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

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

Issued: January 11, 2013

Glossary:

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

Calibration is Performed According to the Following Standards:

a) 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 ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	4.50 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.66 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**75.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.4 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 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 cm^3 (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 cm^3 (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 cm^3 (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 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.3 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 jΩ
Return Loss	- 20.3 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	48.5 Ω - 4.5 jΩ
Return Loss	- 26.4 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	50.6 Ω - 5.8 jΩ
Return Loss	- 24.8 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	53.9 Ω - 3.8 jΩ
Return Loss	- 25.6 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	52.5 Ω - 4.4 jΩ
Return Loss	- 26.1 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	49.3 Ω - 7.9 jΩ
Return Loss	- 22.0 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	48.7 Ω - 3.2 jΩ
Return Loss	- 29.2 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	51.2 Ω - 4.8 jΩ
Return Loss	- 26.2 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	53.6 Ω - 2.1 jΩ
Return Loss	- 27.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	53.3 Ω - 2.9 jΩ
Return Loss	- 27.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 27, 2006

DASY5 Validation Report for Head TSL

Date: 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; σ = 4.5 S/m; ε_r = 34.6; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 4.6 S/m; ε_r = 34.5; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.79 S/m; ε_r = 34.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.88 S/m; ε_r = 34.1; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.09 S/m; ε_r = 33.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 28.12.2012, ConvF(5.1, 5.1, 5.1); Calibrated: 28.12.2012, ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.76, 4.76, 4.76); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

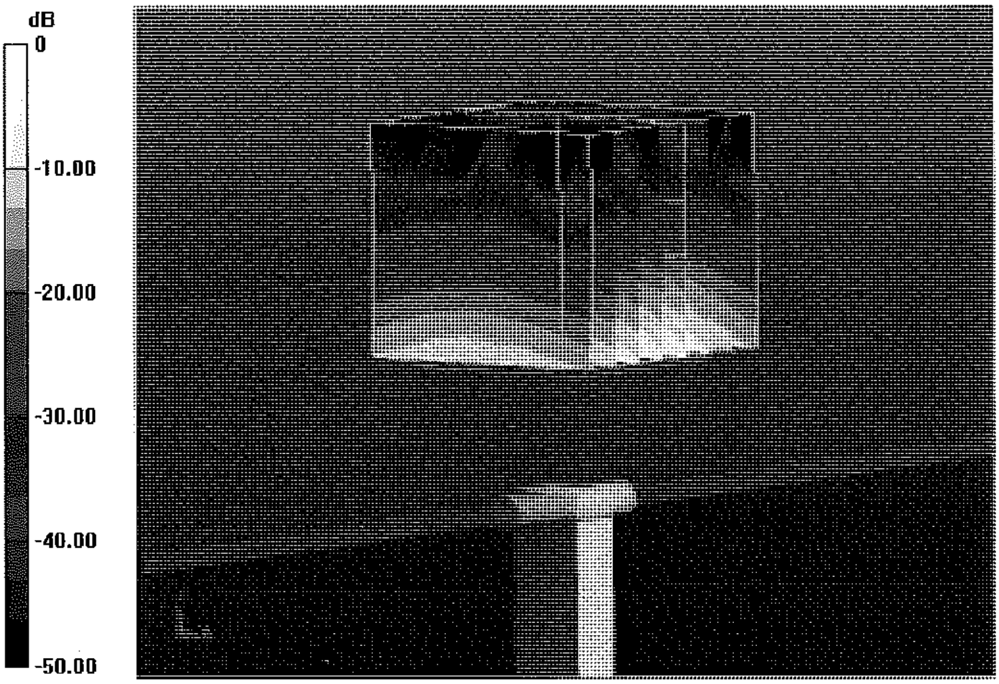
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.671 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 29.4 W/kg
SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (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

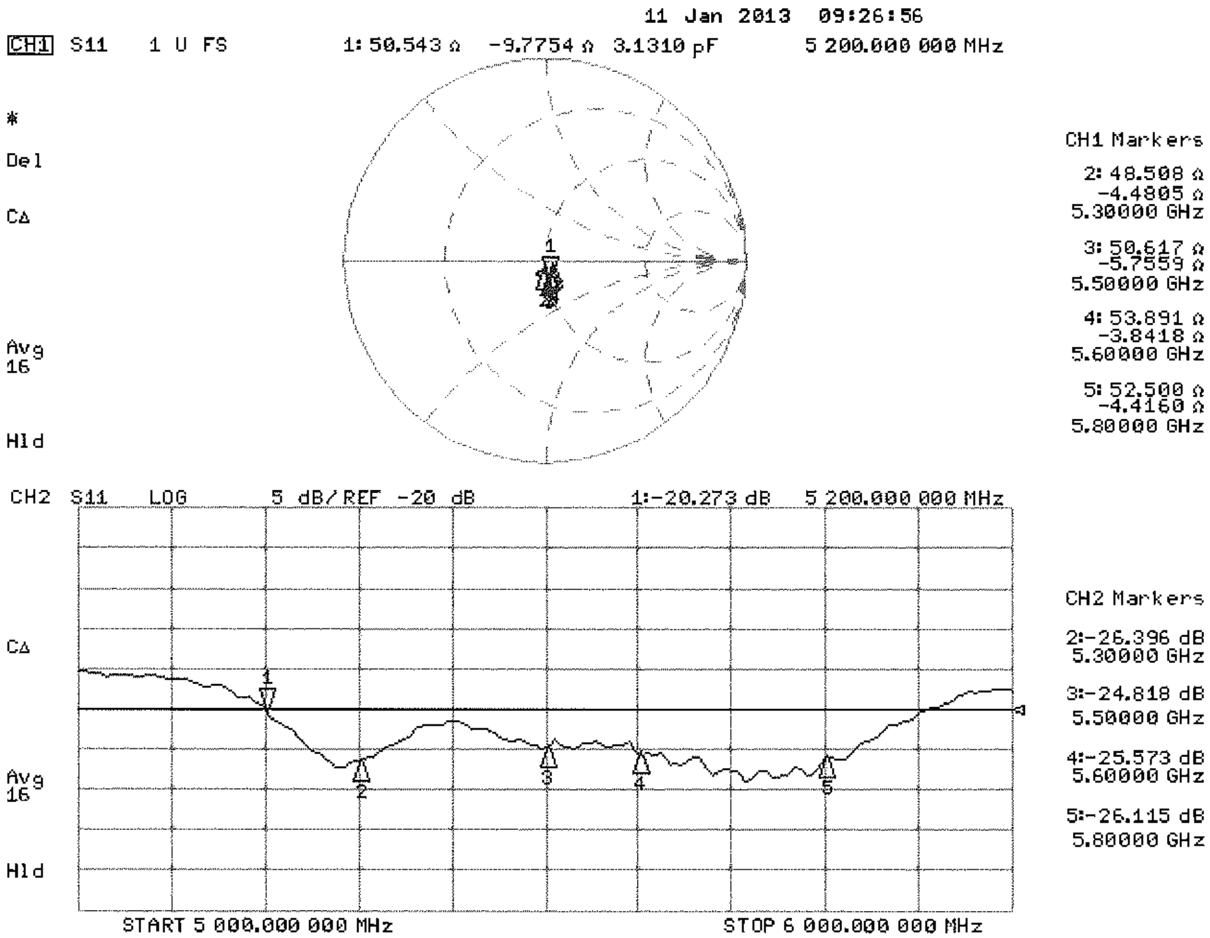
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.848 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 33.5 W/kg
SAR(1 g) = 8.12 W/kg; SAR(10 g) = 2.3 W/kg
Maximum value of SAR (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



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; $\varepsilon_r = 47$; $\rho = 1000$ kg/m^3 , Medium parameters used: f = 5300 MHz; $\sigma = 5.55$ S/m; $\varepsilon_r = 46.8$; $\rho = 1000$ kg/m^3 , Medium parameters used: f = 5500 MHz; $\sigma = 5.81$ S/m; $\varepsilon_r = 46.5$; $\rho = 1000$ kg/m^3 , Medium parameters used: f = 5600 MHz; $\sigma = 5.94$ S/m; $\varepsilon_r = 46.3$; $\rho = 1000$ kg/m^3 , Medium parameters used: f = 5800 MHz; $\sigma = 6.21$ S/m; $\varepsilon_r = 46$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.67, 4.67, 4.67); Calibrated: 28.12.2012, ConvF(4.43, 4.43, 4.43); Calibrated: 28.12.2012, ConvF(4.22, 4.22, 4.22); Calibrated: 28.12.2012, ConvF(4.38, 4.38, 4.38); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

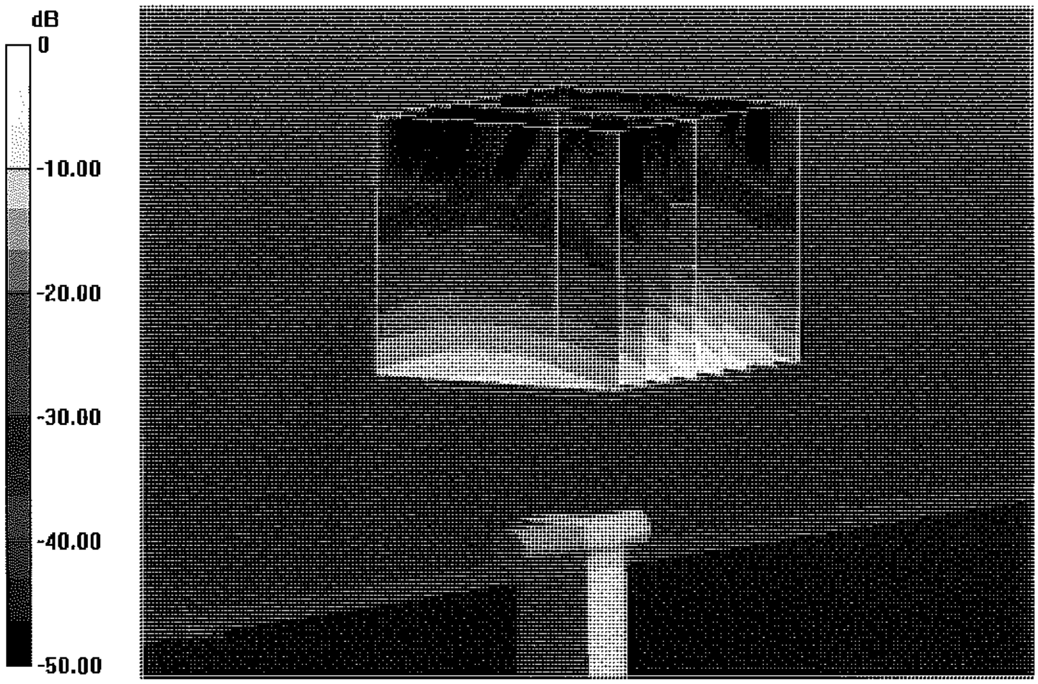
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 59.074 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 30.4 W/kg
SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.13 W/kg
Maximum value of SAR (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

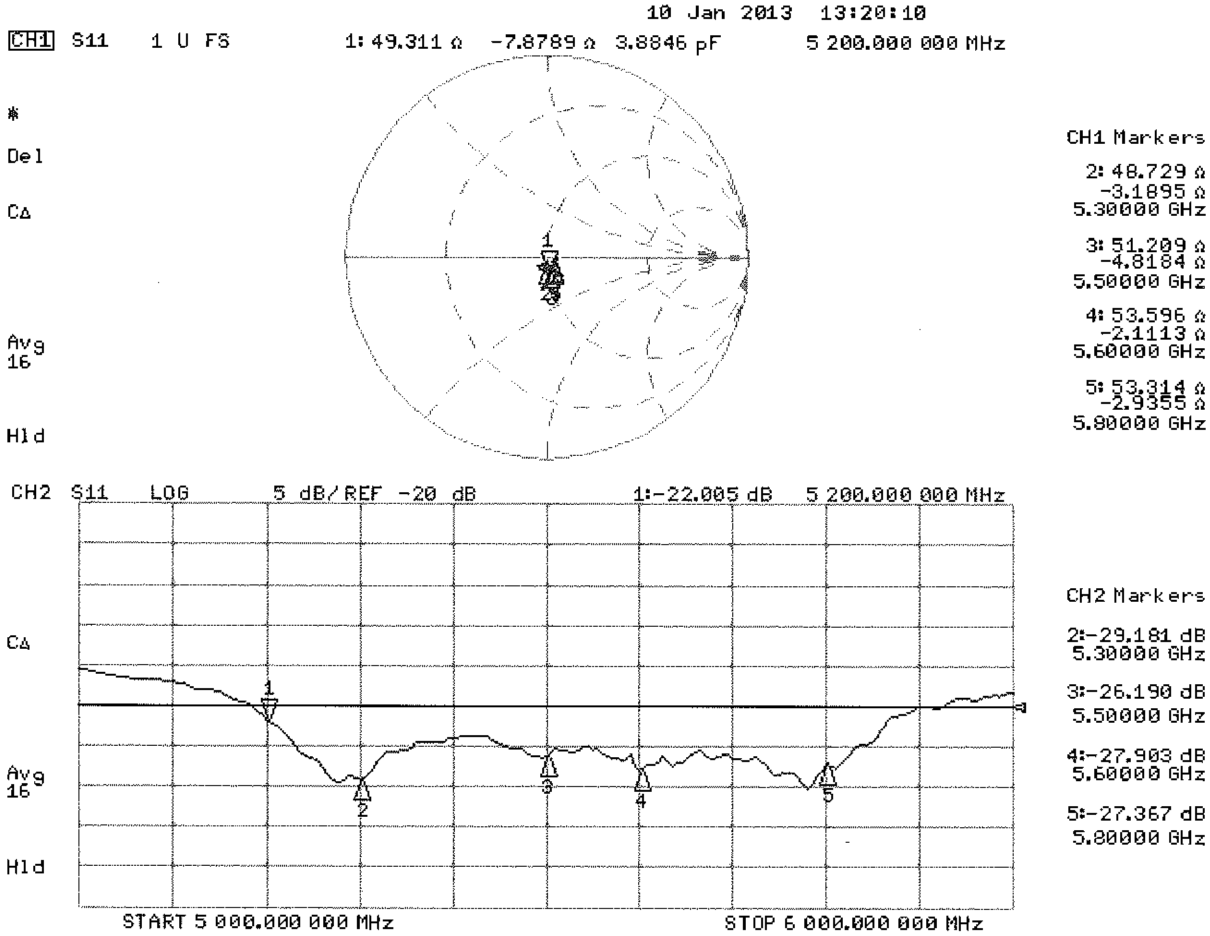
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.884 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 36.3 W/kg
SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR (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



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

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: ES3-3022_Aug12

CALIBRATION CERTIFICATE

Object: ES3DV2 - SN:3022

Calibration procedure(s): QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes

Calibration date: August 28, 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-11)	In house check: Oct-12

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

Issued: August 28, 2012

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,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., ϑ = 0 is normal to probe axis

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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*.
- *DCPx,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
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,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 *NORMx,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 ES3DV2

SN:3022

Manufactured: April 15, 2003
Calibrated: August 28, 2012

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.00	1.04	0.99	± 10.1 %
DCP (mV)[B]	98.3	99.5	101.3	

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	0.00	0.00	1.00	133.3	±2.7 %
			Y	0.00	0.00	1.00	140.3	
			Z	0.00	0.00	1.00	178.9	

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: ES3DV2 - SN:3022

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	6.30	6.30	6.30	0.30	1.72	± 12.0 %
835	41.5	0.90	6.03	6.03	6.03	0.35	1.63	± 12.0 %
1750	40.1	1.37	5.07	5.07	5.07	0.32	1.89	± 12.0 %
1900	40.0	1.40	4.86	4.86	4.86	0.40	1.57	± 12.0 %
2450	39.2	1.80	4.23	4.23	4.23	0.59	1.44	± 12.0 %
2600	39.0	1.96	4.10	4.10	4.10	0.67	1.37	± 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.

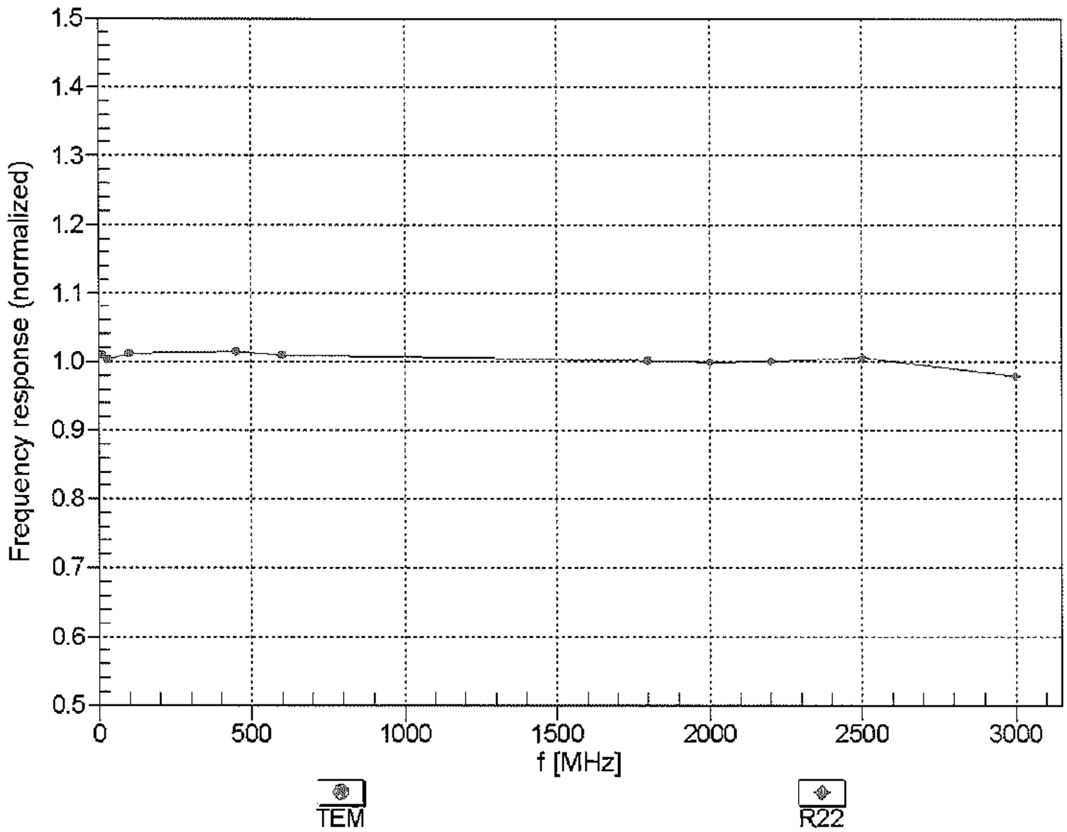
DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

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	6.07	6.07	6.07	0.23	2.09	± 12.0 %
835	55.2	0.97	6.02	6.02	6.02	0.47	1.44	± 12.0 %
1750	53.4	1.49	4.70	4.70	4.70	0.46	1.55	± 12.0 %
1900	53.3	1.52	4.43	4.43	4.43	0.36	1.87	± 12.0 %
2450	52.7	1.95	3.97	3.97	3.97	0.65	1.06	± 12.0 %
2600	52.5	2.16	3.80	3.80	3.80	0.54	0.75	± 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.

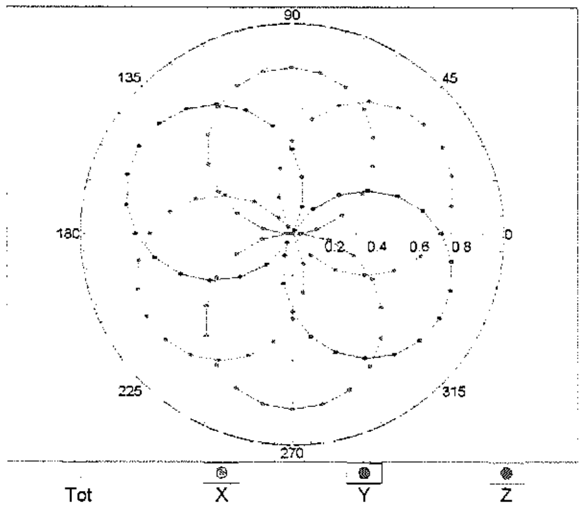
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



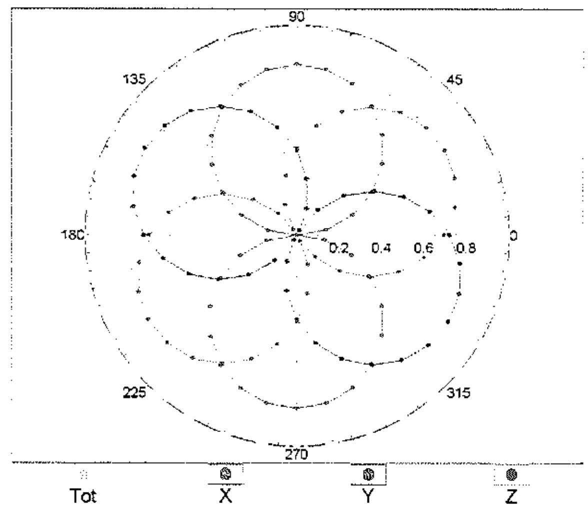
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

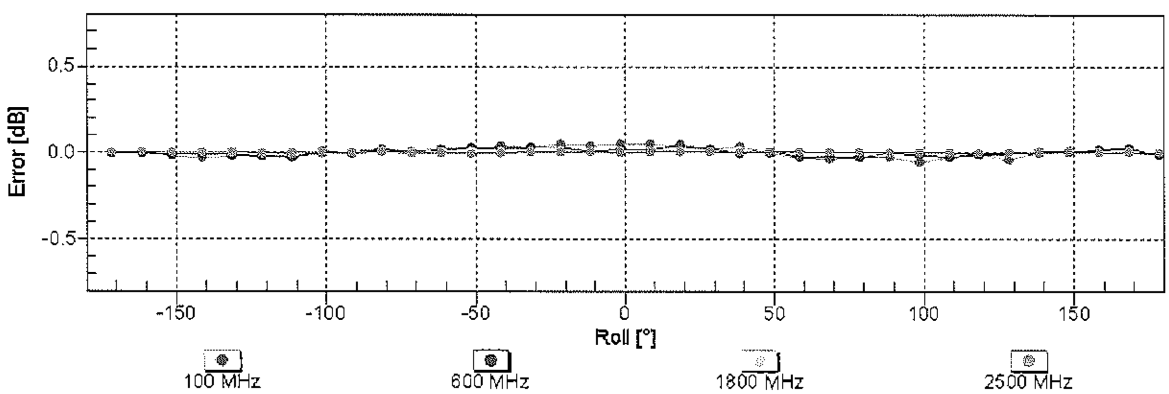
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

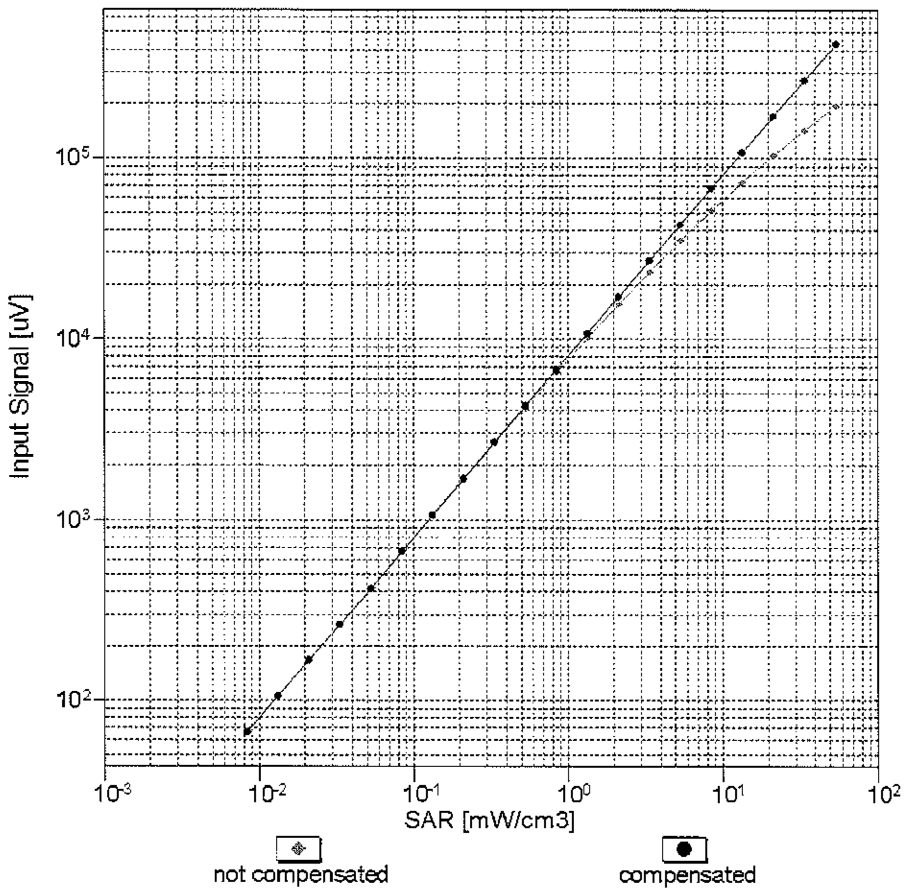


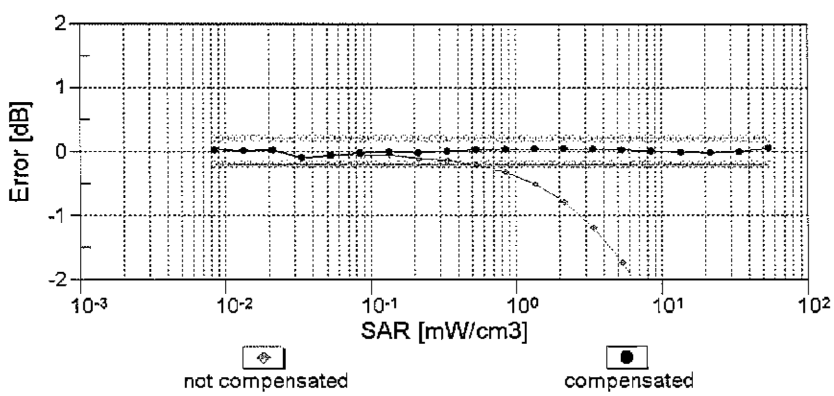


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

(TEM cell , f = 900 MHz)

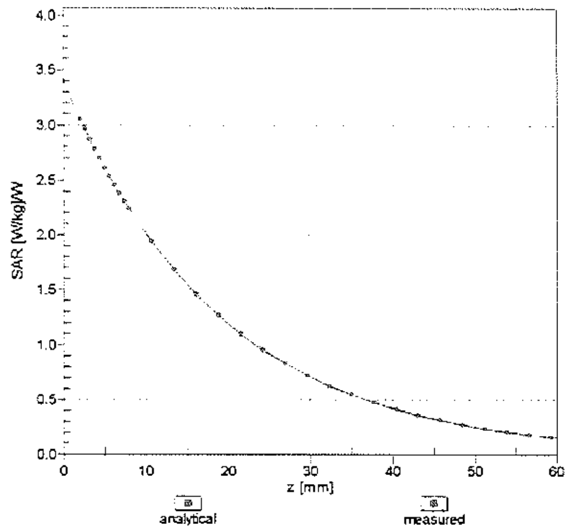




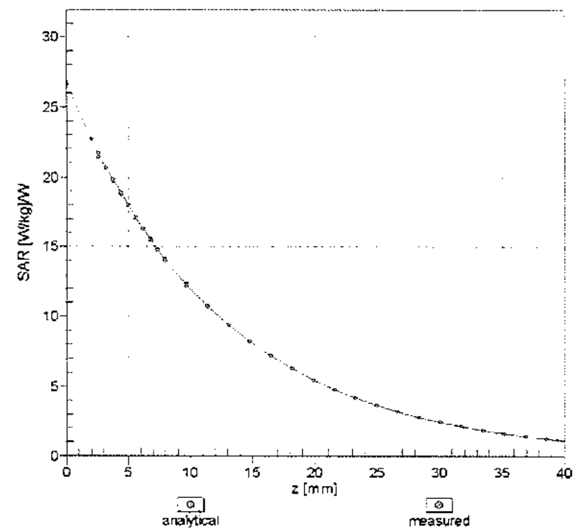
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

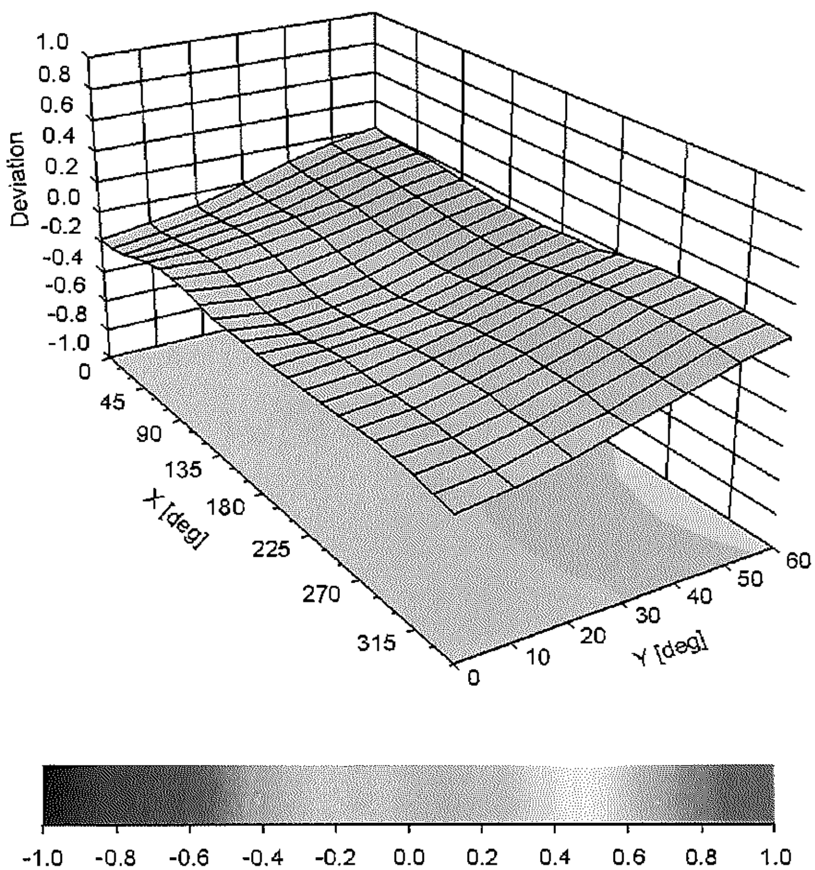


f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	98.5
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: EX3-3920_Feb13/2

CALIBRATION CERTIFICATE (Replacement of No: EX3-3920_Feb13)

Object	EX3DV4 - SN:3920
Calibration procedure(s)	QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	February 27, 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%.

✓ YOK 3/22/13

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	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

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 5, 2013

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,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., ϑ = 0 is normal to probe axis

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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*.
- *DCPx,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
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 ≤ 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 *NORMx,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 EX3DV4

SN:3920

Manufactured: December 18, 2012
Calibrated: February 27, 2013

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.34	0.50	0.50	± 10.1 %
DCP (mV)[B]	101.2	101.0	99.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	134.3	±3.3 %
		Y	0.0	0.0	1.0		164.7	
		Z	0.0	0.0	1.0		161.4	

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: EX3DV4 - SN:3920

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	9.86	9.86	9.86	0.19	1.39	± 12.0 %
835	41.5	0.90	9.58	9.58	9.58	0.77	0.54	± 12.0 %
1750	40.1	1.37	7.97	7.97	7.97	0.57	0.69	± 12.0 %
1900	40.0	1.40	7.73	7.73	7.73	0.54	0.73	± 12.0 %
2450	39.2	1.80	7.04	7.04	7.04	0.40	0.82	± 12.0 %
2600	39.0	1.96	6.80	6.80	6.80	0.49	0.76	± 12.0 %
5200	36.0	4.66	4.87	4.87	4.87	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.73	4.73	4.73	0.37	1.80	± 13.1 %
5500	35.6	4.96	4.52	4.52	4.52	0.39	1.80	± 13.1 %
5600	35.5	5.07	4.17	4.17	4.17	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.02	4.02	4.02	0.45	1.80	± 13.1 %

[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: EX3DV4 - SN:3920

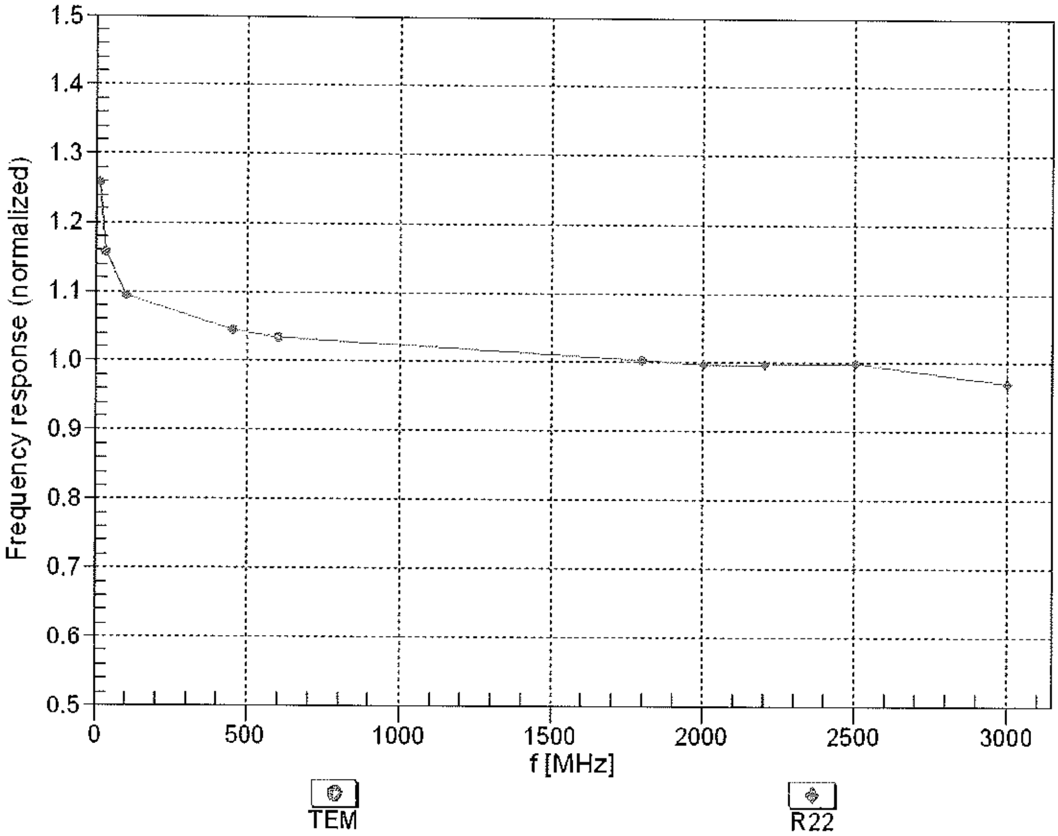
Calibration Parameter Determined in Body Tissue Simulating Media

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	9.57	9.57	9.57	0.43	0.83	± 12.0 %
835	55.2	0.97	9.42	9.42	9.42	0.36	0.98	± 12.0 %
1750	53.4	1.49	7.59	7.59	7.59	0.43	0.78	± 12.0 %
1900	53.3	1.52	7.38	7.38	7.38	0.33	0.91	± 12.0 %
2450	52.7	1.95	7.07	7.07	7.07	0.80	0.55	± 12.0 %
2600	52.5	2.16	6.73	6.73	6.73	0.80	0.56	± 12.0 %
5200	49.0	5.30	4.23	4.23	4.23	0.51	1.90	± 13.1 %
5300	48.9	5.42	4.13	4.13	4.13	0.49	1.90	± 13.1 %
5500	48.6	5.65	3.63	3.63	3.63	0.52	1.90	± 13.1 %
5600	48.5	5.77	3.62	3.62	3.62	0.49	1.90	± 13.1 %
5800	48.2	6.00	3.91	3.91	3.91	0.54	1.90	± 13.1 %

[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.

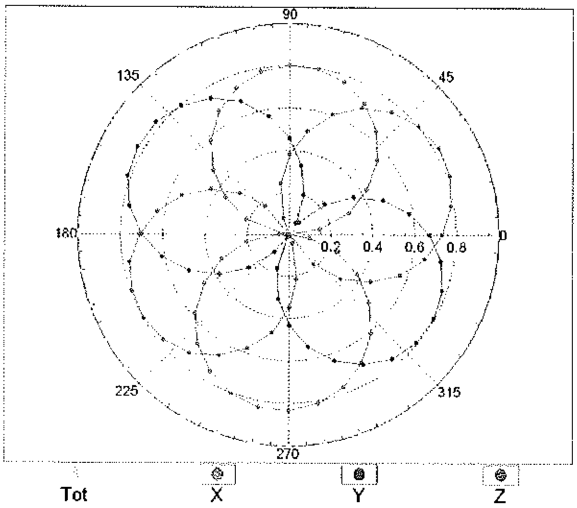
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



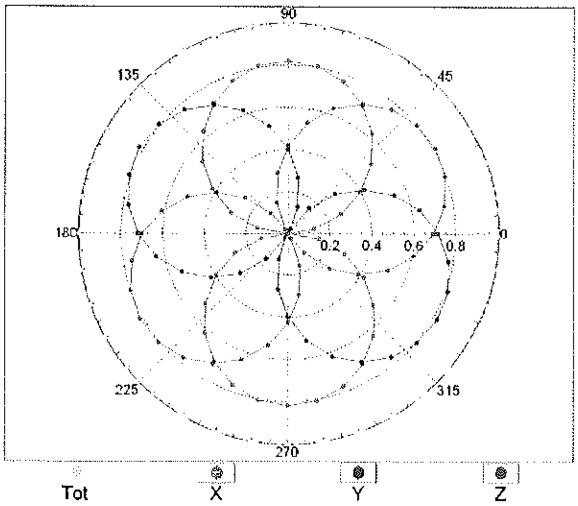
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

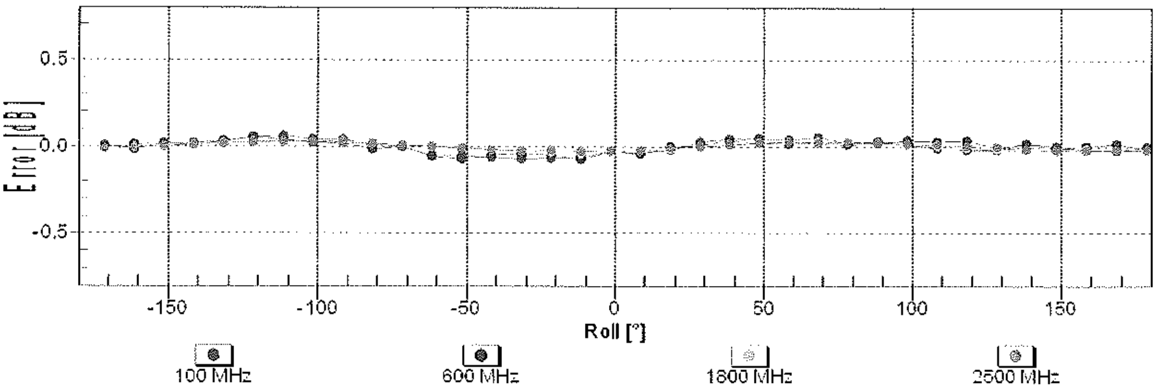
Receiving Pattern (φ), ϑ = 0°

f=600 MHz,TEM



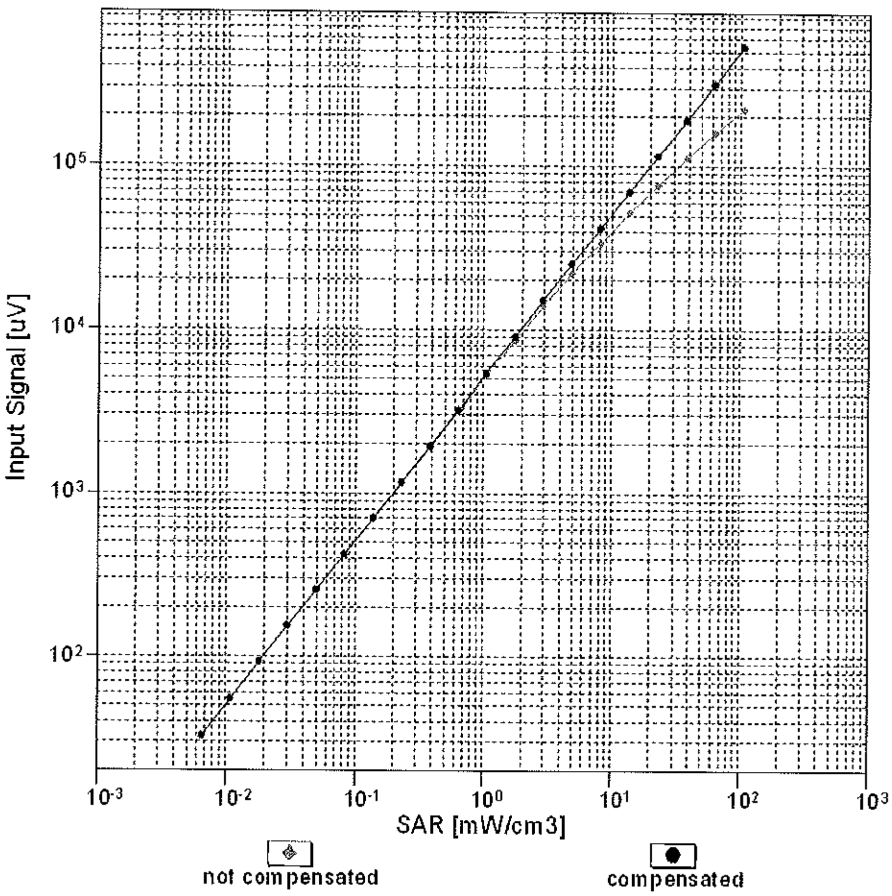
f=1800 MHz,R22

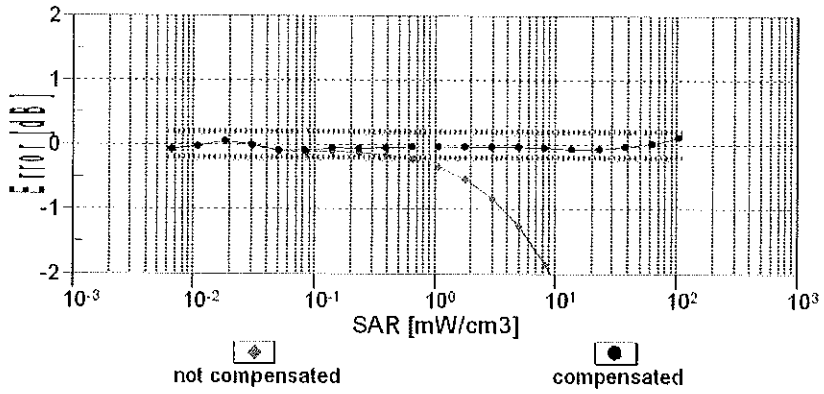




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

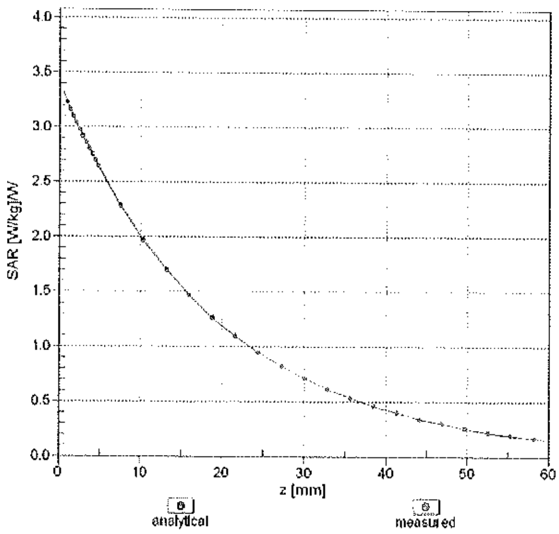




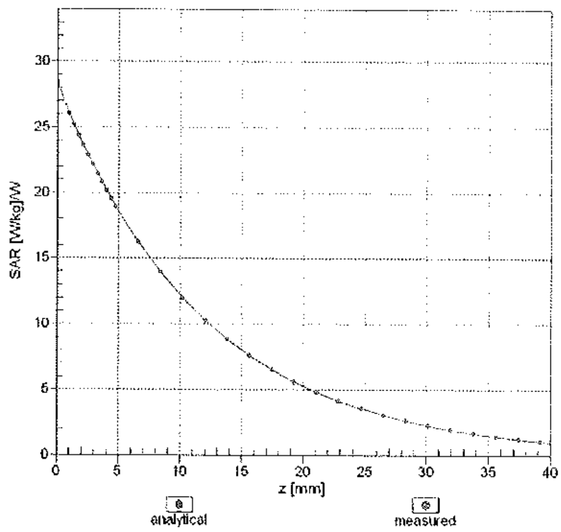
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

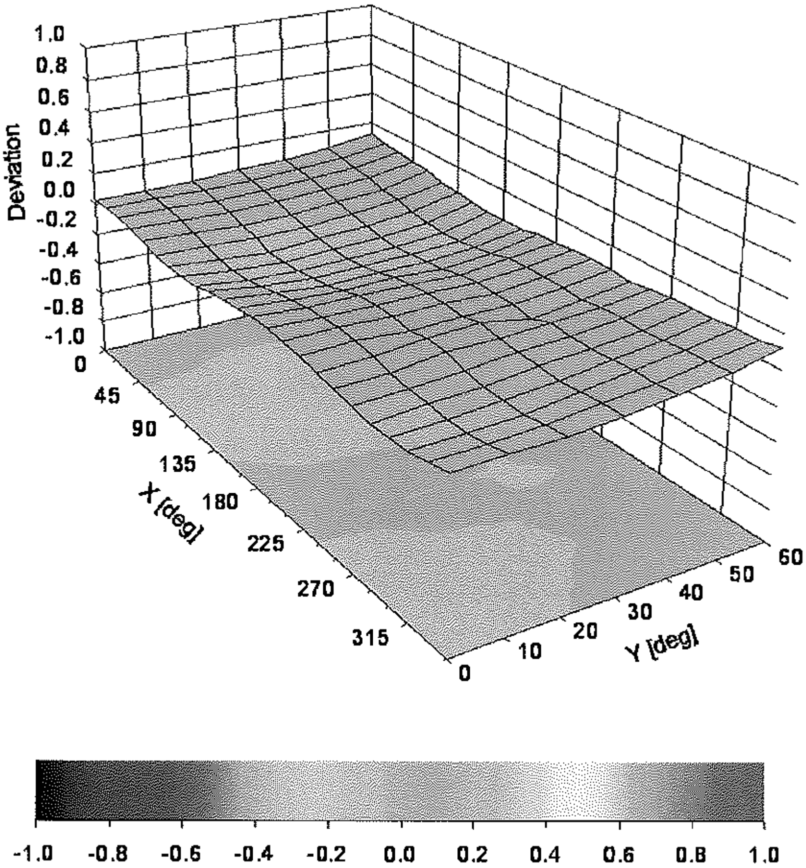


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-21.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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Swiss Calibration Service

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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **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)

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

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

Issued: March 15, 2013

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,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:

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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*.
- *DCPx,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
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 *NORMx,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 (μV/(V/m)^2)[A]	1.35	1.33	1.14	± 10.1 %
DCP (mV)[B]	99.2	97.8	98.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	163.6	±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.

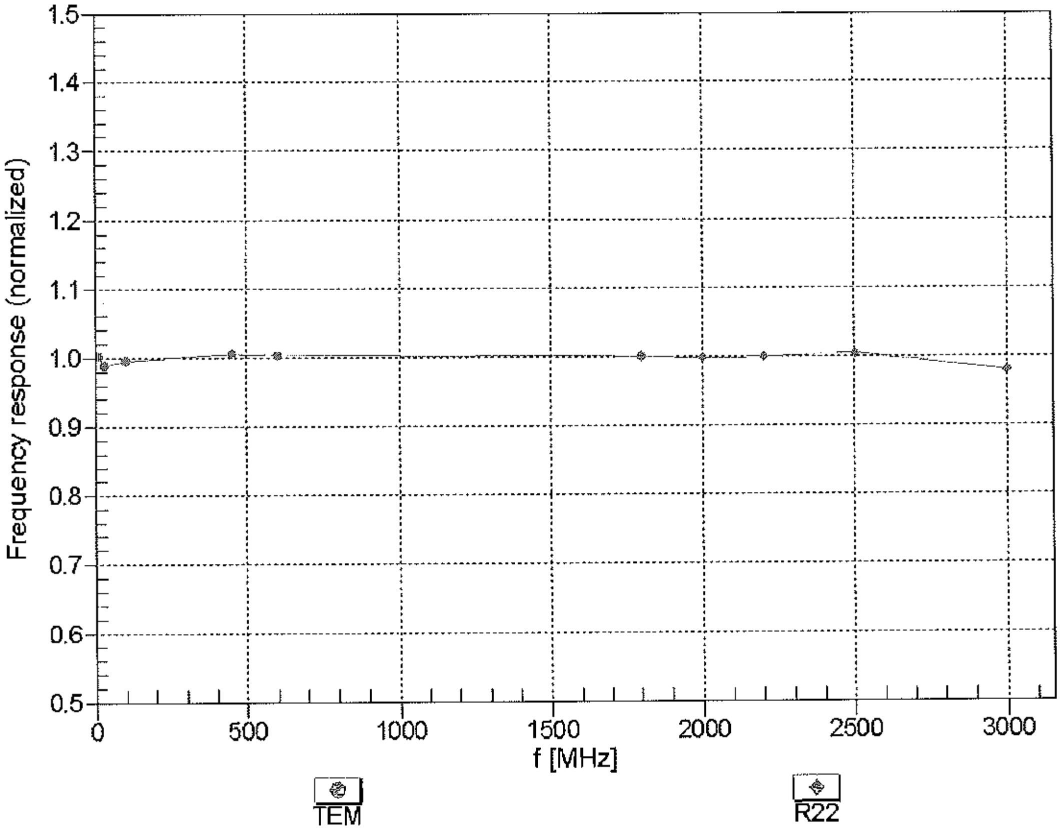
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

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.

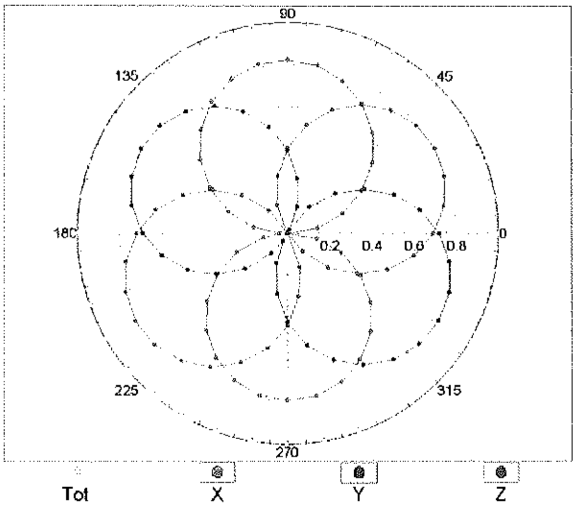
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



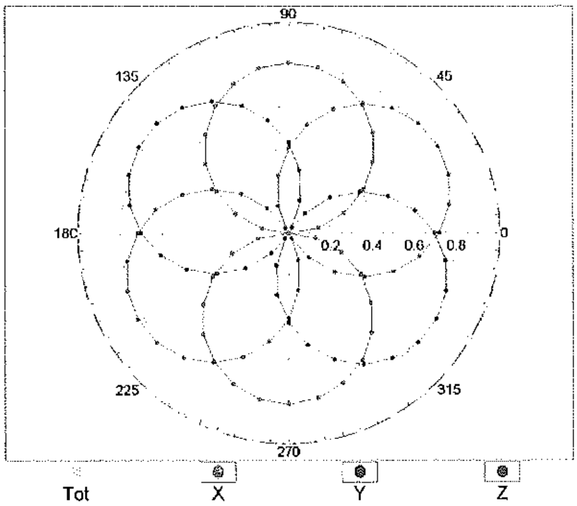
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

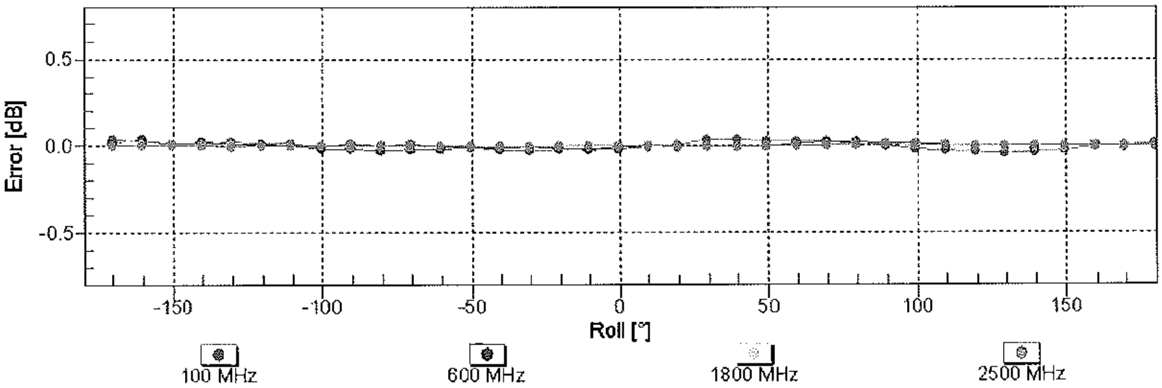
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



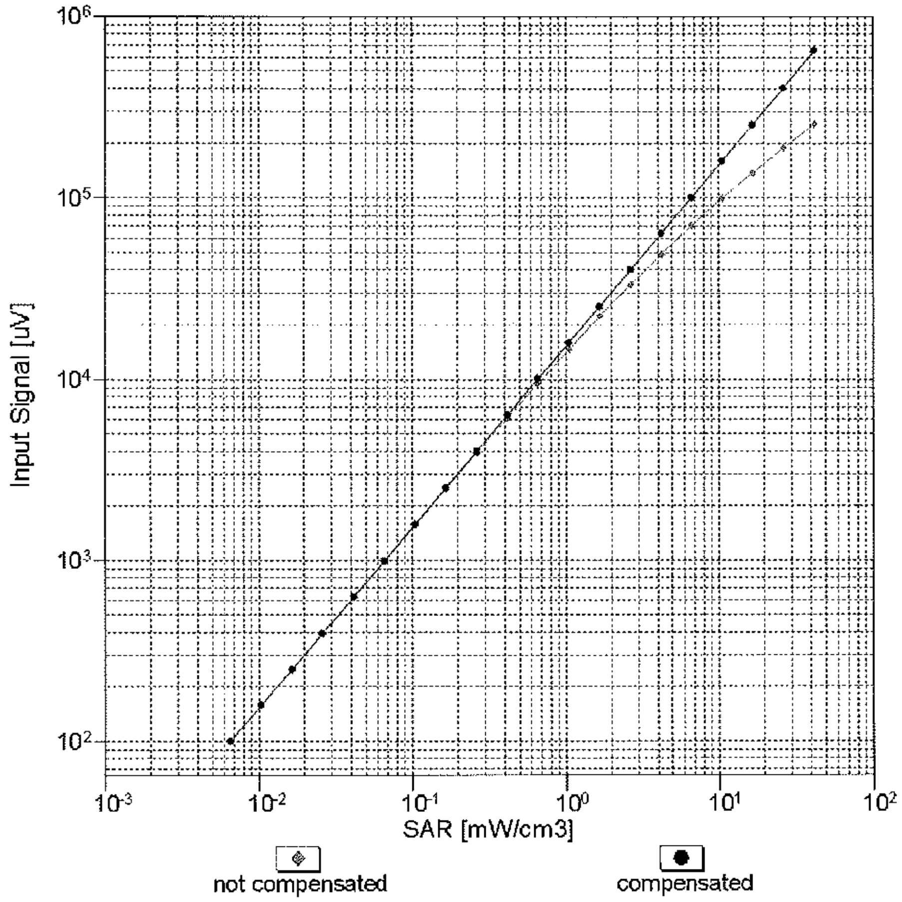
f=1800 MHz,R22

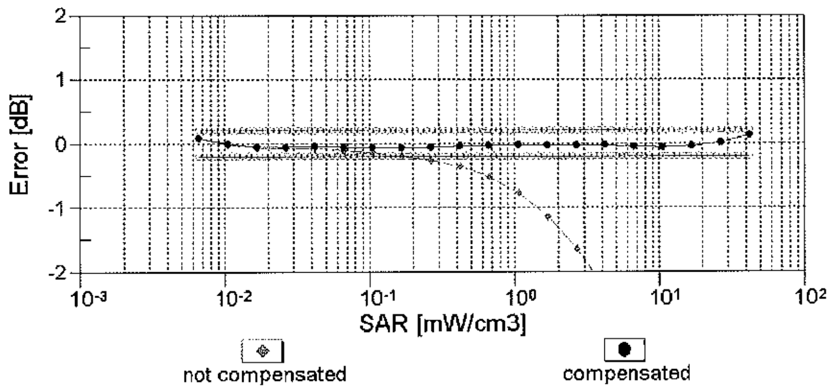




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

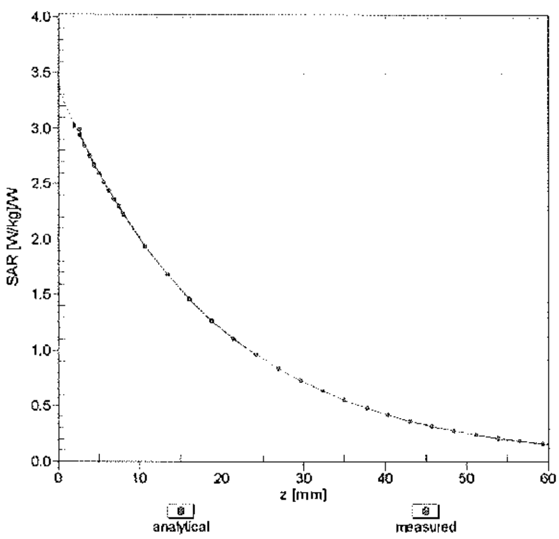
Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

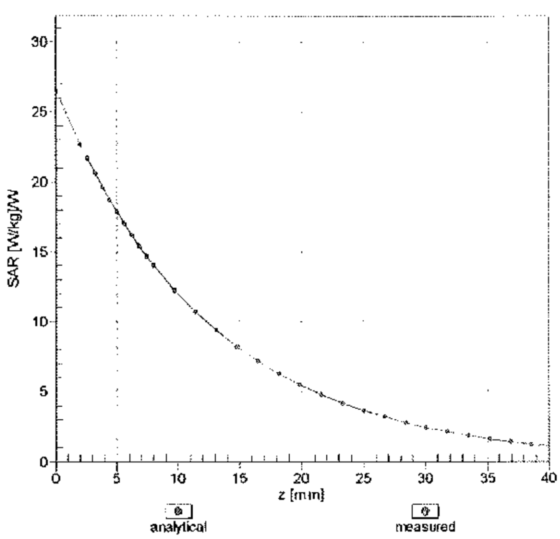




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

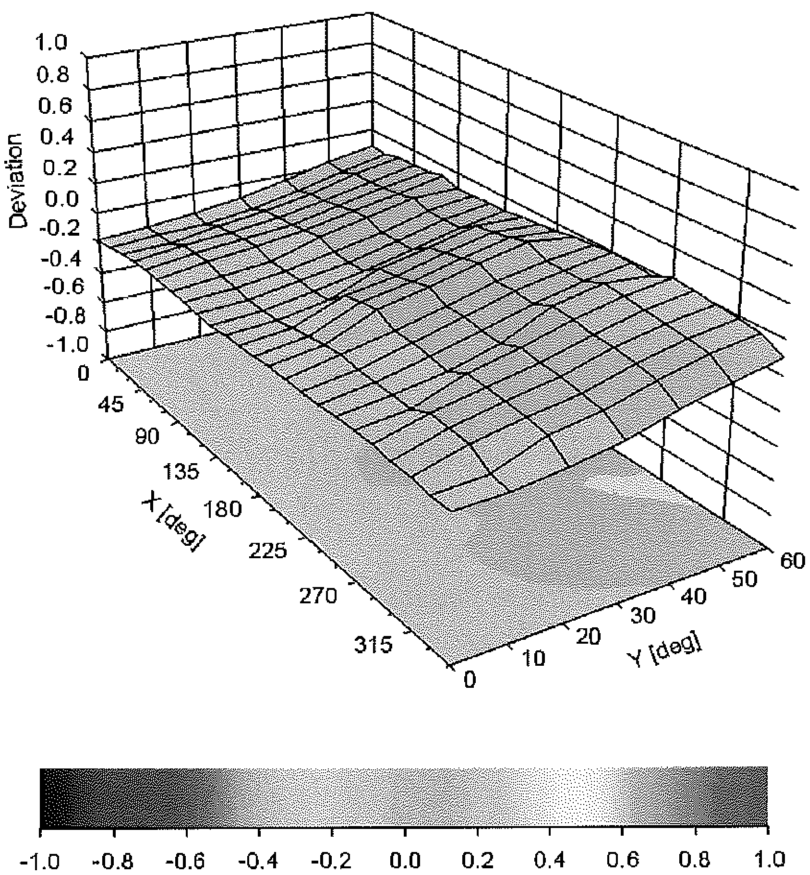
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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

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

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

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

Accreditation No.: SCS 108

Client PC Test

Certificate No: 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

√ KOK 11/20/12

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 16, 2012

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,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., ϑ = 0 is normal to probe axis

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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*.
- *DCPx,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
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,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 ≤ 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 *NORMx,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 ($\mu V/(V/m)^2$)[A]	1.31	1.25	1.25	± 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	±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.

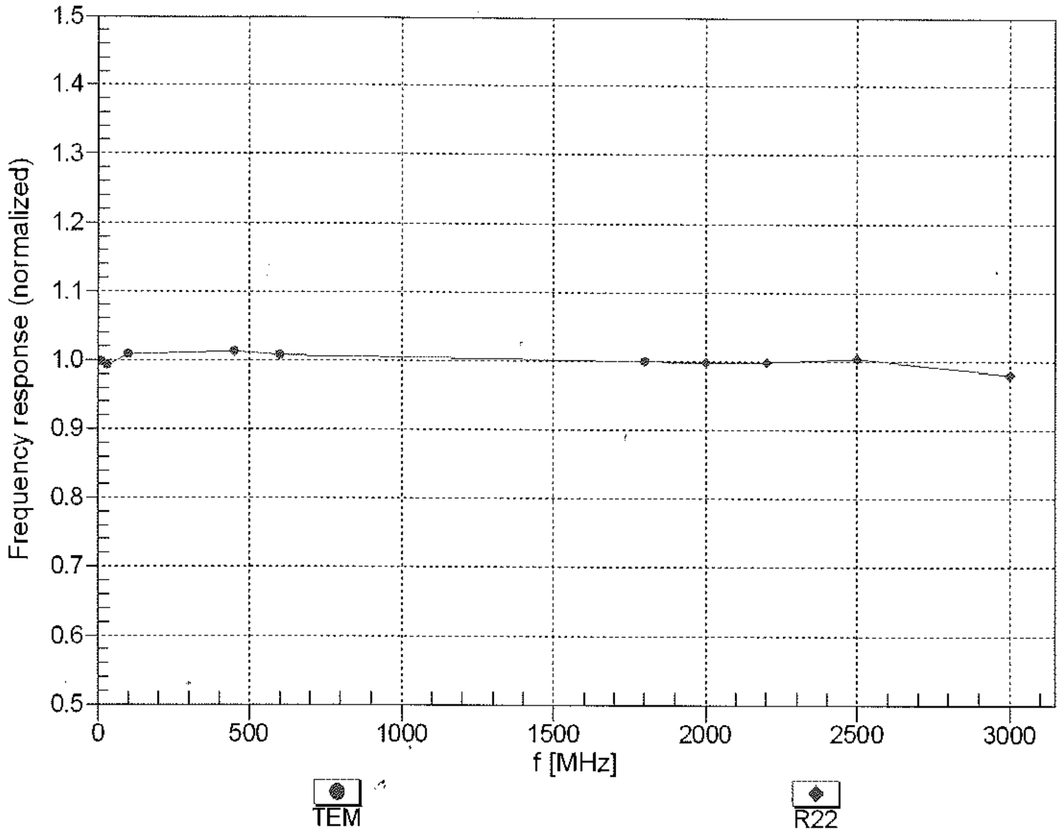
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

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.

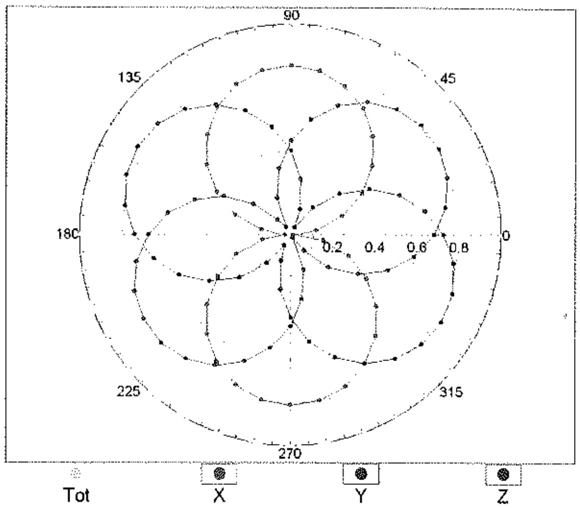
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



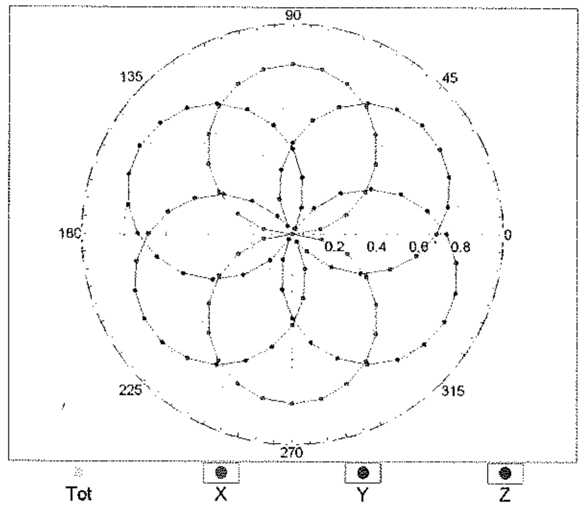
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

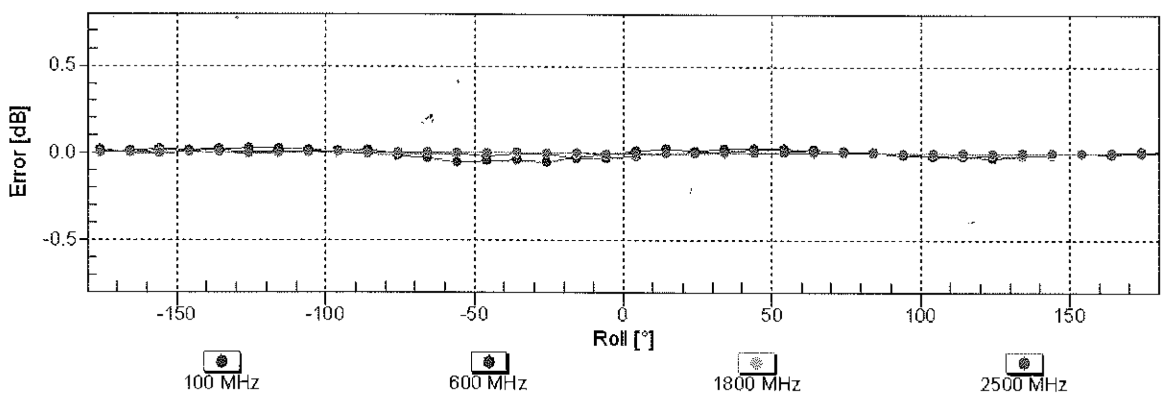
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



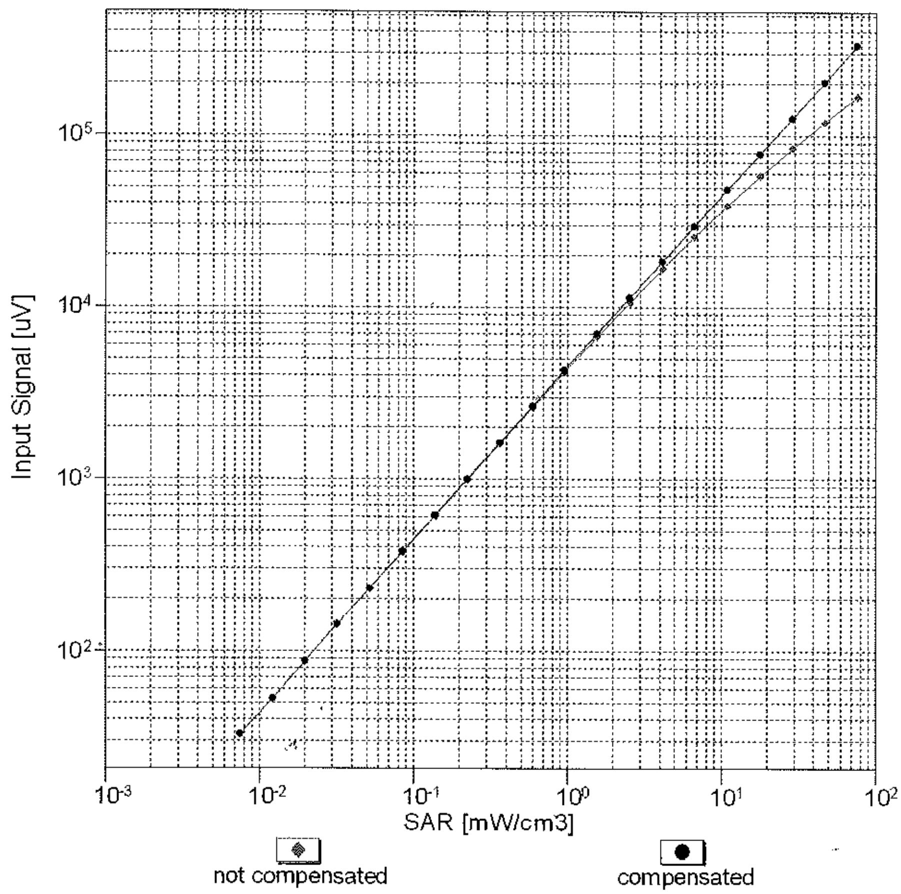
f=1800 MHz,R22

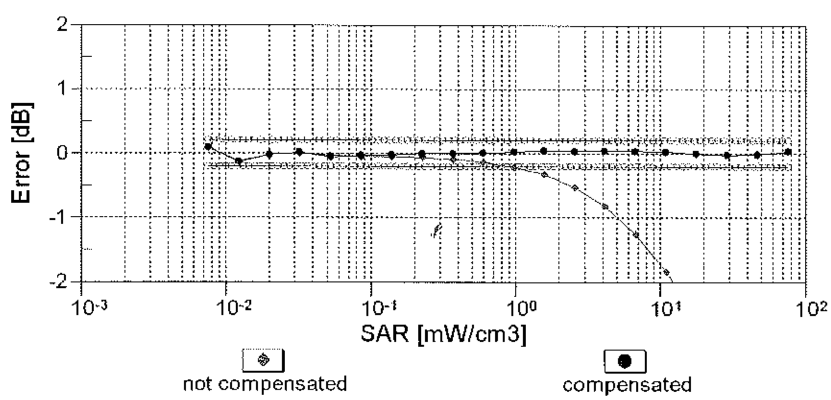




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

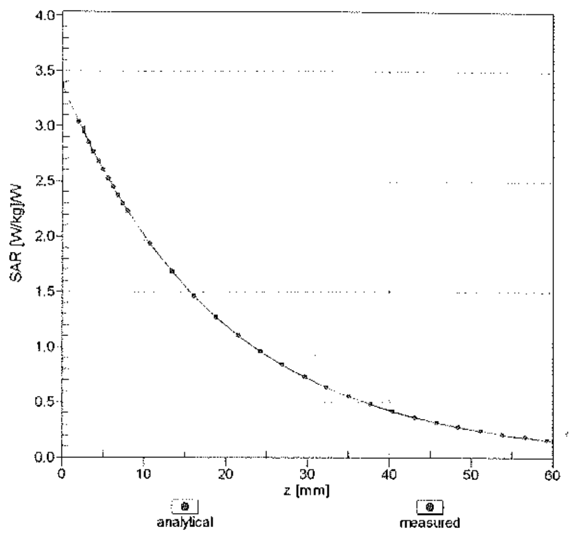




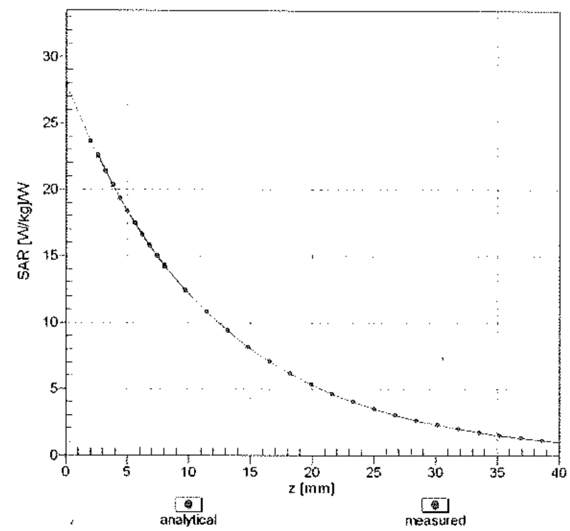
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

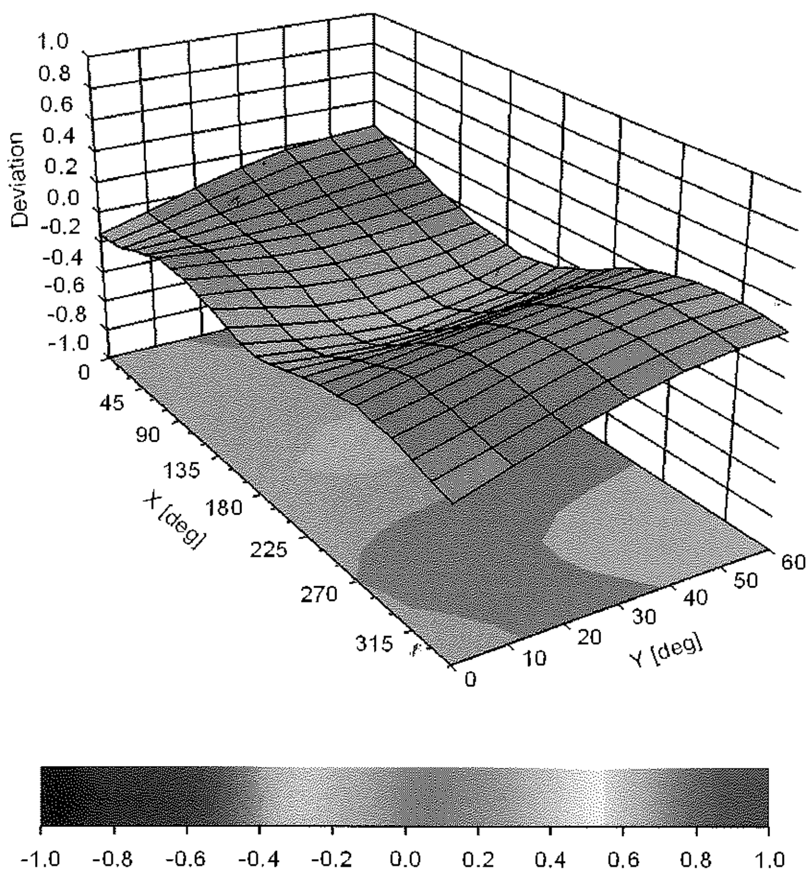


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 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

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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: EX3-3589_Jan13

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3589
Calibration procedure(s)	QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	January 17, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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	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

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

Issued: January 17, 2013

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

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

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

Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,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., ϑ = 0 is normal to probe axis

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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*.
- *DCPx,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
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 ≤ 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 *NORMx,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 EX3DV4

SN:3589

Manufactured: March 30, 2006
Calibrated: January 17, 2013

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.46	0.40	0.40	± 10.1 %
DCP (mV)[B]	100.5	103.8	99.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	165.8	±3.3 %
		Y	0.0	0.0	1.0		134.3	
		Z	0.0	0.0	1.0		140.5	

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: EX3DV4 - SN:3589

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	8.70	8.70	8.70	0.39	0.96	± 12.0 %
835	41.5	0.90	8.40	8.40	8.40	0.52	0.74	± 12.0 %
1750	40.1	1.37	7.34	7.34	7.34	0.45	0.93	± 12.0 %
1900	40.0	1.40	7.09	7.09	7.09	0.80	0.65	± 12.0 %
2450	39.2	1.80	6.37	6.37	6.37	0.39	0.97	± 12.0 %
2600	39.0	1.96	6.19	6.19	6.19	0.30	1.12	± 12.0 %
5200	36.0	4.66	4.48	4.48	4.48	0.45	1.80	± 13.1 %
5300	35.9	4.76	4.27	4.27	4.27	0.45	1.80	± 13.1 %
5500	35.6	4.96	4.14	4.14	4.14	0.50	1.80	± 13.1 %
5600	35.5	5.07	3.81	3.81	3.81	0.55	1.80	± 13.1 %
5800	35.3	5.27	3.85	3.85	3.85	0.55	1.80	± 13.1 %

[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.

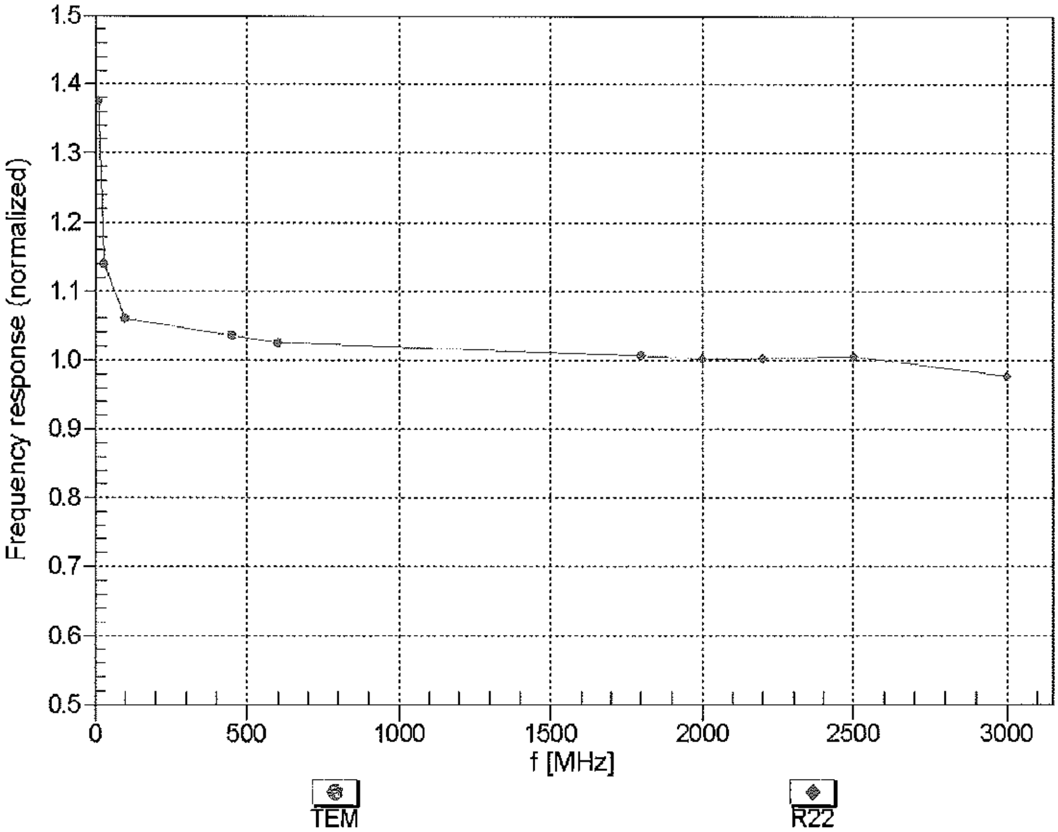
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

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	8.59	8.59	8.59	0.49	0.86	± 12.0 %
835	55.2	0.97	8.43	8.43	8.43	0.38	1.05	± 12.0 %
1750	53.4	1.49	7.87	7.87	7.87	0.44	0.89	± 12.0 %
1900	53.3	1.52	7.46	7.46	7.46	0.58	0.75	± 12.0 %
2450	52.7	1.95	7.07	7.07	7.07	0.80	0.50	± 12.0 %
2600	52.5	2.16	6.68	6.68	6.68	0.80	0.50	± 12.0 %
5200	49.0	5.30	3.99	3.99	3.99	0.50	1.90	± 13.1 %
5300	48.9	5.42	3.81	3.81	3.81	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.52	3.52	3.52	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.32	3.32	3.32	0.60	1.90	± 13.1 %
5800	48.2	6.00	3.66	3.66	3.66	0.60	1.90	± 13.1 %

[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.

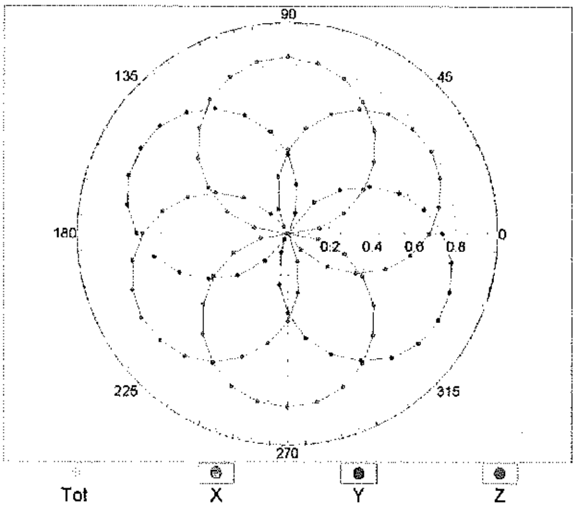
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



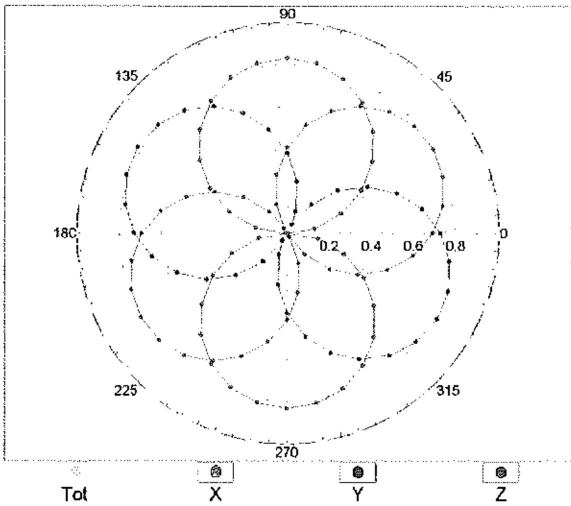
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

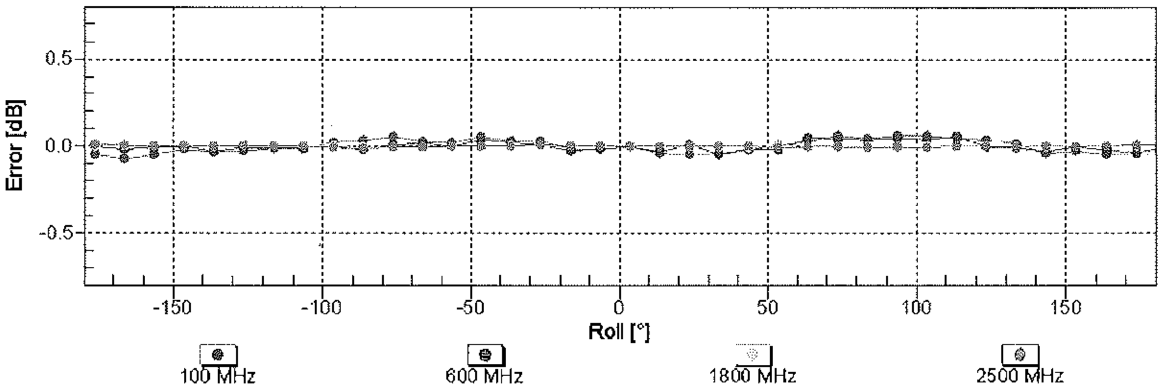
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



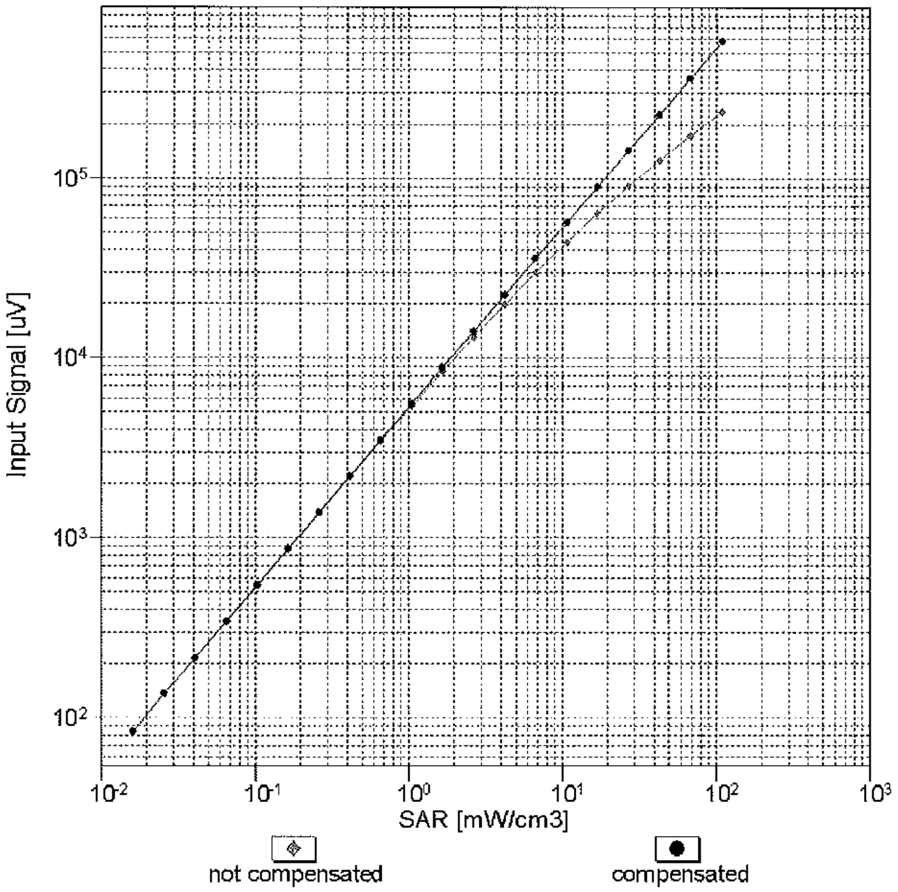
f=1800 MHz,R22

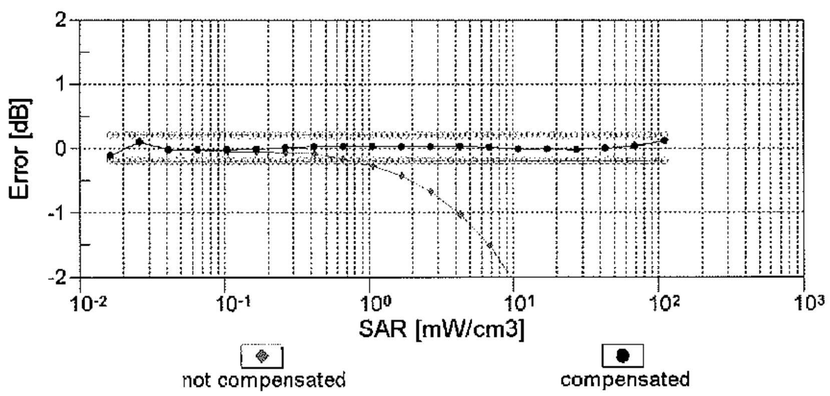




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

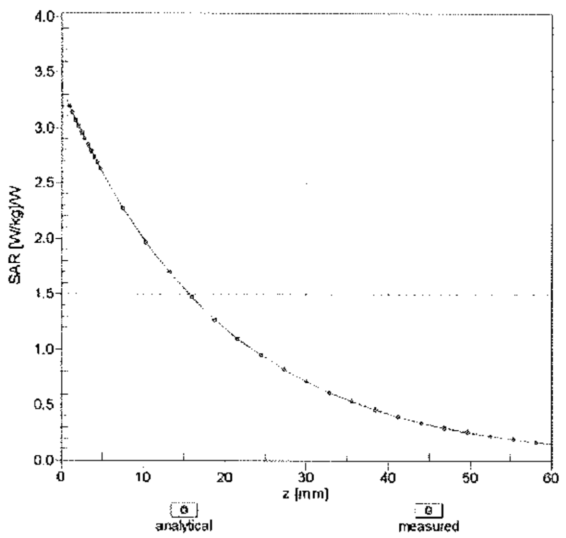
Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

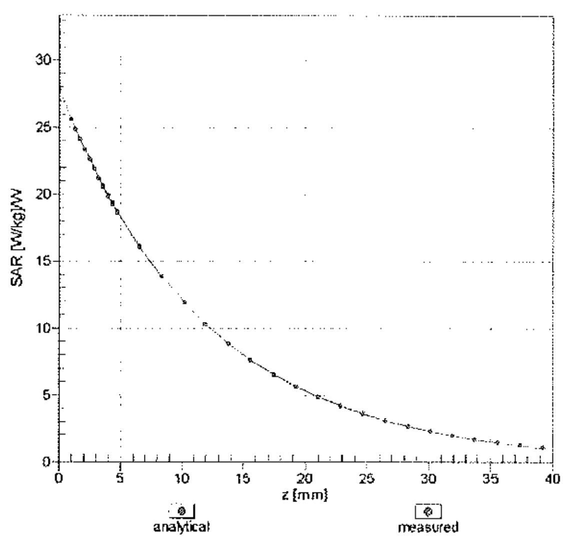




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

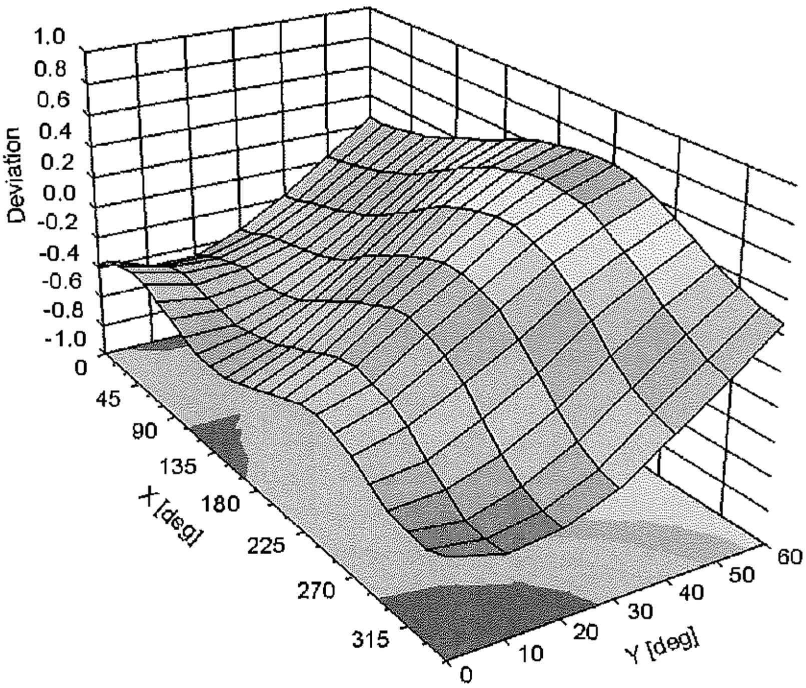
Conversion Factor Assessment

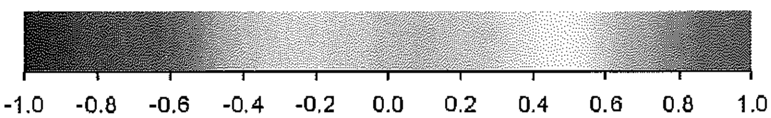




Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-26.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

APPENDIX D: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue verification:

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the tissue. The tissue was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
3) The complex admittance with respect to the probe aperture was measured
4) The complex relative permittivity ε' can be calculated from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon_r\varepsilon_0}{[\ln(b/a)]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi' \frac{\exp\left[-j\omega r(\mu_0\varepsilon_r'\varepsilon_0)^{1/2}\right]}{r} d\phi' d\rho' d\rho$$

where ***Y*** is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

Table D-I
Composition of the Tissue Equivalent Matter

Frequency (MHz)	750	750	835	835	1750	1750	1900	1900	2450-2600	2450-2600	5200-5800	5200-5800
Tissue	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Ingredients (% by weight)												
Bactericide	See Pages 2 & 3	See Page 3	0.1	0.1					See Page 4		See Page 5	
DGBE					47	31	44.92	29.44		26.7		
HEC			1	1								
NaCl			1.45	0.94	0.4	0.2	0.18	0.39		0.1		
Sucrose			57	44.9								
Polysorbate (Tween) 80												20
Water			40.45	53.06	52.6	68.8	54.9	70.17		73.2		80

2 Composition / Information on ingredients

The Item is composed of the following ingredients:

H_2O	Water, 35 – 58%
Sucrose	Sugar, white, refined, 40 – 60%
NaCl	Sodium Chloride, 0 – 6%
Hydroxyethyl-cellulose	Medium Viscosity (CAS# 9004-62-0), <0.3%
Preventol-D7	Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyyl-3(2H)-isothiazolone, 0.1 – 0.7%
	Relevant for safety; Refer to the respective Safety Data Sheet*.

Figure D-1
Composition of 750 MHz Head and Body Tissue Equivalent Matter

Note: 750MHz liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

Item Name	**Body Tissue Simulating Liquid (MSL750)**
Product No.	SL AAM 075 AA (Charge: 111130-3)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe (type DAK).

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

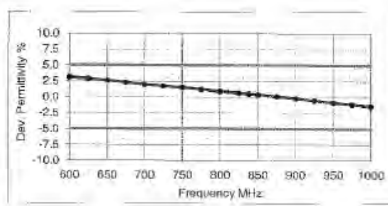
Ambient Condition	22°C ; 30% humidity
TSL Temperature	22°C
Test Date	7-Dec-11

Additional Information

TSL Density	1.212 g/cm³
TSL Heat-capacity	3.006 kJ/(kg*K)

Results

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
600	57.9	25.01	0.83	56.1	0.95	3.1	-12.3
625	57.6	24.66	0.86	56.0	0.95	2.9	-10.1
650	57.4	24.31	0.88	55.9	0.96	2.6	-8.0
675	57.1	24.02	0.90	55.8	0.96	2.3	-5.8
700	56.8	23.74	0.92	55.7	0.96	2.0	-3.7
725	56.6	23.50	0.95	55.6	0.96	1.7	-1.5
750	**56.4**	**23.26**	**0.97**	**55.5**	**0.96**	**1.5**	**0.8**
775	56.1	23.06	0.99	55.4	0.97	1.2	3.0
800	55.8	22.86	1.02	55.3	0.97	0.9	5.2
825	55.6	22.72	1.04	55.2	0.98	0.6	6.6
838	55.5	22.64	1.05	55.2	0.98	0.5	7.3
850	55.4	22.57	1.07	55.2	0.99	0.4	8.0
875	55.1	22.44	1.09	55.1	1.02	0.1	7.2
900	54.9	22.31	1.12	55.0	1.05	-0.2	6.4
925	54.7	22.20	1.14	55.0	1.06	-0.5	7.5
950	54.5	22.09	1.17	54.9	1.08	-0.9	8.5
975	54.3	21.99	1.19	54.9	1.09	-1.2	8.7
1000	54.1	21.89	1.22	54.8	1.10	-1.4	10.9



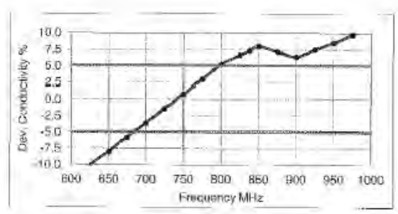


Figure D-2
750MHz Body Tissue Equivalent Matter

FCC ID: ZNFD803	PCTEST	**SAR EVALUATION REPORT**	LG	**Reviewed by:** Quality Manager
Test Dates: 07/02/13 - 07/19/13	**DUT Type:** Portable Handset			APPENDIX D: Page 2 of 5

Measurement Certificate / Material Test

Item Name	**Head Tissue Simulating Liquid (HSL 750)**
Product No.	SL AAH 075 (Charge: 111208-2)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe (type DAK).

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

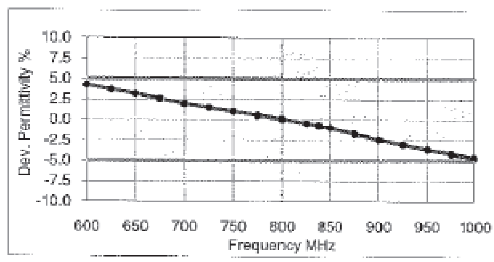
Ambient Condition	22°C ; 30% humidity
TSL Temperature	22°C
Test Date	14-Dec-11

Additional Information

TSL Density	1.284 g/cm^3
TSL Heat-capacity	2.701 kJ/(kg*K)

Results

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e"	sigma	eps	sigma	Δ-eps	Δ-sigma
600	44.5	22.77	0.76	42.7	0.88	4.2	-13.8
625	44.2	22.50	0.78	42.6	0.88	3.7	-11.5
650	43.8	22.24	0.80	42.5	0.89	3.1	-9.2
675	43.4	22.03	0.83	42.3	0.89	2.5	-6.8
700	43.0	21.82	0.85	42.2	0.89	1.9	-4.5
725	42.7	21.64	0.87	42.1	0.89	1.4	-2.1
750	42.3	21.45	0.89	41.9	0.89	1.0	0.2
775	42.0	21.28	0.92	41.8	0.90	0.5	2.4
800	41.7	21.11	0.94	41.7	0.90	0.0	4.7
825	41.4	20.97	0.96	41.6	0.91	-0.5	6.1
838	41.2	20.90	0.97	41.5	0.91	-0.7	6.8
850	41.1	20.83	0.98	41.5	0.92	-1.0	7.5
875	40.8	20.69	1.01	41.5	0.94	-1.7	6.8
900	40.5	20.55	1.03	41.5	0.97	-2.4	6.1
925	40.2	20.45	1.05	41.5	0.98	-3.0	7.1
950	39.9	20.34	1.08	41.4	0.99	-3.6	8.1
975	39.7	20.24	1.10	41.4	1.00	-4.2	9.3
1000	39.4	20.14	1.12	41.3	1.01	-4.7	10.4



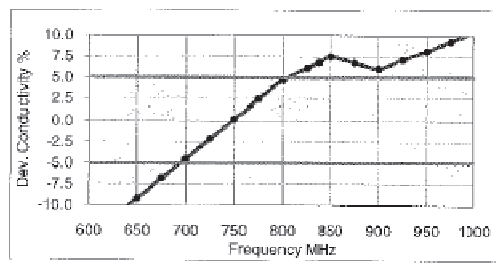


Figure D-3
750MHz Head Tissue Equivalent Matter

2 Composition / Information on ingredients

The Item is composed of the following ingredients:

H_2O	Water, 52 – 75%
$C_8H_{18}O_3$	Diethylene glycol monobutyl ether (DGBE), 25 – 48% (CAS-No. 112-34-5, EC-No. 203-961-6, EC-index-No. 603-096-00-8) Relevant for safety; Refer to the respective Safety Data Sheet*.
NaCl	Sodium Chloride, <1.0%

Figure D-4
Composition of 2.4 GHz Head Tissue Equivalent Matter

Note: 2.4 GHz head liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

Item Name	**Head Tissue Simulating Liquid (HSL 2450)**
Product No.	SL AAH 245 BA (Charge: 120112-4)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe (type DAK).

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

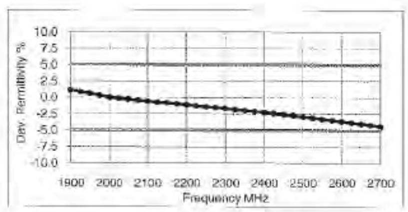
Ambient Condition	22°C ; 30% humidity
TSL Temperature	23°C
Test Date	18-Jan-12

Additional Information

TSL Density	0.988 g/cm^3
TSL Heat-capacity	3.680 kJ/(kg*K)

Results

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
1900	40.5	11.99	1.27	40.0	1.40	1.1	-9.5
1925	40.3	12.08	1.29	40.0	1.40	0.9	-7.6
1950	40.2	12.17	1.32	40.0	1.40	0.6	-5.7
1975	40.1	12.26	1.35	40.0	1.40	0.3	-3.8
2000	40.0	12.35	1.37	40.0	1.40	0.0	-1.9
2025	39.9	12.44	1.40	40.0	1.42	-0.1	-1.5
2050	39.8	12.53	1.43	39.9	1.44	-0.3	-1.1
2075	39.7	12.60	1.46	39.9	1.47	-0.4	-0.8
2100	39.6	12.68	1.48	39.8	1.49	-0.6	-0.5
2125	39.5	12.76	1.51	39.8	1.51	-0.7	-0.2
2150	39.4	12.84	1.54	39.7	1.53	-0.8	0.2
2175	39.3	12.93	1.56	39.7	1.56	-1.0	0.6
2200	39.2	13.02	1.59	39.6	1.58	-1.1	1.0
2225	39.1	13.09	1.62	39.6	1.60	-1.3	1.3
2250	39.0	13.17	1.65	39.6	1.62	-1.4	1.6
2275	38.9	13.25	1.68	39.5	1.64	-1.5	2.0
2300	**38.8**	**13.33**	**1.71**	**39.5**	**1.67**	**-1.7**	**2.3**
2325	38.7	13.40	1.73	39.4	1.69	-1.8	2.7
2350	38.6	13.48	1.76	39.4	1.71	-2.0	3.0
2375	38.5	13.56	1.79	39.3	1.73	-2.1	3.3
2400	38.4	13.63	1.82	39.3	1.76	-2.3	3.7
2425	38.3	13.71	1.85	39.2	1.78	-2.4	4.0
2450	**38.2**	**13.78**	**1.88**	**39.2**	**1.80**	**-2.6**	**4.4**
2475	38.1	13.85	1.91	39.2	1.83	-2.7	4.4
2500	38.0	13.93	1.94	39.1	1.85	-2.8	4.4
2525	37.9	13.99	1.97	39.1	1.88	-3.1	4.4
2550	37.8	14.06	1.99	39.1	1.91	-3.3	4.4
2575	37.7	14.13	2.02	39.0	1.94	-3.5	4.5
2600	**37.6**	**14.20**	**2.05**	**39.0**	**1.96**	**-3.7**	**4.6**
2625	37.5	14.26	2.08	39.0	1.99	-3.8	4.6
2650	37.4	14.32	2.11	38.9	2.02	-4.0	4.6
2675	37.3	14.39	2.14	38.9	2.05	-4.3	4.7
2700	37.1	14.46	2.17	38.9	2.07	-4.5	4.8



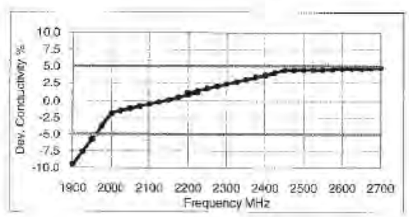


Figure D-5
2.4 GHz Head Tissue Equivalent Matter

2 Composition / Information on ingredients

The Item is composed of the following ingredients:

Water	50 – 65%
Mineral oil	10 – 30%
Emulsifiers	8 – 25%
Sodium salt	0 – 1.5%

Figure D-6
Composition of 5 GHz Head Tissue Equivalent Matter

Note: 5GHz head liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

Item Name	**Head Tissue Simulating Liquid (HBBL3500-5800V5)**
Product No.	SL AAH 502 AB (Charge: 120402-2)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe (type DAK).

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

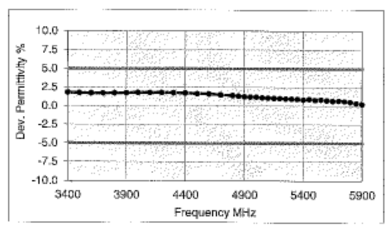
Ambient Condition	22°C ; 30% humidity
TSL Temperature	22°C
Test Date	4-Apr-12

Additional Information

TSL Density	0.985 g/cm^3
TSL Heat-capacity	3.383 kJ/(kg*K)

Results

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
3400	38.7	14.96	2.83	38.0	2.81	1.8	0.7
3500	38.6	14.91	2.90	37.9	2.91	1.7	-0.3
3600	38.5	14.92	2.99	37.8	3.02	1.7	-0.9
3700	38.3	14.92	3.07	37.7	3.12	1.7	-1.5
3800	38.2	14.94	3.16	37.6	3.22	1.7	-1.9
3900	38.1	14.95	3.24	37.5	3.32	1.7	-2.4
4000	38.0	15.00	3.34	37.4	3.43	1.8	-2.5
4100	37.9	15.04	3.43	37.2	3.53	1.8	-2.6
4200	37.8	15.08	3.52	37.1	3.63	1.8	-2.9
4300	37.7	15.14	3.62	37.0	3.73	1.8	-3.0
4400	37.5	15.18	3.71	36.9	3.84	1.7	-3.1
4500	37.4	15.20	3.81	36.8	3.94	1.6	-3.3
4600	37.3	15.29	3.91	36.7	4.04	1.6	-3.2
4700	37.1	15.34	4.01	36.6	4.14	1.5	-3.2
4800	37.0	15.39	4.11	36.4	4.25	1.4	-3.2
4850	36.9	15.43	4.16	36.4	4.30	1.3	-3.1
4900	36.8	15.45	4.21	36.3	4.35	1.3	-3.1
4950	36.7	15.47	4.26	36.3	4.40	1.2	-3.1
5000	36.7	15.50	4.31	36.2	4.45	1.2	-3.1
5050	36.6	15.55	4.37	36.2	4.50	1.1	-3.0
5100	36.5	15.60	4.43	36.1	4.55	1.1	-2.8
5150	36.4	15.62	4.48	36.0	4.60	1.0	-2.8
5200	36.4	15.65	4.53	36.0	4.66	1.0	-2.8
5250	36.3	15.67	4.58	35.9	4.71	1.0	-2.8
5300	36.2	15.70	4.63	35.9	4.76	1.0	-2.7
5350	36.1	15.70	4.67	35.8	4.81	0.9	-2.9
5400	36.1	15.74	4.73	35.8	4.86	0.8	-2.7
5450	36.0	15.75	4.77	35.7	4.91	0.9	-2.8
5500	35.9	15.75	4.82	35.6	4.96	0.8	-2.9
5550	35.9	15.80	4.88	35.6	5.01	0.8	-2.7
5600	35.8	15.82	4.93	35.5	5.07	0.7	-2.7
5650	35.7	15.86	4.98	35.5	5.12	0.7	-2.6
5700	35.7	15.88	5.03	35.4	5.17	0.7	-2.6
5750	35.6	15.90	5.08	35.4	5.22	0.6	-2.6
5800	35.5	15.94	5.14	35.3	5.27	0.5	-2.4
5850	35.4	15.98	5.20	35.3	5.34	0.4	-2.5
5900	35.4	16.02	5.26	35.3	5.40	0.2	-2.6



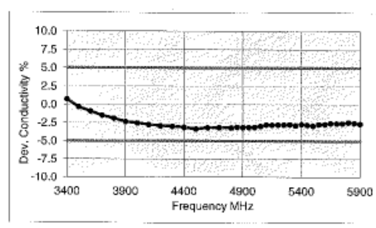


Figure D-7
5GHz Head Tissue Equivalent Matter

APPENDIX E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01r01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in IEEE 1528-2003 and FCC KDB 865664 D01v01r01. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table E-I
SAR System Validation Summary

SAR SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
							(σ)	(ε_r)	SENSI-TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
C	750	10/24/2012	3022	ES3DV2	750	Head	0.865	40.53	PASS	PASS	PASS	N/A	N/A	N/A
E	835	3/12/2013	3920	EX3DV4	835	Head	0.943	41.71	PASS	PASS	PASS	GMSK	PASS	N/A
E	1750	3/13/2013	3920	EX3DV4	1750	Head	1.386	38.47	PASS	PASS	PASS	N/A	N/A	N/A
C	1900	10/17/2012	3022	ES3DV2	1900	Head	1.441	39.38	PASS	PASS	PASS	GMSK	PASS	N/A
C	2450	11/9/2012	3022	ES3DV2	2450	Head	1.874	38.23	PASS	PASS	PASS	OFDM	N/A	PASS
C	2600	5/10/2013	3022	ES3DV2	2600	Head	2.007	39.36	PASS	PASS	PASS	TDD	PASS	N/A
E	5200	3/21/2013	3920	EX3DV4	5200	Head	4.529	35.64	PASS	PASS	PASS	OFDM	N/A	PASS
E	5300	3/21/2013	3920	EX3DV4	5300	Head	4.638	35.52	PASS	PASS	PASS	OFDM	N/A	PASS
E	5500	3/28/2013	3920	EX3DV4	5500	Head	4.813	34.07	PASS	PASS	PASS	OFDM	N/A	PASS
E	5800	3/22/2013	3920	EX3DV4	5800	Head	5.108	34.76	PASS	PASS	PASS	OFDM	N/A	PASS
G	750	3/28/2013	3209	ES3DV3	750	Body	0.974	55.21	PASS	PASS	PASS	N/A	N/A	N/A
G	835	3/26/2013	3209	ES3DV3	835	Body	1.006	54.42	PASS	PASS	PASS	GMSK	PASS	N/A
E	1750	3/16/2013	3920	EX3DV4	1750	Body	1.491	52.88	PASS	PASS	PASS	N/A	N/A	N/A
B	1900	1/29/2013	3287	ES3DV3	1900	Body	1.570	51.00	PASS	PASS	PASS	GMSK	PASS	N/A
B	2450	1/30/2013	3287	ES3DV3	2450	Body	1.985	51.49	PASS	PASS	PASS	OFDM	N/A	PASS
E	2450	3/18/2013	3920	EX3DV4	2450	Body	2.011	51.68	PASS	PASS	PASS	OFDM	N/A	PASS
E	2600	7/16/2013	3920	ES3DV4	2600	Body	2.131	51.35	PASS	PASS	PASS	TDD	PASS	N/A
A	5200	1/23/2013	3589	EX3DV4	5200	Body	5.292	47.85	PASS	PASS	PASS	OFDM	N/A	PASS
A	5300	1/23/2013	3589	EX3DV4	5300	Body	5.477	47.47	PASS	PASS	PASS	OFDM	N/A	PASS
A	5500	1/23/2013	3589	EX3DV4	5500	Body	5.729	47.03	PASS	PASS	PASS	OFDM	N/A	PASS
A	5800	1/23/2013	3589	EX3DV4	5800	Body	6.233	46.20	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: All measurements were performed using probes calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r01. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.