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SAR EVALUATION REPORT

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

Date of Testing:
03/10/14 - 04/14/14
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1402240470.A3L

FCC ID: A3LSMT231

APPLICANT: SAMSUNG ELECTRONICS, CO. LTD.

DUT Type: Portable Tablet
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): SM-T231

Equipment Class	Band & Mode	Tx Frequency	SAR	
			1 gm Head (W/kg)	1 gm Body (W/kg)
PCB	GSM/GPRS/EDGE Rx Only 850	824.20 - 848.80 MHz	0.25	0.77
PCB	GSM/GPRS/EDGE Rx Only 1900	1850.20 - 1909.80 MHz	0.96	1.06
PCB	UMTS 850	826.40 - 846.60 MHz	0.44	0.54
PCB	UMTS 1900	1852.4 - 1907.6 MHz	0.71	1.03
DTS	2.4 GHz WLAN	2412 - 2462 MHz	< 0.1	1.10
DTS	Bluetooth LE	2402 - 2480 MHz	N/A	
DTS	5.8 GHz WLAN	5745 - 5825 MHz	< 0.1	0.99
NII	5.2 GHz WLAN	5180 - 5240 MHz	< 0.1	0.75
NII	5.3 GHz WLAN	5260 - 5320 MHz	< 0.1	0.72
NII	5.5 GHz WLAN	5500 - 5700 MHz	< 0.1	0.89
DSS	Bluetooth	2402 - 2480 MHz	N/A	0.34
Simultaneous SAR per KDB 690783 D01v01r02:			1.54	

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 1.7 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

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1 DEVICE UNDER TEST

1.1 Device Overview

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

1.2 Power Reduction for SAR

This device uses proximity sensoring mechanisms for SAR compliance. Powers are reduced when the device is held-to-ear (for voice or VoIP calls) and when it is used in close proximity to the user's body (tablet operations). The proximity sensors trigger power reduction for all voice and data modes. There are no body-worn accessories for this device.

The held-to-ear RF exposure conditions were evaluated at reduced power according to the Head SAR test positions described in IEEE 1528. Since the device is a full size tablet, the Body SAR was evaluated per FCC KDB Publication 616217 D04 for full sized tablets.

1.3 Nominal and Maximum Output Power Specifications

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

1.3.1 Maximum Power:

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)			
		1 TX Slot	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*
GSM/GPRS 850	Maximum	**33.5**	**33.5**	**31.0**	**29.0**	**27.0**
	Nominal	**33.0**	**33.0**	**30.5**	**28.5**	**26.5**
GSM/GPRS 1900	Maximum	**30.5**	**30.5**	**28.0**	**26.0**	**24.0**
	Nominal	**30.0**	**30.0**	**27.5**	**25.5**	**23.5**

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

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	**10.5**
	Nominal	**10.0**
IEEE 802.11g (2.4 GHz)	Maximum	**10.5**
	Nominal	**10.0**
IEEE 802.11n (2.4 GHz)	Maximum	**10.5**
	Nominal	**10.0**
IEEE 802.11a (5.2 GHz)	Maximum	**9.0**
	Nominal	**8.5**
IEEE 802.11a (5.3 GHz)	Maximum	**9.5**
	Nominal	**9.0**
IEEE 802.11a (5.5 GHz)	Maximum	**9.5**
	Nominal	**9.0**
IEEE 802.11a (5.8 GHz)	Maximum	**9.5**
	Nominal	**9.0**
IEEE 802.11n (5.2 GHz)	Maximum	**8.5**
	Nominal	**8.0**
IEEE 802.11n (5.3 GHz)	Maximum	**8.5**
	Nominal	**8.0**
IEEE 802.11n (5.5 GHz)	Maximum	**7.5**
	Nominal	**7.0**
IEEE 802.11n (5.8 GHz)	Maximum	**8.5**
	Nominal	**8.0**
Bluetooth	Maximum	**11.0**
	Nominal	**10.5**
Bluetooth LE	Maximum	**7.5**
	Nominal	**7.0**

1.3.2 Reduced Power - Head and Body at 0 mm:

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)			
		1 TX Slot	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*
GSM/GPRS 850	Maximum	**25.5**	**25.5**	**24.5**	**23.0**	**21.5**
	Nominal	**25.0**	**25.0**	**24.0**	**22.5**	**21.0**
GSM/GPRS 1900	Maximum	**23.5**	**20.0**	**18.0**	**16.5**	**14.5**
	Nominal	**23.0**	**19.5**	**17.5**	**16.0**	**14.0**

Mode / Band		Modulated Average (dBm)		
		3GPP WCDMA Rel 99	*3GPP HSDPA Rel 6*	*3GPP HSUPA Rel 6*
UMTS Band 5 (850 MHz)	Maximum	**18.5**	**18.0**	**18.0**
	Nominal	**18.0**	**17.5**	**17.5**
UMTS Band 2 (1900 MHz)	Maximum	**12.5**	**12.0**	**11.0**
	Nominal	**12.0**	**11.5**	**10.5**

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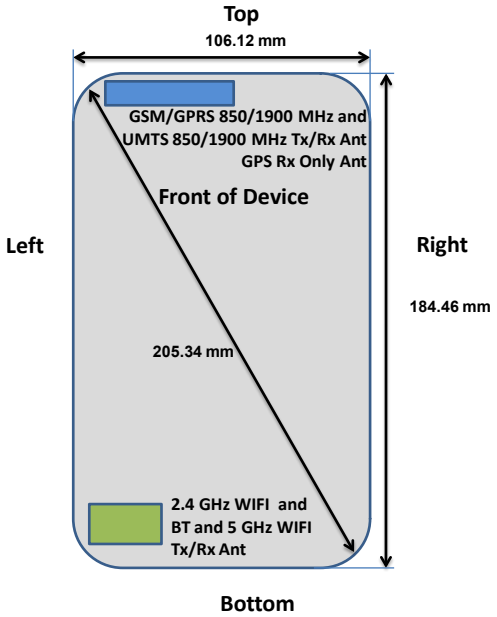
1.4 DUT Antenna Locations



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

Figure 1-1
DUT Antenna Locations

Table 1-1
Sides for Body SAR Testing

Sides for Body SAR Testing					
Mode	Back	Top	Bottom	Right	Left
GPRS 850	Yes	Yes	No	No	Yes
GPRS 1900	Yes	Yes	No	No	Yes
UMTS 850	Yes	Yes	No	No	Yes
UMTS 1900	Yes	Yes	No	No	Yes
2.4 GHz WLAN	Yes	No	Yes	No	Yes
5 GHz WLAN	Yes	No	Yes	No	Yes
2.4 GHz Bluetooth	Yes	No	Yes	No	Yes

Note: Per FCC KDB 616217 D04v01r01, Particular DUT edges were not required to be evaluated for SAR based on the SAR exclusion threshold in KDB 447498 D01v05r01. The antenna document shows the distances between the transmit antennas and the edges of the device.

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1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D05v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds.

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

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body	Notes
1	GSM voice + 2.4 GHz WI-FI	Yes	Yes	
2	GSM voice + 5 GHz WI-FI	Yes	Yes	
3	GSM voice + 2.4 GHz Bluetooth	N/A	Yes	
4	UMTS + 2.4 GHz WI-FI	Yes	Yes	
5	UMTS + 5 GHz WI-FI	Yes	Yes	
6	UMTS + 2.4 GHz Bluetooth	N/A	Yes	
7	GPRS + 2.4 GHz WI-FI	N/A	Yes	
8	GPRS + 5 GHz WI-FI	N/A	Yes	5 GHz WIFI Direct
9	GPRS + 2.4 GHz Bluetooth	N/A	Yes	

Notes:

1. 2.4 GHz WLAN, 2.4 GHz Bluetooth, and 5 GHz WLAN share the same antenna path and cannot transmit simultaneously.
2. 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.
3. Per FCC KDB 616217 D04 4.3, when voice mode is limited to speaker mode or headset operations only for body operations, additional SAR testing for tablet voice use is not required. Therefore, voice standalone and simultaneous combinations are not evaluated for body configurations. Corresponding data modes are used for summation with Bluetooth when applicable.

1.6 SAR Test Exclusions Applied

(A) BT

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

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

Based on the maximum conducted power of Bluetooth LE (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth LE SAR was not required; [(6/5)* √2.440] = 1.9< 3.0. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

(B) Licensed Transmitter(s)

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

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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.

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.

1.7 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (2G/3G and Hotspot)
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05 (General SAR Guidance)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 616217 D04 (Tablet SAR Considerations)
- October 2013 TCB Workshop Notes (GPRS SAR Considerations)

1.8 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.

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	Max Power Head Serial Number	Reduced Power Head Serial	Max Power Body Serial Number	Reduced Power Body Serial
GSM/GPRS 850	N/A	FL-084-I	FL-084-H	FL-084-I
GSM/GPRS 1900	N/A	FL-084-I	FL-084-H	FL-084-I
UMTS 850	N/A	FL-084-I	FL-084-H	FL-084-I
UMTS 1900	N/A	FL-084-I	FL-084-H	FL-084-I
2.4 GHz WLAN	FL-095-A	N/A	FL-095-A	N/A
5 GHz WLAN	FL-084-A	N/A	FL-095-A	N/A
Bluetooth	N/A	N/A	FL-095-C	N/A

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2 INTRODUCTION

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

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

2.1 SAR Definition

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

Equation 2-1
SAR Mathematical Equation

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

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

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

where:

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

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

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3 DOSIMETRIC ASSESSMENT

3.1 Measurement Procedure

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

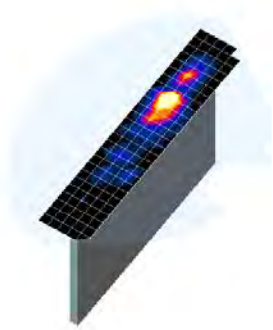

Figure 3-1
Sample SAR Area Scan

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

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

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

*Also compliant to IEEE 1528-2013 Table 6

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4 DEFINITION OF REFERENCE POINTS

4.1 EAR REFERENCE POINT

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

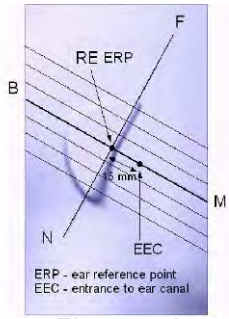

Figure 4-1
Close-Up Side view of ERP

4.2 HANDSET REFERENCE POINTS

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

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

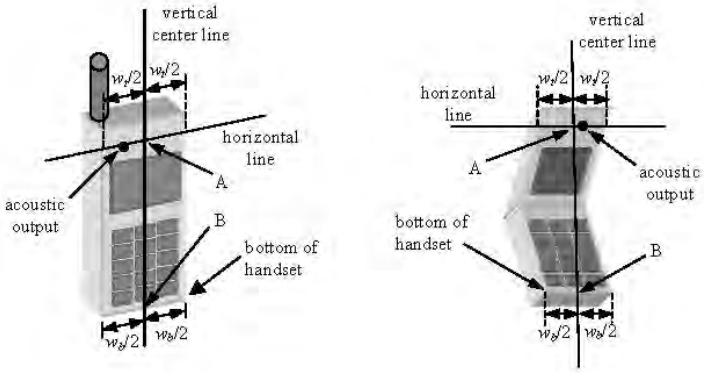

Figure 4-3
Handset Vertical Center & Horizontal Line Reference Points

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5 SAR TESTING PROCEDURES

5.1 Device Holder

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

5.2 Positioning for Cheek

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

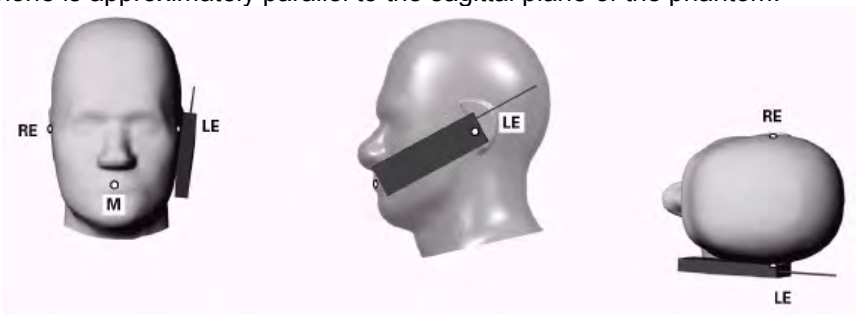

Figure 5-1 Front, Side and Top View of Cheek Position

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

5.3 Positioning for Ear / 15º Tilt

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

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

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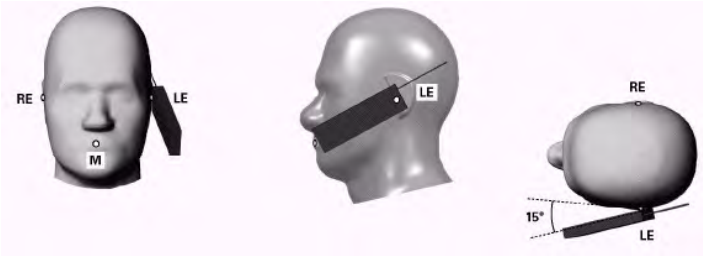

Figure 5-2 Front, Side and Top View of Ear/15º Tilt Position

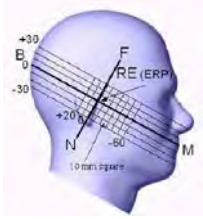

Figure 5-3
Side view w/ relevant markings

5.4 SAR Testing for Tablet per KDB Publication 616217 D04

This device is used in full sized tablet exposure conditions due to its size. Per FCC KDB 616217, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR Exclusion Threshold in KDB 447498 D01v05 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

5.5 Additional Test Positions due to Proximity Sensor Considerations

This device uses a proximity sensor to reduce voice and data powers in tablet-device use conditions.

While the device's antenna is within a certain distance of the user, the proximity sensor activates and reduces the maximum output power allowed. However, the sensor is not active when the device is moved beyond the sensor triggering distance and the maximum output power is no longer limited. Therefore, an additional exposure condition is needed in the vicinity of the triggering distance to ensure SAR is compliant when the device is allowed to operate at a non-reduced output power level.

FCC KDB 616217 D04 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional exposure conditions. Since the proximity sensor activation distance for the back side of the device is 15 mm, a conservative distance of 14 mm was tested for SAR on the back side at maximum power. Since the proximity sensor activation distance for the top edge of the device is 12 mm, a conservative distance of 11 mm was tested for SAR on the top edge at maximum power. Sensor triggering distance summary data is included in Appendix G.

The sensor is designed to support sufficient detection range and sensitivity to cover regions of the sensors in all applicable directions since the sensor entirely covers the antenna.

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6 RF EXPOSURE LIMITS

6.1 Uncontrolled Environment

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

6.2 Controlled Environment

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

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

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

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

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7 FCC MEASUREMENT PROCEDURES

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

7.1 Measured and Reported SAR

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

7.2 Procedures Used to Establish RF Signal for SAR

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

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

7.3 SAR Measurement Conditions for UMTS

7.3.1 Output Power Verification

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

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

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7.3.2 Head SAR Measurements for Handsets

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

7.3.3 Body SAR Measurements

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

7.3.4 Procedures Used to Establish RF Signal for SAR HSDPA Data Devices

The following procedures are applicable to HSDPA data devices operating under 3GPP Release 5. Body exposure conditions are typically applicable to these devices, including handsets and data modems operating in various electronic devices. HSDPA operates in conjunction with UMTS and requires an active DPCCH. The default test configuration is to measure SAR in UMTS without HSDPA, with an established radio link between the DUT and a communication test set with 12.2 kbps RMC mode configured in Test Loop Mode 1; and tested with HSDPA with FRC and a 12.2 kbps RMC using the highest SAR configuration in UMTS. SAR is selectively confirmed for other physical channel configurations according to output power, exposure conditions and device operating capabilities. Maximum output power is verified according to 3GPP TS 23.121 (Release 5) and SAR must be measured according to these maximum output conditions.

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

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

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

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

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

7.3.5 SAR Measurement Conditions for HSUPA Data Devices

SAR for body exposure configurations are measured according to the 'Body SAR Measurements' procedures in the 'WCDMA Handsets' section of the KDB 941225 D01 FCC 3G document. In addition, Body SAR is also measured for HSPA when the maximum average output of each RF channel with HSPA active is at least ¼ dB higher of that measured without HSPA in 12.2 kbps RMC mode or the maximum SAR for 12.2 kbps RMC is above 75% of the SAR limit. Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 with power control algorithm 2, according to the highest body

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SAR configuration in 12.2 kbps RMC without HSPA. When VOIP is applicable for head exposure, SAR is not required when the maximum output of each RF channel with HSPA is less than ¼ dB higher than that measured using 12.2 kbps RMC; otherwise, the same HSPA configuration used for body measurements should be used to test for head exposure.

Due to inner loop power control requirements in HSPA, a commercial communication test set should be used for the output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and EDCH configurations for HSPA should be configured according to the β values indicated below as well as other applicable procedures described in the 'WCDMA Handset' and 'Release 5 HSDPA Data Devices' sections of the FCC 3G document.

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

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

7.4 SAR Testing with 802.11 Transmitters

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

7.4.1 General Device Setup

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

7.4.2 Frequency Channel Configurations [24]

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

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

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channels for SAR testing. 802.11n modes and higher data rates for 802.11a/n were evaluated only if the respective mode was higher than 0.25 dB or more than the 802.11a mode.

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.

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8 RF CONDUCTED POWERS

8.1 GSM Conducted Powers

Table 8-1
Maximum GSM/GPRS Average RF Conducted Powers

		Maximum Burst-Averaged Output Power				
		Voice	*GPRS Data (GMSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**
GSM 850	128	32.54	32.56	30.84	**28.89**	26.89
	190	32.55	32.56	30.82	**28.92**	26.96
	251	32.64	32.63	30.90	**28.95**	27.00
GSM 1900	512	30.01	29.71	28.00	**26.00**	23.93
	661	29.72	29.55	27.94	**25.94**	23.95
	810	29.62	29.43	27.95	**25.89**	23.99
		Calculated Maximum Frame-Averaged Output Power				
		Voice	*GPRS Data (GMSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**
GSM 850	128	23.51	23.53	24.82	**24.63**	23.88
	190	23.52	23.53	24.80	**24.66**	23.95
	251	23.61	23.60	24.88	**24.69**	23.99
GSM 1900	512	20.98	20.68	21.98	**21.74**	20.92
	661	20.69	20.52	21.92	**21.68**	20.94
	810	20.59	20.40	21.93	**21.63**	20.98
GSM 850	**Frame Avg.Targets:**	23.97	23.97	24.48	**24.24**	23.49
GSM 1900		20.97	20.97	21.48	**21.24**	20.49

Table 8-2
Reduced GSM/GPRS Average RF Conducted Powers Representing Head and Body at 0 mm

		Maximum Burst-Averaged Output Power				
		Voice	*GPRS Data (GMSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**
GSM 850	128	25.05	25.11	24.21	**22.57**	21.00
	190	25.08	25.15	24.25	**22.67**	21.02
	251	25.17	25.24	24.34	**22.69**	21.15
GSM 1900	512	22.77	19.47	17.42	**16.02**	14.16
	661	22.84	19.54	17.44	**16.12**	14.31
	810	22.87	19.77	17.70	**16.48**	14.47

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		Calculated Maximum Frame-Averaged Output Power				
		Voice	*GPRS Data (GMSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**
GSM 850	128	16.02	16.08	18.19	**18.31**	17.99
	190	16.05	16.12	18.23	**18.41**	18.01
	251	16.14	16.21	18.32	**18.43**	18.14
GSM 1900	512	13.74	10.44	11.40	**11.76**	11.15
	661	13.81	10.51	11.42	**11.86**	11.30
	810	13.84	10.74	11.68	**12.22**	11.46
GSM 850	**Frame Avg.Targets:**	15.97	15.97	17.98	**18.24**	17.99
GSM 1900		13.97	10.47	11.48	**11.74**	10.99

Note:
1. Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
2. The source-based frame-averaged output power was evaluated for all GPRS slot configurations. The configuration with the highest target frame averaged output power was evaluated for body SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
3. GPRS (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.

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

Figure 8-1
Power Measurement Setup

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8.2 UMTS Conducted Powers

Table 8-3
Maximum UMTS Average RF Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	22.85	22.61	22.90	22.73	22.67	22.83	-
99		12.2 kbps AMR	22.93	22.72	23.00	22.76	22.64	22.86	-
6	HSDPA	Subtest 1	22.42	22.41	22.47	22.50	22.34	22.45	0
6		Subtest 2	22.44	22.24	22.40	22.34	22.18	22.25	0
6		Subtest 3	21.97	21.94	22.05	22.10	21.84	21.82	0.5
6		Subtest 4	21.00	21.02	21.10	20.94	21.04	21.01	0.5
6	HSUPA	Subtest 1	21.55	21.65	21.73	21.78	21.66	21.61	0
6		Subtest 2	20.02	20.31	20.07	19.93	20.01	19.94	2
6		Subtest 3	20.29	20.74	20.71	20.05	20.24	20.56	1
6		Subtest 4	19.81	20.28	20.25	20.14	20.11	20.15	2
6		Subtest 5	21.83	21.70	21.36	21.73	21.18	21.94	0

Table 8-4
Reduced UMTS Average RF Conducted Powers
Representing Head and Body at 0 mm

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	17.54	17.60	17.67	12.17	12.04	12.03	-
99		12.2 kbps AMR	17.59	17.61	17.81	12.13	11.99	11.97	-
6	HSDPA	Subtest 1	17.42	17.65	17.71	11.50	11.19	11.26	0
6		Subtest 2	17.29	17.42	17.41	11.50	11.30	11.20	0
6		Subtest 3	17.00	17.03	17.20	10.87	10.94	10.86	0.5
6		Subtest 4	16.33	16.50	16.47	10.22	10.09	10.00	0.5
6	HSUPA	Subtest 1	16.62	16.73	17.01	9.26	9.88	9.48	0
6		Subtest 2	15.20	15.25	15.67	7.98	8.18	8.03	2
6		Subtest 3	15.68	15.85	15.57	8.11	8.41	8.38	1
6		Subtest 4	15.08	15.34	15.55	7.95	8.07	7.98	2
6		Subtest 5	16.98	16.69	16.59	9.48	9.48	9.51	0

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

This device does not support DC-HSDPA.

It is expected by the manufacturer that MPR for some HSPA subtests may be up to 2 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model.

Figure 8-2
Power Measurement Setup

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8.3 WLAN Conducted Powers

Table 8-5
IEEE 802.11b Average RF Power

Mode	Freq	Channel	802.11b (2.4 GHz) Conducted Power [dBm]			
			Data Rate [Mbps]			
	[MHz]		1	2	5.5	11
802.11b	2412	1*	**9.75**	9.75	9.51	9.48
802.11b	2437	6*	**10.15**	10.08	9.90	10.10
802.11b	2462	11*	**10.01**	9.93	10.22	9.72

Table 8-6
IEEE 802.11g Average RF Power

Mode	Freq	Channel	802.11g (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6	9	12	18	24	36	48	54
802.11g	2412	1	9.88	9.83	9.91	9.80	9.67	9.41	9.56	9.27
802.11g	2437	6	9.87	9.87	9.42	9.79	10.05	9.49	9.58	10.10
802.11g	2462	11	10.01	9.63	10.01	9.60	10.05	9.80	10.17	9.85

Table 8-7
IEEE 802.11n Average RF Power

Mode	Freq	Channel	802.11n (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6.5	13	20	26	39	52	58	65
802.11n	2412	1	9.64	9.25	9.64	9.62	9.51	9.45	9.58	9.50
802.11n	2437	6	9.62	9.29	9.56	9.58	9.35	9.41	9.53	9.41
802.11n	2462	11	9.50	9.55	9.71	9.77	9.65	9.66	9.76	9.63

Table 8-8
IEEE 802.11a Average RF Power

Mode	Freq	Channel	802.11a (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6	9	12	18	24	36	48	54
802.11a	5180	36*	**8.73**	8.51	8.51	8.58	8.70	8.31	8.69	8.56
802.11a	5200	40	8.63	8.31	8.35	8.51	8.60	8.59	8.62	8.51
802.11a	5220	44	8.83	8.30	8.42	8.42	8.36	8.50	8.38	8.48
802.11a	5240	48*	**8.85**	8.28	8.31	8.22	8.21	8.53	8.45	8.55
802.11a	5260	52*	**9.49**	9.29	9.08	9.17	9.05	8.92	9.06	8.75
802.11a	5280	56	9.35	9.13	9.00	8.99	9.18	8.82	9.01	8.62
802.11a	5300	60	9.13	9.10	9.03	8.91	8.98	8.51	8.65	8.73
802.11a	5320	64*	**9.28**	8.91	8.81	8.70	8.88	8.56	8.62	8.40
802.11a	5500	100	8.62	8.73	8.56	8.64	8.56	8.51	8.64	8.51
802.11a	5520	104*	8.61	8.59	8.75	8.70	8.67	8.50	8.56	8.40
802.11a	5540	108	**8.75**	8.67	8.77	8.71	8.74	8.30	8.61	8.31
802.11a	5560	112	8.65	8.65	8.60	8.74	8.80	8.34	8.67	8.30
802.11a	5580	116*	**8.69**	8.93	8.69	8.66	8.75	8.30	8.64	8.33
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	9.03	8.68	8.92	8.75	8.71	8.48	8.74	8.51
802.11a	5680	136*	8.86	8.83	8.91	8.82	8.85	8.35	8.51	8.56
802.11a	5700	140	**9.06**	8.98	8.87	8.70	8.97	8.51	8.73	8.51
802.11a	5745	149*	**9.03**	8.95	8.91	8.94	9.01	8.66	8.68	8.67
802.11a	5765	153	9.02	8.91	8.90	8.84	8.75	8.76	8.92	8.51
802.11a	5785	157*	8.91	9.08	8.82	8.91	8.97	8.40	8.59	8.71
802.11a	5805	161	**9.02**	9.04	8.86	8.99	8.96	8.61	8.74	8.68
802.11a	5825	165*	**9.07**	8.93	9.02	8.93	9.15	8.69	8.81	8.73

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

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

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Table 8-9
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	8.01	7.73	7.96	8.16	8.31	8.41	8.31	8.26
802.11n	5200	40	7.73	7.80	7.22	7.43	7.35	7.18	7.51	7.28
802.11n	5220	44	7.61	8.25	7.78	7.53	7.51	7.54	8.27	7.58
802.11n	5240	48	7.55	7.91	7.09	6.98	7.42	8.20	8.03	6.92
802.11n	5260	52	8.23	7.87	7.75	8.32	7.73	8.23	7.64	8.33
802.11n	5280	56	8.37	7.79	8.38	7.83	8.18	8.16	7.53	8.30
802.11n	5300	60	8.03	7.90	7.94	8.39	7.62	7.88	7.66	7.38
802.11n	5320	64	8.43	8.27	7.71	8.22	8.16	8.25	7.86	8.00
802.11n	5500	100	6.67	6.52	6.69	6.89	6.67	6.56	6.75	6.51
802.11n	5520	104	6.56	6.75	6.46	6.50	6.77	6.58	6.54	6.67
802.11n	5540	108	6.54	6.64	6.54	6.46	6.53	6.43	6.74	6.71
802.11n	5560	112	6.78	6.98	6.94	6.77	6.68	6.59	6.64	6.61
802.11n	5580	116	6.54	6.52	6.74	6.47	6.31	6.40	6.53	6.62
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	6.61	6.78	6.39	6.59	6.47	6.64	6.46	6.48
802.11n	5680	136	6.33	6.47	6.29	6.30	6.54	6.26	6.37	6.26
802.11n	5700	140	6.63	6.74	6.70	6.80	6.85	6.55	6.71	6.59
802.11n	5745	149	8.42	7.59	8.45	7.96	7.84	7.59	8.39	8.24
802.11n	5765	153	8.30	7.69	8.35	8.23	7.57	7.50	8.14	8.34
802.11n	5785	157	8.41	7.52	7.89	7.64	7.93	7.50	7.81	8.08
802.11n	5805	161	7.94	8.40	7.40	8.33	7.51	7.94	7.59	7.35
802.11n	5825	165	8.39	8.36	8.25	7.75	8.15	7.80	7.93	8.22

Table 8-10
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	8.14	8.19	8.14	8.26	7.97	7.89	7.63	7.71
802.11n	5230	46	8.28	8.42	7.89	8.43	7.97	8.07	8.41	7.80
802.11n	5270	54	7.42	7.06	7.56	7.16	6.90	7.53	7.95	7.79
802.11n	5310	62	7.72	8.26	8.13	7.88	7.63	7.25	7.99	7.79
802.11n	5510	102	7.32	7.31	7.26	7.20	7.00	7.28	7.31	7.03
802.11n	5550	110	7.25	7.15	7.33	7.22	7.23	7.19	7.01	7.02
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	6.78	6.62	6.80	6.81	6.78	6.73	6.88	6.68
802.11n	5755	151	7.58	7.56	7.26	7.66	7.73	7.13	7.71	7.40
802.11n	5795	159	7.78	8.00	7.39	8.15	7.99	7.78	7.67	8.12

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

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

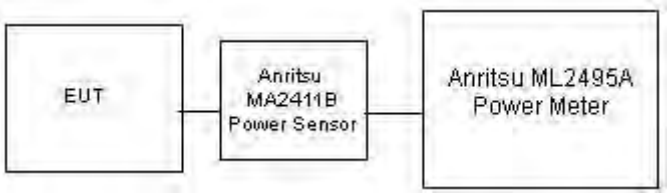

Figure 8-3
Power Measurement Setup

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8.4 Bluetooth Conducted Powers

Table 8-11
Bluetooth RF Conducted Powers

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
			[dBm]	[mW]
2402	1.0	0	**10.81**	12.061
2441	1.0	39	10.70	11.755
2480	1.0	78	10.46	11.108
2402	2.0	0	7.73	5.933
2441	2.0	39	7.66	5.841
2480	2.0	78	7.31	5.383
2402	3.0	0	7.81	6.036
2441	3.0	39	7.70	5.894
2480	3.0	78	7.45	5.555

The bolded data rate and channel above were tested for SAR.

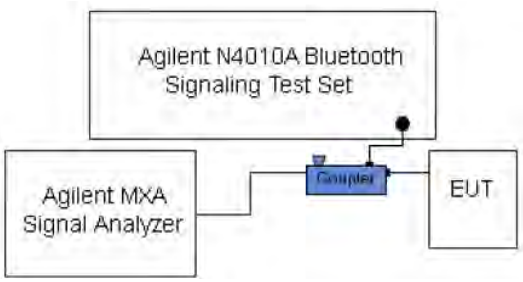

Figure 8-4
Power Measurement Setup

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9 SYSTEM VERIFICATION

9.1 Tissue Verification

Table 9-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C°)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
3/26/2014	835H	23.1	820	0.904	41.808	0.899	41.578	0.56%	0.55%
			835	0.920	41.602	0.900	41.500	2.22%	0.25%
			850	0.935	41.386	0.916	41.500	2.07%	-0.27%
3/24/2014	1900H	23.4	1850	1.393	39.563	1.400	40.000	-0.50%	-1.09%
			1880	1.426	39.452	1.400	40.000	1.86%	-1.37%
			1910	1.459	39.305	1.400	40.000	4.21%	-1.74%
3/10/2014	2450H	22.1	2401	1.764	38.293	1.756	39.287	0.46%	-2.53%
			2450	1.819	38.117	1.800	39.200	1.06%	-2.76%
			2499	1.869	37.941	1.853	39.138	0.86%	-3.06%
03/12/2014	5200H-5800H	23.9	5180	4.579	36.337	4.635	36.009	-1.21%	0.91%
			5200	4.595	36.301	4.655	35.986	-1.29%	0.88%
			5240	4.649	36.237	4.696	35.940	-1.00%	0.83%
			5260	4.671	36.221	4.717	35.917	-0.98%	0.85%
			5300	4.684	36.176	4.758	35.871	-1.56%	0.85%
			5320	4.710	36.137	4.778	35.849	-1.42%	0.80%
			5500	4.889	35.895	4.963	35.643	-1.49%	0.71%
			5540	4.927	35.852	5.004	35.597	-1.54%	0.72%
			5580	4.965	35.771	5.045	35.551	-1.59%	0.62%
			5600	4.990	35.750	5.065	35.529	-1.48%	0.62%
			5700	5.082	35.624	5.168	35.414	-1.66%	0.59%
			5745	5.153	35.585	5.214	35.363	-1.17%	0.63%
			5800	5.180	35.513	5.270	35.300	-1.71%	0.60%
			5805	5.182	35.505	5.275	35.294	-1.76%	0.60%
			5825	5.203	35.440	5.296	35.271	-1.76%	0.48%
3/24/2014	835B	22.1	820	0.986	54.640	0.969	55.258	1.75%	-1.12%
			835	1.001	54.502	0.970	55.200	3.20%	-1.26%
			850	1.016	54.323	0.988	55.154	2.83%	-1.51%
3/31/2014	1900B	23.3	1850	1.510	51.115	1.520	53.300	-0.66%	-4.10%
			1880	1.545	51.042	1.520	53.300	1.64%	-4.24%
			1910	1.581	50.925	1.520	53.300	4.01%	-4.46%
4/14/2014	1900B	23.0	1850	1.522	52.517	1.520	53.300	0.13%	-1.47%
			1880	1.554	52.394	1.520	53.300	2.24%	-1.70%
			1910	1.591	52.307	1.520	53.300	4.67%	-1.86%
3/19/2014	2450B	23.8	2401	1.913	52.261	1.903	52.765	0.53%	-0.96%
			2450	1.979	52.093	1.950	52.700	1.49%	-1.15%
			2499	2.043	51.914	2.019	52.638	1.19%	-1.38%
03/18/2014	5200B-5800B	22.9	5180	5.113	47.526	5.276	49.041	-3.09%	-3.09%
			5200	5.162	47.513	5.299	49.014	-2.59%	-3.06%
			5240	5.216	47.368	5.346	48.960	-2.43%	-3.25%
			5260	5.234	47.327	5.369	48.933	-2.51%	-3.28%
			5300	5.289	47.204	5.416	48.879	-2.34%	-3.43%
			5320	5.319	47.142	5.439	48.851	-2.21%	-3.50%
			5500	5.563	46.658	5.650	48.607	-1.54%	-4.01%
			5540	5.629	46.560	5.696	48.553	-1.18%	-4.10%
			5580	5.689	46.509	5.743	48.499	-0.94%	-4.10%
			5600	5.712	46.518	5.766	48.471	-0.94%	-4.03%
			5700	5.856	46.466	5.883	48.336	-0.46%	-3.87%
			5745	5.919	46.532	5.936	48.275	-0.29%	-3.61%
			5800	5.985	46.544	6.000	48.200	-0.25%	-3.44%
			5805	5.987	46.565	6.006	48.193	-0.32%	-3.38%
			5825	6.019	46.602	6.029	48.166	-0.17%	-3.25%

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB 865664 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

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9.2 Test System Verification

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

Table 9-2
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	$Deviation_{1g}$ (%)
G	835	HEAD	03/26/2014	24.4	23.5	0.100	4d119	3258	0.953	9.680	9.530	-1.55%
G	1900	HEAD	03/24/2014	24.4	23.9	0.100	5d149	3258	4.090	40.400	40.900	1.24%
E	2450	HEAD	03/10/2014	24.4	22.1	0.040	719	3914	2.110	53.200	52.750	-0.85%
E	5200	HEAD	03/12/2014	24.5	24.4	0.040	1057	3914	2.930	78.000	73.250	-6.09%
E	5300	HEAD	03/12/2014	24.5	24.3	0.040	1057	3914	3.260	83.000	81.500	-1.81%
E	5600	HEAD	03/12/2014	24.5	23.5	0.040	1057	3914	3.170	83.500	79.250	-5.09%
E	5800	HEAD	03/12/2014	24.5	23.5	0.040	1057	3914	2.920	79.300	73.000	-7.94%
K	835	BODY	03/24/2014	23.9	22.2	0.100	4d119	3333	0.988	9.540	9.880	3.56%
D	1900	BODY	03/31/2014	23.2	21.6	0.100	5d149	3022	4.200	40.500	42.000	3.70%
H	1900	BODY	04/14/2014	23.1	23.0	0.100	5d149	3589	4.150	40.500	41.500	2.47%
H	2450	BODY	03/19/2014	23.4	23.4	0.100	719	3589	5.010	51.700	50.100	-3.09%
A	5200	BODY	03/18/2014	22.5	21.2	0.100	1007	3920	7.320	72.600	73.200	0.83%
A	5300	BODY	03/18/2014	22.5	21.2	0.100	1007	3920	7.570	74.700	75.700	1.34%
A	5500	BODY	03/18/2014	22.4	21.2	0.100	1007	3920	7.500	75.900	75.000	-1.19%
A	5600	BODY	03/18/2014	22.4	21.2	0.100	1007	3920	7.610	77.300	76.100	-1.55%
A	5800	BODY	03/18/2014	22.5	21.2	0.100	1007	3920	7.220	72.900	72.200	-0.96%

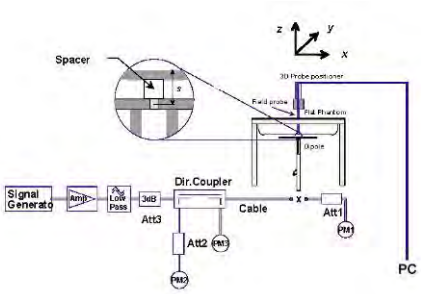

Figure 9-1
System Verification Setup Diagram

Figure 9-2
System Verification Setup Photo

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10 SAR DATA SUMMARY

10.1 Standalone Head SAR Data

Table 10-1
GSM 850 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	25.5	25.08	0.06	Right	Cheek	FL-084-I	1:8.3	0.226	1.102	0.249	A1
836.60	190	GSM 850	GSM	25.5	25.08	0.06	Right	Tilt	FL-084-I	1:8.3	0.160	1.102	0.176	
836.60	190	GSM 850	GSM	25.5	25.08	0.04	Left	Cheek	FL-084-I	1:8.3	0.164	1.102	0.181	
836.60	190	GSM 850	GSM	25.5	25.08	-0.01	Left	Tilt	FL-084-I	1:8.3	0.115	1.102	0.127	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 10-2
GSM 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1850.20	512	GSM 1900	GSM	23.5	22.77	0.17	Right	Cheek	FL-084-I	1:8.3	0.644	1.183	0.762	
1880.00	661	GSM 1900	GSM	23.5	22.84	0.15	Right	Cheek	FL-084-I	1:8.3	0.754	1.164	0.878	
1909.80	810	GSM 1900	GSM	23.5	22.87	0.14	Right	Cheek	FL-084-I	1:8.3	0.827	1.156	**0.956**	A2
1880.00	661	GSM 1900	GSM	23.5	22.84	0.12	Right	Tilt	FL-084-I	1:8.3	0.642	1.164	0.747	
1880.00	661	GSM 1900	GSM	23.5	22.84	-0.09	Left	Cheek	FL-084-I	1:8.3	0.282	1.164	0.328	
1880.00	661	GSM 1900	GSM	23.5	22.84	-0.03	Left	Tilt	FL-084-I	1:8.3	0.253	1.164	0.294	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 10-3
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	18.5	17.60	0.04	Right	Cheek	FL-084-I	1:1	0.355	1.230	0.437	A3
836.60	4183	UMTS 850	RMC	18.5	17.60	0.04	Right	Tilt	FL-084-I	1:1	0.250	1.230	0.308	
836.60	4183	UMTS 850	RMC	18.5	17.60	0.01	Left	Cheek	FL-084-I	1:1	0.236	1.230	0.290	
836.60	4183	UMTS 850	RMC	18.5	17.60	-0.01	Left	Tilt	FL-084-I	1:1	0.178	1.230	0.219	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 10-4
UMTS 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	12.5	12.04	0.18	Right	Cheek	FL-084-I	1:1	0.642	1.112	0.714	A4
1880.00	9400	UMTS 1900	RMC	12.5	12.04	0.17	Right	Tilt	FL-084-I	1:1	0.479	1.112	0.533	
1880.00	9400	UMTS 1900	RMC	12.5	12.04	-0.06	Left	Cheek	FL-084-I	1:1	0.230	1.112	0.256	
1880.00	9400	UMTS 1900	RMC	12.5	12.04	-0.08	Left	Tilt	FL-084-I	1:1	0.198	1.112	0.220	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

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Table 10-5
DTS Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2437	6	IEEE 802.11b	DSSS	10.5	10.15	0.18	Right	Cheek	FL-095-A	1	1:1	0.003	1.084	**0.003**	A5
2437	6	IEEE 802.11b	DSSS	10.5	10.15	0.18	Right	Tilt	FL-095-A	1	1:1	0.002	1.084	0.002	
2437	6	IEEE 802.11b	DSSS	10.5	10.15	0.15	Left	Cheek	FL-095-A	1	1:1	0.000	1.084	0.000	
2437	6	IEEE 802.11b	DSSS	10.5	10.15	0.19	Left	Tilt	FL-095-A	1	1:1	0.000	1.084	0.000	
5825	165	IEEE 802.11a	OFDM	9.5	9.07	-0.10	Right	Cheek	FL-084-A	6	1:1	0.005	1.104	0.006	
5825	165	IEEE 802.11a	OFDM	9.5	9.07	0.12	Right	Tilt	FL-084-A	6	1:1	0.005	1.104	0.006	
5825	165	IEEE 802.11a	OFDM	9.5	9.07	-0.14	Left	Cheek	FL-084-A	6	1:1	0.026	1.104	**0.029**	A7
5825	165	IEEE 802.11a	OFDM	9.5	9.07	-0.19	Left	Tilt	FL-084-A	6	1:1	0.010	1.104	0.011	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							**Head 1.6 W/kg (mW/g)** averaged over 1 gram								

Table 10-6
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)	
5240	48	IEEE 802.11a	OFDM	9.0	8.85	0.13	Right	Cheek	FL-084-A	6	1:1	0.005	1.035	0.005	
5240	48	IEEE 802.11a	OFDM	9.0	8.85	0.14	Right	Tilt	FL-084-A	6	1:1	0.006	1.035	0.006	
5240	48	IEEE 802.11a	OFDM	9.0	8.85	0.15	Left	Cheek	FL-084-A	6	1:1	0.008	1.035	**0.008**	
5240	48	IEEE 802.11a	OFDM	9.0	8.85	-0.14	Left	Tilt	FL-084-A	6	1:1	0.008	1.035	**0.008**	
5260	52	IEEE 802.11a	OFDM	9.5	9.49	0.14	Right	Cheek	FL-084-A	6	1:1	0.003	1.002	0.003	
5260	52	IEEE 802.11a	OFDM	9.5	9.49	-0.18	Right	Tilt	FL-084-A	6	1:1	0.010	1.002	0.010	
5260	52	IEEE 802.11a	OFDM	9.5	9.49	0.18	Left	Cheek	FL-084-A	6	1:1	0.008	1.002	0.008	
5260	52	IEEE 802.11a	OFDM	9.5	9.49	-0.12	Left	Tilt	FL-084-A	6	1:1	0.012	1.002	**0.012**	
5700	140	IEEE 802.11a	OFDM	9.5	9.06	0.15	Right	Cheek	FL-084-A	6	1:1	0.015	1.107	0.017	
5700	140	IEEE 802.11a	OFDM	9.5	9.06	0.12	Right	Tilt	FL-084-A	6	1:1	0.025	1.107	0.028	
5700	140	IEEE 802.11a	OFDM	9.5	9.06	0.03	Left	Cheek	FL-084-A	6	1:1	0.040	1.107	**0.044**	A6
5700	140	IEEE 802.11a	OFDM	9.5	9.06	0.21	Left	Tilt	FL-084-A	6	1:1	0.030	1.107	0.033	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							**Head 1.6 W/kg (mW/g)** averaged over 1 gram								

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10.2 Standalone Body SAR Data

Table 10-7
GSM/UMTS Body SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of GPRS Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GPRS	29.0	28.92	0.05	14 mm	FL-084-H	3	1:2.76	back	0.058	1.019	0.059	
836.60	190	GSM 850	GPRS	29.0	28.92	-0.01	11 mm	FL-084-H	3	1:2.76	top	0.072	1.019	0.073	
836.60	190	GSM 850	GPRS	29.0	28.92	0.01	0 mm	FL-084-H	3	1:2.76	left	0.047	1.019	0.048	
836.60	190	GSM 850	GPRS	23.0	22.67	0.07	0 mm	FL-084-I	3	1:2.76	back	0.717	1.079	0.774	A8
836.60	190	GSM 850	GPRS	23.0	22.67	-0.01	0 mm	FL-084-I	3	1:2.76	top	0.359	1.079	0.387	
1880.00	661	GSM 1900	GPRS	26.0	25.94	-0.04	14 mm	FL-084-H	3	1:2.76	back	0.727	1.014	0.737	
1880.00	661	GSM 1900	GPRS	26.0	25.94	-0.09	11 mm	FL-084-H	3	1:2.76	top	0.248	1.014	0.251	
1880.00	661	GSM 1900	GPRS	26.0	25.94	0.04	0 mm	FL-084-H	3	1:2.76	left	0.494	1.014	0.501	
1850.20	512	GSM 1900	GPRS	16.5	16.02	0.08	0 mm	FL-084-I	3	1:2.76	back	0.896	1.117	1.001	
1880.00	661	GSM 1900	GPRS	16.5	16.12	0.05	0 mm	FL-084-I	3	1:2.76	back	0.925	1.091	1.009	
1909.80	810	GSM 1900	GPRS	16.5	16.48	0.00	0 mm	FL-084-I	3	1:2.76	back	1.050	1.005	**1.055**	A9
1880.00	661	GSM 1900	GPRS	16.5	16.12	-0.08	0 mm	FL-084-I	3	1:2.76	top	0.474	1.091	0.517	
1909.80	810	GSM 1900	GPRS	16.5	16.48	0.03	0 mm	FL-084-I	3	1:2.76	back	1.050	1.005	1.055	
836.60	4183	UMTS 850	RMC	23.5	22.61	0.04	14 mm	FL-084-H	N/A	1:1	back	0.062	1.227	0.076	
836.60	4183	UMTS 850	RMC	23.5	22.61	0.02	11 mm	FL-084-H	N/A	1:1	top	0.075	1.227	0.092	
836.60	4183	UMTS 850	RMC	23.5	22.61	0.11	0 mm	FL-084-H	N/A	1:1	left	0.069	1.227	0.085	
836.60	4183	UMTS 850	RMC	18.5	17.60	0.03	0 mm	FL-084-I	N/A	1:1	back	0.442	1.230	0.544	A10
836.60	4183	UMTS 850	RMC	18.5	17.60	0.12	0 mm	FL-084-I	N/A	1:1	top	0.084	1.230	0.103	
1880.00	9400	UMTS 1900	RMC	23.5	22.67	0.03	14 mm	FL-084-H	N/A	1:1	back	0.106	1.211	0.128	
1880.00	9400	UMTS 1900	RMC	23.5	22.67	-0.17	11 mm	FL-084-H	N/A	1:1	top	0.105	1.211	0.127	
1880.00	9400	UMTS 1900	RMC	23.5	22.67	0.00	0 mm	FL-084-H	N/A	1:1	left	0.071	1.211	0.086	
1852.40	9262	UMTS 1900	RMC	12.5	12.17	-0.01	0 mm	FL-084-I	N/A	1:1	back	0.954	1.079	1.029	A11
1880.00	9400	UMTS 1900	RMC	12.5	12.04	0.00	0 mm	FL-084-I	N/A	1:1	back	0.873	1.112	0.971	
1907.60	9538	UMTS 1900	RMC	12.5	12.03	0.00	0 mm	FL-084-I	N/A	1:1	back	0.916	1.114	1.020	
1880.00	9400	UMTS 1900	RMC	12.5	12.04	0.07	0 mm	FL-084-I	N/A	1:1	top	0.552	1.112	0.614	
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: Variability tests are highlighted blue in the above table.

Table 10-8
DTS Body SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2412	1	IEEE 802.11b	DSSS	10.5	9.75	0.13	0 mm	FL-095-A	1	back	1:1	0.922	1.189	**1.096**	
2437	6	IEEE 802.11b	DSSS	10.5	10.15	0.00	0 mm	FL-095-A	1	back	1:1	0.994	1.084	1.077	
2462	11	IEEE 802.11b	DSSS	10.5	10.01	0.05	0 mm	FL-095-A	1	back	1:1	0.909	1.119	1.017	
2437	6	IEEE 802.11b	DSSS	10.5	10.15	-0.01	0 mm	FL-095-A	1	bottom	1:1	0.491	1.084	0.532	
2437	6	IEEE 802.11b	DSSS	10.5	10.15	0.05	0 mm	FL-095-A	1	left	1:1	0.027	1.084	0.029	
2437	6	IEEE 802.11b	DSSS	10.5	10.15	0.10	0 mm	FL-095-A	1	back	1:1	1.010	1.084	1.095	A12
5745	149	IEEE 802.11a	OFDM	9.5	9.03	0.18	0 mm	FL-095-A	6	back	1:1	0.731	1.114	0.814	
5805	161	IEEE 802.11a	OFDM	9.5	9.02	0.06	0 mm	FL-095-A	6	back	1:1	0.887	1.117	0.991	A15
5825	165	IEEE 802.11a	OFDM	9.5	9.07	-0.13	0 mm	FL-095-A	6	back	1:1	0.794	1.104	0.877	
5825	165	IEEE 802.11a	OFDM	9.5	9.07	-0.11	0 mm	FL-095-A	6	bottom	1:1	0.230	1.104	0.254	
5825	165	IEEE 802.11a	OFDM	9.5	9.07	0.16	0 mm	FL-095-A	6	left	1:1	0.108	1.104	0.119	
5805	161	IEEE 802.11a	OFDM	9.5	9.02	0.07	0 mm	FL-095-A	6	back	1:1	0.813	1.117	0.908	
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: Variability tests are highlighted blue in the above table.

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Table 10-9
NII Body SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
5180	36	IEEE 802.11a	OFDM	9.0	8.73	0.20	0 mm	FL-095-A	6	back	1:1	0.505	1.064	0.537	
5240	48	IEEE 802.11a	OFDM	9.0	8.85	0.19	0 mm	FL-095-A	6	back	1:1	0.723	1.035	0.748	
5240	48	IEEE 802.11a	OFDM	9.0	8.85	-0.13	0 mm	FL-095-A	6	bottom	1:1	0.210	1.035	0.217	
5240	48	IEEE 802.11a	OFDM	9.0	8.85	0.13	0 mm	FL-095-A	6	left	1:1	0.149	1.035	0.154	
5260	52	IEEE 802.11a	OFDM	9.5	9.49	-0.01	0 mm	FL-095-A	6	back	1:1	0.720	1.002	0.721	
5320	64	IEEE 802.11a	OFDM	9.5	9.28	0.05	0 mm	FL-095-A	6	back	1:1	0.616	1.052	0.648	
5260	52	IEEE 802.11a	OFDM	9.5	9.49	-0.17	0 mm	FL-095-A	6	bottom	1:1	0.247	1.002	0.247	
5260	52	IEEE 802.11a	OFDM	9.5	9.49	0.18	0 mm	FL-095-A	6	left	1:1	0.165	1.002	0.165	
5540	108	IEEE 802.11a	OFDM	9.5	8.75	-0.01	0 mm	FL-095-A	6	back	1:1	0.355	1.189	0.422	
5580	116	IEEE 802.11a	OFDM	9.5	8.69	0.11	0 mm	FL-095-A	6	back	1:1	0.300	1.205	0.362	
5700	140	IEEE 802.11a	OFDM	9.5	9.06	0.10	0 mm	FL-095-A	6	back	1:1	0.801	1.107	**0.887**	A14
5700	140	IEEE 802.11a	OFDM	9.5	9.06	-0.11	0 mm	FL-095-A	6	bottom	1:1	0.079	1.107	0.087	
5700	140	IEEE 802.11a	OFDM	9.5	9.06	0.18	0 mm	FL-095-A	6	left	1:1	0.064	1.107	0.071	
5700	140	IEEE 802.11a	OFDM	9.5	9.06	0.05	0 mm	FL-095-A	6	back	1:3	0.790	1.107	0.875	
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: Variability tests are highlighted blue in the above table.

Table 10-10
DSS Body 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)	
2402	0	Bluetooth	FHSS	11.0	10.81	-0.06	0 mm	FL-095-C	1	back	1:1	0.324	1.044	0.338	A13
2402	0	Bluetooth	FHSS	11.0	10.81	-0.02	0 mm	FL-095-C	1	bottom	1:1	0.130	1.044	0.136	
2402	0	Bluetooth	FHSS	11.0	10.81	0.11	0 mm	FL-095-C	1	left	1:1	0.000	1.044	0.000	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							**Body 1.6 W/kg (mW/g) averaged over 1 gram**								

10.3 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 616217 D04 and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Per FCC KDB 865664 D01 v01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 12 for variability analysis.
7. Per FCC KDB 616217 D04 Section 4.3, SAR tests are required for the back surface and edges of the tablet with the tablet touching the phantom. The SAR Exclusion Threshold in FCC KDB 447498 D01v05 was applied to determine SAR test exclusion for adjacent edge configurations. SAR tests were required for top and left edge for the main antenna and bottom and left edge for the BT/WLAN antenna.

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8. Head SAR testing was required for this tablet because it has a speaker/receiver and microphone positioning that allows for a held-to-ear configuration usage. All head SAR tests were performed at reduced power levels for all modes.

GSM Test Notes:

1. Justification for reduced test configurations per KDB Publication 941225 D03v01 and October 2013 TCB Workshop Notes: The source-based frame-averaged output power was evaluated for all GPRS slot configurations. The configuration with the highest target frame averaged output power was evaluated for body SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
2. Per FCC KDB Publication 447498 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.
3. Per FCC KDB 616217 D04 4.3, when the voice mode is limited to speaker mode or headset operations only for body configurations, additional SAR testing for tablet voice use is not required.

UMTS Notes:

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

WLAN/BT 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) 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. WIFI transmission was verified using an uncalibrated spectrum analyzer.
4. When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is >1.6 W/kg or the reported 1g averaged SAR is >0.8 W/kg, SAR testing on other default channels was required.
5. There is no proximity sensor power reduction mechanism applied for WIFI/BT modes.
6. The Bluetooth highest output power channel was tested for SAR.

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11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

11.1 Introduction

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

11.2 Simultaneous Transmission Procedures

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

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

Table 11-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth LE	2440	7.50	5	**0.250**

Notes:

1. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.
2. When the test separation distance was > 50 mm, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion, for configurations excluded per FCC KDB Publication 447498 D01v05. When the test separation distance was < 50 mm, an estimated SAR was determined per FCC KDB Publication 447498 D01v05.
3. Per FCC KDB 447498, when the test separation distance is < 5mm, a distance of 5 mm is applied to determine estimated SAR.

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11.3 Head SAR Simultaneous Transmission Analysis

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

Simult Tx	Configuration	GSM 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.249	0.003	**0.252**
	Right Tilt	0.176	0.002	0.178
	Left Cheek	0.181	0.000	0.181
	Left Tilt	0.127	0.000	0.127

Simult Tx	Configuration	GSM 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.956	0.003	**0.959**
	Right Tilt	0.747	0.002	0.749
	Left Cheek	0.328	0.000	0.328
	Left Tilt	0.294	0.000	0.294

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.437	0.003	**0.440**
	Right Tilt	0.308	0.002	0.310
	Left Cheek	0.290	0.000	0.290
	Left Tilt	0.219	0.000	0.219

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.714	0.003	**0.717**
	Right Tilt	0.533	0.002	0.535
	Left Cheek	0.256	0.000	0.256
	Left Tilt	0.220	0.000	0.220

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

Simult Tx	Configuration	GSM 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.249	0.017	**0.266**
	Right Tilt	0.176	0.028	0.204
	Left Cheek	0.181	0.044	0.225
	Left Tilt	0.127	0.033	0.160

Simult Tx	Configuration	GSM 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.956	0.017	**0.973**
	Right Tilt	0.747	0.028	0.775
	Left Cheek	0.328	0.044	0.372
	Left Tilt	0.294	0.033	0.327

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.437	0.017	**0.454**
	Right Tilt	0.308	0.028	0.336
	Left Cheek	0.290	0.044	0.334
	Left Tilt	0.219	0.033	0.252

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.714	0.017	**0.731**
	Right Tilt	0.533	0.028	0.561
	Left Cheek	0.256	0.044	0.300
	Left Tilt	0.220	0.033	0.253

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11.4 Body SAR Simultaneous Transmission Analysis

Table 11-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body at 0.0 cm))

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.774	1.096	See note 1	0.02
	Top	0.387	0.400	0.787	N/A
	Bottom	0.400	0.532	0.932	N/A
	Right	0.400	0.400	0.800	N/A
	Left	0.048	0.029	0.077	N/A

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.055	1.096	See note 1	0.02
	Top	0.517	0.400	0.917	N/A
	Bottom	0.400	0.532	0.932	N/A
	Right	0.400	0.400	0.800	N/A
	Left	0.501	0.029	0.530	N/A

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.544	1.096	See note 1	0.01
	Top	0.103	0.400	0.503	N/A
	Bottom	0.400	0.532	0.932	N/A
	Right	0.400	0.400	0.800	N/A
	Left	0.085	0.029	0.114	N/A

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.029	1.096	See note 1	0.02
	Top	0.614	0.400	1.014	N/A
	Bottom	0.400	0.532	0.932	N/A
	Right	0.400	0.400	0.800	N/A
	Left	0.086	0.029	0.115	N/A

Table 11-5
Simultaneous Transmission Scenario with 5 GHz WLAN (Body at 0.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.774	0.991	See note 1	0.01
	Top	0.387	0.400	0.787	N/A
	Bottom	0.400	0.254	0.654	N/A
	Right	0.400	0.400	0.800	N/A
	Left	0.048	0.165	0.213	N/A

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.055	0.991	See note 1	0.02
	Top	0.517	0.400	0.917	N/A
	Bottom	0.400	0.254	0.654	N/A
	Right	0.400	0.400	0.800	N/A
	Left	0.501	0.165	0.666	N/A

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.544	0.991	**1.535**	N/A
	Top	0.103	0.400	0.503	N/A
	Bottom	0.400	0.254	0.654	N/A
	Right	0.400	0.400	0.800	N/A
	Left	0.085	0.165	0.250	N/A

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.029	0.991	See note 1	0.02
	Top	0.614	0.400	1.014	N/A
	Bottom	0.400	0.254	0.654	N/A
	Right	0.400	0.400	0.800	N/A
	Left	0.086	0.165	0.251	N/A

Table 11-6
Simultaneous Transmission Scenario with Bluetooth (Body at 0.0 cm)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.774	0.338	**1.112**	N/A
	Top	0.387	0.400	0.787	N/A
	Bottom	0.400	0.250	0.650	N/A
	Right	0.400	0.400	0.800	N/A
	Left	0.048	0.250	0.298	N/A

Simult Tx	Configuration	GSM 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.055	0.338	**1.393**	N/A
	Top	0.517	0.400	0.917	N/A
	Bottom	0.400	0.250	0.650	N/A
	Right	0.400	0.400	0.800	N/A
	Left	0.501	0.250	0.751	N/A

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.544	0.338	**0.882**	N/A
	Top	0.103	0.400	0.503	N/A
	Bottom	0.400	0.250	0.650	N/A
	Right	0.400	0.400	0.800	N/A
	Left	0.085	0.250	0.335	N/A

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.029	0.338	**1.367**	N/A
	Top	0.614	0.400	1.014	N/A
	Bottom	0.400	0.250	0.650	N/A
	Right	0.400	0.400	0.800	N/A
	Left	0.086	0.250	0.336	N/A

Estimated Bluetooth LE values are used for Bottom and Left edges instead of the measured Bluetooth values since estimated Bluetooth LE SAR is greater than measured Bluetooth SAR for these configurations.

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Table 11-7
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body at 1.4 cm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GSM 850	0.059	< 1.096	< 1.155	N/A
Back Side	GSM 1900	0.737	< 1.096	See note 1	< 0.01
Back Side	UMTS 850	0.076	< 1.096	< 1.172	N/A
Back Side	UMTS 1900	0.128	< 1.096	< 1.224	N/A

Table 11-8
Simultaneous Transmission Scenario with 5 GHz WLAN (Body at 1.4 cm)

Configuration	Mode	2G/3G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GSM 850	0.059	< 0.991	< 1.05	N/A
Back Side	GSM 1900	0.737	< 0.991	See note 1	< 0.01
Back Side	UMTS 850	0.076	< 0.991	< 1.067	N/A
Back Side	UMTS 1900	0.128	< 0.991	< 1.119	N/A

Table 11-9
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth (Body at 1.4 cm)

Configuration	Mode	2G/3G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GSM 850	0.059	< 0.338	< 0.397	N/A
Back Side	GSM 1900	0.737	< 0.338	< 1.075	N/A
Back Side	UMTS 850	0.076	< 0.338	< 0.414	N/A
Back Side	UMTS 1900	0.128	< 0.338	< 0.466	N/A

Table 11-10
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body at 1.1 cm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	GSM 850	0.073	0.400	0.473	N/A
Top Edge	GSM 1900	0.251	0.400	0.651	N/A
Top Edge	UMTS 850	0.092	0.400	0.492	N/A
Top Edge	UMTS 1900	0.127	0.400	0.527	N/A

Table 11-11
Simultaneous Transmission Scenario with 5 GHz WLAN (Body at 1.1 cm)

Configuration	Mode	2G/3G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	GSM 850	0.073	0.400	0.473	N/A
Top Edge	GSM 1900	0.251	0.400	0.651	N/A
Top Edge	UMTS 850	0.092	0.400	0.492	N/A
Top Edge	UMTS 1900	0.127	0.400	0.527	N/A

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Table 11-12
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth (Body at 1.1 cm)

Configuration	Mode	2G/3G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	GSM 850	0.073	0.400	0.473	N/A
Top Edge	GSM 1900	0.251	0.400	0.651	N/A
Top Edge	UMTS 850	0.092	0.400	0.492	N/A
Top Edge	UMTS 1900	0.127	0.400	0.527	N/A

Notes:

1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was not higher than 0.04 per FCC KDB 447498 D01v05. See Section 11.5 for detailed SPLS ratio analysis.
2. When the test separation distance was > 50 mm, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion, for configuration excluded per FCC KDB 447498 D01v05. Therefore, an estimated SAR of 0.4 W/kg for 2.4 GHz WLAN, 5 GHz WLAN, and Bluetooth was used to evaluate the simultaneous sums.
3. For body SAR summations for back side at 1.4 cm, 2.4 GHz WLAN and Bluetooth and 5 GHz WLAN SAR values for 0.0 cm were used since the 0.0 cm test distance for 2.4 GHz WLAN and Bluetooth and 5 GHz WLAN were more conservative. "<" denotes that the 0.0 cm 2.4 GHz WLAN and Bluetooth and 5 GHz WLAN SAR values were used for summation purposes.
4. Per FCC KDB 616217 D04 4.3, when the voice mode is limited to speaker mode or headset operations only for body configurations, additional SAR testing for tablet voice use is not required. Therefore, voice standalone and simultaneous combinations with Bluetooth are not evaluated for body configurations.

11.5 SPLSR Evaluation and Analysis

Per FCC KDB Publication 447498 D01v05, when the sum of the standalone transmitters is more than 1.6 W/kg, the SAR sum to peak locations can be analyzed to determine SAR distribution overlaps. When the SAR peak to location ratio (shown below) for each pair of antennas is ≤ 0.04, simultaneous SAR evaluation is not required. The distance between the transmitters was calculated using the following formula.

$$\text{Distance}_{Tx1-Tx2} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

$$\text{SPLS Ratio} = \frac{(SAR_1 + SAR_2)^{1.5}}{R_i}$$

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with GPRS 850 MHz antenna operating at limited output power with 2.4 GHz WLAN.

Table 11-13
Peak SAR Locations for Body Back Side at 0 mm GPRS 850 and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 850 MHz	25.00	85.50
802.11b	-6.40	-81.00

Figure 11-1
Peak SAR Locations of 2.4 GHz WLAN and GPRS 850

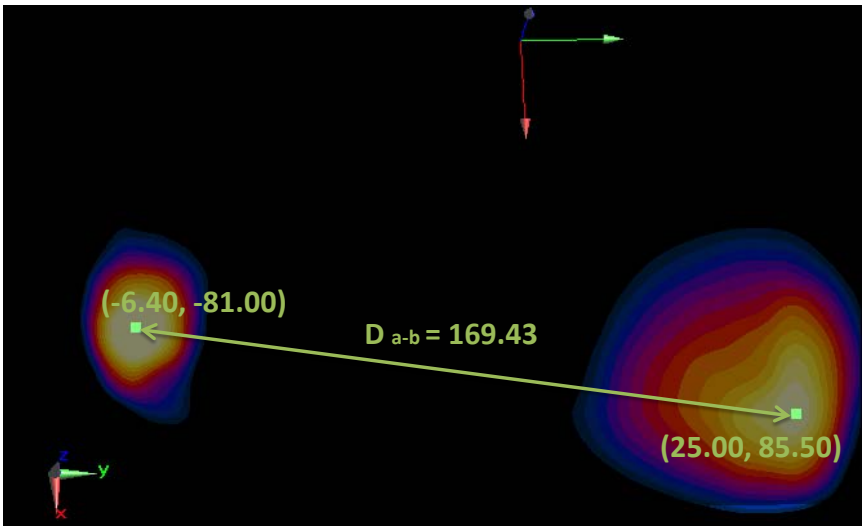

Table 11-14
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 850 MHz	802.11b	0.774	1.096	1.87	169.43	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with GPRS 1900 MHz antenna operating at limited output power with 2.4 GHz WLAN.

Table 11-15
Peak SAR Locations for Body Back Side at 0 mm GPRS 1900 and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 1900 MHz	12.00	88.00
802.11b	-6.40	-81.00

Figure 11-2
Peak SAR Locations of 2.4 GHz WLAN and GPRS 1900

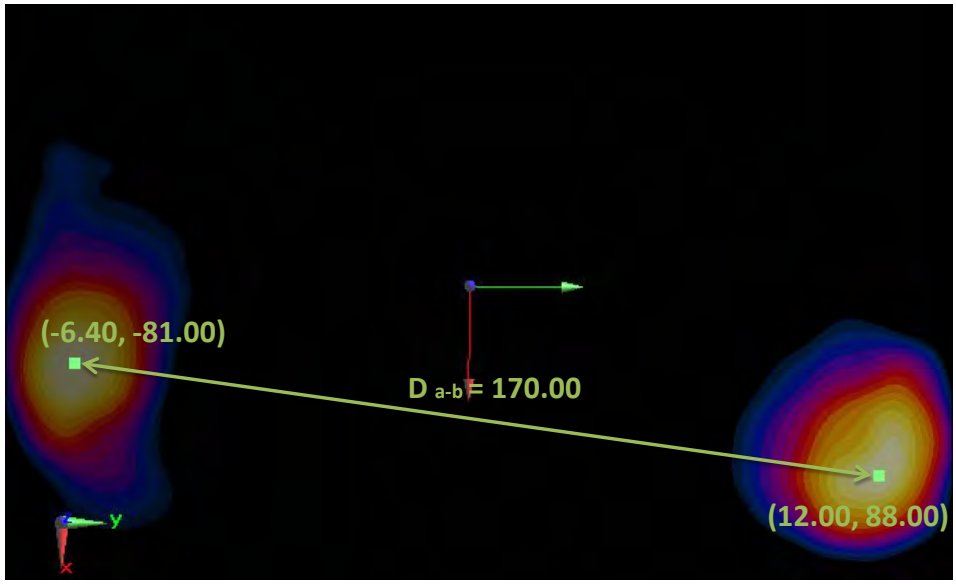

Table 11-16
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900 MHz	802.11b	1.055	1.096	2.151	170	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with UMTS 850 MHz antenna operating at limited output power with 2.4 GHz WLAN.

Table 11-17
Peak SAR Locations for Body Back Side at 0 mm UMTS 850 and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
UMTS 850 MHz	19.50	77.50
802.11b	-6.40	-81.00

Figure 11-3
Peak SAR Locations of 2.4 GHz WLAN and UMTS 850

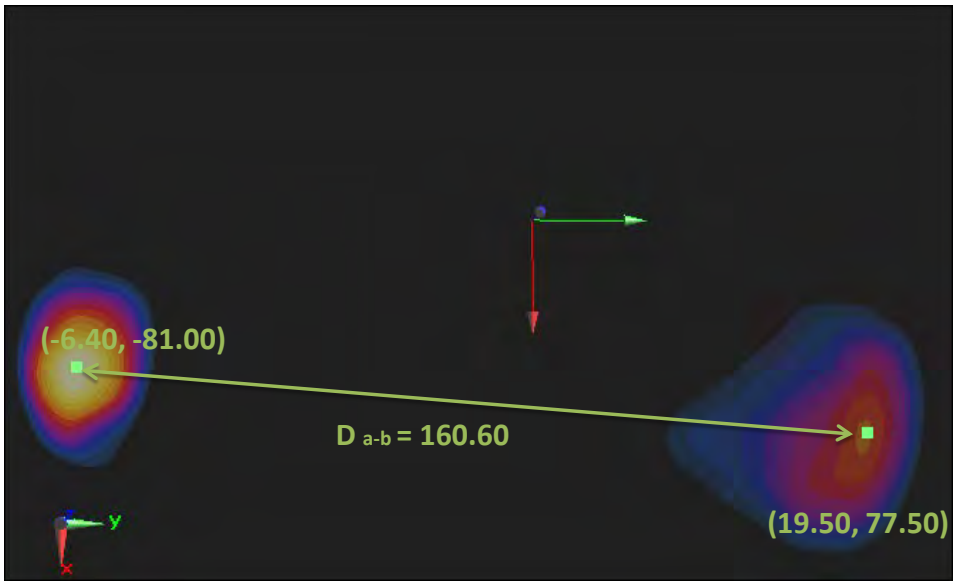

Table 11-18
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 850 MHz	802.11b	0.544	1.096	1.64	160.6	0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with UMTS 1900 MHz antenna operating at limited output power with 2.4 GHz WLAN.

Table 11-19
Peak SAR Locations for Body Back Side at 0 mm UMTS 1900 and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
UMTS 1900 MHz	3.00	88.50
802.11b	-6.40	-81.00

Figure 11-4
Peak SAR Locations of 2.4 GHz WLAN and UMTS 1900

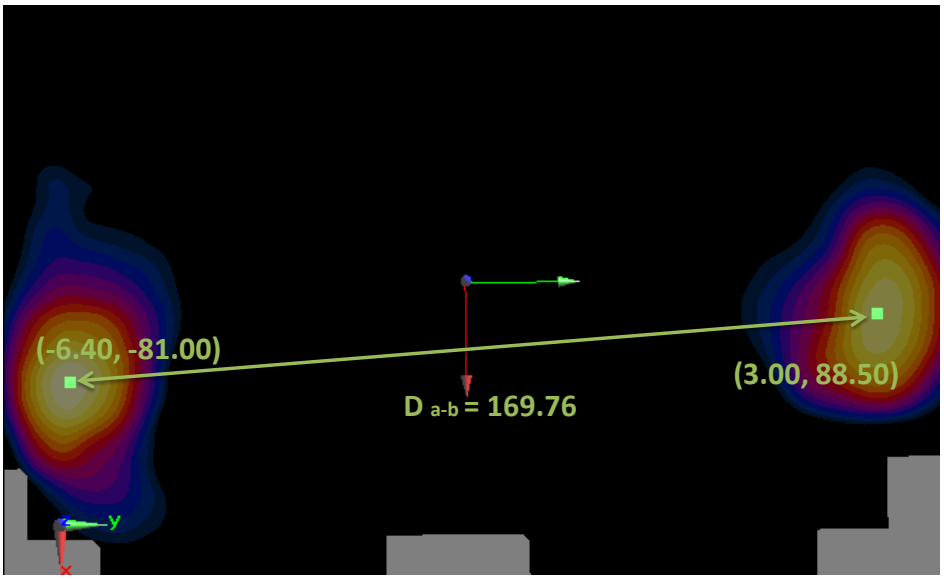

Table 11-20
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 1900 MHz	802.11b	1.029	1.096	2.125	169.76	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with GPRS 850 MHz antenna operating at limited output power with 5 GHz WLAN.

Table 11-21
Peak SAR Locations for Body Back Side at 0 mm GPRS 850 and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 850 MHz	25.00	85.50
802.11a	-0.03	-76.00

Figure 11-5
Peak SAR Locations of 5 GHz WLAN and GPRS 850

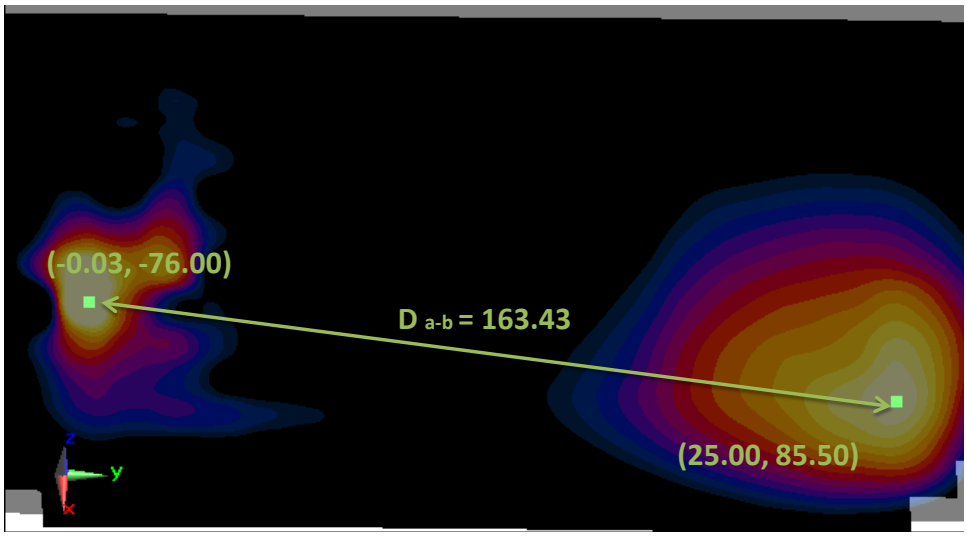

Table 11-22
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 850 MHz	802.11a	0.774	0.991	1.765	163.43	0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with GPRS 1900 MHz antenna operating at limited output power with 5 GHz WLAN.

Table 11-23
Peak SAR Locations for Body Back Side at 0 mm GPRS 1900 and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 1900 MHz	12.00	88.00
802.11a	-0.03	-76.00

Figure 11-6
Peak SAR Locations of 5 GHz WLAN and GPRS 1900

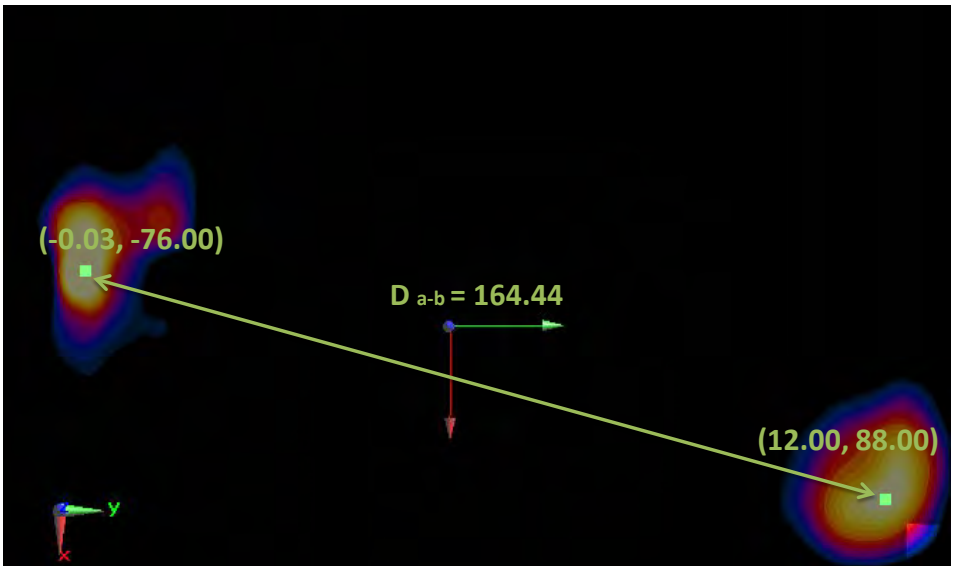

Table 11-24
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900 MHz	802.11a	1.055	0.991	2.046	164.44	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with UMTS 1900 MHz antenna operating at limited output power with 5 GHz WLAN.

Table 11-25
Peak SAR Locations for Body Back Side at 0 mm UMTS 1900 and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)
UMTS 1900 MHz	3.00	88.50
802.11a	-0.03	-76.00

Figure 11-7
Peak SAR Locations of 5 GHz WLAN and UMTS 1900

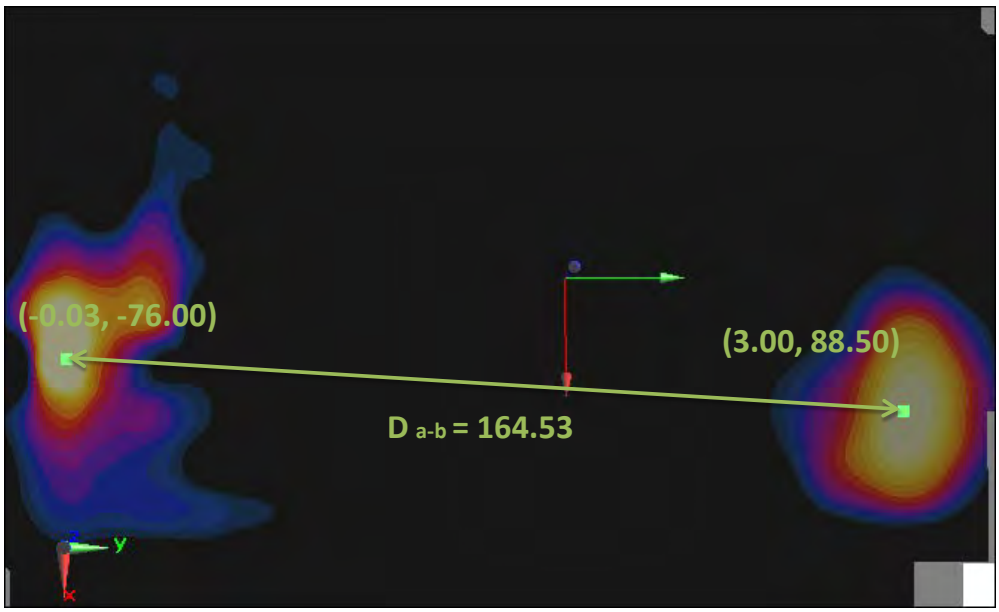

Table 11-26
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 1900 MHz	802.11a	1.029	0.991	2.02	164.53	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 1.4 mm with GPRS 1900 MHz antenna operating at maximum output power with 2.4 GHz WLAN.

Table 11-27
Peak SAR Locations for Body Back Side at 14 mm GPRS 1900 and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 1900	13.00	96.00
802.11b	-6.40	-81.00

Figure 11-8
Peak SAR Locations of 2.4 GHz WLAN and GPRS 1900

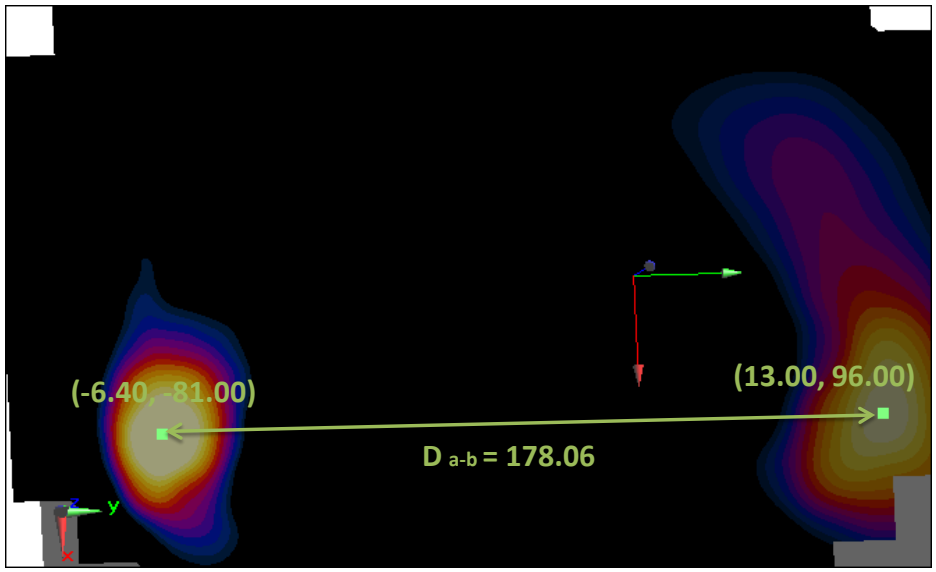

Table 11-28
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900	802.11b	0.737	< 1.096	< 1.833	178.06	< 0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 1.4 mm with GPRS 1900 MHz antenna operating at maximum output power with 5 GHz WLAN.

Table 11-29
Peak SAR Locations for Body Back Side at 14 mm GPRS 1900 and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 1900 MHz	13.00	96.00
802.11a	-0.03	-76.00

Figure 11-9
Peak SAR Locations of 5 GHz WLAN and GPRS 1900

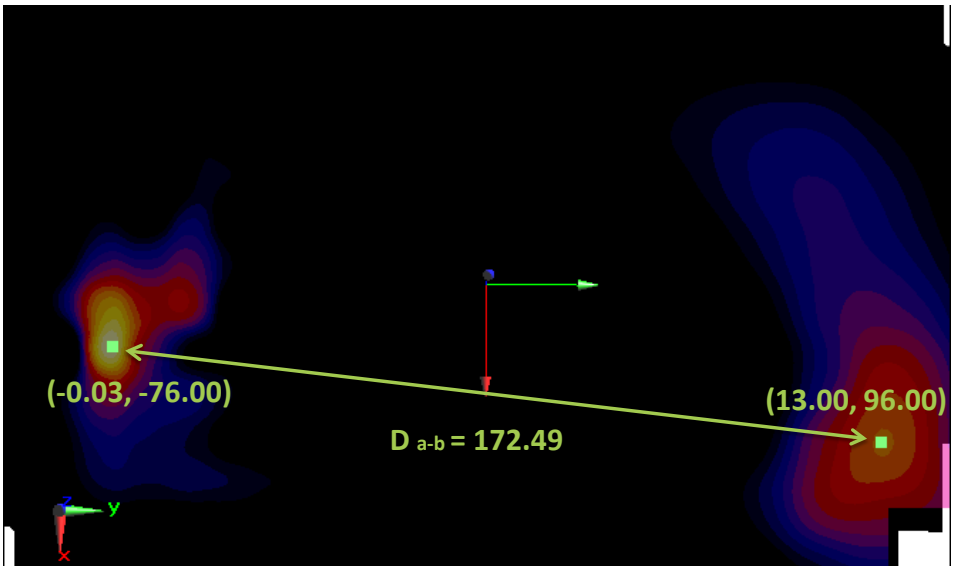

Table 11-30
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900 MHz	802.11a	0.737	< 0.991	< 1.728	172.49	< 0.01

11.6 Simultaneous Transmission Conclusion

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

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12 SAR MEASUREMENT VARIABILITY

12.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01, 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 12-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS																
Band	FREQUENCY		Mode	Service	# of Time Slots	Data Rate (Mbps)	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)	
1900	1909.80	810	GSM 1900	GPRS	3	N/A	back	0 mm	1.050	1.050	1.00	N/A	N/A	N/A	N/A
2450	2437.00	6	IEEE 802.11b	DSSS	N/A	1	back	0 mm	0.994	1.010	1.02	N/A	N/A	N/A	N/A
5800	5805.00	161	IEEE 802.11a	OFDM	N/A	6	back	0 mm	0.887	0.813	1.09	N/A	N/A	N/A	N/A
5600	5700.00	140	IEEE 802.11a	OFDM	N/A	6	back	0 mm	0.801	0.790	1.01	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						

12.2 Measurement Uncertainty

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

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13 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00579
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	8753E	(30kHz-6GHz) Network Analyzer	4/16/2013	Annual	4/16/2014	JP38020182
Agilent	8753E	(30kHz-6GHz) Network Analyzer	7/23/2013	Annual	7/23/2014	US37390350
Agilent	8753ES	S-Parameter Network Analyzer	10/29/2013	Annual	10/29/2014	US39170122
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/16/2013	Annual	4/16/2014	MY45470194
Agilent	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Anritsu	MA24106A	USB Power Sensor	1/3/2014	Annual	1/3/2015	1344554
Anritsu	MA24106A	USB Power Sensor	1/3/2014	Annual	1/3/2015	1344557
Anritsu	MA2411B	Pulse Power Sensor	11/14/2013	Annual	11/14/2014	1126066
Anritsu	MA2481A	Power Sensor	10/30/2013	Annual	10/30/2014	5605
Anritsu	ML2495A	Power Meter	10/31/2013	Annual	10/31/2014	1039008
Anritsu	MT8820C	Radio Communication Analyzer	12/12/2013	Annual	12/12/2014	6200901190
Anritsu	MT8820C	Radio Communication Analyzer	12/12/2013	Annual	12/12/2014	6201300731
Control Company	4052	Long Stem Thermometer	9/27/2013	Biennial	9/27/2015	130567447
Fisher Scientific	15-077-960	Digital Thermometer	11/6/2012	Biennial	11/6/2014	122640025
Fisher Scientific	15-078J	Long Stem Thermometer	10/30/2012	Biennial	10/30/2014	122626059
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	9/23/2013	Annual	9/23/2014	109892
Rohde & Schwarz	CMU200	Base Station Simulator	5/3/2013	Annual	5/3/2014	836371/0079
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	12/9/2013	Annual	12/9/2014	109366
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	6/6/2013	Annual	6/6/2014	111427
Rohde & Schwarz	NRVD	Dual Channel Power Meter	10/12/2012	Biennial	10/12/2014	101695
Rohde & Schwarz	NRVS	Single Channel Power Meter	10/31/2013	Annual	10/31/2014	835360/0079
Rohde & Schwarz	NRV-Z32	Peak Power Sensor	10/12/2012	Biennial	10/12/2014	836019/013
Rohde & Schwarz	SME06	Signal Generator	10/30/2013	Annual	10/30/2014	832026
Rohde & Schwarz	SMIQ03B	Signal Generator	4/17/2013	Annual	4/17/2014	DE27259
Seekonk	NC-100	Torque Wrench (8" lb)	3/5/2012	Triennial	3/5/2015	N/A
SPEAG	D1900V2	1900 MHz SAR Dipole	7/22/2013	Annual	7/22/2014	5d149
SPEAG	D2450V2	2450 MHz SAR Dipole	8/23/2013	Annual	8/23/2014	719
SPEAG	D5GHzV2	5 GHz SAR Dipole	9/23/2013	Annual	9/23/2014	1007
SPEAG	D5GHzV2	5 GHz SAR Dipole	1/27/2014	Annual	1/27/2015	1057
SPEAG	D835V2	835 MHz SAR Dipole	4/25/2013	Annual	4/25/2014	4d119
SPEAG	DAE4	Dasy Data Acquisition Electronics	12/12/2013	Annual	12/12/2014	649
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/26/2014	Annual	2/26/2015	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/22/2014	Annual	1/22/2015	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/21/2013	Annual	8/21/2014	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/19/2013	Annual	11/19/2014	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/19/2013	Annual	11/19/2014	1408
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/14/2013	Annual	5/14/2014	1070
SPEAG	DAK-3.5	Dielectric Assessment Kit	11/13/2013	Annual	11/13/2014	1091
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/18/2013	Annual	8/18/2014	1008
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/18/2013	Annual	8/18/2014	1009
SPEAG	ES3DV2	SAR Probe	8/22/2013	Annual	8/22/2014	3022
SPEAG	ES3DV3	SAR Probe	2/25/2014	Annual	2/25/2015	3258
SPEAG	ES3DV3	SAR Probe	11/22/2013	Annual	11/22/2014	3333
SPEAG	EX3DV4	SAR Probe	1/29/2014	Annual	1/29/2015	3589
SPEAG	EX3DV4	SAR Probe	10/23/2013	Annual	10/23/2014	3914
SPEAG	EX3DV4	SAR Probe	12/18/2013	Annual	12/18/2014	3920
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/17/2013	Annual	4/17/2014	B010177
VWR	23226-658	Long Stem Thermometer	5/16/2012	Biennial	5/16/2014	122295544
VWR	36934-158	Wall-Mounted Thermometer	8/8/2013	Annual	8/8/2014	130258636

Note:
1. 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.
2. All equipment was used solely within its calibration period.

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14 MEASUREMENT UNCERTAINTIES

Applicable for frequencies less than 3000 MHz.

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

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

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Applicable for frequencies up to 6 GHz.

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

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

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15 CONCLUSION

15.1 Measurement Conclusion

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

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

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APPENDIX A: SAR TEST DATA

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PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-084-I

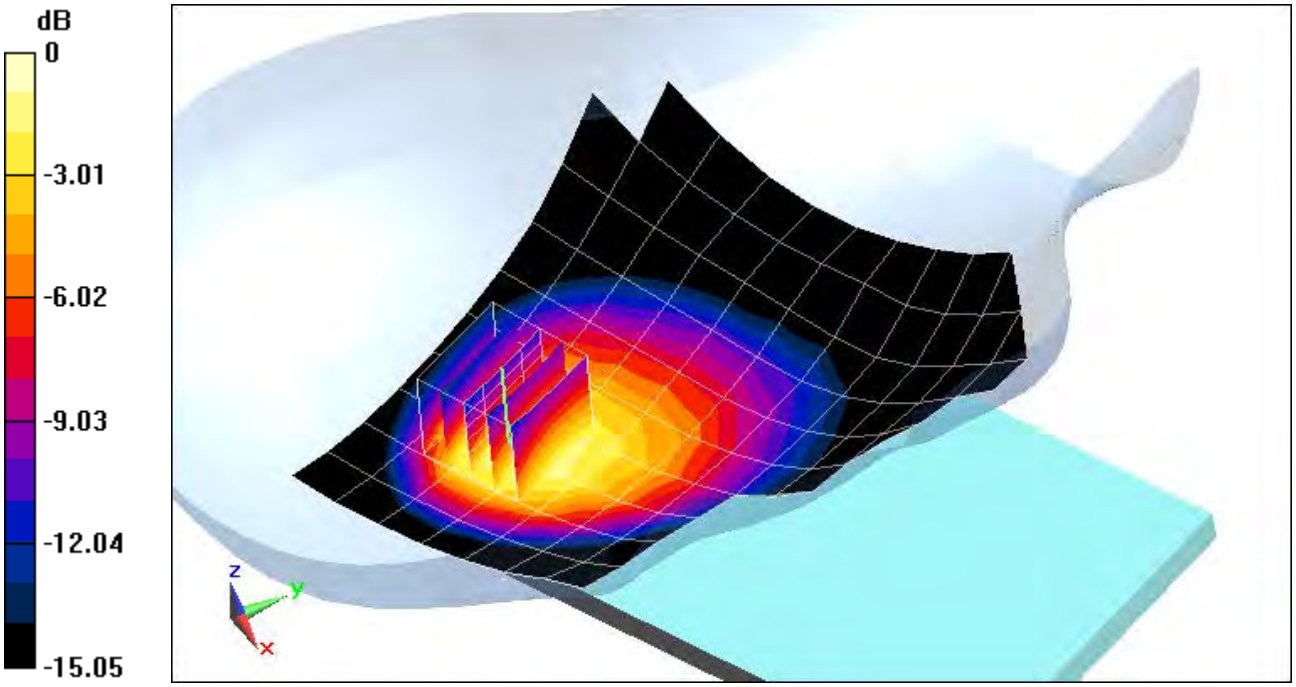
Communication System: UID 0, GSM; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium: 835 Head Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.922 S/m; ε_r = 41.579; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 03-26-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3258; ConvF(6.27, 6.27, 6.27); Calibrated: 2/25/2014;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (11x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.933 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.407 W/kg
SAR(1 g) = 0.226 W/kg



0 dB = 0.240 W/kg = -6.20 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-084-I

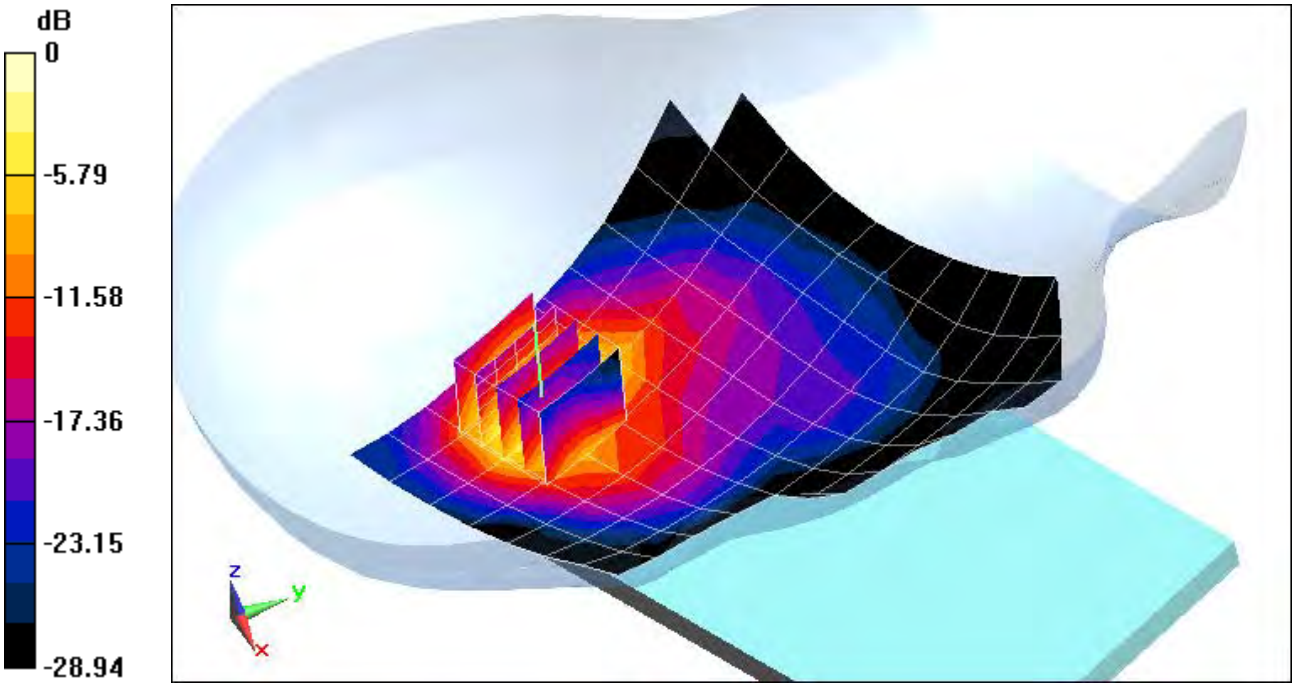
Communication System: UID 0, GSM; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3
Medium: 1900 Head Medium parameters used:
f = 1910 MHz; σ = 1.459 S/m; ε_r = 39.305; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 03-24-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.9°C

Probe: ES3DV3 - SN3258; ConvF(5.04, 5.04, 5.04); Calibrated: 2/25/2014;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (11x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.528 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 1.78 W/kg
SAR(1 g) = 0.827 W/kg



0 dB = 0.956 W/kg = -0.20 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-084-I

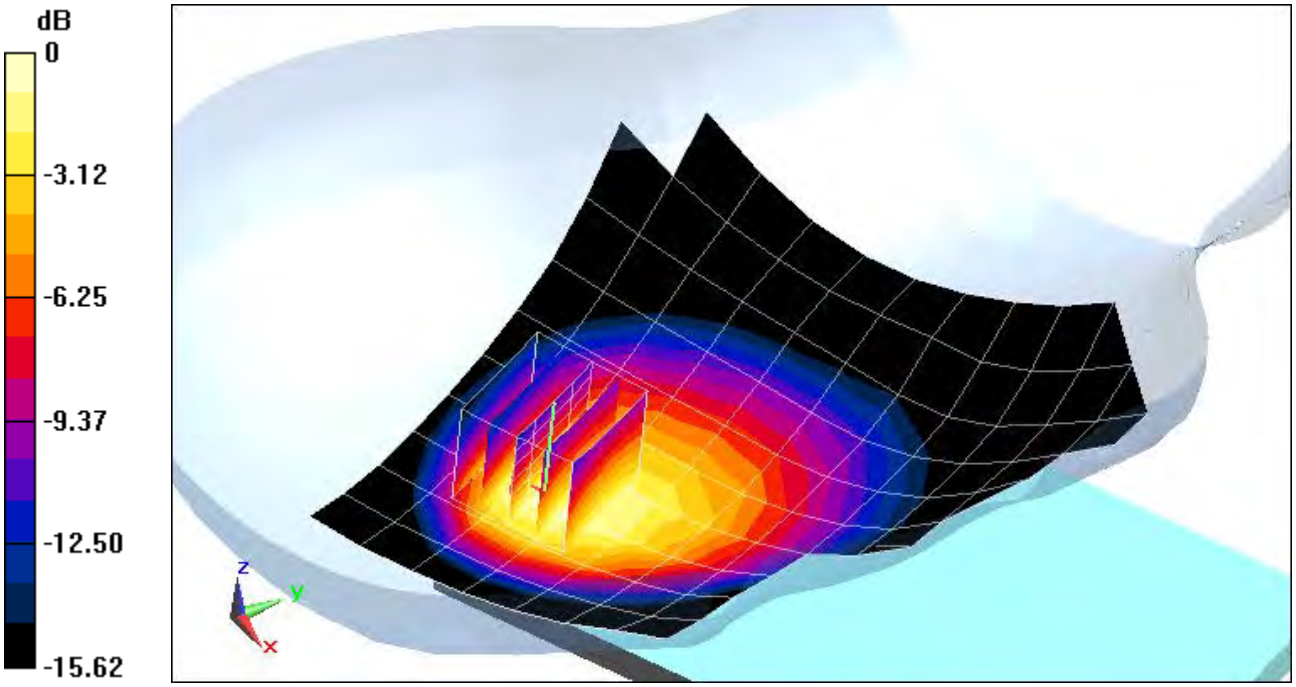
Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Head Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.922 S/m; ε_r = 41.579; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 03-26-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3258; ConvF(6.27, 6.27, 6.27); Calibrated: 2/25/2014;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (11x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.469 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.633 W/kg
SAR(1 g) = 0.355 W/kg



0 dB = 0.379 W/kg = -4.21 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-084-I

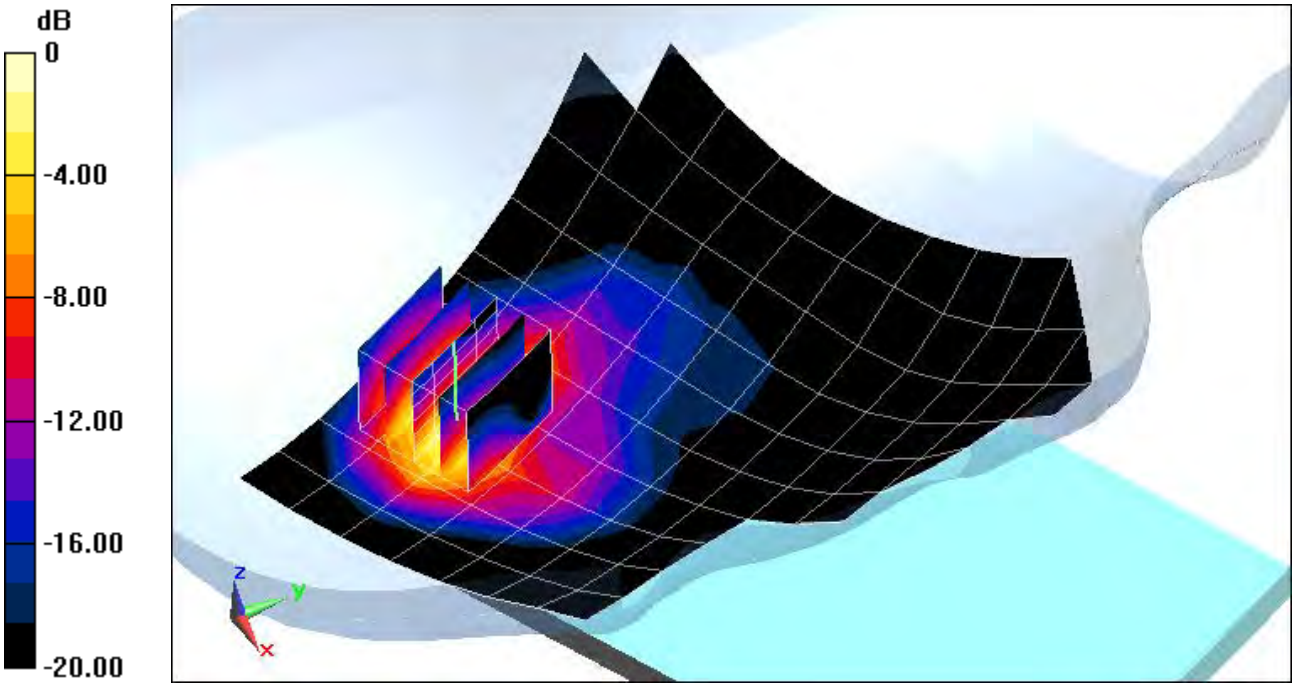
Communication System: UID 0, UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.426 S/m; ε_r = 39.452; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 03-24-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.9°C

Probe: ES3DV3 - SN3258; ConvF(5.04, 5.04, 5.04); Calibrated: 2/25/2014;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (11x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.410 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 1.39 W/kg
SAR(1 g) = 0.642 W/kg



0 dB = 0.744 W/kg = -1.28 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-095-A

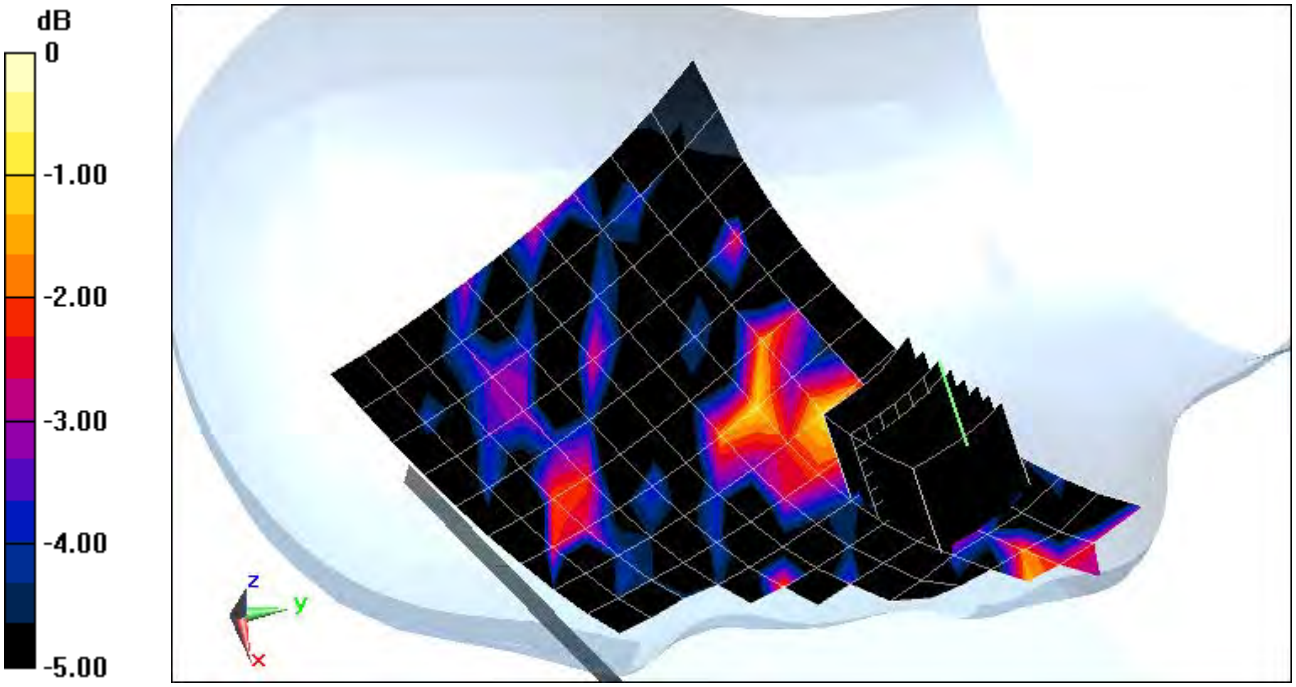
Communication System: UID 0, IEEE 802.11b (0); Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used (interpolated):
f = 2437 MHz; σ = 1.804 S/m; ε_r = 38.164; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 03-10-2014; Ambient Temp: 24.4°C; Tissue Temp: 22.1°C

Probe: EX3DV4 - SN3914; ConvF(6.95, 6.95, 6.95); Calibrated: 10/23/2013;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11b, Right Head, Cheek, Ch 6, 1 Mbps

Area Scan (11x18x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.666 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 0.0140 W/kg
SAR(1 g) = 0.00252 W/kg



0 dB = 0.00541 W/kg = -22.67 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-084-A

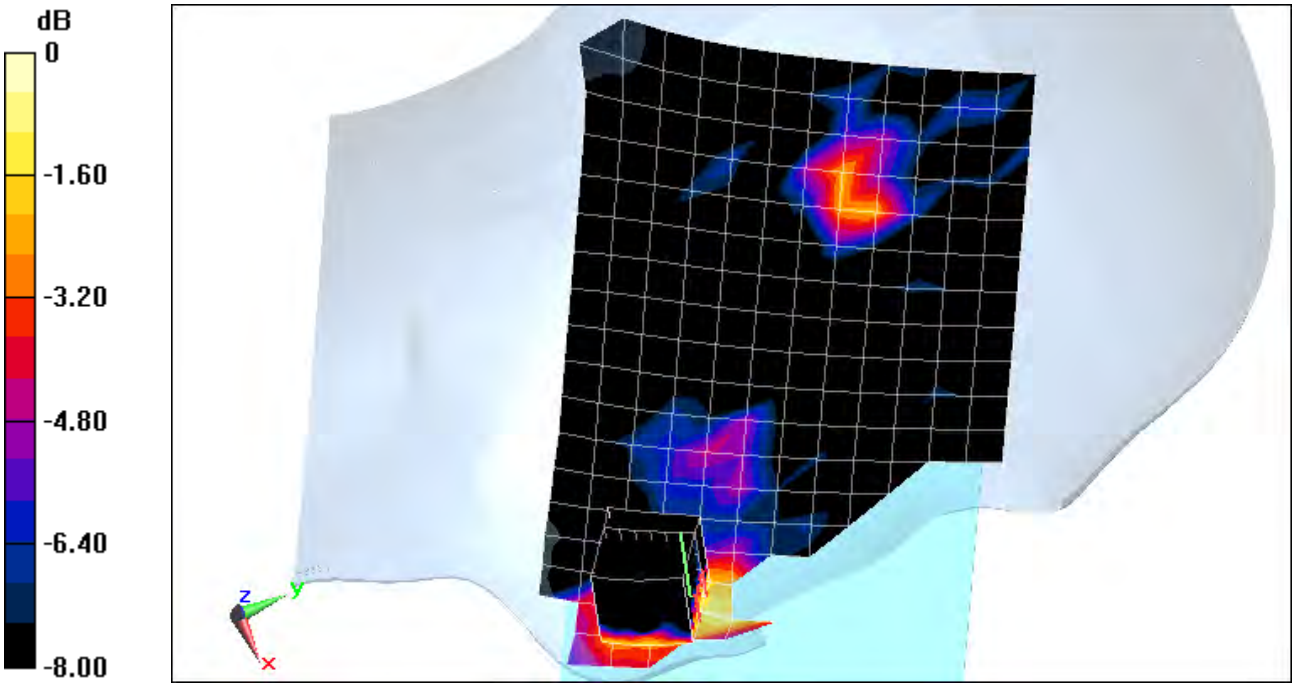
Communication System: UID 0, IEEE 802.11a (0); Frequency: 5700 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5700 MHz; σ = 5.082 S/m; ε_r = 35.624; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 03-12-2014; Ambient Temp: 24.5°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3914; ConvF(4.37, 4.37, 4.37); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.5 - 5.7 GHz, Left Head, Cheek, Ch 140, 6 Mbps

Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 4.233 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.161 W/kg
SAR(1 g) = 0.040 W/kg



0 dB = 0.0991 W/kg = -10.04 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-084-A

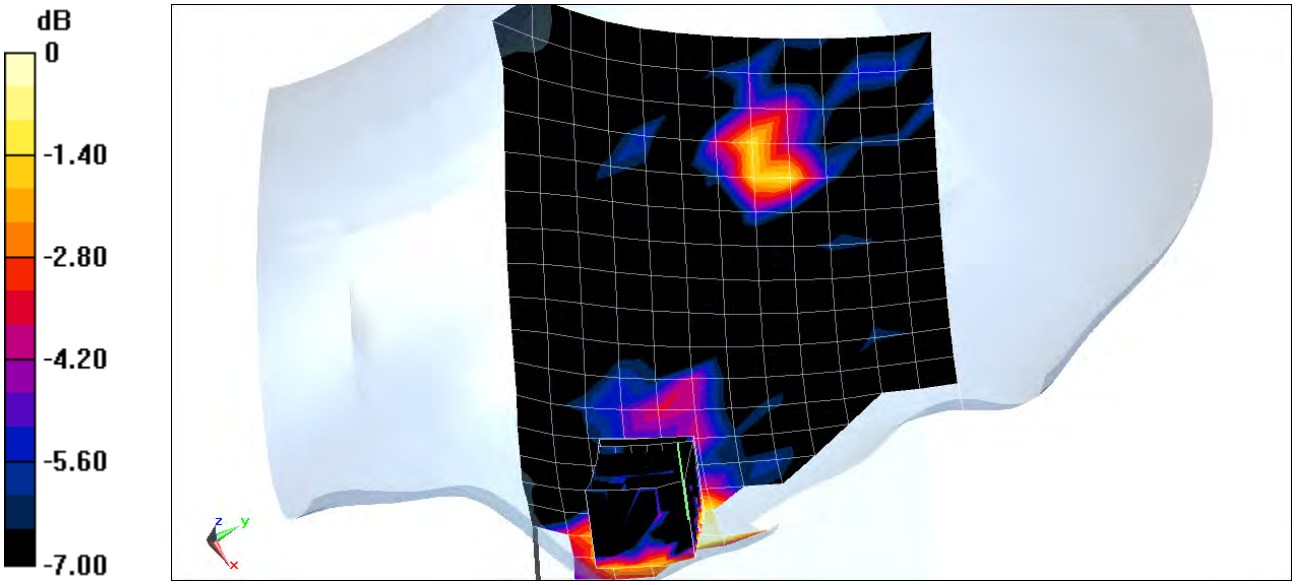
Communication System: UID 0, IEEE 802.11a (0); Frequency: 5825 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5825 MHz; σ = 5.203 S/m; ε_r = 35.44; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 03-12-2014; Ambient Temp: 24.5°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3914; ConvF(4.52, 4.52, 4.52); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.8 GHz, Left Head, Cheek, Ch 165, 6 Mbps

Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 3.666 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 0.151 W/kg
SAR(1 g) = 0.026 W/kg



0 dB = 0.0782 W/kg = -11.07 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-084-I

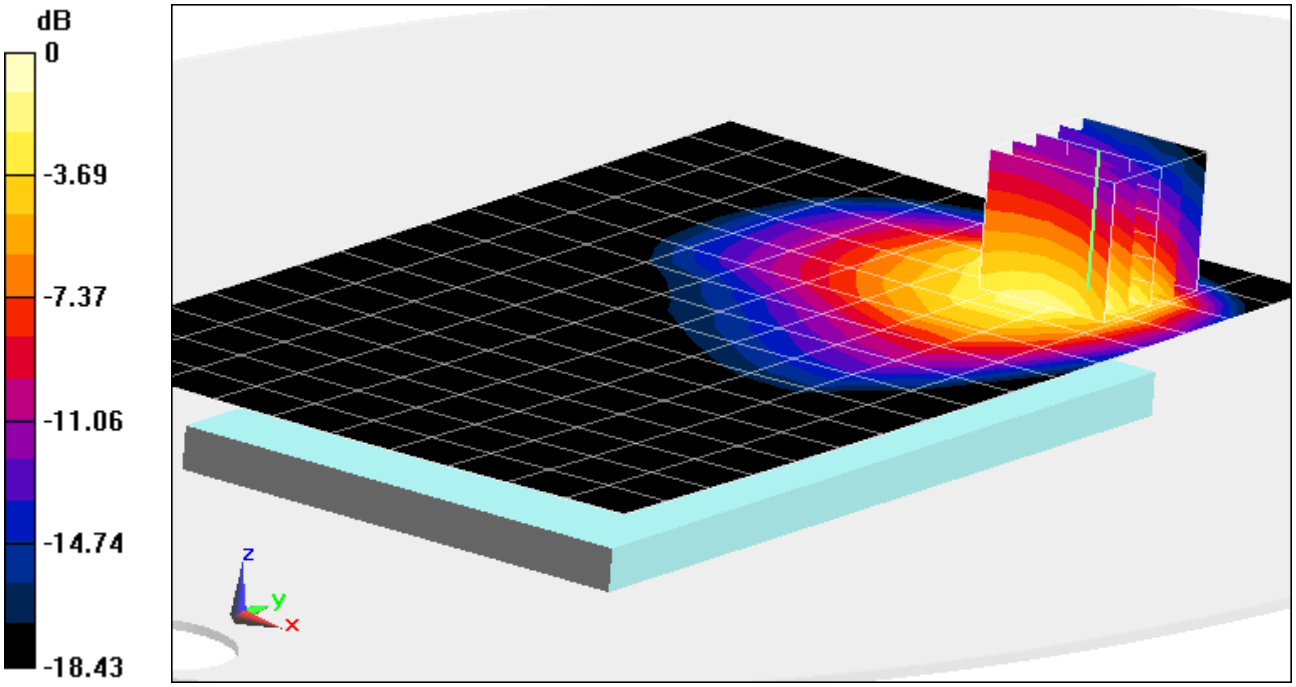
Communication System: UID 0, GSM GPRS; 3 Tx slots; Frequency: 836.6 MHz; Duty Cycle: 1:2.76
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.003 S/m; ε_r = 54.483; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-24-2014; Ambient Temp: 23.9°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3333; ConvF(6.07, 6.07, 6.07); Calibrated: 11/22/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 11/19/2013
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (11x17x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.554 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 1.47 W/kg
SAR(1 g) = 0.717 W/kg



0 dB = 0.783 W/kg = -1.06 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-084-I

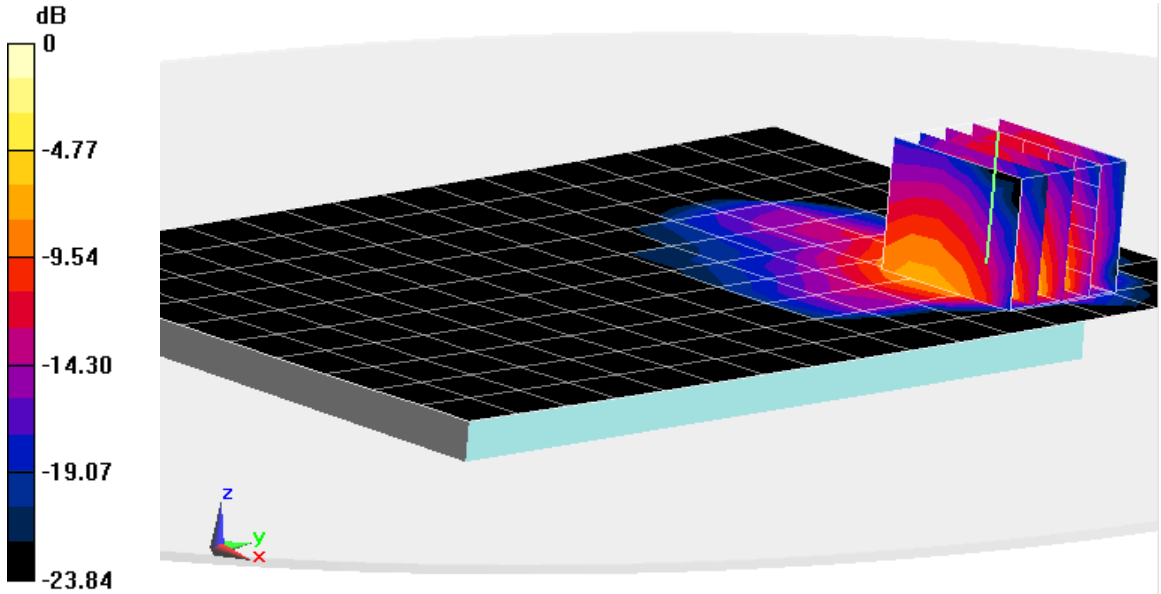
Communication System: UID 0, GSM GPRS; 3 Tx slots (0); Frequency: 1909.8 MHz;Duty Cycle: 1:2.76
Medium: 1900 Body Medium parameters used:
f = 1910 MHz; σ = 1.591 S/m; ε_r = 52.307; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-14-2014; Ambient Temp: 23.1°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN3589; ConvF(6.54, 6.54, 6.54); Calibrated: 1/29/2014;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/22/2014
Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: GPRS 1900, Body SAR, Back side, High.ch, 3 Tx Slots

Area Scan (11x17x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.258 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 2.33 W/kg
SAR(1 g) = 1.05 W/kg



0 dB = 1.21 W/kg = 0.83 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-084-I

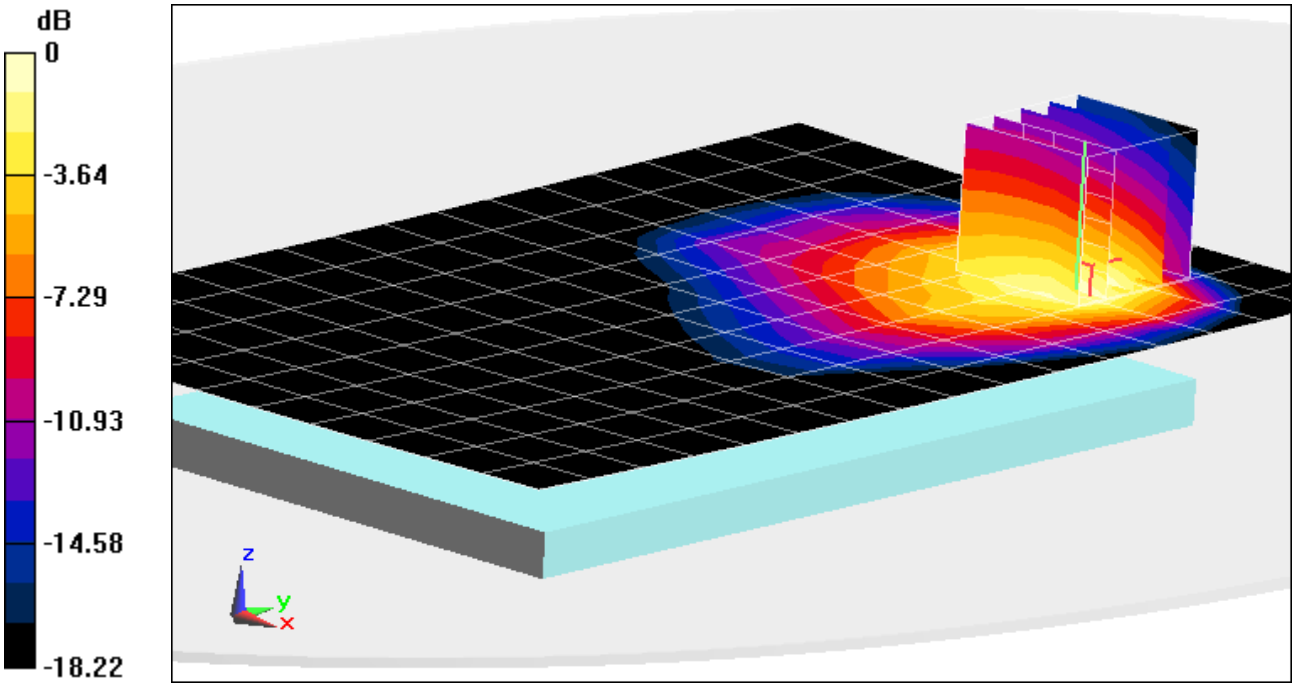
Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.003 S/m; ε_r = 54.483; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-24-2014; Ambient Temp: 23.9°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3333; ConvF(6.07, 6.07, 6.07); Calibrated: 11/22/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 11/19/2013
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
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 (11x17x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.112 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.862 W/kg
SAR(1 g) = 0.442 W/kg



0 dB = 0.476 W/kg = -3.22 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-084-I

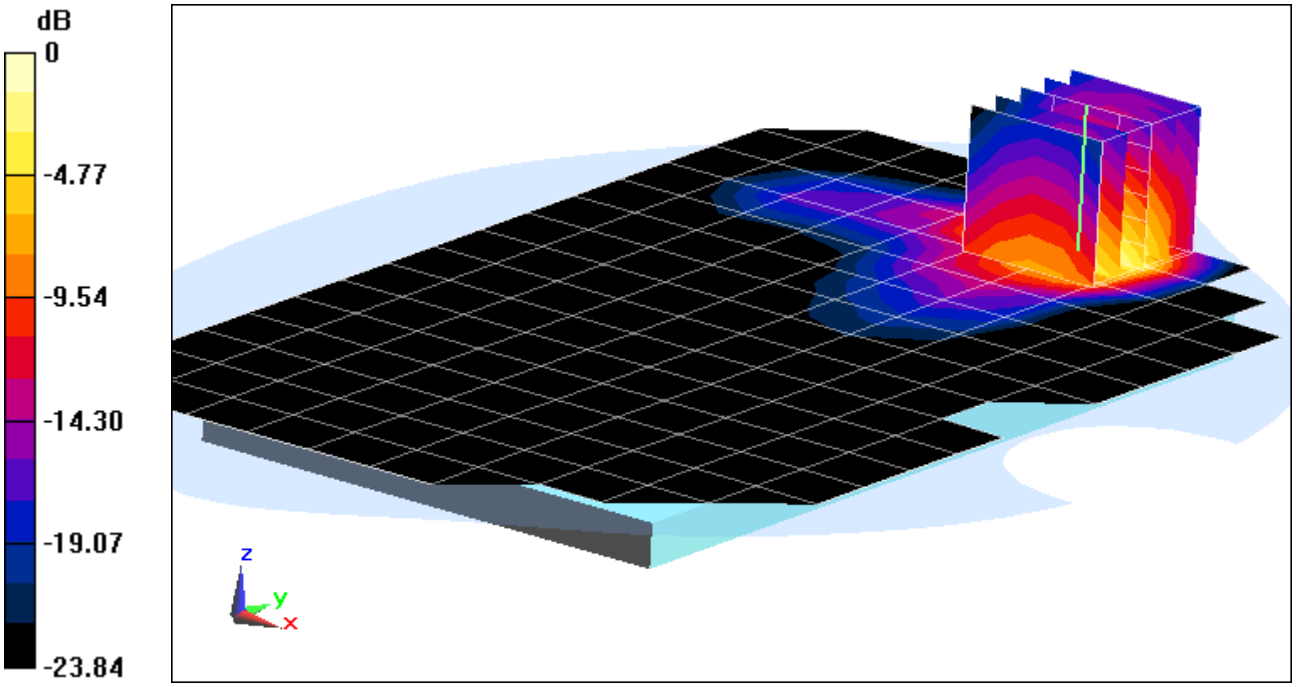
Communication System: UID 0, UMTS, Frequency: 1852.4 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1852.4 MHz; σ = 1.513 S/m; ε_r = 51.109; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-31-2014; Ambient Temp: 23.2°C; Tissue Temp: 21.6°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/22/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/21/2013
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (11x17x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.021 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.99 W/kg
SAR(1 g) = 0.954 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-095-A

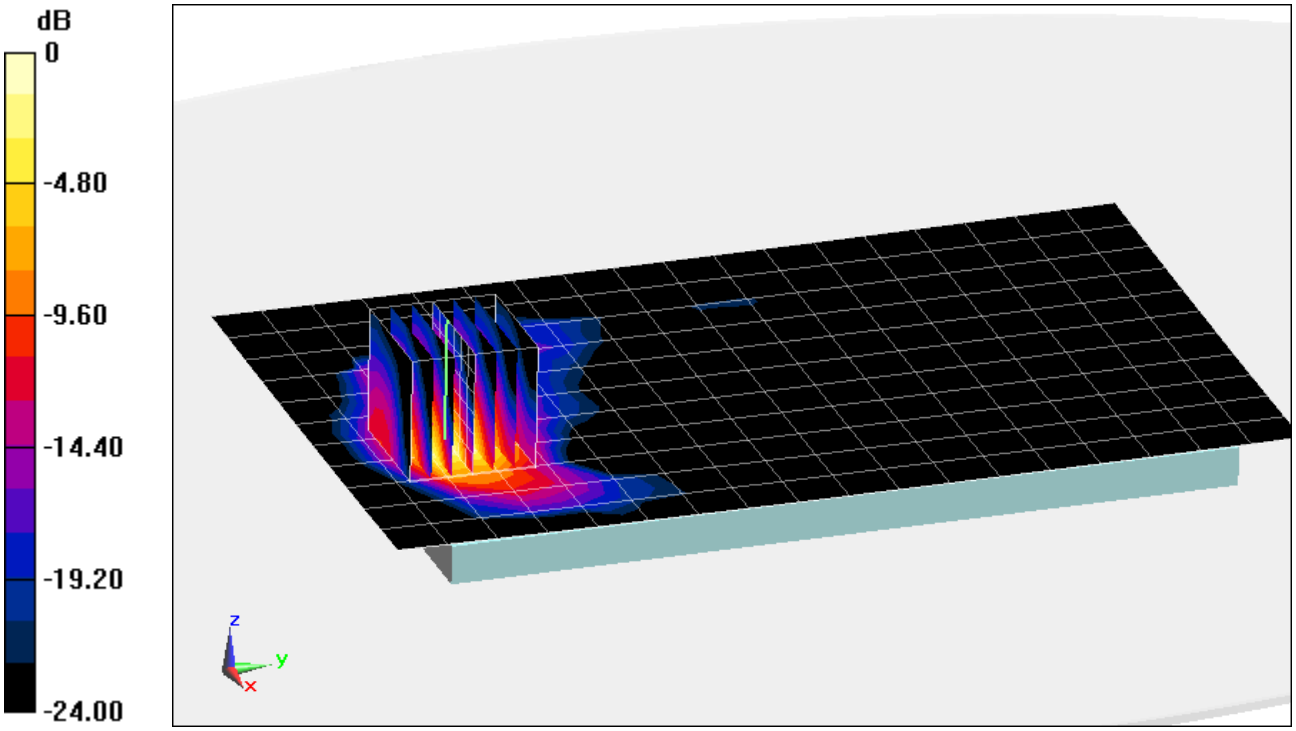
Communication System: UID 0, IEEE 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2437 MHz; σ = 1.961 S/m; ε_r = 52.138; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-19-2014; Ambient Temp: 23.4°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(6.26, 6.26, 6.26); Calibrated: 1/29/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/22/2014
Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (12x19x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 14.629 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 2.60 W/kg
SAR(1 g) = 1.01 W/kg



0 dB = 1.47 W/kg = 1.67 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-095-C

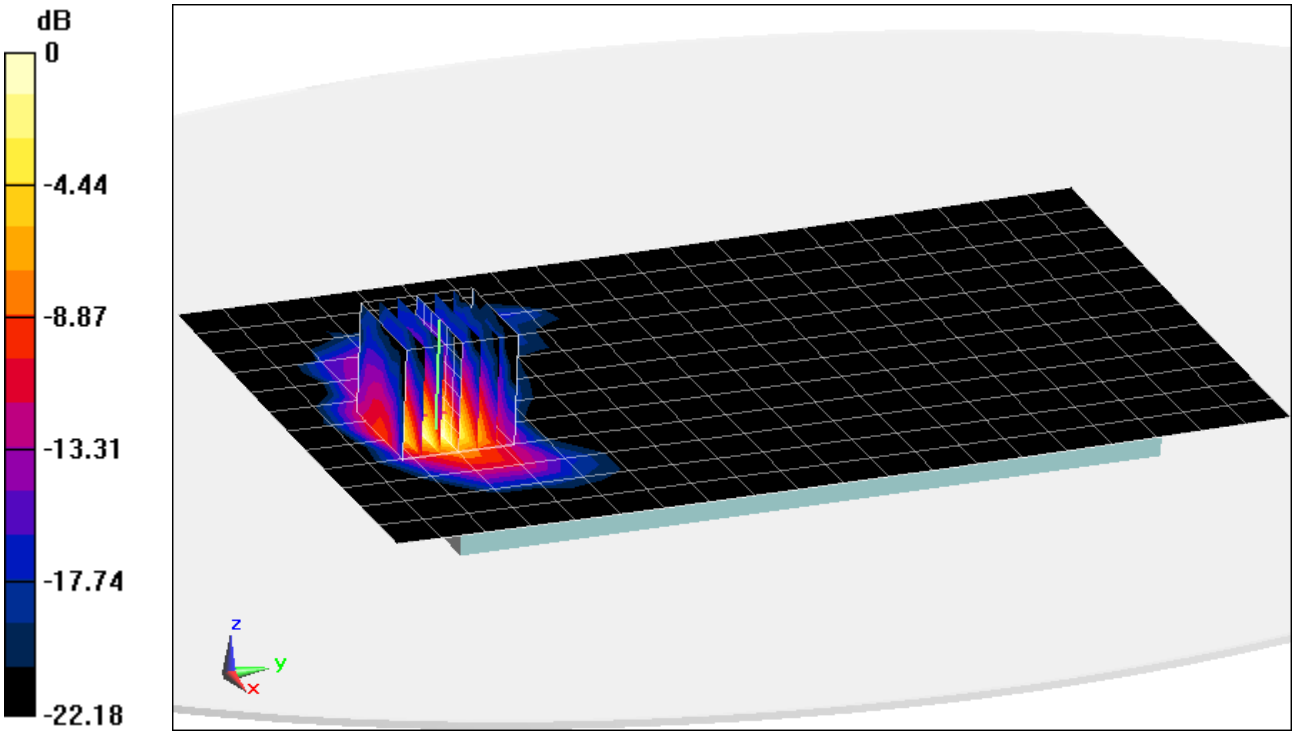
Communication System: UID 0, Bluetooth (0); Frequency: 2402 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2402 MHz; σ = 1.914 S/m; ε_r = 52.258; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-19-2014; Ambient Temp: 23.4°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(6.26, 6.26, 6.26); Calibrated: 1/29/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/22/2014
Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: Bluetooth, Body SAR, Ch 0, 1 Mbps, Back Side

Area Scan (13x21x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 14.249 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.814 W/kg
SAR(1 g) = 0.324 W/kg



0 dB = 0.443 W/kg = -3.54 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-095-A

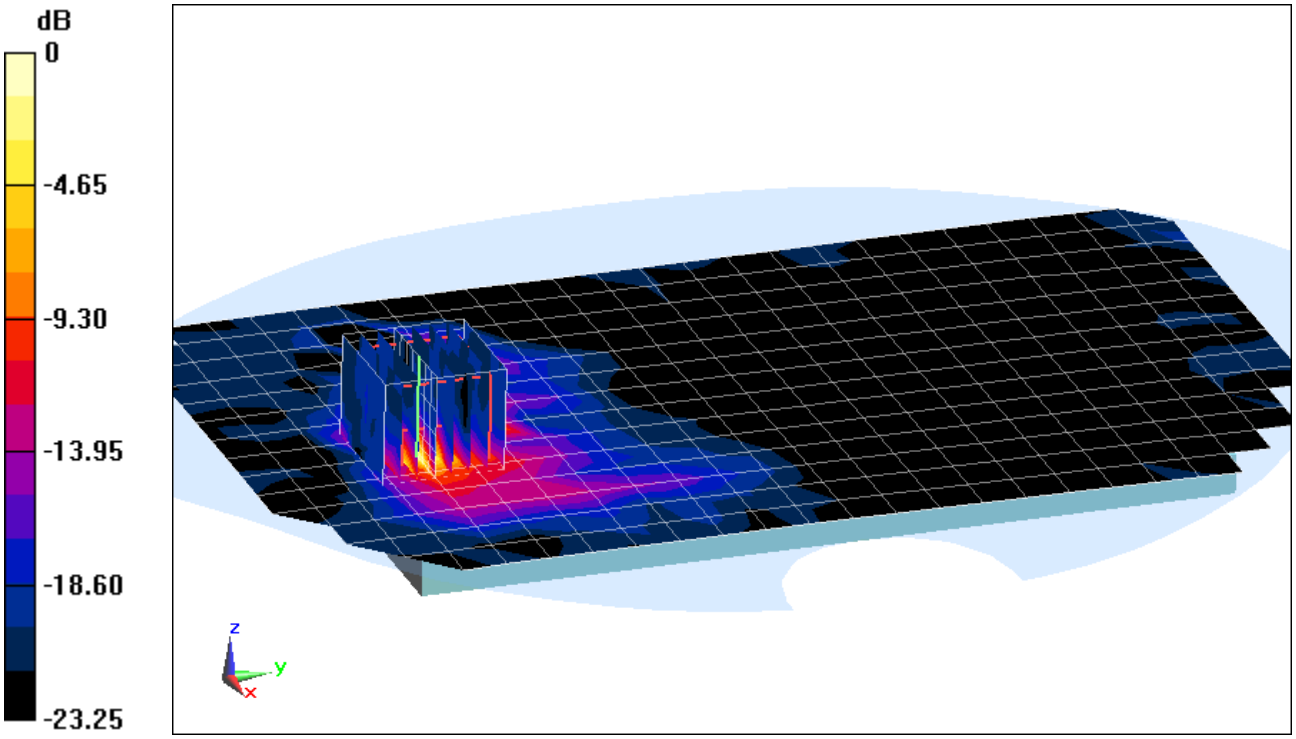
Communication System: UID 0, IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5700 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5700 MHz; σ = 5.856 S/m; ε_r = 46.466; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-18-2014; Ambient Temp: 22.4°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3920; ConvF(3.62, 3.62, 3.62); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.5 - 5.7 GHz, Body SAR, Ch 140, 6 Mbps, Back Side

Area Scan (15x25x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio:1.4
Reference Value = 13.998 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 7.65 W/kg
SAR(1 g) = 0.801 W/kg



0 dB = 2.52 W/kg = 4.01 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT231; Type: Portable Tablet; Serial: FL-095-A

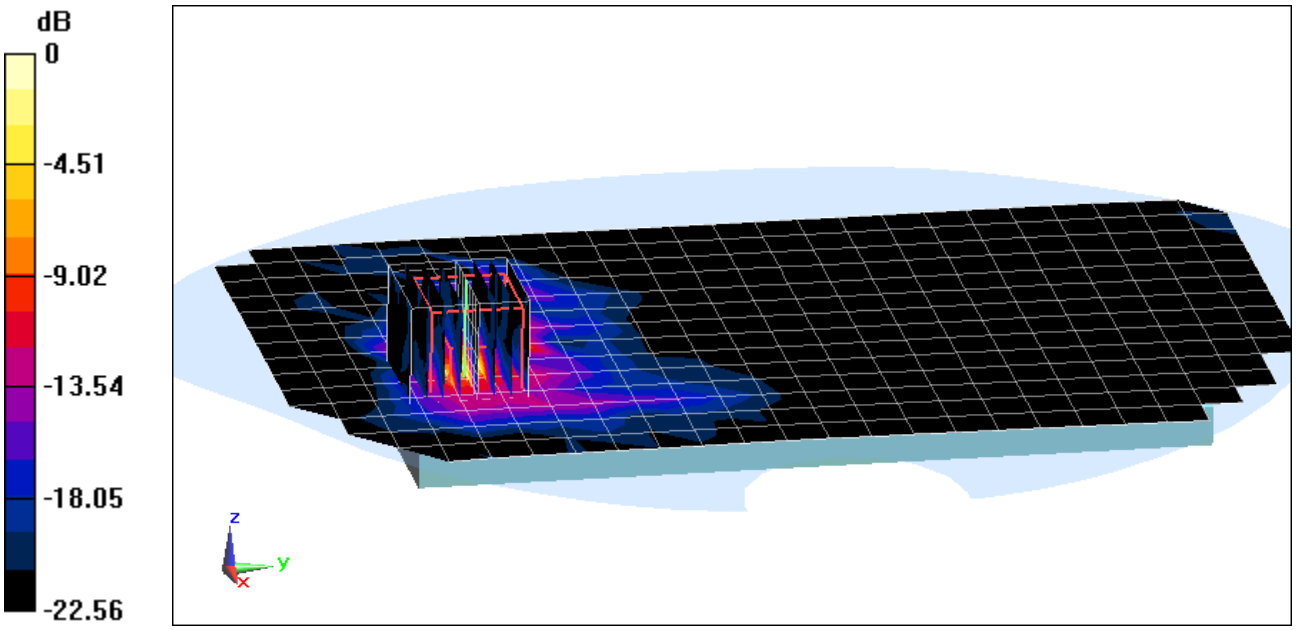
Communication System: UID 0, IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5805 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5805 MHz; σ = 5.987 S/m; ε_r = 46.565; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-18-2014; Ambient Temp: 22.5°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3920; ConvF(4, 4, 4); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 161, 6 Mbps, Back Side

Area Scan (15x25x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 9.739 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 7.59 W/kg
SAR(1 g) = 0.887 W/kg



0 dB = 2.29 W/kg = 3.60 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

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PCTEST ENGINEERING LABORATORY, INC.

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

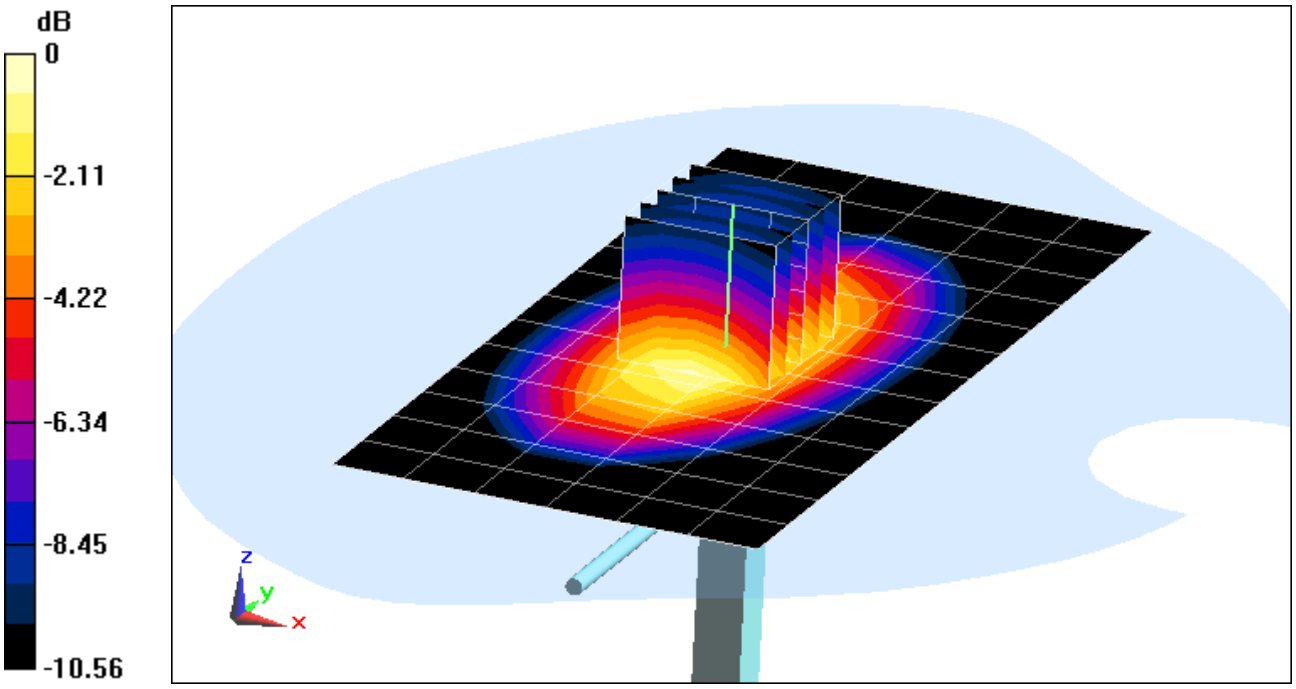
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Head Medium parameters used:
f = 835 MHz; σ = 0.92 S/m; ε_r = 41.602; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 03-26-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3258; ConvF(6.27, 6.27, 6.27); Calibrated: 2/25/2014;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 1.43 W/kg
SAR(1 g) = 0.953 W/kg
Deviation = -1.55%



0 dB = 1.03 W/kg = 0.13 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 1900 MHz; Type: D1900V2; Serial: 5d149

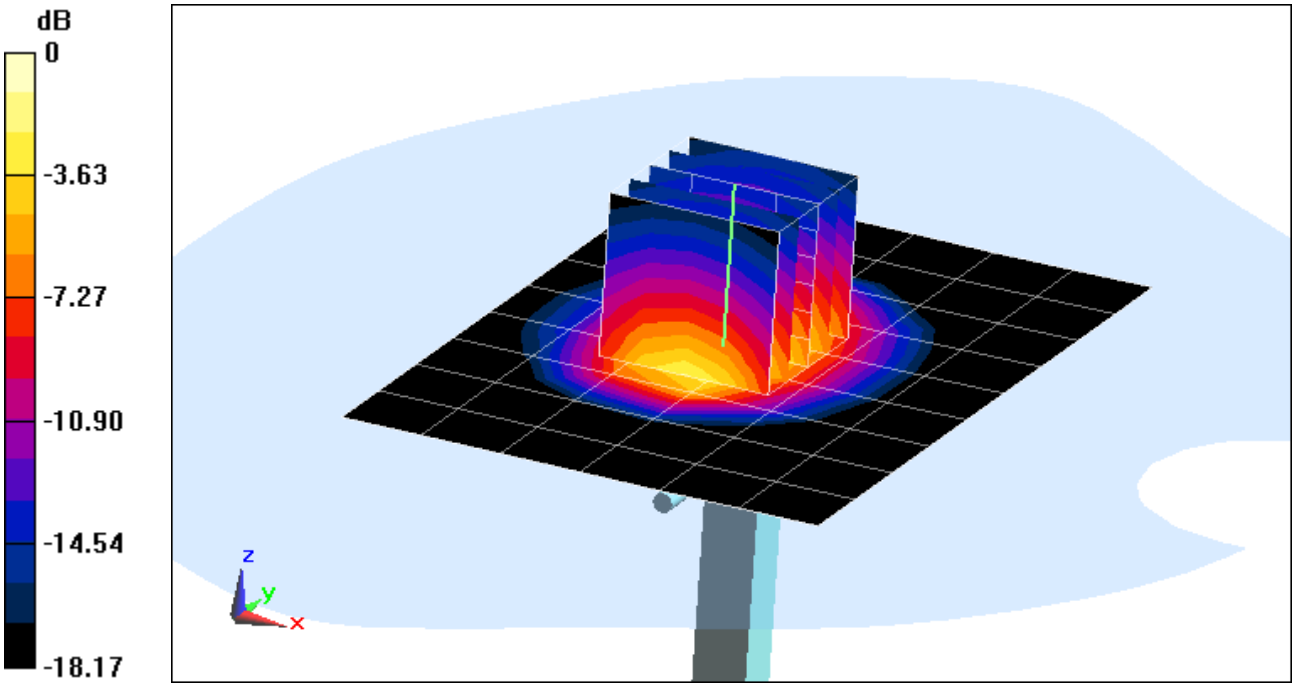
Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.448 S/m; ε_r = 39.354; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-24-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.9°C

Probe: ES3DV3 - SN3258; ConvF(5.04, 5.04, 5.04); Calibrated: 2/25/2014;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 7.67 W/kg
SAR(1 g) = 4.09 W/kg
Deviation = 1.24%



0 dB = 4.57 W/kg = 6.60 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

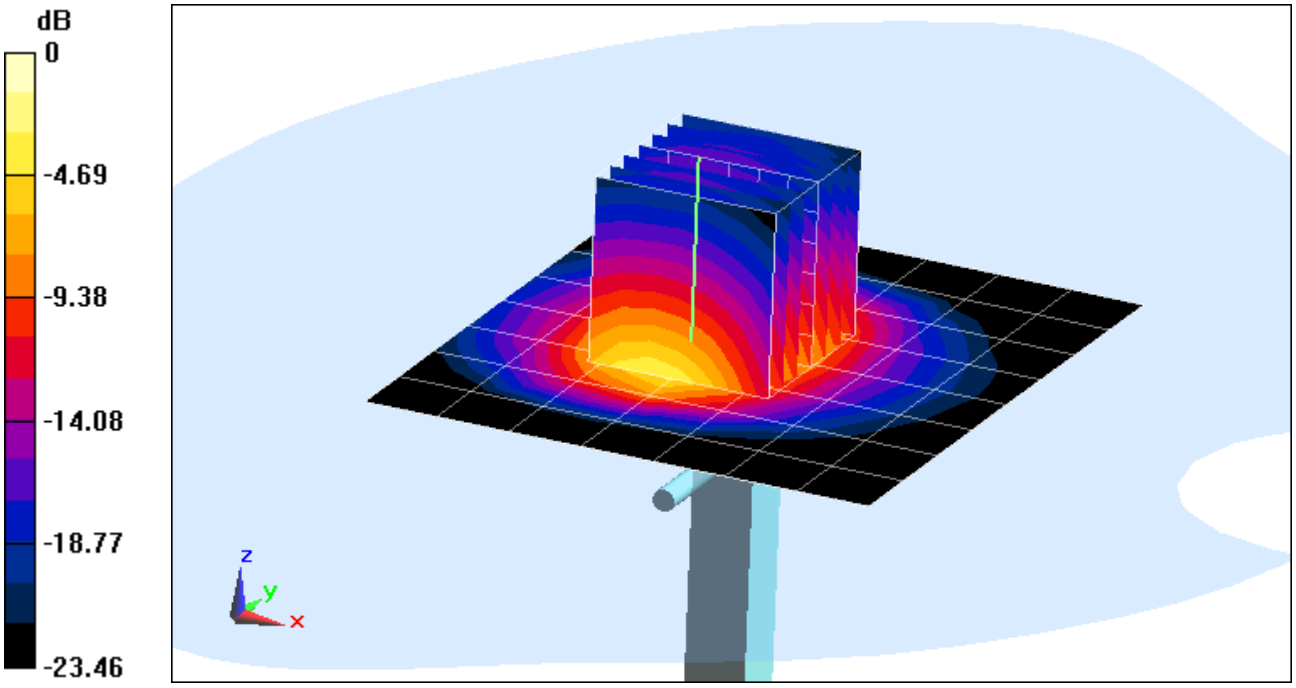
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used:
f = 2450 MHz; σ = 1.819 S/m; ε_r = 38.117; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space = 1.0 cm

Test Date: 03-10-2014; Ambient Temp: 24.4°C; Tissue Temp: 22.1°C

Probe: EX3DV4 - SN3914; ConvF(6.95, 6.95, 6.95); Calibrated: 10/23/2013;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (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 = 16 dBm (40 mW)
Peak SAR (extrapolated) = 4.38 W/kg
SAR(1 g) = 2.11 W/kg
Deviation = -0.85%



0 dB = 2.75 W/kg = 4.39 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

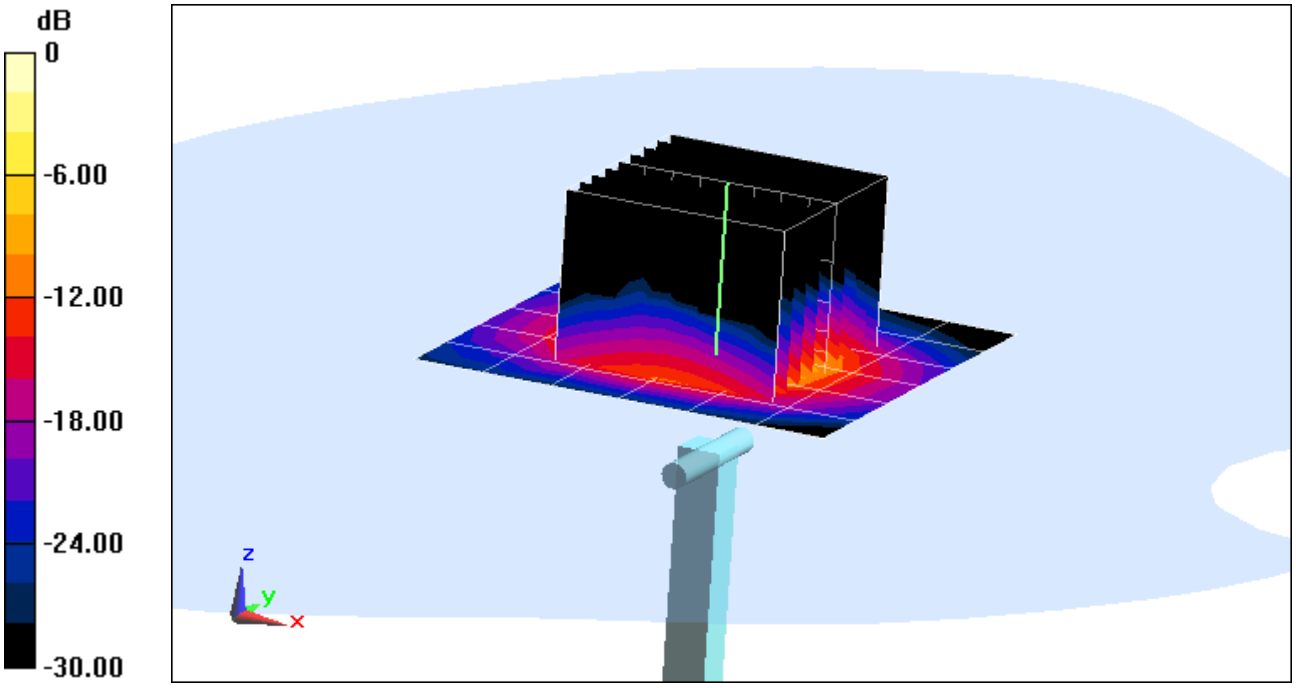
Communication System: UID 0, CW; Frequency: 5200 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5200 MHz; σ = 4.595 S/m; ε_r = 36.301; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-12-2014; Ambient Temp: 24.5°C; Tissue Temp: 24.4°C

Probe: EX3DV4 - SN3914; ConvF(4.99, 4.99, 4.99); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

5200 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 16 dBm (40 mW)
Peak SAR (extrapolated) = 12.4 W/kg
SAR(1 g) = 2.93 W/kg
Deviation = -6.09%



0 dB = 7.43 W/kg = 8.71 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

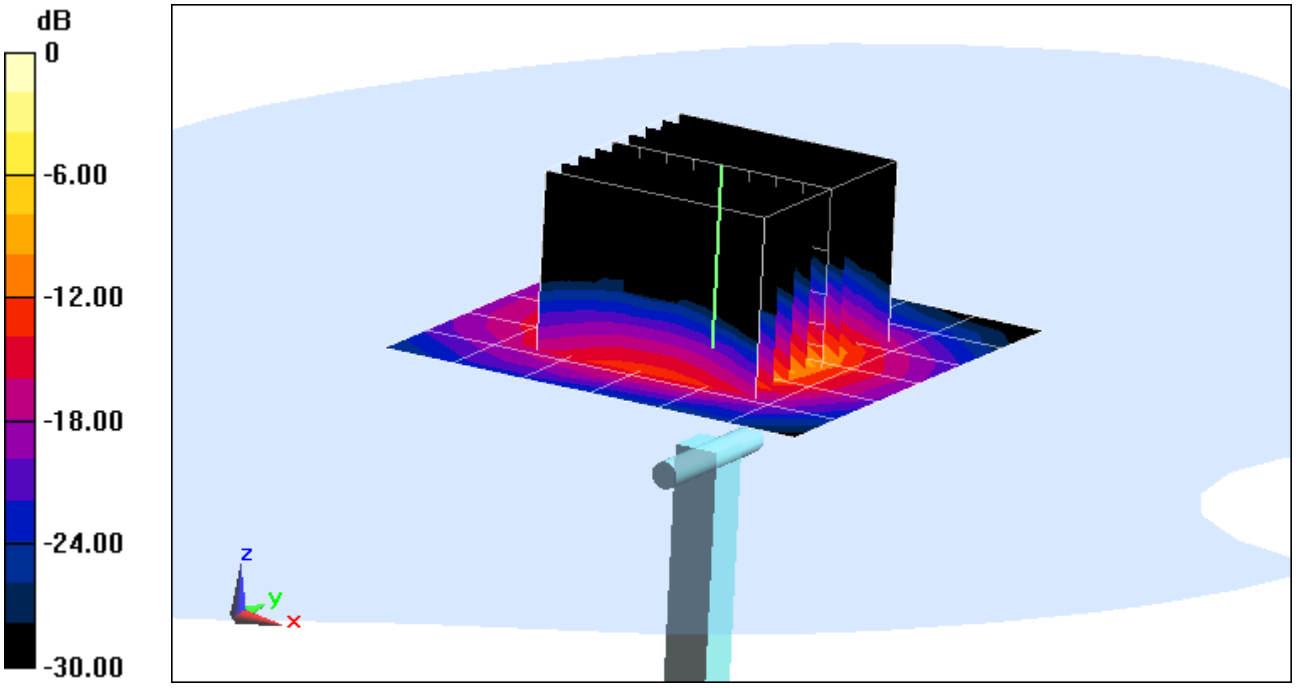
Communication System: UID 0, CW; Frequency: 5300 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5300 MHz; σ = 4.684 S/m; ε_r = 36.176; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-12-2014; Ambient Temp: 24.5°C; Tissue Temp: 24.3°C

Probe: EX3DV4 - SN3914; ConvF(4.82, 4.82, 4.82); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

5300 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 16 dBm (40 mW)
Peak SAR (extrapolated) = 14.3 W/kg
SAR(1 g) = 3.26 W/kg
Deviation = -1.81%



0 dB = 8.40 W/kg = 9.24 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

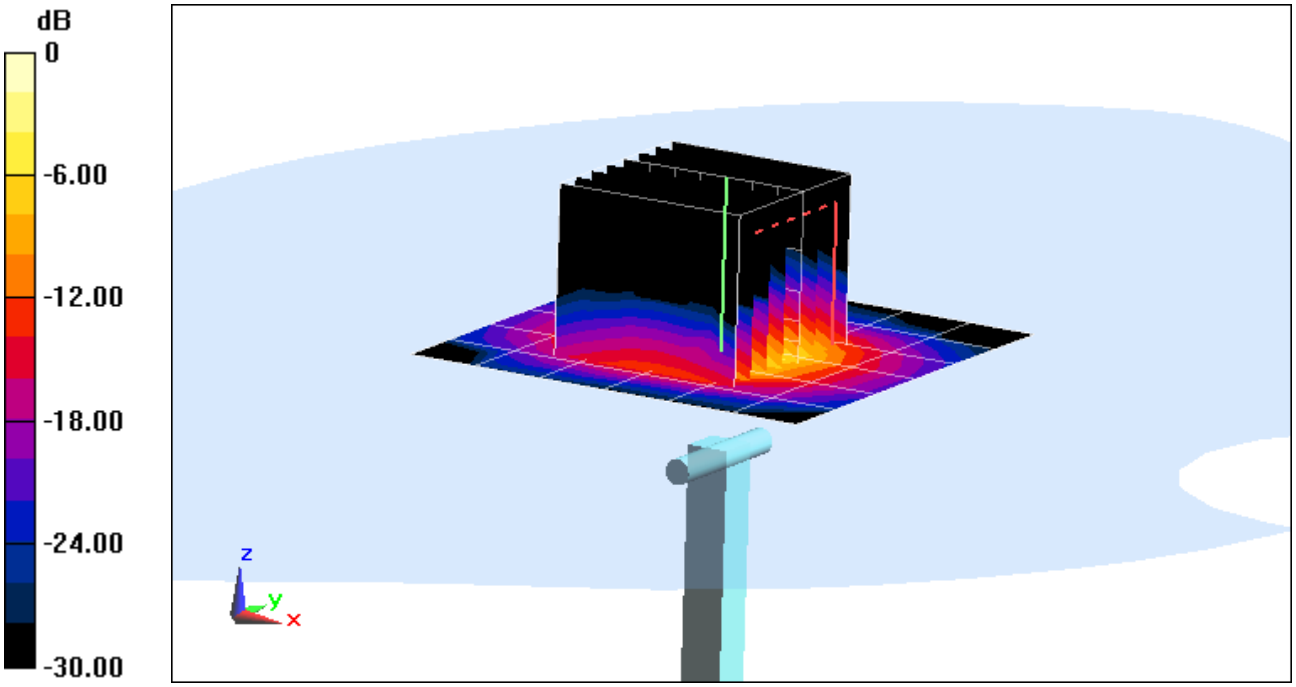
Communication System: UID 0, CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5600 MHz; σ = 4.99 S/m; ε_r = 35.75; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-12-2014; Ambient Temp: 24.5°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3914; ConvF(4.37, 4.37, 4.37); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

5600 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 16 dBm (40 mW)
Peak SAR (extrapolated) = 14.5 W/kg
SAR(1 g) = 3.17 W/kg
Deviation = -5.09%



0 dB = 8.34 W/kg = 9.21 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

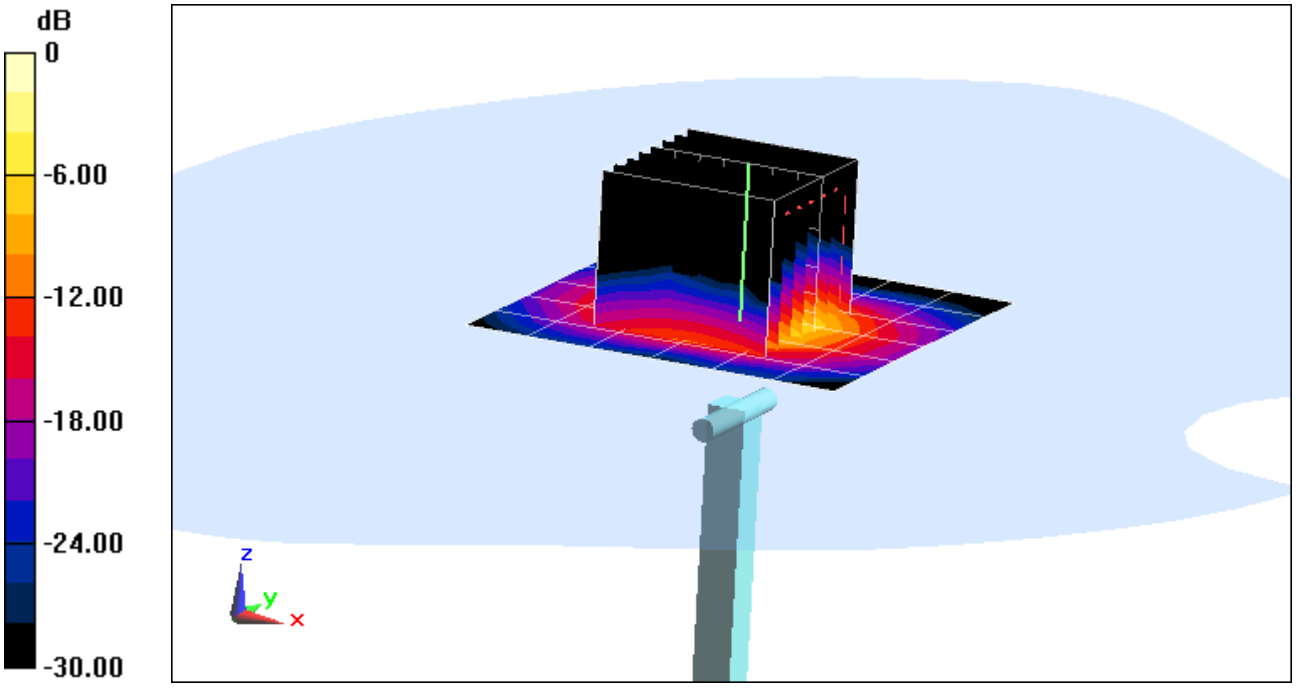
Communication System: UID 0, CW; Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5800 MHz; σ = 5.18 S/m; ε_r = 35.513; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-12-2014; Ambient Temp: 24.5°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3914; ConvF(4.52, 4.52, 4.52); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

5800 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 16 dBm (40 mW)
Peak SAR (extrapolated) = 13.8 W/kg
SAR(1 g) = 2.92 W/kg
Deviation = -7.94%



0 dB = 7.69 W/kg = 8.86 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

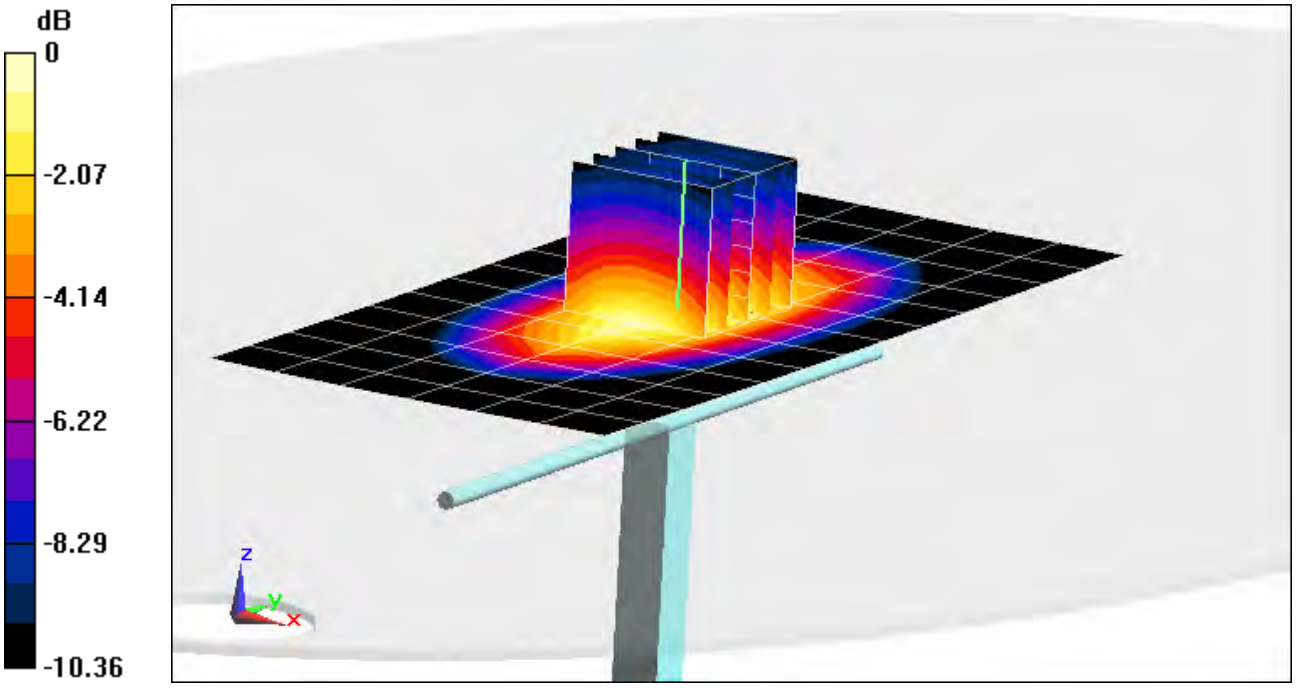
Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used:
f = 835 MHz; σ = 1.001 S/m; ε_r = 54.502; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 03-24-2014; Ambient Temp: 23.9°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3333; ConvF(6.07, 6.07, 6.07); Calibrated: 11/22/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 11/19/2013
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
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 dBm (100 mW)
Peak SAR (extrapolated) = 1.44 W/kg
SAR(1 g) = 0.988 W/kg
Deviation = 3.56%



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

PCTEST ENGINEERING LABORATORY, INC.

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

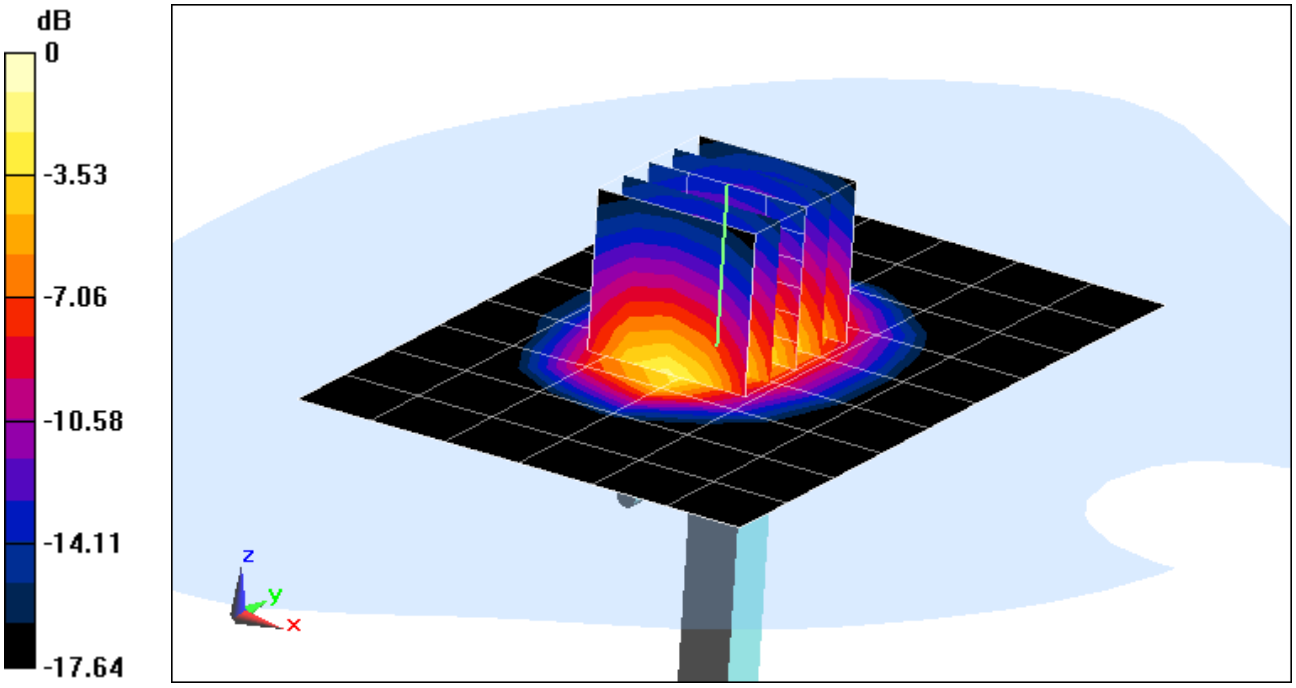
Communication System: UID 0 , CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.569 S/m; ε_r = 50.964; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-31-2014; Ambient Temp: 23.2°C; Tissue Temp: 21.6°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/22/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/21/2013
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 7.65 W/kg
SAR(1 g) = 4.2 W/kg
Deviation = 3.70%



0 dB = 4.73 W/kg = 6.75 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

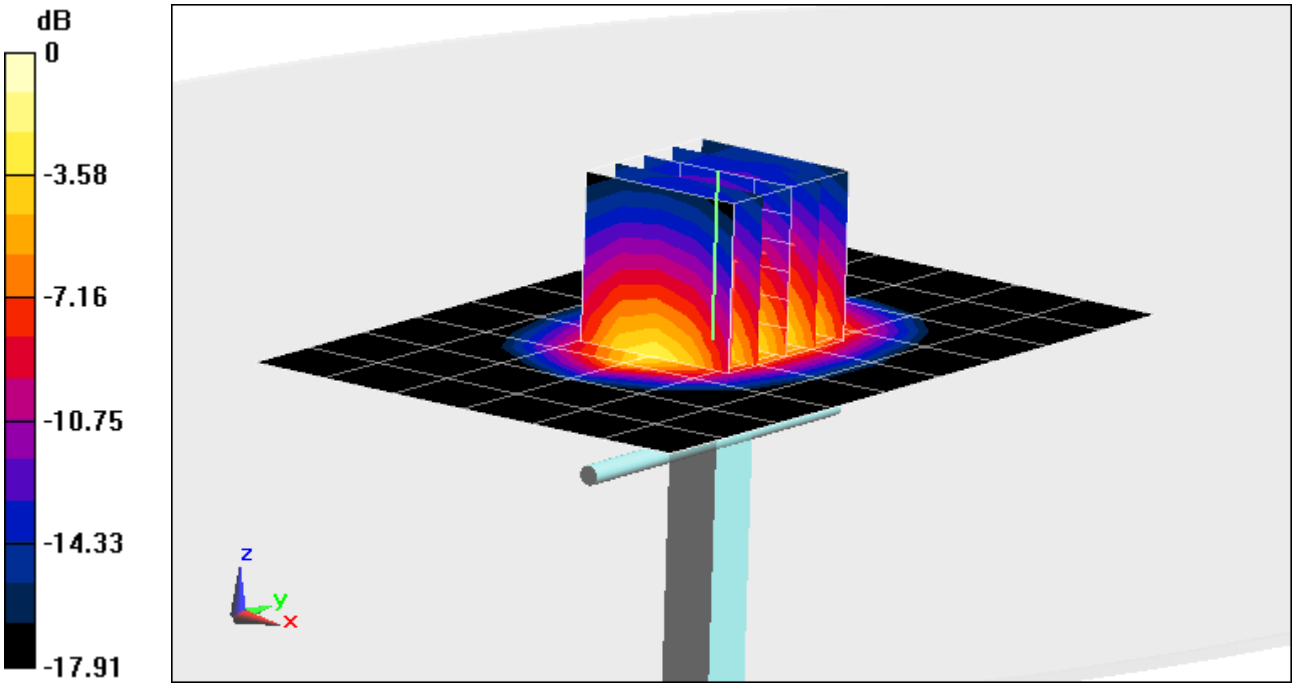
Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.579 S/m; ε_r = 52.336; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-14-2014; Ambient Temp: 23.1°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN3589; ConvF(6.54, 6.54, 6.54); Calibrated: 1/29/2014;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/22/2014
Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 7.66 W/kg
SAR(1 g) = 4.15 W/kg
Deviation = 2.47%



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

PCTEST ENGINEERING LABORATORY, INC.

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

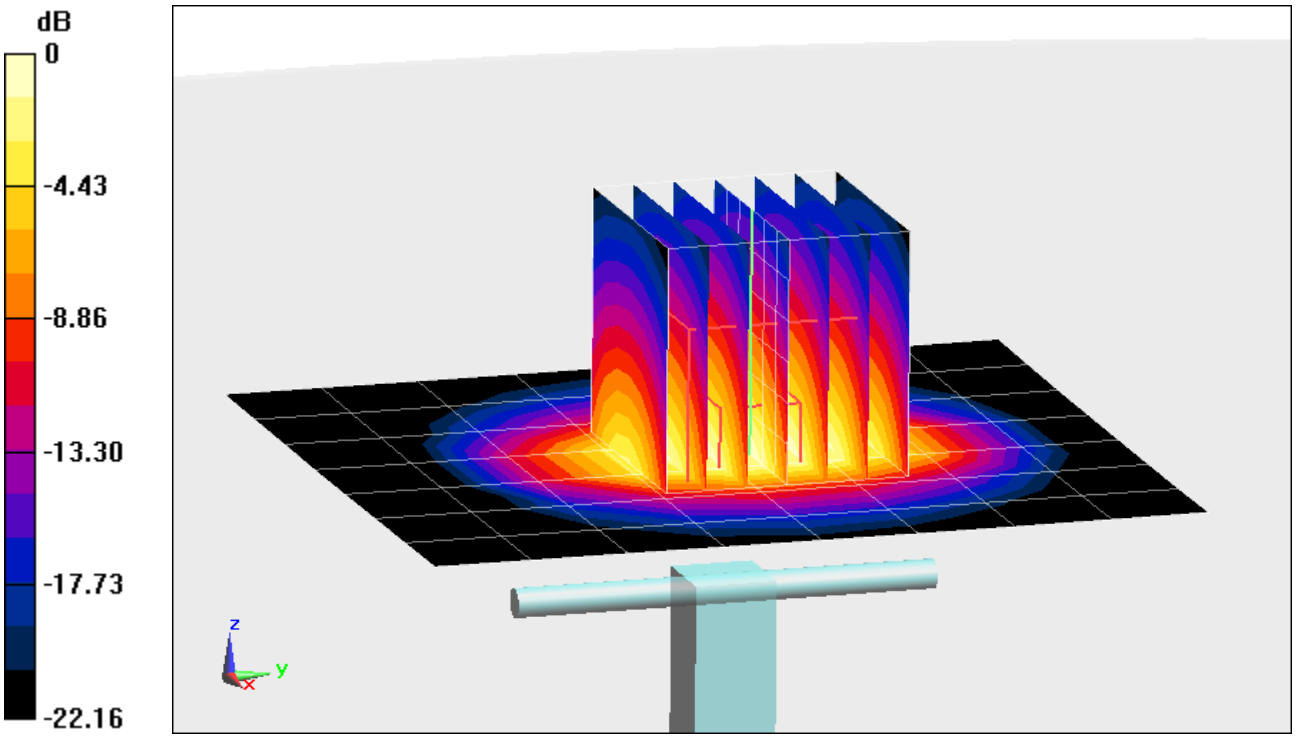
Communication System: UID 0, CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used:
f = 2450 MHz; σ = 1.979 S/m; ε_r = 52.093; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-19-2014; Ambient Temp: 23.4°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(6.26, 6.26, 6.26); Calibrated: 1/29/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/22/2014
Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

2450 MHz System Verification

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 10.5 W/kg
SAR(1 g) = 5.01 W/kg
Deviation = -3.09%



0 dB = 6.57 W/kg = 8.18 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

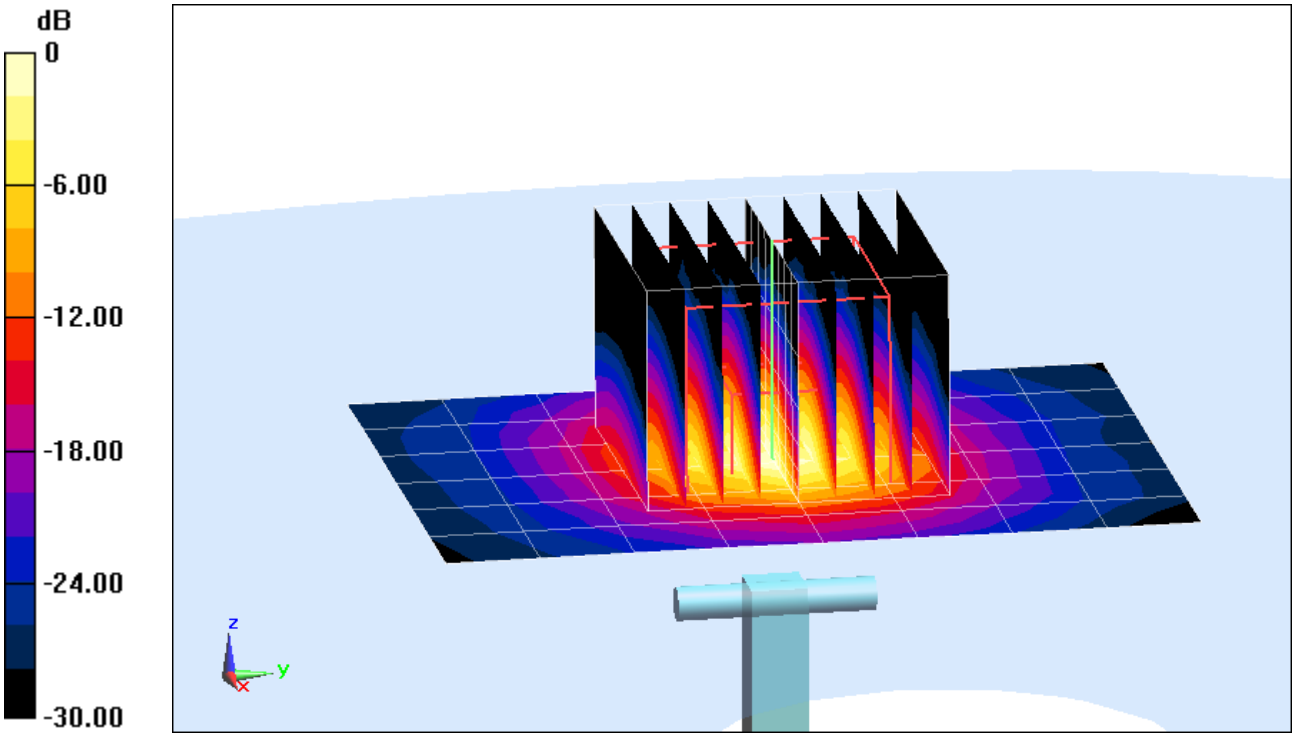
Communication System: UID 0, CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5200 MHz; σ = 5.162 S/m; ε_r = 47.513; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-18-2014; Ambient Temp: 22.5°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3920; ConvF(4.23, 4.23, 4.23); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5200MHz System Verification

Area Scan(7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 29.1 W/kg
SAR(1 g) = 7.32 W/kg
Deviation = 0.83%



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

PCTEST ENGINEERING LABORATORY, INC.

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

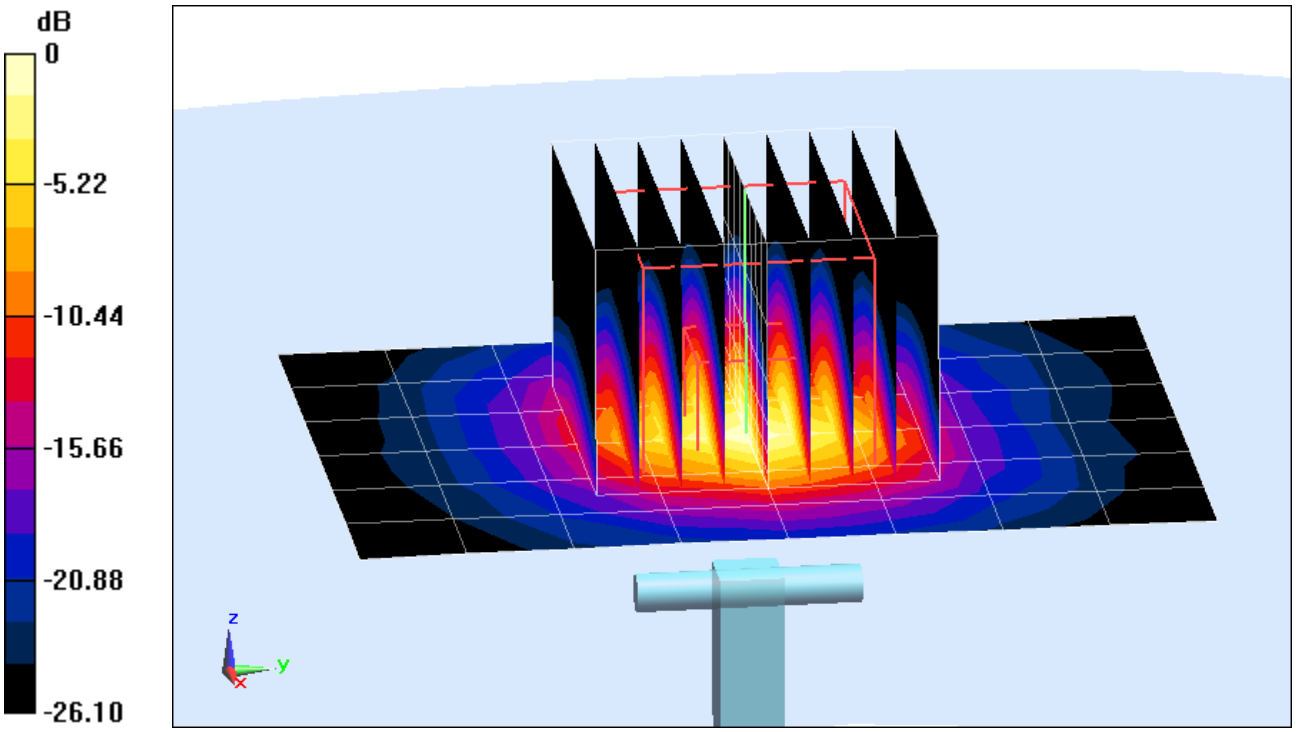
Communication System: UID 0, CW; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5300 MHz; σ = 5.289 S/m; ε_r = 47.204; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-18-2014; Ambient Temp: 22.5°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3920; ConvF(4.11, 4.11, 4.11); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5300MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 31.2 W/kg
SAR(1 g) = 7.57 W/kg
Deviation = 1.34%



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

PCTEST ENGINEERING LABORATORY, INC.

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

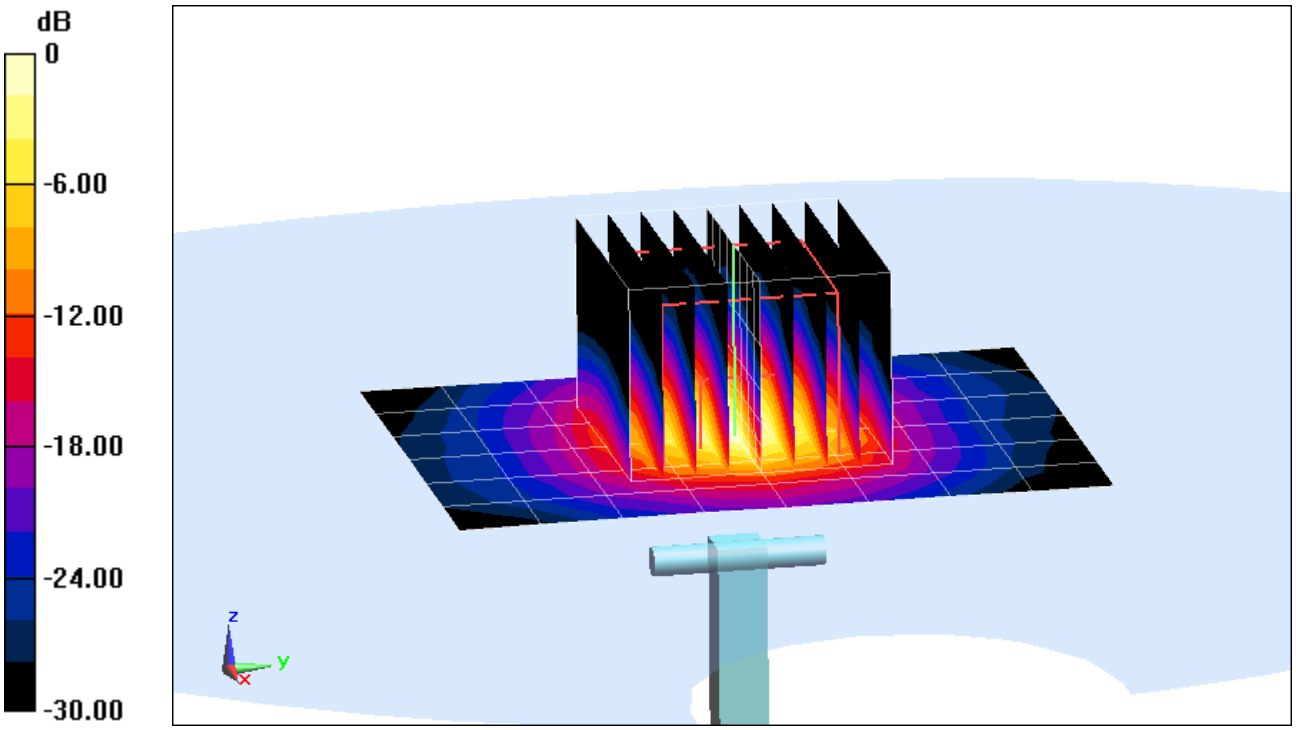
Communication System: UID 0, CW; Frequency: 5500 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5500 MHz; σ = 5.563 S/m; ε_r = 46.658; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-18-2014; Ambient Temp: 22.4°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3920; ConvF(3.8, 3.8, 3.8); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5500MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 33.4 W/kg
SAR(1 g) = 7.5 W/kg
Deviation = -1.19%



0 dB = 20.3 W/kg = 13.07 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

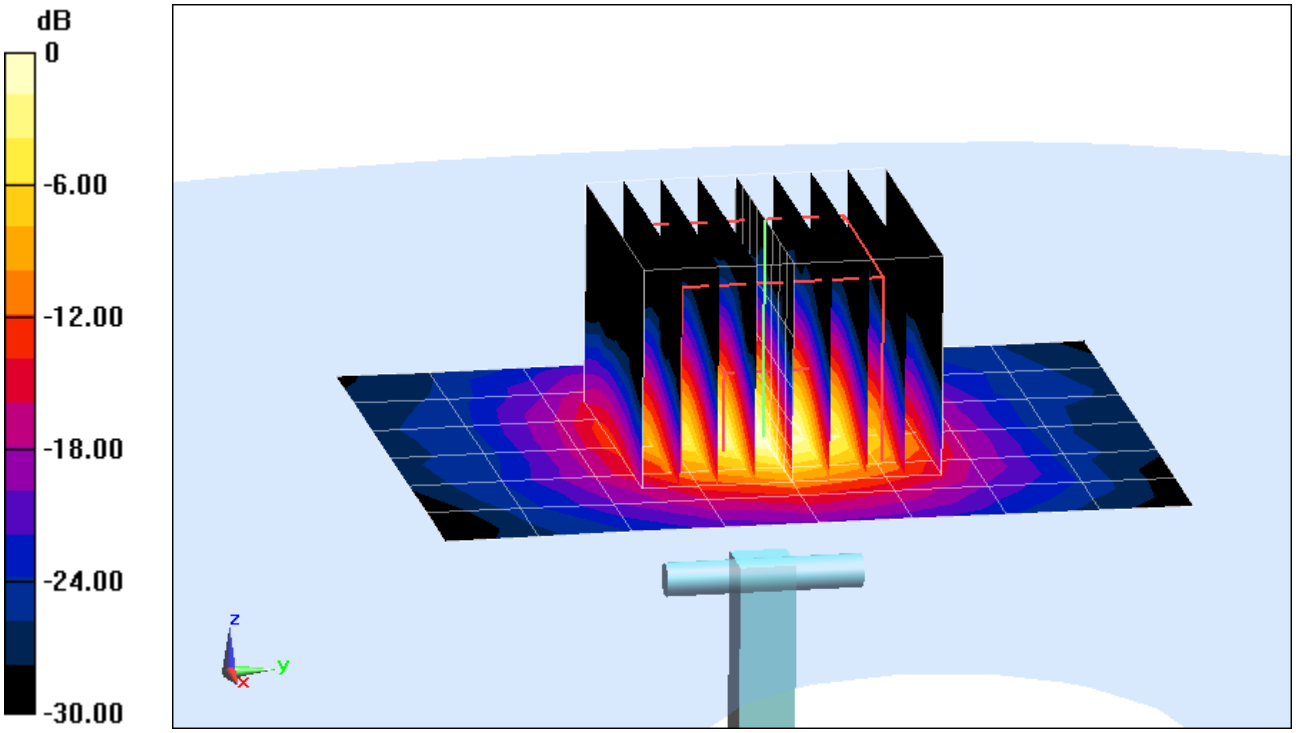
Communication System: UID 0, CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5600 MHz; σ = 5.712 S/m; ε_r = 46.518; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-18-2014; Ambient Temp: 22.4°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3920; ConvF(3.62, 3.62, 3.62); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5600MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 33.9 W/kg
SAR(1 g) = 7.61 W/kg
Deviation = -1.55%



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

PCTEST ENGINEERING LABORATORY, INC.

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

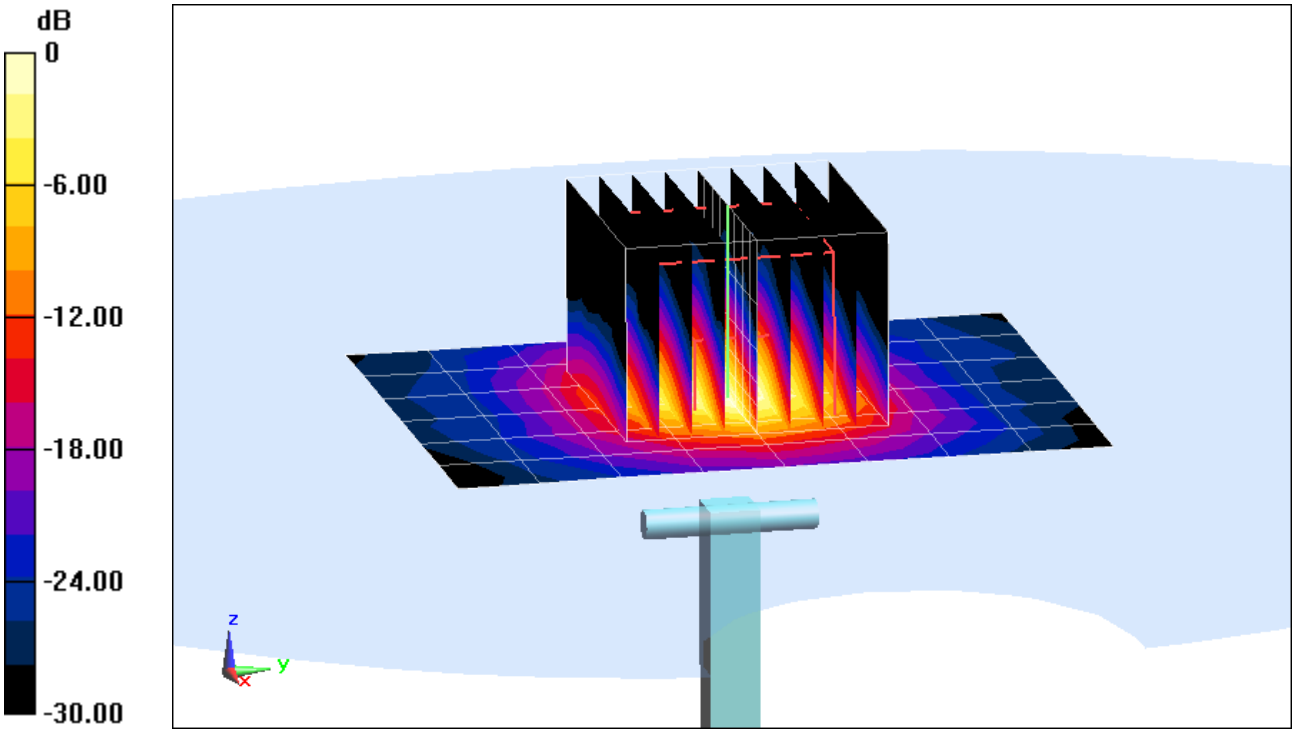
Communication System: UID 0, CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5800 MHz; σ = 5.985 S/m; ε_r = 46.544; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-18-2014; Ambient Temp: 22.5°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3920; ConvF(4, 4, 4); Calibrated: 12/18/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 12/12/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5800MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 32.1 W/kg
SAR(1 g) = 7.22 W/kg
Deviation = -0.96%



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

APPENDIX C: PROBE CALIBRATION

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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D835V2-4d119_Apr13

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d119
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 25, 2013

✓ KOK 5/8/13

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 909	11-Sep-12 (No. DAE4-909_Sep12)	Sep-13

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

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

Issued: April 26, 2013

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "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	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	40.8 ± 6 %	0.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.51 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.68 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.62 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.30 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	54.0 ± 6 %	1.01 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	2.47 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.54 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.31 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.1 Ω - 4.7 jΩ
Return Loss	- 26.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8 Ω - 6.3 jΩ
Return Loss	- 22.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.385 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 29, 2010

DASY5 Validation Report for Head TSL

Date: 25.04.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

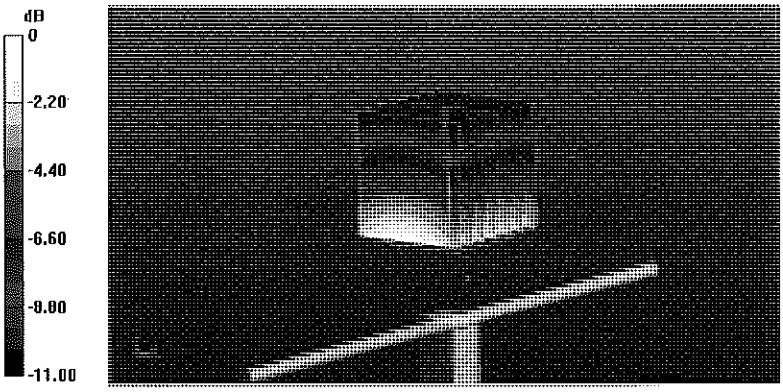
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 40.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn909; Calibrated: 11.09.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

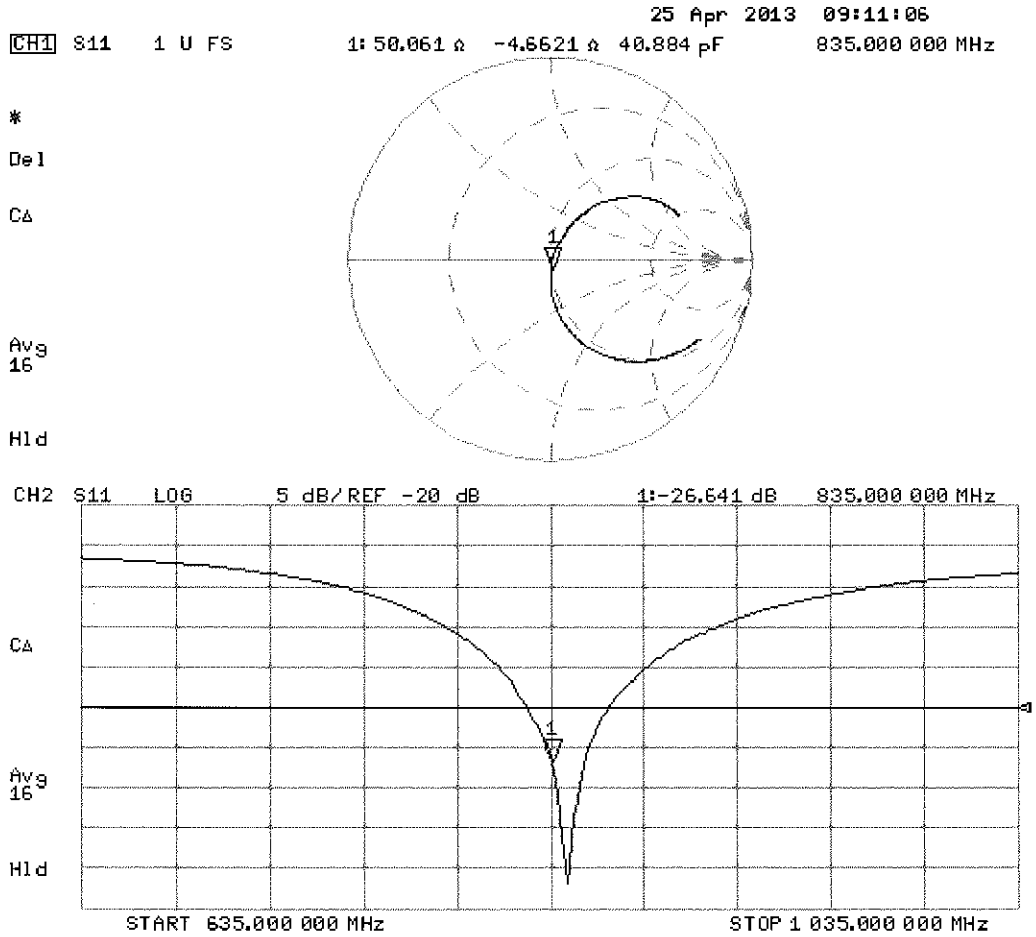
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.387 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 3.86 W/kg
SAR(1 g) = 2.51 W/kg; SAR(10 g) = 1.62 W/kg
Maximum value of SAR (measured) = 2.93 W/kg



0 dB = 2.93 W/kg = 4.67 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 24.04.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

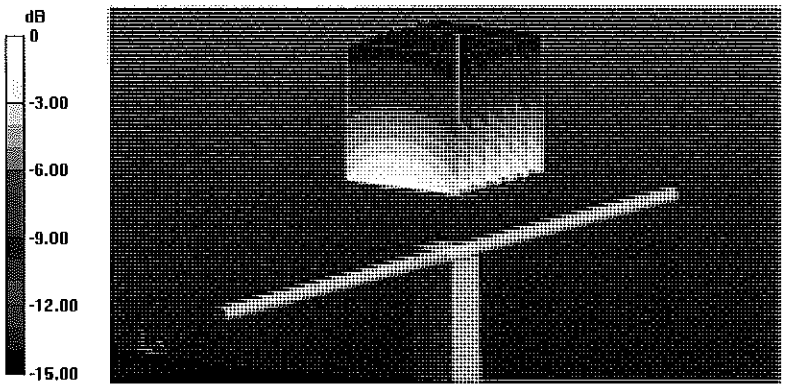
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.01 S/m; ε_r = 54; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn909; Calibrated: 11.09.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

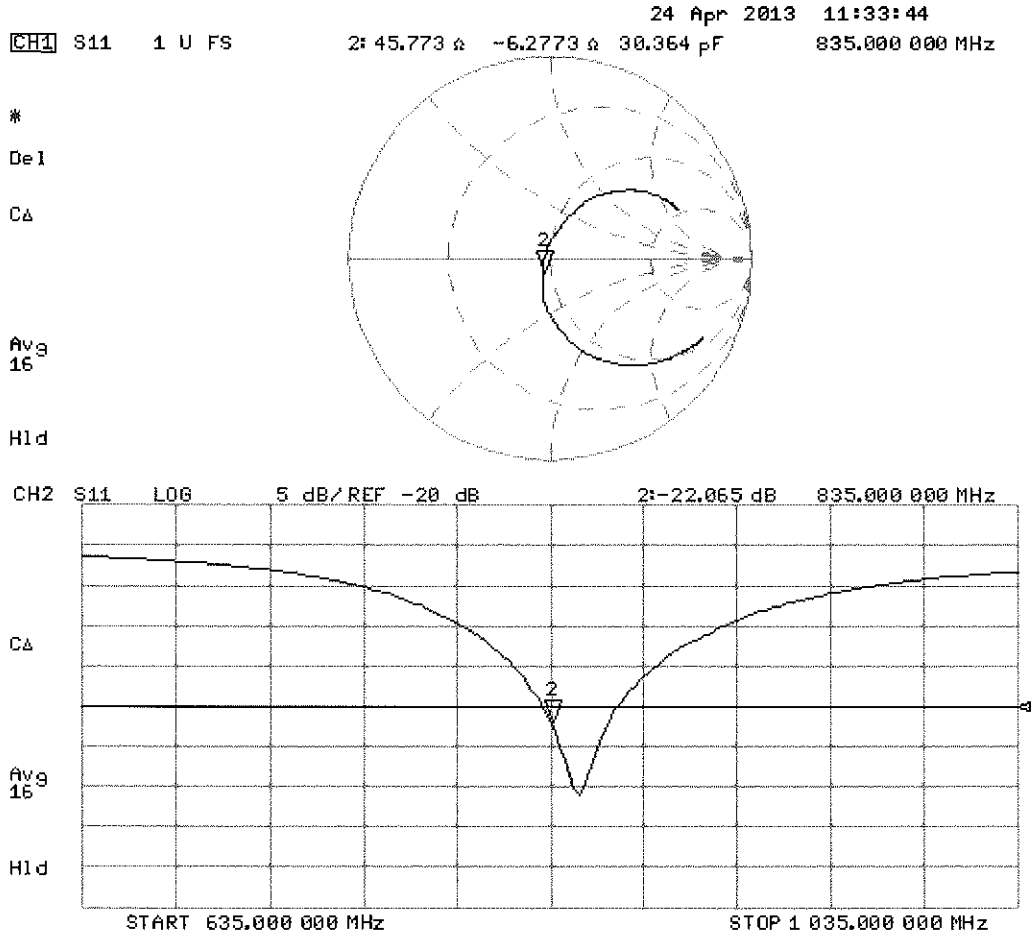
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.178 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 3.68 W/kg
SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.62 W/kg
Maximum value of SAR (measured) = 2.89 W/kg



0 dB = 2.89 W/kg = 4.61 dBW/kg

Impedance Measurement Plot for Body TSL



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

S Schweizerischer Kalibrierdienst
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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: D1900V2-5d149_Jul13

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d149
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 22, 2013

✓ KOK 8/19/13

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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 22, 2013

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.36 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	9.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.3 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.4 ± 6 %	1.49 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**40.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.36 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.6 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.9 Ω + 6.0 jΩ
Return Loss	- 23.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.5 Ω + 6.4 jΩ
Return Loss	- 23.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.196 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

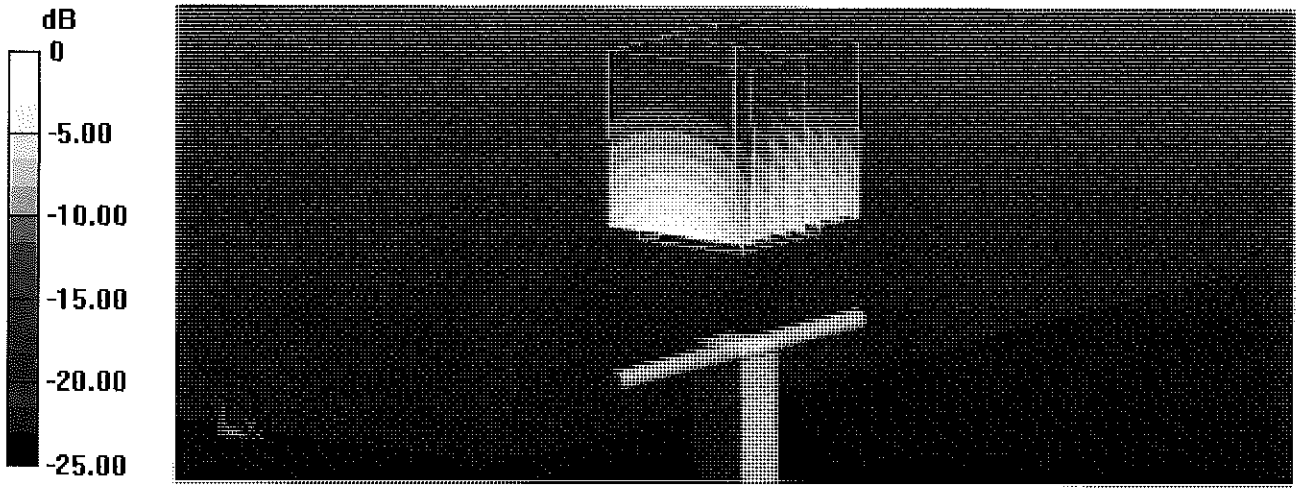
Communication System: UID 0 - CW ; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.36 S/m; ε_r = 38.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); 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 52.8.7(1137); SEMCAD X 14.6.10(7164)

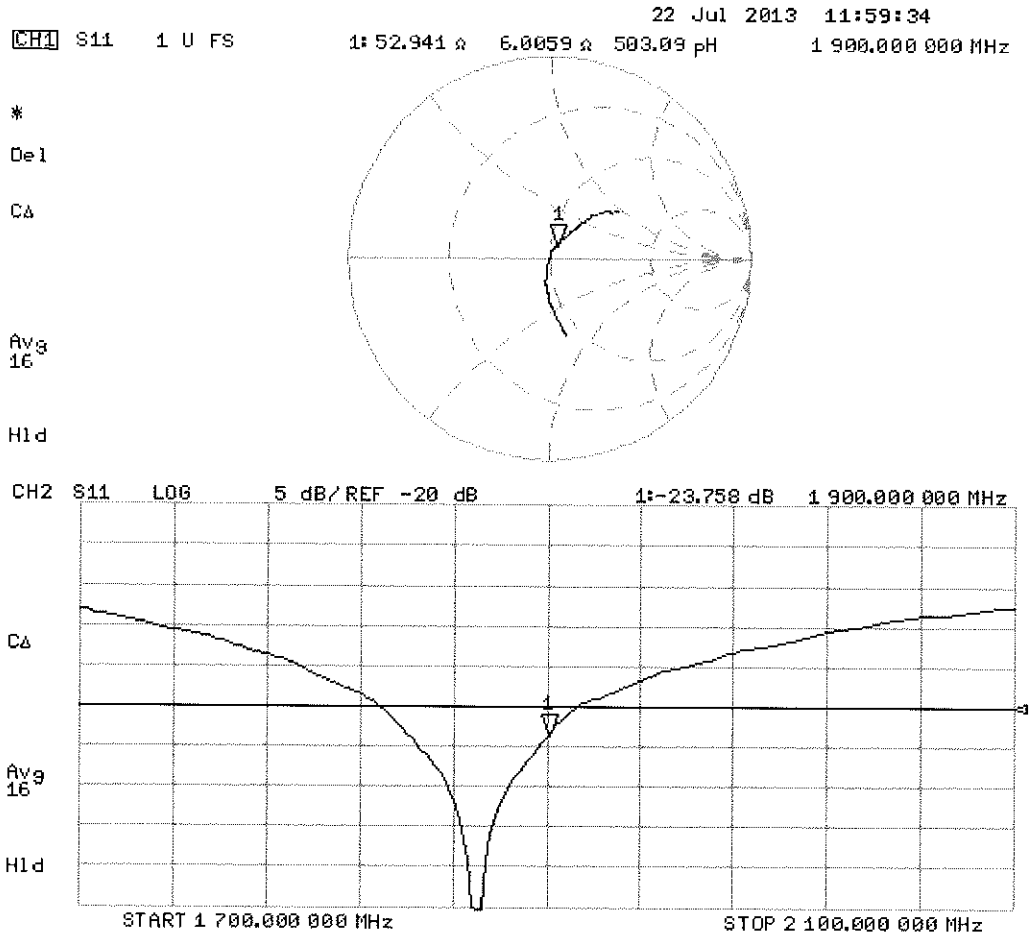
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.173 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 18.0 W/kg
SAR(1 g) = 9.99 W/kg; SAR(10 g) = 5.28 W/kg
Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12.4 W/kg = 10.93 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

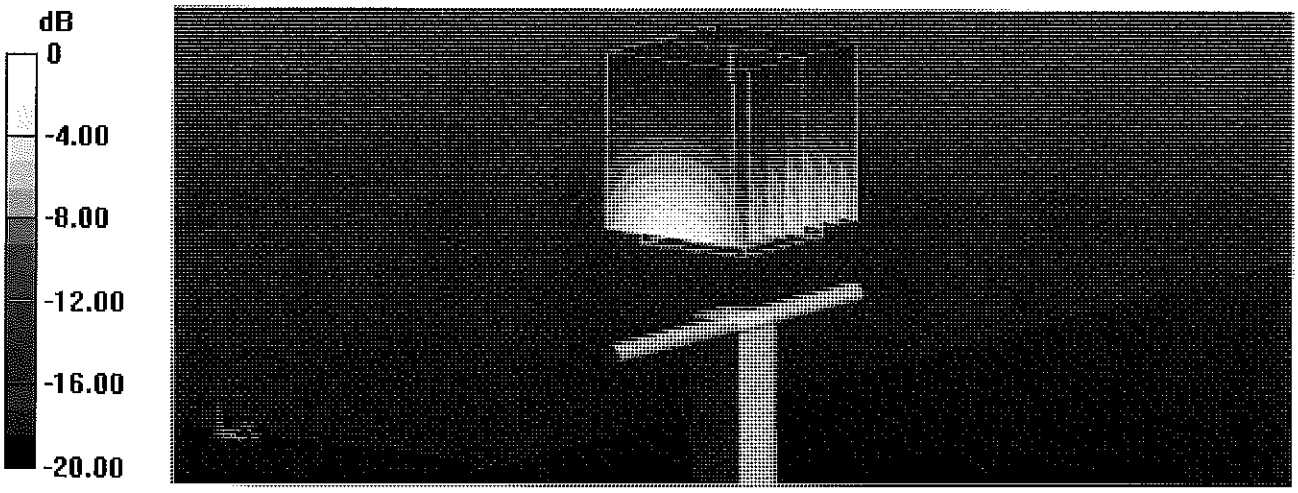
Communication System: UID 0 - CW ; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.49 S/m; ε_r = 53.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); 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 52.8.7(1137); SEMCAD X 14.6.10(7164)

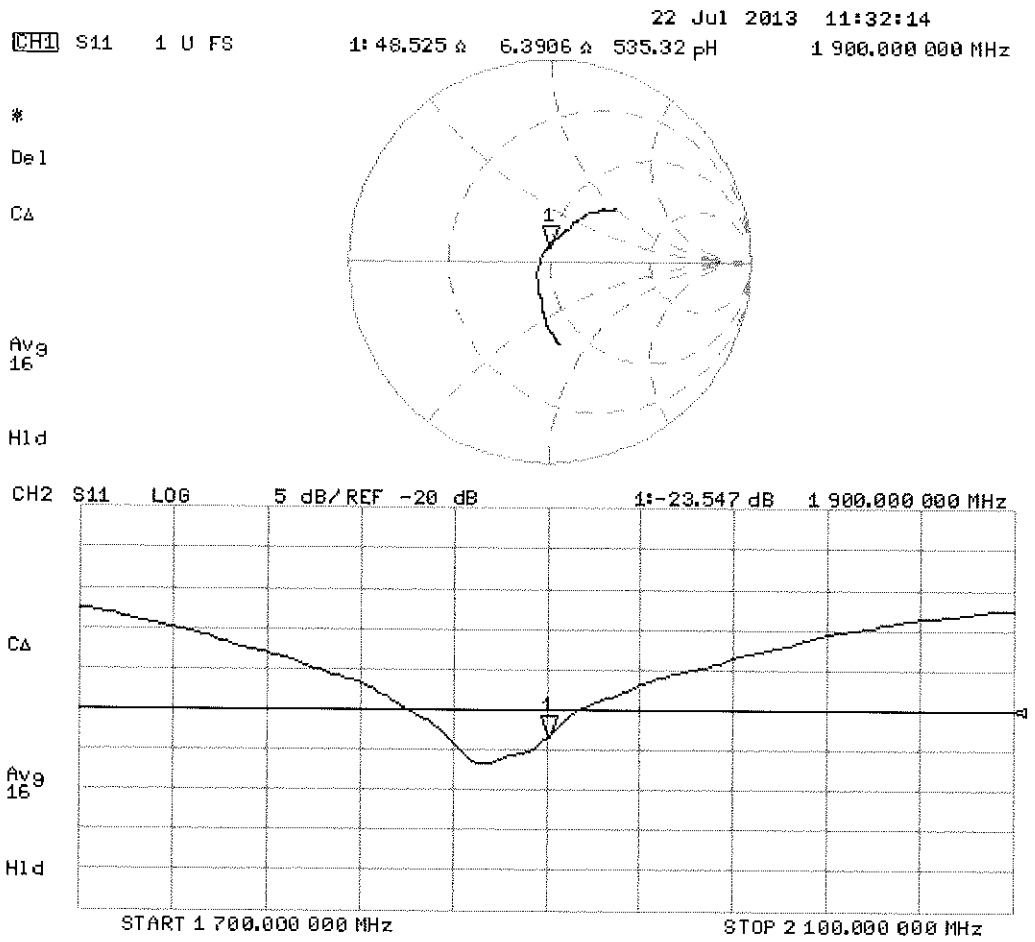
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.173 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 17.0 W/kg
SAR(1 g) = 10 W/kg; SAR(10 g) = 5.36 W/kg
Maximum value of SAR (measured) = 12.6 W/kg



0 dB = 12.6 W/kg = 11.00 dBW/kg

Impedance Measurement Plot for Body TSL



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

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S Swiss Calibration Service

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D2450V2-719_Aug13

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 719
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	August 23, 2013

JCC 9/13/13

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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 23, 2013

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.8 ± 6 %	1.80 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	**53.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.8 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.6 ± 6 %	2.03 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	13.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.1 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.6 Ω + 3.5 jΩ
Return Loss	- 25.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.1 Ω + 5.4 jΩ
Return Loss	- 25.3 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	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 22.08.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

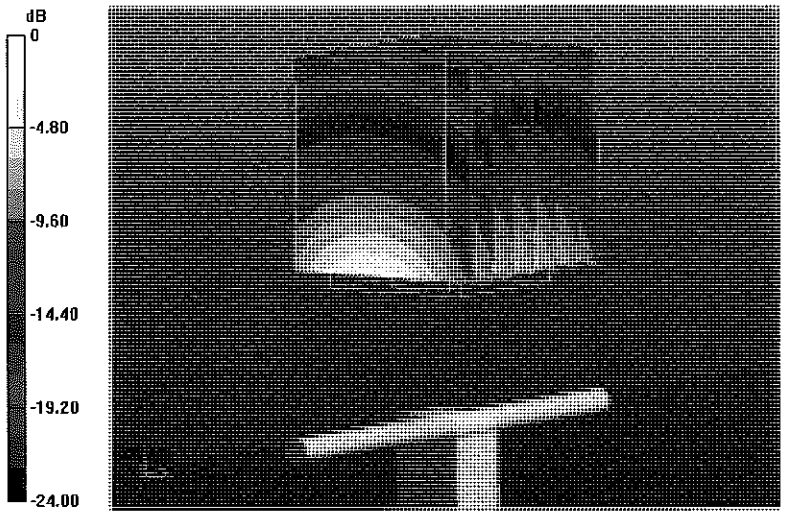
Communication System: UID 0 - CW ; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.8 S/m; ε_r = 37.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); 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 52.8.7(1137); SEMCAD X 14.6.10(7164)

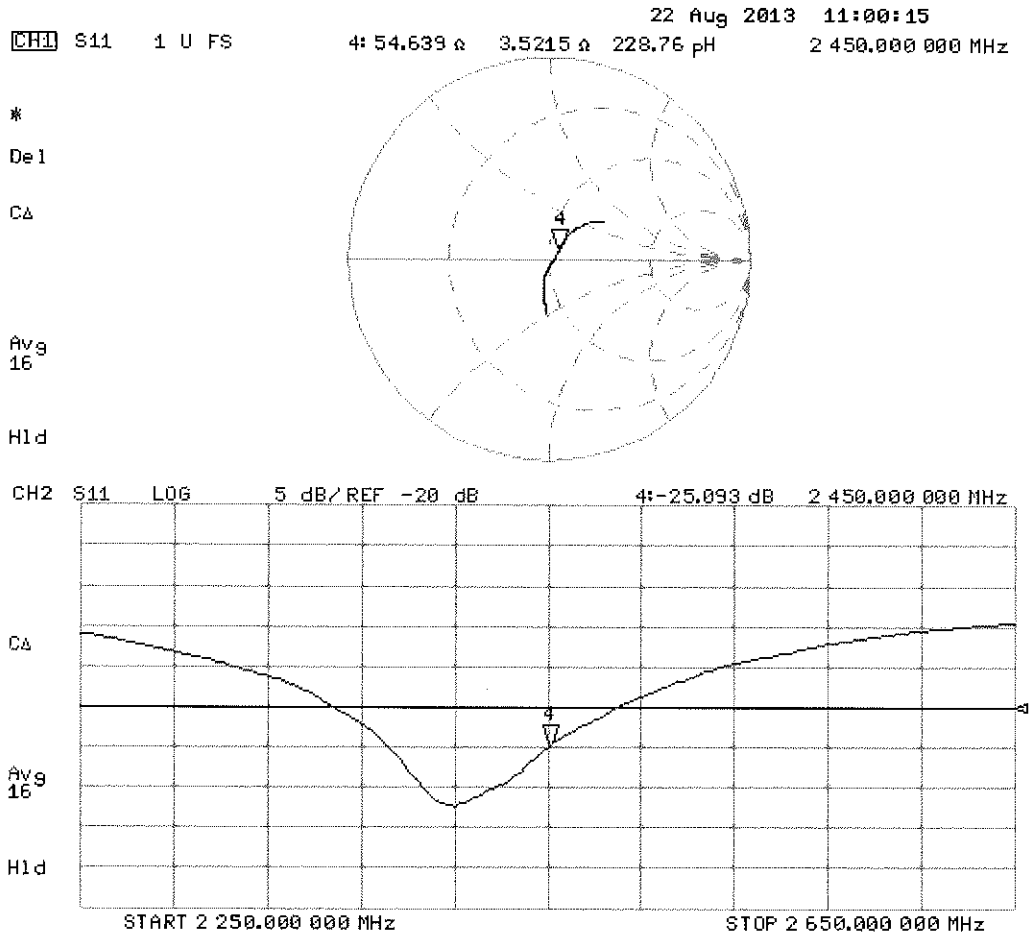
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.7 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.23 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: 23.08.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

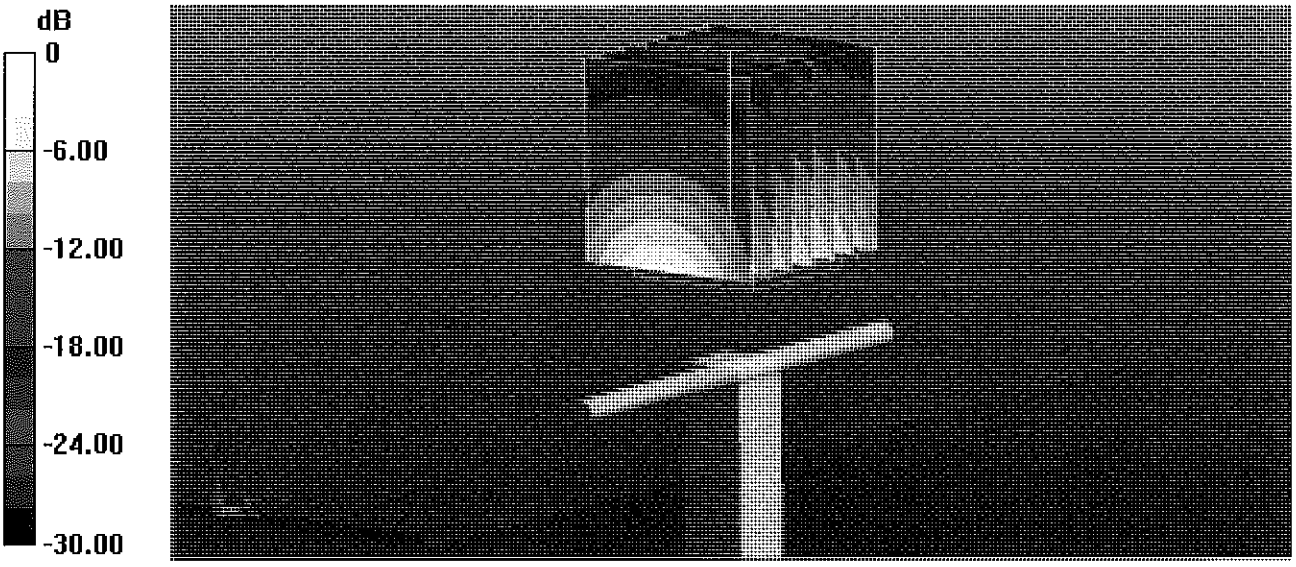
Communication System: UID 0 - CW ; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.03 S/m; ε_r = 50.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); 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 52.8.7(1137); SEMCAD X 14.6.10(7164)

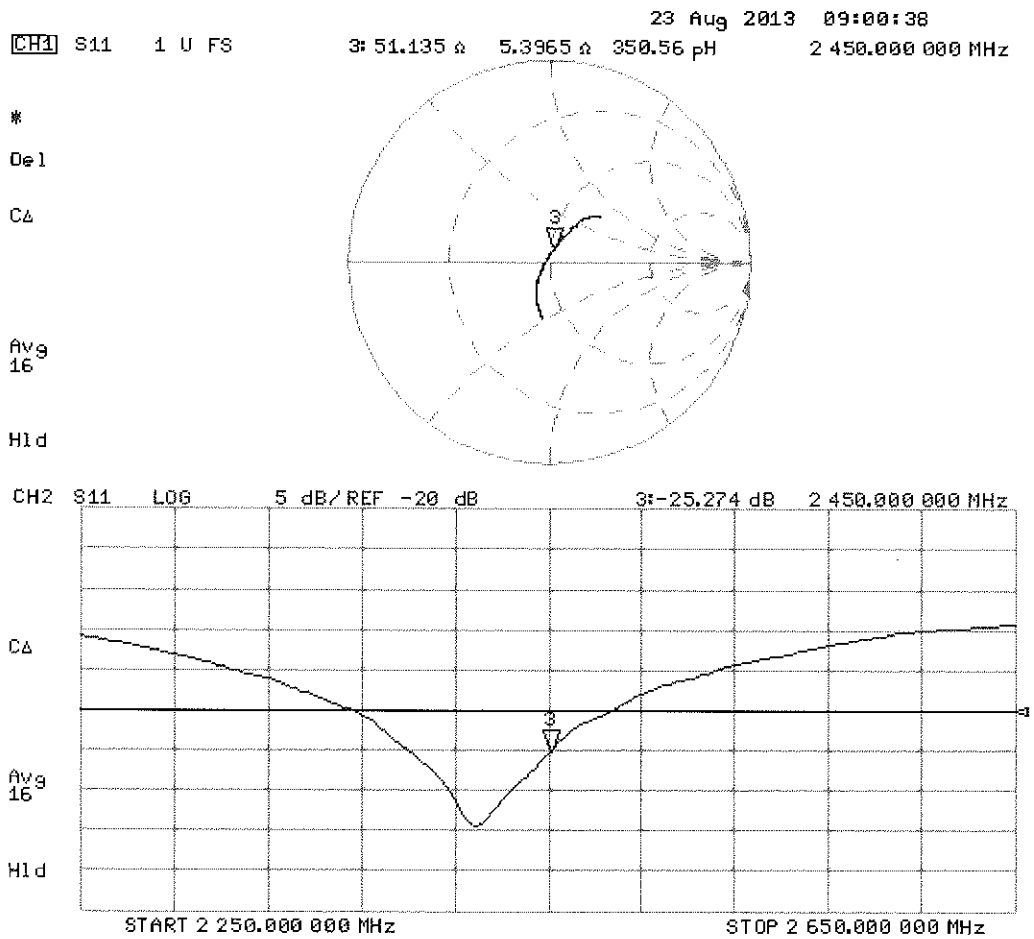
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.688 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.14 W/kg
Maximum value of SAR (measured) = 17.2 W/kg



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

Impedance Measurement Plot for Body TSL



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

S Schweizerischer Kalibrierdienst
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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: D5GHzV2-1057_Jan14

CALIBRATION CERTIFICATE

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

CC 2/5/14 ✓

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	30-Dec-13 (No. EX3-3503_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

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

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

Issued: January 27, 2014

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

PCT# 753

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
c) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.0 ± 6 %	4.45 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.85 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**78.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.3 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	4.54 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

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

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.8 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	4.74 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

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

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.0 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	4.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

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

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.8 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	5.07 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

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

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.6 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.3 ± 6 %	5.44 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.58 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.2 ± 6 %	5.57 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

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

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.84 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

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

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.0 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.6 ± 6 %	5.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**80.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.2 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	6.23 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.48 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.3 W/kg ± 19.9 % (k=2)**

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

Appendix

Antenna Parameters with Head TSL at 5200 MHz

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

Antenna Parameters with Head TSL at 5300 MHz

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

Antenna Parameters with Head TSL at 5500 MHz

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

Antenna Parameters with Head TSL at 5600 MHz

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

Antenna Parameters with Head TSL at 5800 MHz

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

Antenna Parameters with Body TSL at 5200 MHz

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

Antenna Parameters with Body TSL at 5300 MHz

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

Antenna Parameters with Body TSL at 5500 MHz

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

Antenna Parameters with Body TSL at 5600 MHz

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

Antenna Parameters with Body TSL at 5800 MHz

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.186 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 27, 2006

DASY5 Validation Report for Head TSL

Date: 27.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

DASY52 Configuration:

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

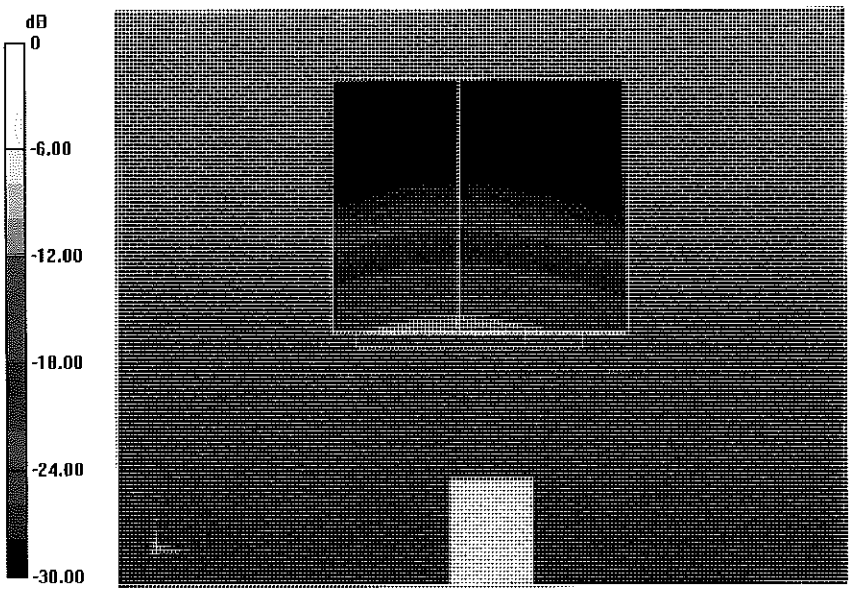
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.497 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 28.2 W/kg
SAR(1 g) = 7.85 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR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

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.444 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 31.2 W/kg
SAR(1 g) = 8.36 W/kg; SAR(10 g) = 2.4 W/kg
Maximum value of SAR (measured) = 20.1 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.807 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 33.0 W/kg
SAR(1 g) = 8.5 W/kg; SAR(10 g) = 2.42 W/kg
Maximum value of SAR (measured) = 20.8 W/kg

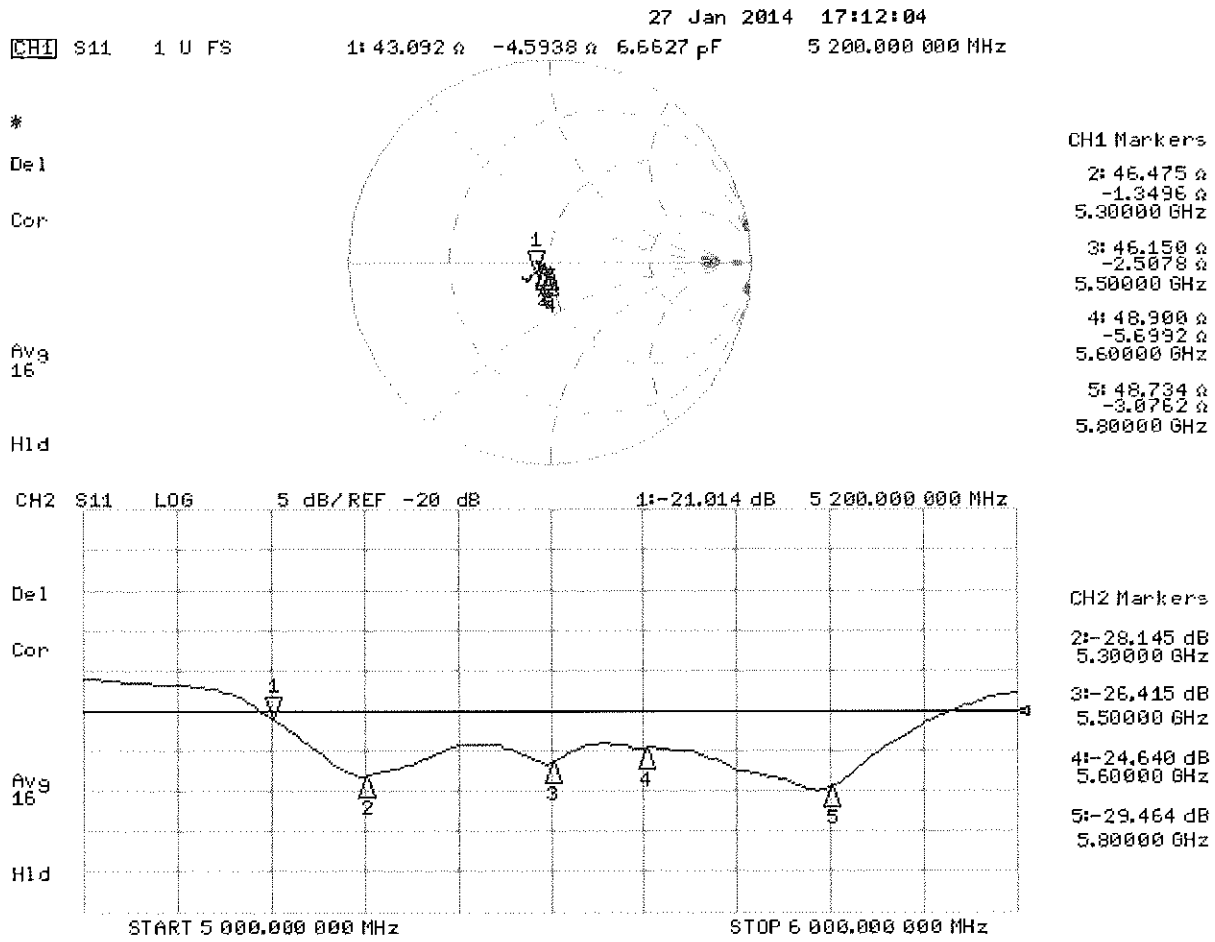
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.194 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 33.2 W/kg
SAR(1 g) = 8.42 W/kg; SAR(10 g) = 2.4 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.646 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 32.9 W/kg
SAR(1 g) = 8 W/kg; SAR(10 g) = 2.28 W/kg
Maximum value of SAR (measured) = 19.9 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 24.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

DASY52 Configuration:

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

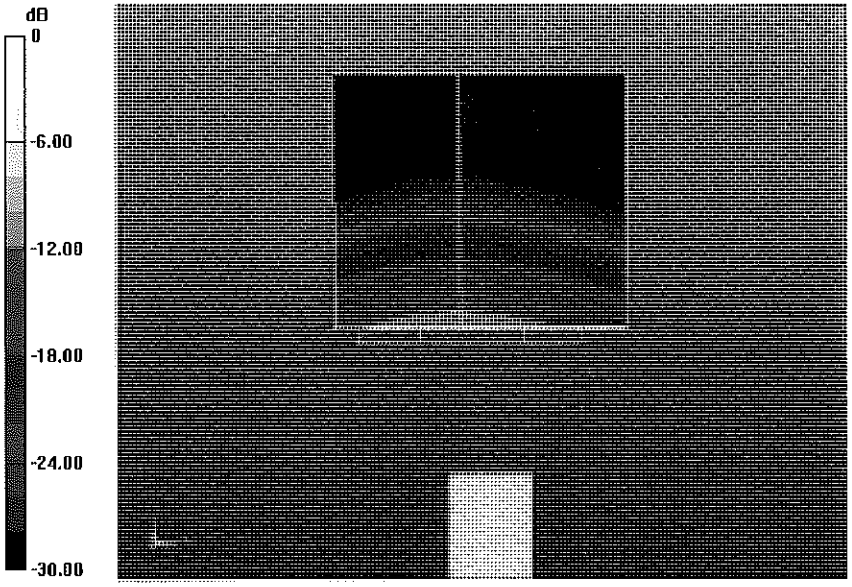
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.809 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 30.1 W/kg
SAR(1 g) = 7.58 W/kg; SAR(10 g) = 2.12 W/kg
Maximum value of SAR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

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.585 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 32.2 W/kg
SAR(1 g) = 7.79 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 19.1 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.364 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 34.4 W/kg
SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.22 W/kg
Maximum value of SAR (measured) = 19.4 W/kg

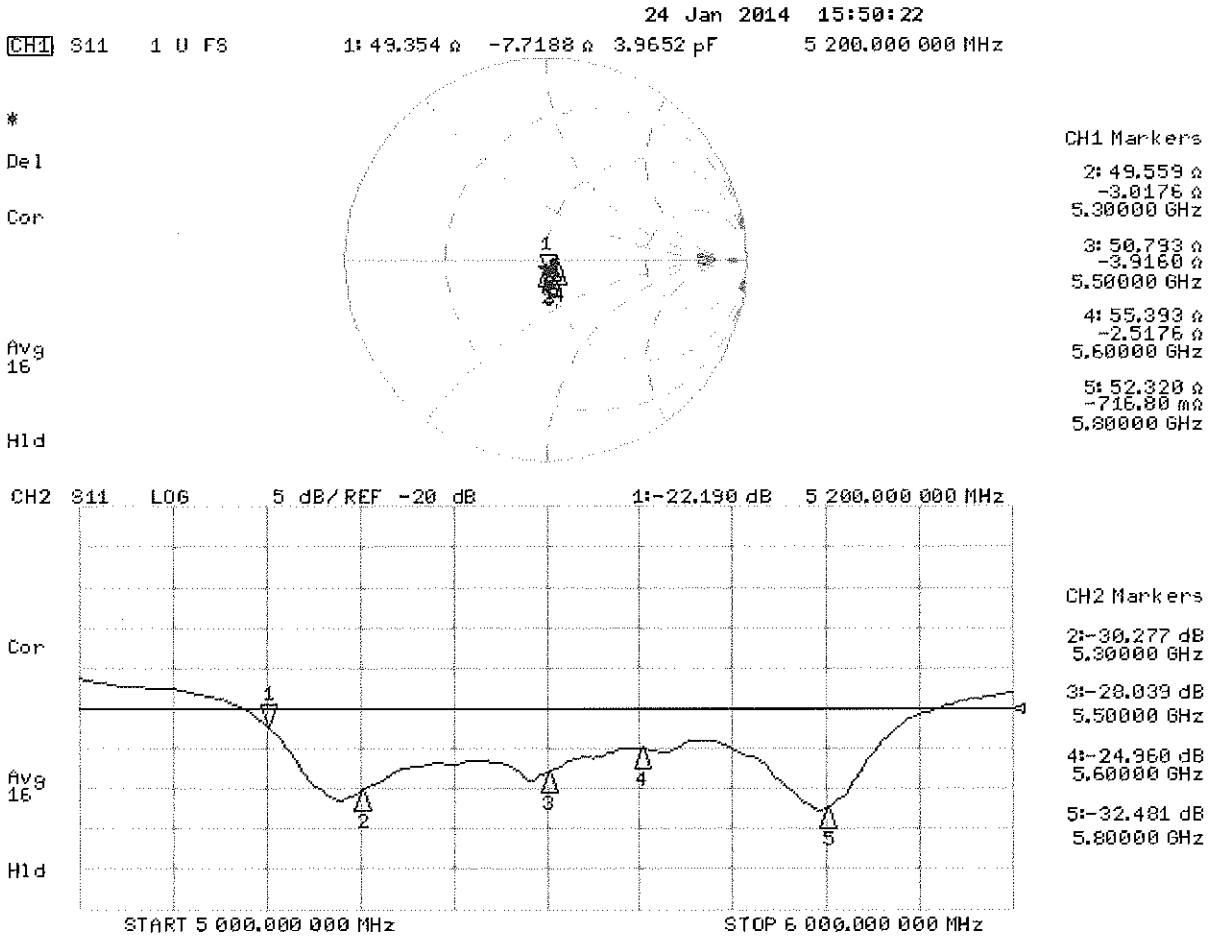
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 57.864 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 35.8 W/kg
SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.24 W/kg
Maximum value of SAR (measured) = 19.8 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 54.817 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 35.1 W/kg
SAR(1 g) = 7.48 W/kg; SAR(10 g) = 2.06 W/kg
Maximum value of SAR (measured) = 18.8 W/kg



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

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
Schmid & Partner
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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: D5GHzV2-1007_Sep13/2

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

Object: D5GHzV2 - SN: 1007

CC✓ 10/5/13

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

Calibration date: September 23, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

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

Issued: October 4, 2013

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

PCT# 685

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
c) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.8 ± 6 %	4.48 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.77 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**77.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.2 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.6 ± 6 %	4.62 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

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

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.9 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.4 ± 6 %	4.76 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

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

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.1 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 6 %	4.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

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

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.7 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.0 ± 6 %	5.07 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

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

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.9 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.3 ± 6 %	5.36 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.28 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**72.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.2 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.1 ± 6 %	5.56 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

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

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.8 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.8 ± 6 %	5.75 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

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

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.6 ± 6 %	5.88 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

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

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.3 ± 6 %	6.17 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

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

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

Appendix

Antenna Parameters with Head TSL at 5200 MHz

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

Antenna Parameters with Head TSL at 5300 MHz

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

Antenna Parameters with Head TSL at 5500 MHz

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

Antenna Parameters with Head TSL at 5600 MHz

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

Antenna Parameters with Head TSL at 5800 MHz

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

Antenna Parameters with Body TSL at 5200 MHz

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

Antenna Parameters with Body TSL at 5300 MHz

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

Antenna Parameters with Body TSL at 5500 MHz

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

Antenna Parameters with Body TSL at 5600 MHz

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

Antenna Parameters with Body TSL at 5800 MHz

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 28, 2003

DASY5 Validation Report for Head TSL

Date: 23.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.48 S/m; ε_r = 35.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 4.62 S/m; ε_r = 35.6; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.76 S/m; ε_r = 35.4; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.86 S/m; ε_r = 35.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.07 S/m; ε_r = 35; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 28.12.2012, ConvF(5.1, 5.1, 5.1); Calibrated: 28.12.2012, ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.76, 4.76, 4.76); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

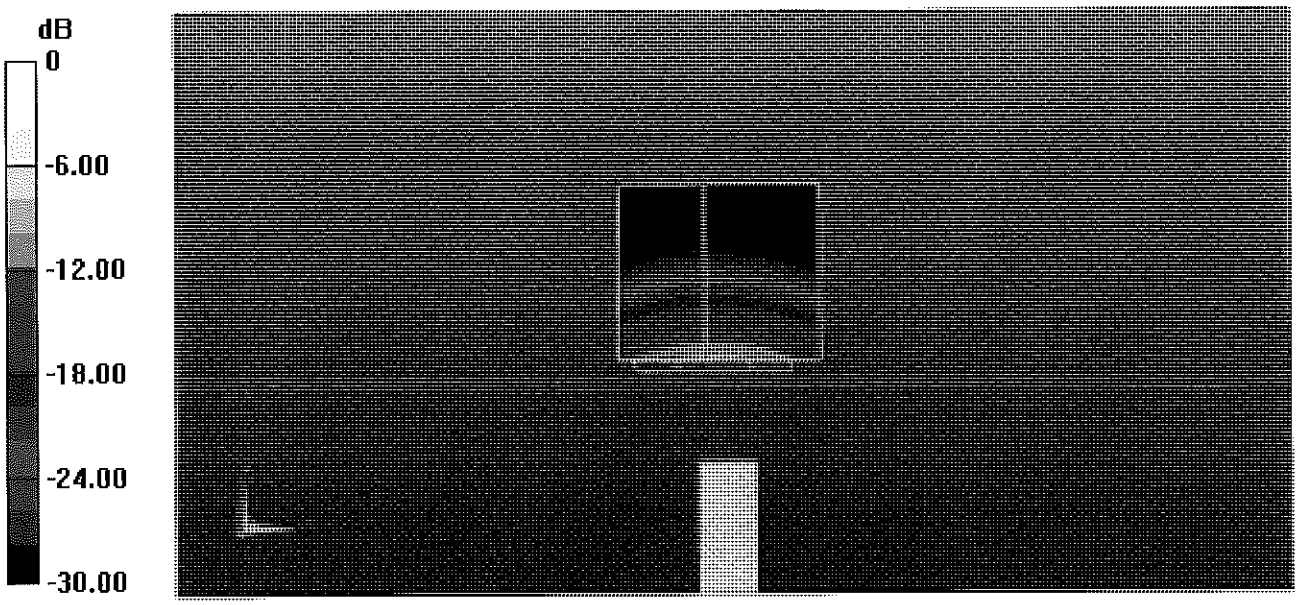
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.505 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 28.1 W/kg
SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.23 W/kg
Maximum value of SAR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

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.817 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 29.7 W/kg
SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.3 W/kg
Maximum value of SAR (measured) = 18.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.029 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 32.0 W/kg
SAR(1 g) = 8.17 W/kg; SAR(10 g) = 2.32 W/kg
Maximum value of SAR (measured) = 19.7 W/kg

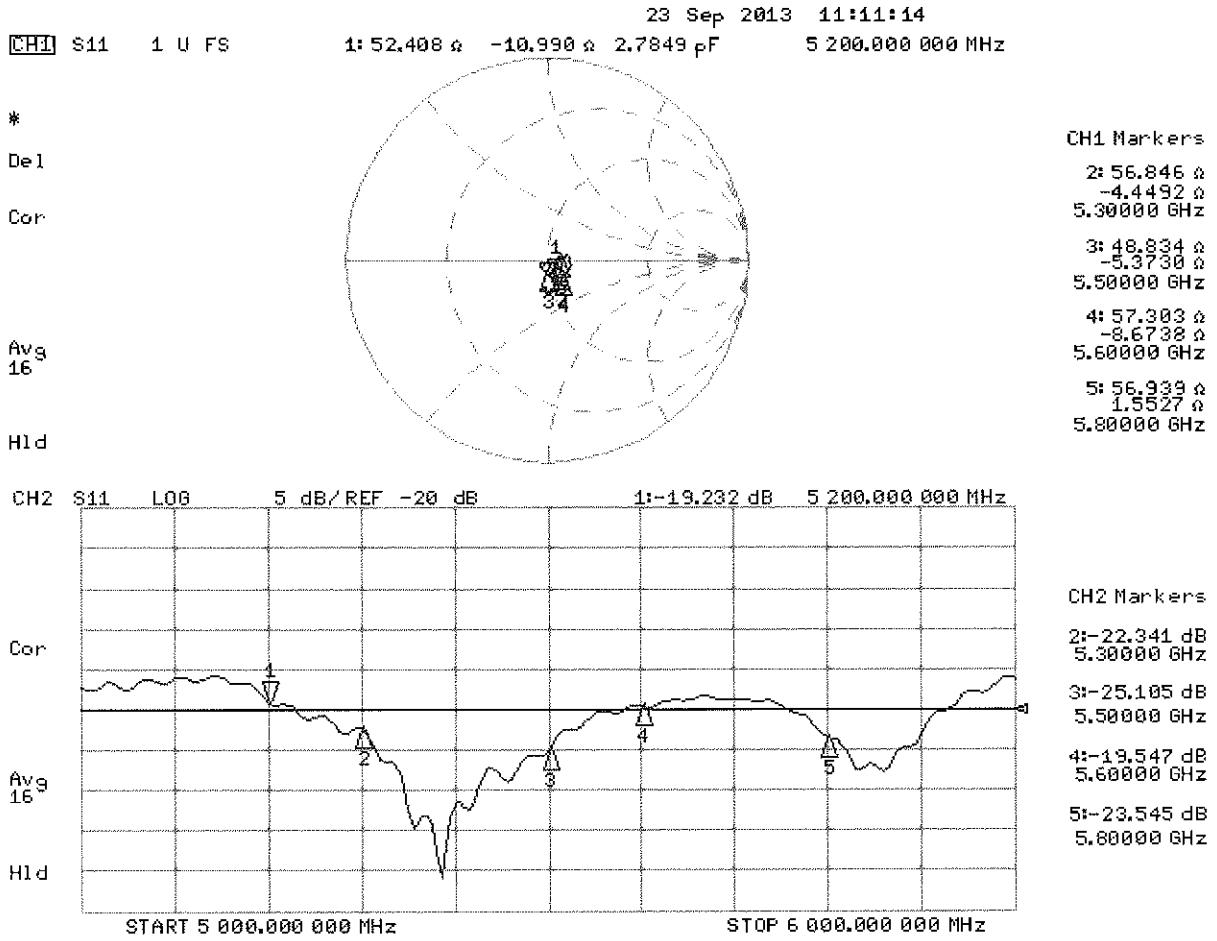
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.403 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 31.3 W/kg
SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.28 W/kg
Maximum value of SAR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

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.987 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 31.9 W/kg
SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.2 W/kg
Maximum value of SAR (measured) = 19.0 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 20.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.36 S/m; ε_r = 48.3; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 5.56 S/m; ε_r = 48.1; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 5.75 S/m; ε_r = 47.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 5.88 S/m; ε_r = 47.6; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.17 S/m; ε_r = 47.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.67, 4.67, 4.67); Calibrated: 28.12.2012, ConvF(4.43, 4.43, 4.43); Calibrated: 28.12.2012, ConvF(4.22, 4.22, 4.22); Calibrated: 28.12.2012, ConvF(4.38, 4.38, 4.38); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

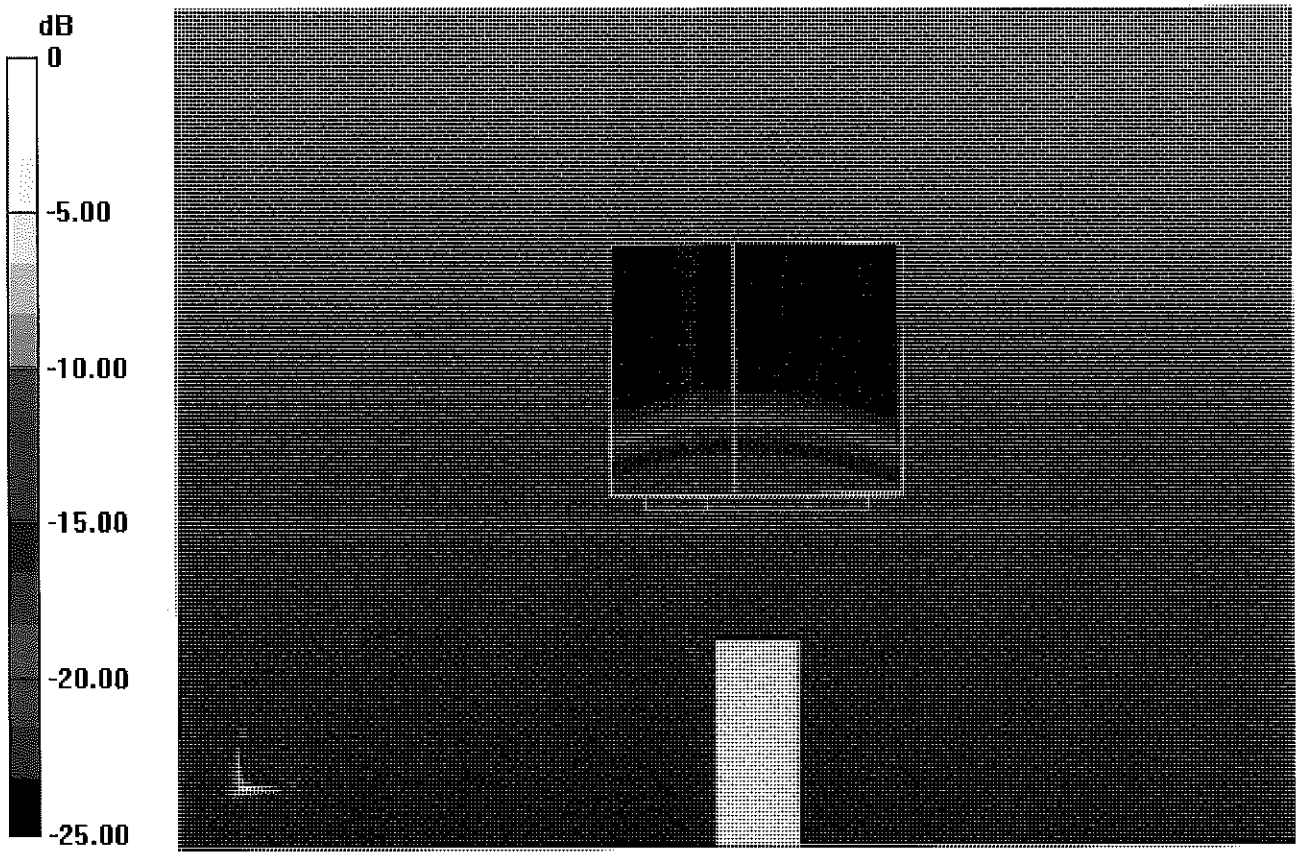
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.606 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 28.6 W/kg
SAR(1 g) = 7.28 W/kg; SAR(10 g) = 2.03 W/kg
Maximum value of SAR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

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.305 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 30.3 W/kg
SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.09 W/kg
Maximum value of SAR (measured) = 17.8 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.471 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 32.4 W/kg
SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.11 W/kg
Maximum value of SAR (measured) = 18.5 W/kg

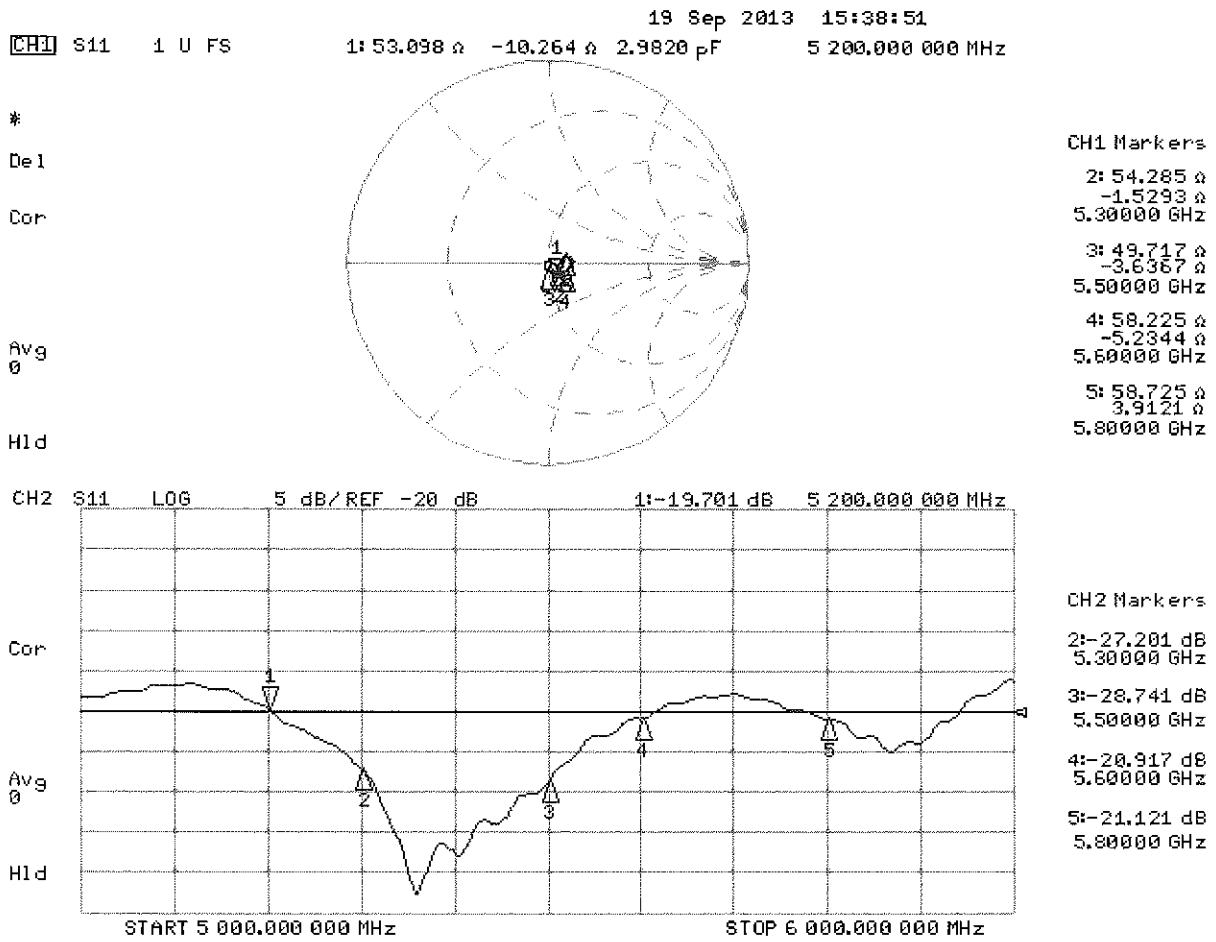
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.333 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 33.8 W/kg
SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.16 W/kg
Maximum value of SAR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

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.389 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 34.1 W/kg
SAR(1 g) = 7.31 W/kg; SAR(10 g) = 2.02 W/kg
Maximum value of SAR (measured) = 18.3 W/kg



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

Impedance Measurement Plot for Body TSL



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

S Schweizerischer Kalibrierdienst
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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: ES3-3258_Feb14

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3258
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	February 25, 2014

CCV 3/6/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: February 27, 2014

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

PCT# 80615

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
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ES3DV3

SN:3258

Manufactured: January 25, 2010
Calibrated: February 25, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.29	1.19	1.23	± 10.1 %
DCP (mV)[B]	104.5	107.0	103.0	

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	222.4	±3.8 %
		Y	0.0	0.0	1.0		202.2	
		Z	0.0	0.0	1.0		207.1	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	5.09	65.6	14.1	10.00	44.8	±1.9 %
		Y	1.68	57.4	9.3		40.7	
		Z	4.01	62.4	13.0		51.1	
10011-CAB	UMTS-FDD (WCDMA)	X	3.34	67.5	18.9	2.91	131.2	±0.5 %
		Y	3.43	67.9	18.7		137.1	
		Z	3.42	67.8	19.0		146.0	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.40	70.9	19.8	1.87	134.2	±0.7 %
		Y	3.19	70.2	19.2		137.9	
		Z	3.46	70.8	19.6		149.6	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	30.24	99.7	28.7	9.39	131.2	±1.4 %
		Y	12.91	88.5	23.9		147.5	
		Z	30.37	99.5	28.9		128.0	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	29.88	100.0	29.0	9.57	123.0	±1.9 %
		Y	16.02	92.5	25.4		140.7	
		Z	30.01	100.0	29.4		125.8	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	44.57	99.7	25.9	6.56	119.6	±1.7 %
		Y	28.97	95.3	23.2		127.6	
		Z	43.72	99.8	26.3		120.1	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	53.52	99.7	24.4	4.80	129.4	±2.2 %
		Y	54.55	99.9	22.9		143.3	
		Z	51.63	99.7	24.8		127.5	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	58.93	99.8	23.4	3.55	133.4	±2.2 %
		Y	77.54	99.7	21.3		125.3	
		Z	56.64	99.8	23.8		130.8	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	47.03	99.5	21.3	1.16	136.3	±1.7 %
		Y	95.86	95.2	17.1		138.2	
		Z	39.68	100.0	22.2		132.3	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.84	66.8	19.1	4.57	131.3	±0.9 %
		Y	4.75	67.0	18.9		135.2	
		Z	4.86	66.7	19.0		127.2	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	4.06	66.8	19.0	3.97	148.4	±0.7 %
		Y	3.96	66.6	18.6		134.7	
		Z	4.13	66.9	19.1		143.4	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.63	66.8	18.7	3.98	137.3	±0.7 %
		Y	4.75	67.5	18.8		148.4	
		Z	4.65	66.7	18.7		133.2	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.66	68.5	20.3	5.67	144.0	±1.2 %
		Y	6.27	67.1	19.3		130.6	
		Z	6.62	68.2	20.1		140.5	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.53	68.0	20.2	5.80	142.6	±1.4 %
		Y	6.17	66.8	19.3		129.2	
		Z	6.52	67.8	20.1		139.0	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.19	67.3	19.9	5.75	137.9	±1.4 %
		Y	6.12	67.3	19.6		149.5	
		Z	6.19	67.1	19.8		136.1	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.49	69.5	21.7	8.10	132.4	±2.5 %
		Y	10.23	69.1	21.3		144.3	
		Z	10.45	69.3	21.6		129.5	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.46	69.5	21.7	8.07	133.9	±2.5 %
		Y	10.26	69.2	21.3		147.4	
		Z	10.47	69.4	21.7		130.5	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	11.61	77.4	26.8	9.28	118.8	±3.0 %
		Y	9.89	75.2	25.7		144.9	
		Z	12.01	77.8	26.9		119.6	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.20	67.3	19.9	5.75	139.2	±1.2 %
		Y	5.86	66.2	19.0		128.5	
		Z	6.22	67.3	19.9		136.3	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.63	67.8	20.1	5.82	144.1	±1.4 %
		Y	6.31	66.8	19.3		133.1	
		Z	6.66	67.7	20.0		140.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.25	67.5	20.2	5.73	143.6	±1.2 %
		Y	4.92	66.7	19.5		131.0	
		Z	5.29	67.4	20.2		140.7	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	13.49	87.5	31.6	9.21	139.0	±2.7 %
		Y	7.83	75.5	26.0		124.9	
		Z	13.47	86.5	31.1		137.8	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.22	67.4	20.1	5.72	144.3	±1.4 %
		Y	5.08	67.5	19.9		147.9	
		Z	5.26	67.2	20.0		139.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.24	67.5	20.1	5.72	144.5	±1.2 %
		Y	5.06	67.4	19.8		147.0	
		Z	5.29	67.3	20.1		139.2	

10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	10.12	69.1	21.6	8.09	128.8	±2.2 %
		Y	9.76	68.4	21.0		132.8	
		Z	10.08	68.9	21.5		123.4	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.15	69.2	21.7	8.10	130.2	±2.2 %
		Y	9.77	68.5	21.0		134.1	
		Z	10.10	69.0	21.5		124.0	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	10.02	69.0	21.5	8.03	128.7	±2.2 %
		Y	9.67	68.5	21.0		133.3	
		Z	10.02	68.9	21.5		123.9	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.46	69.6	21.7	8.06	134.0	±2.2 %
		Y	10.09	68.8	21.1		139.7	
		Z	10.40	69.3	21.6		128.7	
10225-CAB	UMTS-FDD (HSPA+)	X	7.09	67.1	19.6	5.97	131.2	±1.4 %
		Y	6.98	67.2	19.4		138.0	
		Z	7.06	66.8	19.4		127.2	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	13.63	87.8	31.7	9.21	141.6	±3.0 %
		Y	7.85	75.5	26.0		126.5	
		Z	13.99	87.7	31.6		141.4	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	12.86	81.4	28.9	9.24	142.1	±3.0 %
		Y	8.91	73.4	24.8		129.9	
		Z	13.15	81.4	28.8		142.0	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	11.63	77.5	26.8	9.30	118.7	±3.0 %
		Y	9.62	74.3	25.2		138.4	
		Z	11.96	77.7	26.9		119.3	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.14	67.4	19.3	4.87	149.9	±0.9 %
		Y	5.90	66.9	18.7		132.8	
		Z	6.20	67.5	19.3		146.6	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.45	66.9	18.9	3.96	130.1	±0.7 %
		Y	4.50	67.2	18.8		137.9	
		Z	4.64	67.6	19.3		149.2	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.79	67.5	19.2	3.46	145.3	±0.7 %
		Y	3.74	67.5	18.9		128.2	
		Z	3.78	67.3	19.1		139.1	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.77	67.8	19.3	3.39	147.0	±0.5 %
		Y	3.69	67.7	18.9		130.1	
		Z	3.73	67.3	19.0		141.3	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.52	67.9	20.1	5.81	141.4	±1.4 %
		Y	6.41	67.6	19.7		147.4	
		Z	6.51	67.7	20.1		135.4	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.17	68.7	20.7	6.06	147.7	±1.4 %
		Y	6.69	67.2	19.6		128.6	
		Z	7.12	68.4	20.5		142.0	

10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	3.04	70.0	19.6	1.71	129.8	±0.5 %
		Y	3.25	71.3	19.7		136.9	
		Z	3.09	69.9	19.5		148.7	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.73	67.3	18.6	3.76	135.7	±0.5 %
		Y	4.93	69.1	19.0		141.5	
		Z	4.73	67.1	18.4		132.7	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.67	67.5	18.6	3.77	134.0	±0.5 %
		Y	4.92	69.4	19.1		139.8	
		Z	4.65	67.1	18.5		130.7	

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 8 and 9).
[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:3258

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 [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	6.53	6.53	6.53	0.40	1.60	± 12.0 %
835	41.5	0.90	6.27	6.27	6.27	0.80	1.17	± 12.0 %
1750	40.1	1.37	5.19	5.19	5.19	0.80	1.10	± 12.0 %
1900	40.0	1.40	5.04	5.04	5.04	0.68	1.27	± 12.0 %
2450	39.2	1.80	4.52	4.52	4.52	0.78	1.23	± 12.0 %
2600	39.0	1.96	4.34	4.34	4.34	0.76	1.33	± 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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

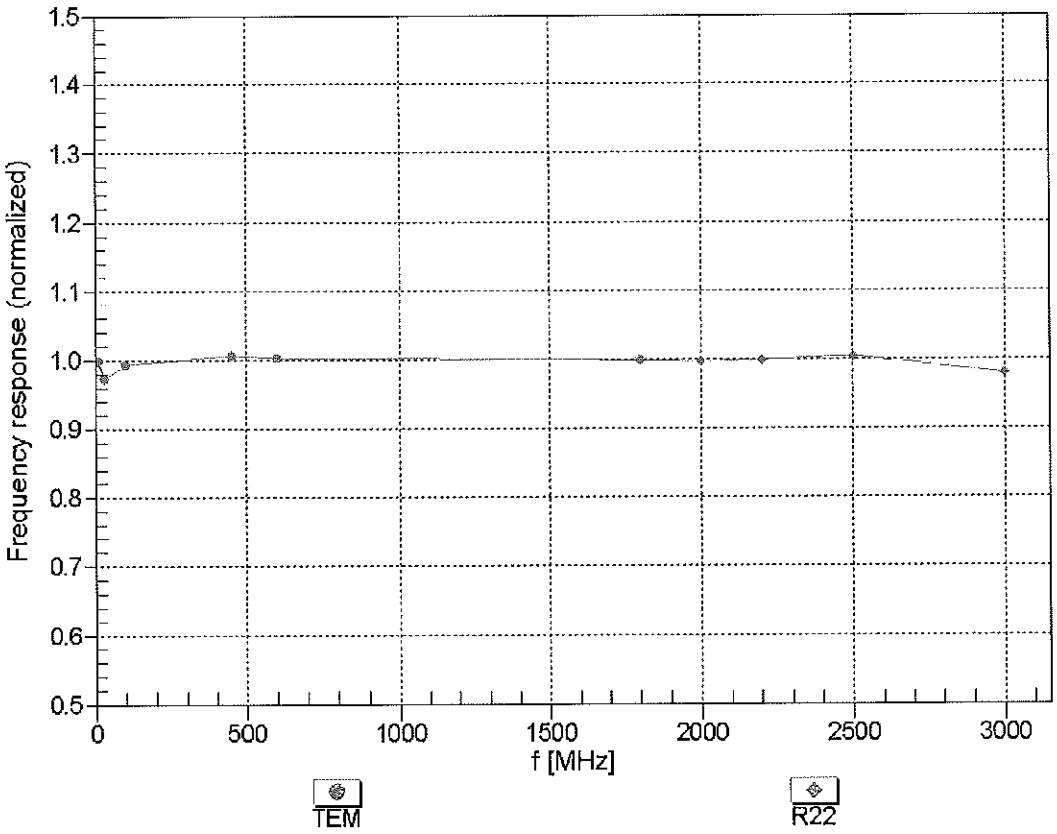
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

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 [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	6.15	6.15	6.15	0.61	1.32	± 12.0 %
835	55.2	0.97	6.11	6.11	6.11	0.80	1.15	± 12.0 %
1750	53.4	1.49	4.83	4.83	4.83	0.47	1.74	± 12.0 %
1900	53.3	1.52	4.61	4.61	4.61	0.55	1.59	± 12.0 %
2450	52.7	1.95	4.14	4.14	4.14	0.80	1.11	± 12.0 %
2600	52.5	2.16	3.91	3.91	3.91	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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

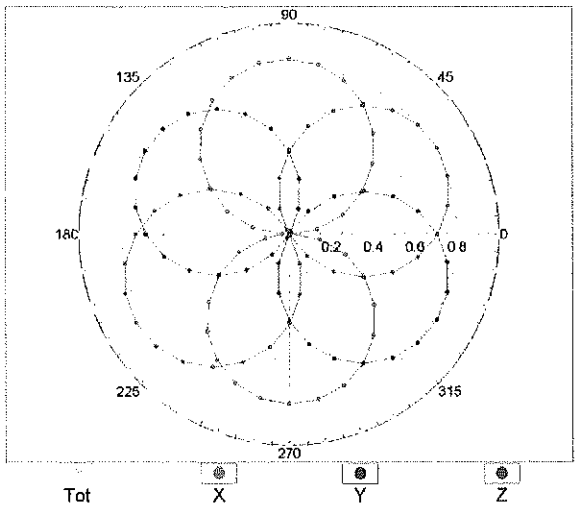
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



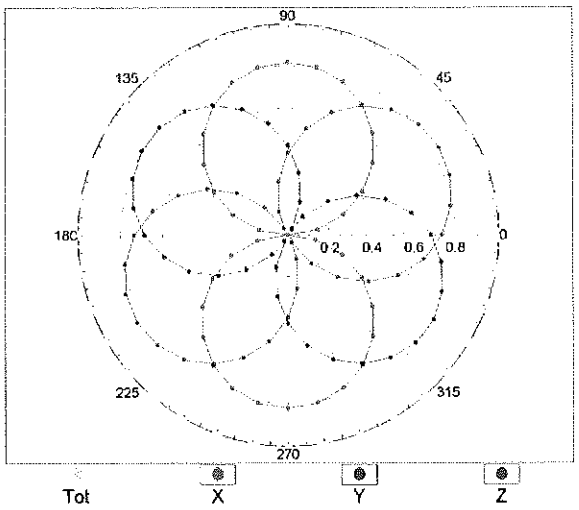
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

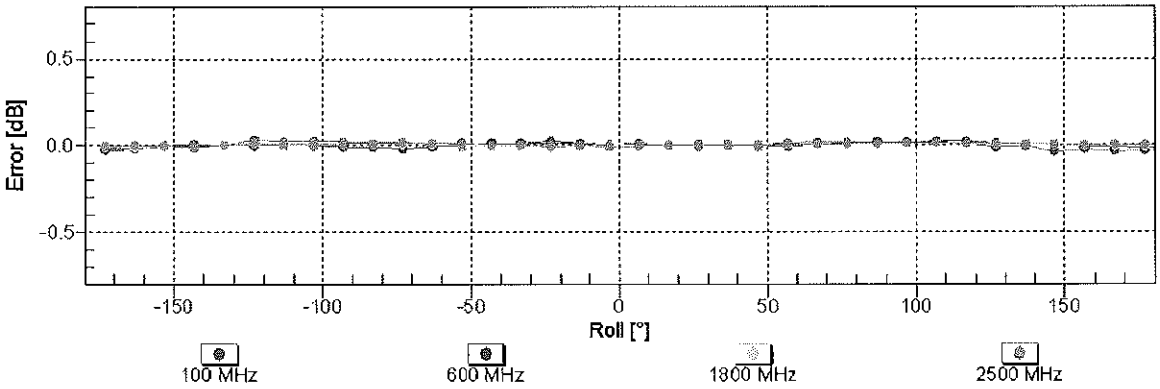
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

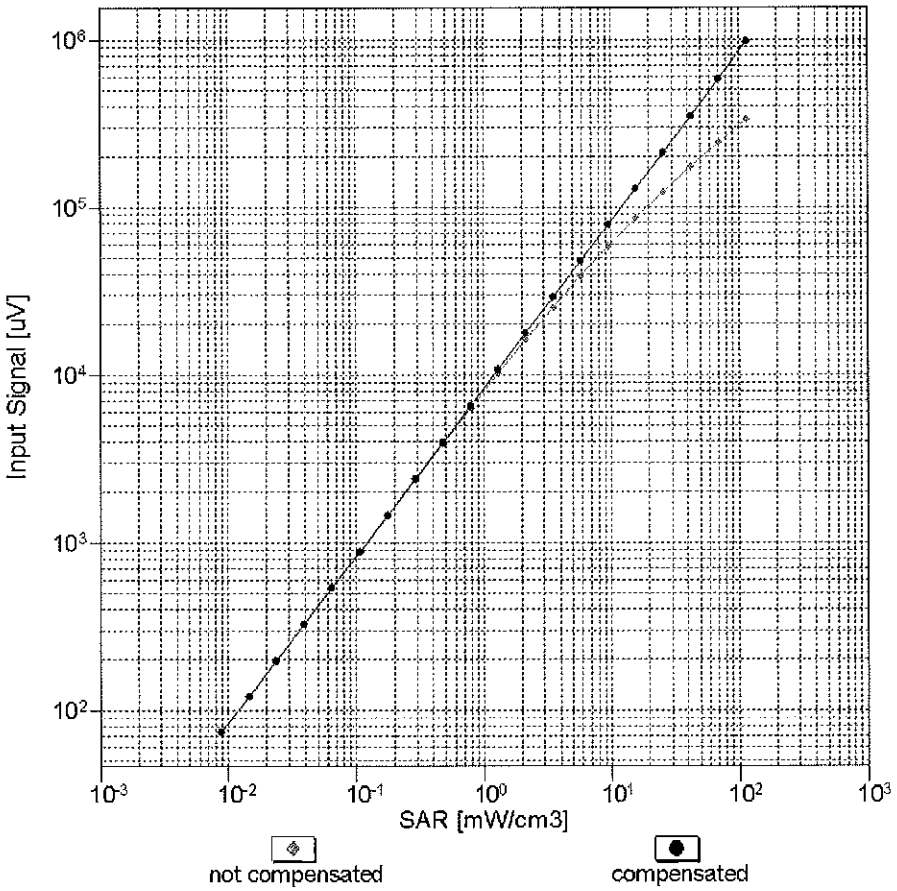


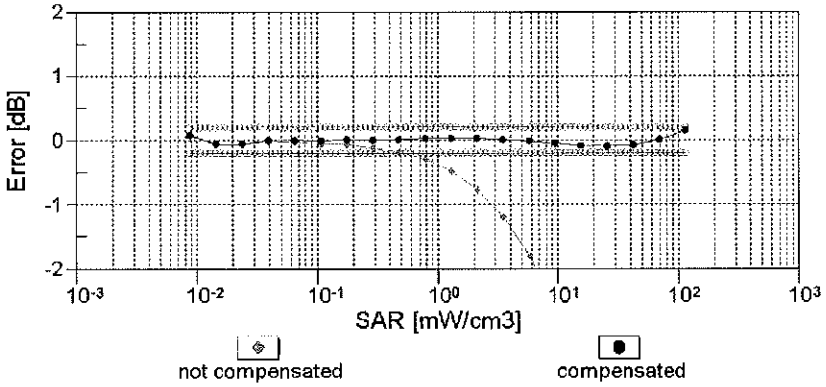


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

(TEM cell , f_{eval}= 1900 MHz)

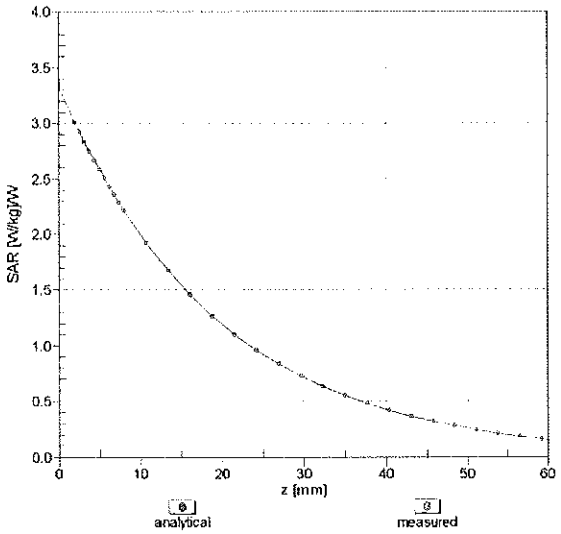




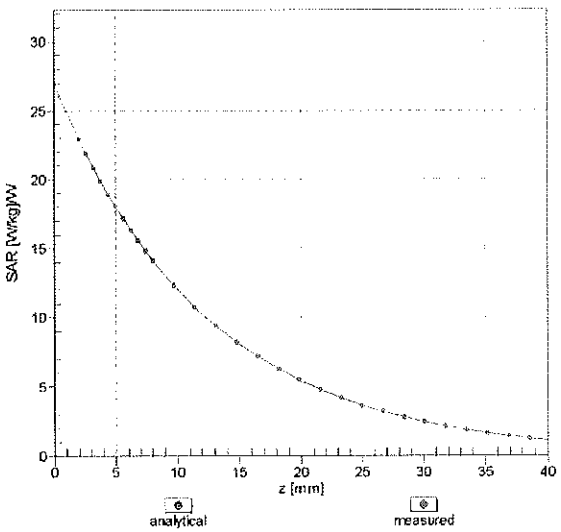
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

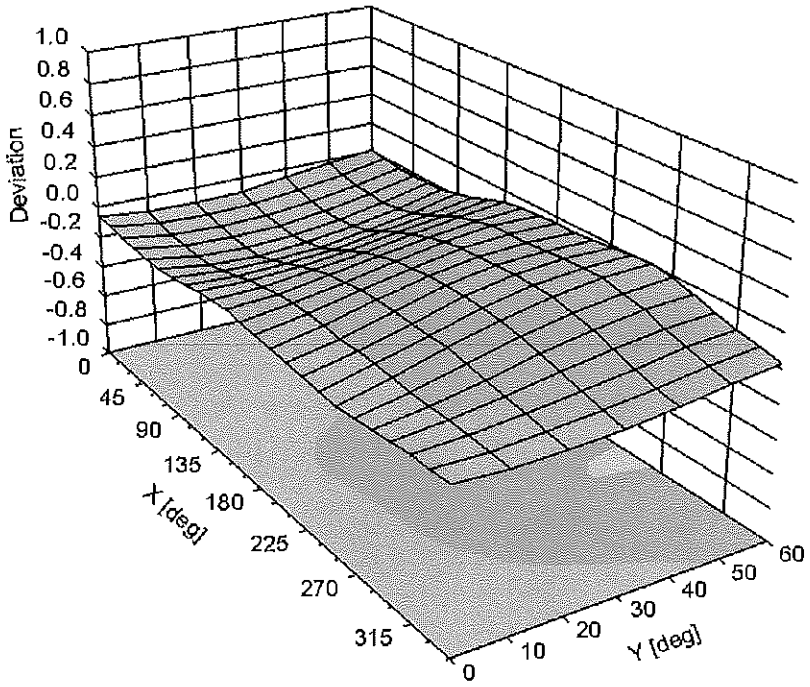


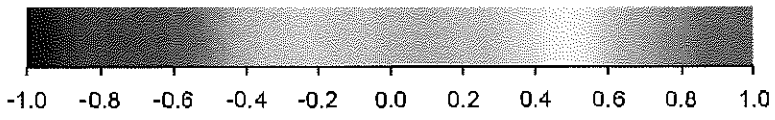
f = 1750 MHz,WGLS R22 (H_convF)



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: ES3DV3 - SN:3258

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-123.1
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: EX3-3914_Oct13

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3914

Calibration procedure(s): QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: October 23, 2013

VCC
11/26/2013

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	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Sep-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: October 25, 2013

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

PCT # 81072

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
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3914

Manufactured: December 18, 2012
Calibrated: October 23, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3914

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.47	0.49	0.51	± 10.1 %
DCP (mV)[B]	99.2	98.9	98.2	

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	158.3	±3.0 %
		Y	0.0	0.0	1.0		154.6	
		Z	0.0	0.0	1.0		170.8	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	0.71	53.3	6.1	10.00	48.4	±2.5 %
		Y	2.43	67.0	13.8		39.9	
		Z	4.18	68.7	13.8		45.7	
10011-CAA	UMTS-FDD (WCDMA)	X	3.05	64.4	16.5	2.91	122.4	±0.5 %
		Y	3.31	66.5	18.2		123.5	
		Z	3.34	66.3	17.8		136.6	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.49	64.8	16.1	1.87	120.6	±0.5 %
		Y	2.94	68.6	18.7		123.6	
		Z	2.63	65.9	17.0		135.4	
10021-DAA	GSM-FDD (TDMA, GMSK)	X	1.52	61.5	10.9	9.39	83.6	±1.2 %
		Y	2.22	67.4	15.0		116.0	
		Z	2.47	66.8	14.7		95.9	
10023-DAA	GPRS-FDD (TDMA, GMSK, TN 0)	X	1.73	63.3	11.9	9.57	81.5	±1.7 %
		Y	2.11	66.2	14.2		111.8	
		Z	2.76	69.0	16.0		93.6	
10024-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	1.34	62.1	9.4	6.56	121.0	±1.2 %
		Y	4.24	78.6	17.9		130.0	
		Z	2.91	70.7	14.9		141.4	
10027-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	1.25	63.5	9.7	4.80	143.5	±1.4 %
		Y	1.59	66.9	12.2		149.7	
		Z	2.98	71.5	14.0		123.3	
10028-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	0.51	58.3	7.4	3.55	113.4	±1.2 %
		Y	25.43	100.0	22.6		121.3	
		Z	38.67	97.5	20.6		133.3	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	0.28	58.6	5.3	1.16	134.7	±0.9 %
		Y	65.75	99.6	18.6		141.3	
		Z	0.20	55.6	4.1		112.1	
10039-CAA	CDMA2000 (1xRTT, RC1)	X	4.33	64.6	17.4	4.57	113.8	±0.7 %
		Y	4.55	66.0	18.6		120.8	
		Z	4.85	66.2	18.4		135.9	
10062-CAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	9.83	67.6	20.7	8.68	109.0	±2.5 %
		Y	10.06	68.4	21.5		118.2	
		Z	10.66	69.2	21.7		134.0	

10081-CAA	CDMA2000 (1xRTT, RC3)	X	3.59	63.9	16.9	3.97	113.6	±0.7 %
		Y	3.84	65.6	18.2		119.6	
		Z	3.95	65.4	17.8		134.5	
10098-CAA	UMTS-FDD (HSUPA, Subtest 2)	X	4.41	65.2	17.3	3.98	126.0	±0.7 %
		Y	4.73	66.9	18.6		132.5	
		Z	4.51	65.5	17.7		105.6	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.26	66.2	18.6	5.67	130.5	±1.2 %
		Y	6.61	67.7	19.8		139.3	
		Z	6.21	66.0	18.7		107.7	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.13	65.8	18.6	5.80	126.3	±1.2 %
		Y	6.40	67.1	19.6		135.6	
		Z	6.10	65.5	18.5		107.4	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.78	65.3	18.3	5.75	123.1	±1.2 %
		Y	5.97	66.3	19.2		131.5	
		Z	5.86	65.3	18.4		104.9	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	9.92	67.7	20.3	8.10	115.7	±2.5 %
		Y	10.25	68.7	21.2		126.8	
		Z	10.71	69.4	21.3		146.0	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	9.95	67.8	20.3	8.07	116.6	±2.5 %
		Y	10.26	68.7	21.1		128.3	
		Z	10.70	69.4	21.3		146.9	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.19	67.3	21.5	9.28	145.0	±2.2 %
		Y	7.40	68.3	22.4		110.8	
		Z	7.79	68.4	22.0		128.0	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.79	65.3	18.3	5.75	124.2	±1.2 %
		Y	6.03	66.5	19.4		131.9	
		Z	6.29	66.9	19.3		149.7	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.23	65.9	18.6	5.82	128.3	±1.2 %
		Y	6.51	67.2	19.7		136.9	
		Z	6.24	65.7	18.6		107.3	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.83	66.0	18.9	5.73	147.5	±1.2 %
		Y	4.72	65.8	19.2		113.8	
		Z	5.03	66.1	19.1		129.7	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.83	69.2	22.8	9.21	149.9	±1.9 %
		Y	5.81	69.4	23.4		120.3	
		Z	6.38	70.0	23.2		137.2	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.86	66.1	18.9	5.72	149.8	±1.2 %
		Y	4.72	65.8	19.2		113.3	
		Z	5.09	66.4	19.1		126.0	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.83	66.0	18.9	5.72	146.3	±1.2 %
		Y	4.69	65.6	19.1		112.2	
		Z	5.02	66.1	19.0		125.1	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.51	67.4	20.2	8.09	108.6	±2.5 %
		Y	9.72	68.1	20.9		118.2	
		Z	10.30	68.9	21.1		135.0	

10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.52	67.4	20.2	8.10	111.6	±2.5 %
		Y	9.79	68.3	21.1		121.3	
		Z	10.30	68.9	21.2		139.2	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.47	67.4	20.2	8.03	111.8	±2.2 %
		Y	9.67	68.3	21.0		120.0	
		Z	10.20	68.9	21.1		138.0	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	9.96	67.9	20.4	8.06	118.4	±2.5 %
		Y	10.25	68.8	21.2		128.2	
		Z	10.65	69.3	21.3		144.5	
10225-CAA	UMTS-FDD (HSPA+)	X	6.96	66.7	18.9	5.97	140.0	±1.4 %
		Y	7.23	67.9	20.0		148.9	
		Z	7.03	66.4	18.9		115.6	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.51	67.5	21.8	9.21	114.2	±1.9 %
		Y	5.82	69.4	23.4		123.0	
		Z	6.49	70.6	23.6		140.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.83	67.1	21.4	9.24	136.6	±1.9 %
		Y	7.30	69.4	23.2		147.3	
		Z	7.36	68.1	22.0		117.5	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	7.26	67.5	21.6	9.30	142.7	±1.9 %
		Y	7.44	68.4	22.4		110.5	
		Z	7.84	68.7	22.2		122.6	
10274-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.86	66.2	18.2	4.87	135.4	±0.9 %
		Y	6.12	67.5	19.2		142.3	
		Z	5.91	65.9	18.2		107.6	
10275-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.17	64.8	17.3	3.96	115.6	±0.7 %
		Y	4.42	66.4	18.5		124.6	
		Z	4.47	66.0	18.0		132.6	
10291-AAA	CDMA2000, RC3, SO55, Full Rate	X	3.36	64.7	17.1	3.46	109.4	±0.5 %
		Y	3.55	66.2	18.3		118.2	
		Z	3.60	65.6	17.7		120.9	
10292-AAA	CDMA2000, RC3, SO32, Full Rate	X	3.34	64.9	17.2	3.39	110.1	±0.5 %
		Y	3.57	66.7	18.5		121.0	
		Z	3.54	65.6	17.7		123.9	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.14	65.8	18.6	5.81	125.1	±1.2 %
		Y	6.44	67.2	19.7		135.7	
		Z	6.52	67.0	19.3		142.2	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.76	66.6	19.1	6.06	131.8	±1.4 %
		Y	7.03	67.8	20.0		142.5	
		Z	7.15	67.7	19.7		148.6	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.42	64.6	16.1	1.71	116.8	±0.5 %
		Y	3.00	69.3	19.0		126.9	
		Z	2.61	66.3	17.2		128.2	
10317-AAA	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	9.71	67.6	20.5	8.36	111.7	±2.5 %
		Y	9.99	68.6	21.4		122.2	
		Z	10.38	68.9	21.3		129.5	

10400-AAA	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	9.83	67.8	20.6	8.37	112.9	±2.5 %
		Y	10.09	68.7	21.4		123.9	
		Z	10.48	68.9	21.3		130.5	
10402-AAA	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	10.61	68.3	20.7	8.53	121.1	±2.5 %
		Y	11.25	70.0	21.9		135.4	
		Z	11.15	69.4	21.4		137.4	
10403-AAA	CDMA2000 (1xEV-DO, Rev. 0)	X	4.51	67.4	17.8	3.76	119.2	±0.5 %
		Y	4.91	69.5	19.3		128.3	
		Z	4.84	67.5	18.1		135.4	
10404-AAA	CDMA2000 (1xEV-DO, Rev. A)	X	4.51	67.7	18.0	3.77	117.4	±0.5 %
		Y	4.92	69.8	19.5		125.4	
		Z	4.71	67.3	18.0		131.9	

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 8 and 9).
[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:3914

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 [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	9.70	9.70	9.70	0.34	1.01	± 12.0 %
835	41.5	0.90	9.34	9.34	9.34	0.67	0.67	± 12.0 %
1750	40.1	1.37	7.99	7.99	7.99	0.79	0.56	± 12.0 %
1900	40.0	1.40	7.69	7.69	7.69	0.80	0.58	± 12.0 %
2450	39.2	1.80	6.95	6.95	6.95	0.41	0.77	± 12.0 %
2600	39.0	1.96	6.79	6.79	6.79	0.40	0.82	± 12.0 %
5200	36.0	4.66	4.99	4.99	4.99	0.30	1.80	± 13.1 %
5300	35.9	4.76	4.82	4.82	4.82	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.55	4.55	4.55	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.37	4.37	4.37	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.52	4.52	4.52	0.35	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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3914

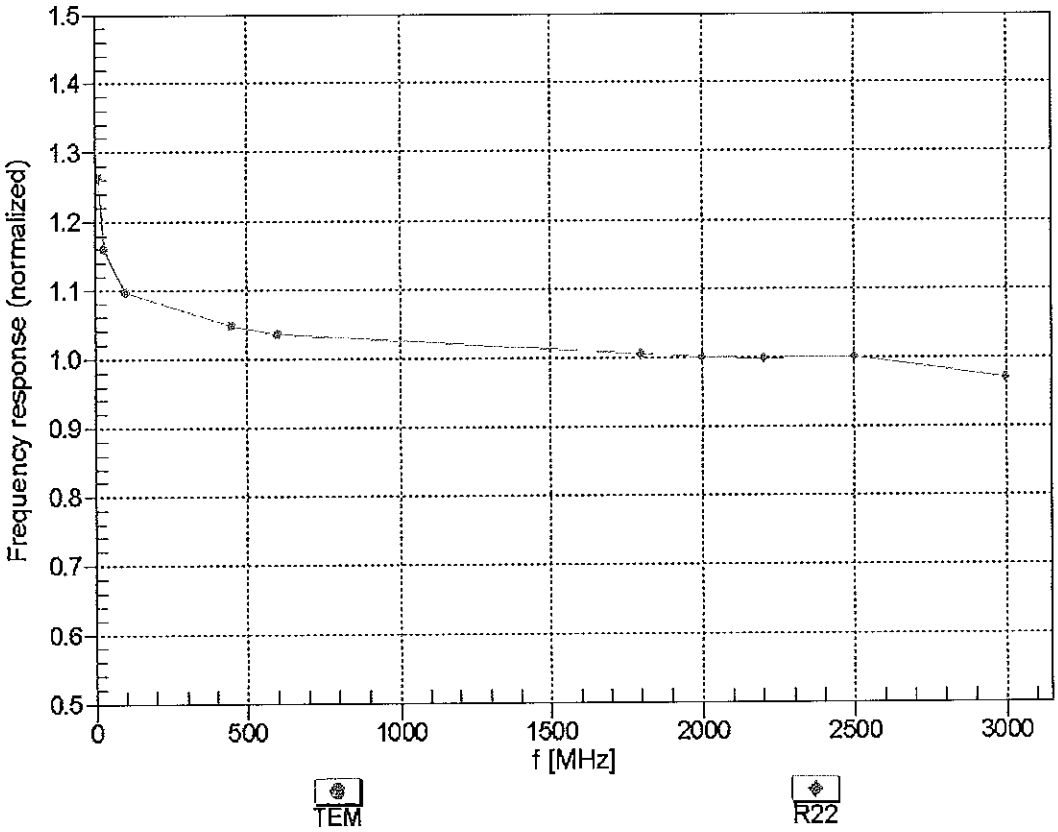
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	9.39	9.39	9.39	0.63	0.74	± 12.0 %
835	55.2	0.97	9.31	9.31	9.31	0.56	0.76	± 12.0 %
1750	53.4	1.49	7.89	7.89	7.89	0.32	1.03	± 12.0 %
1900	53.3	1.52	7.51	7.51	7.51	0.51	0.76	± 12.0 %
2450	52.7	1.95	7.02	7.02	7.02	0.80	0.50	± 12.0 %
2600	52.5	2.16	6.81	6.81	6.81	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.52	4.52	4.52	0.35	1.90	± 13.1 %
5300	48.9	5.42	4.32	4.32	4.32	0.35	1.90	± 13.1 %
5500	48.6	5.65	4.07	4.07	4.07	0.35	1.90	± 13.1 %
5600	48.5	5.77	3.97	3.97	3.97	0.35	1.90	± 13.1 %
5800	48.2	6.00	4.14	4.14	4.14	0.40	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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

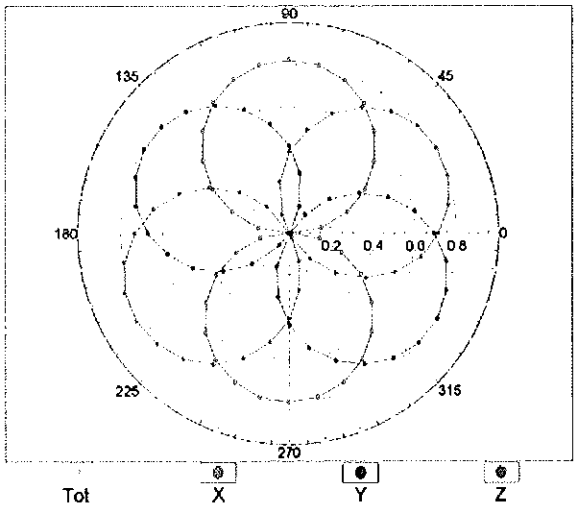
(TEM-Cell:ifi110 EXX, Waveguide: R22)



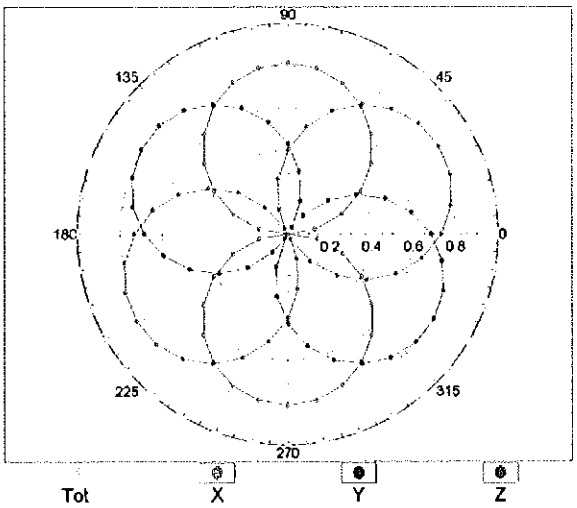
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

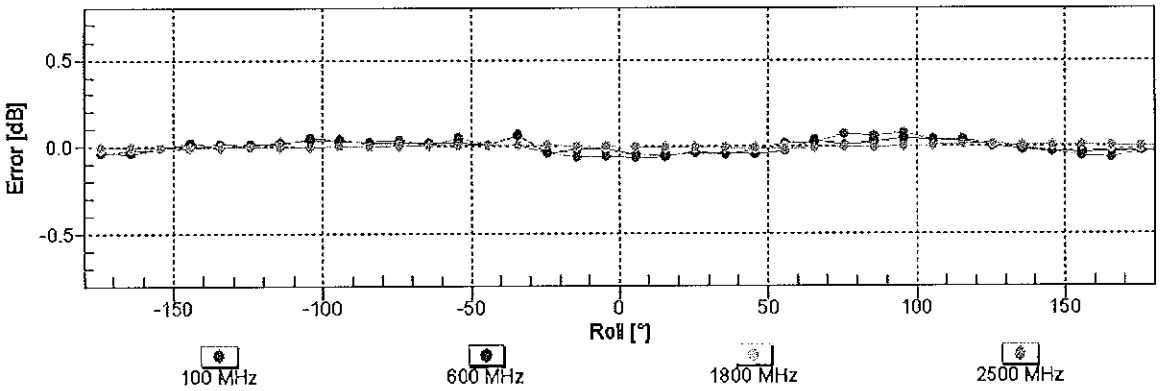
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



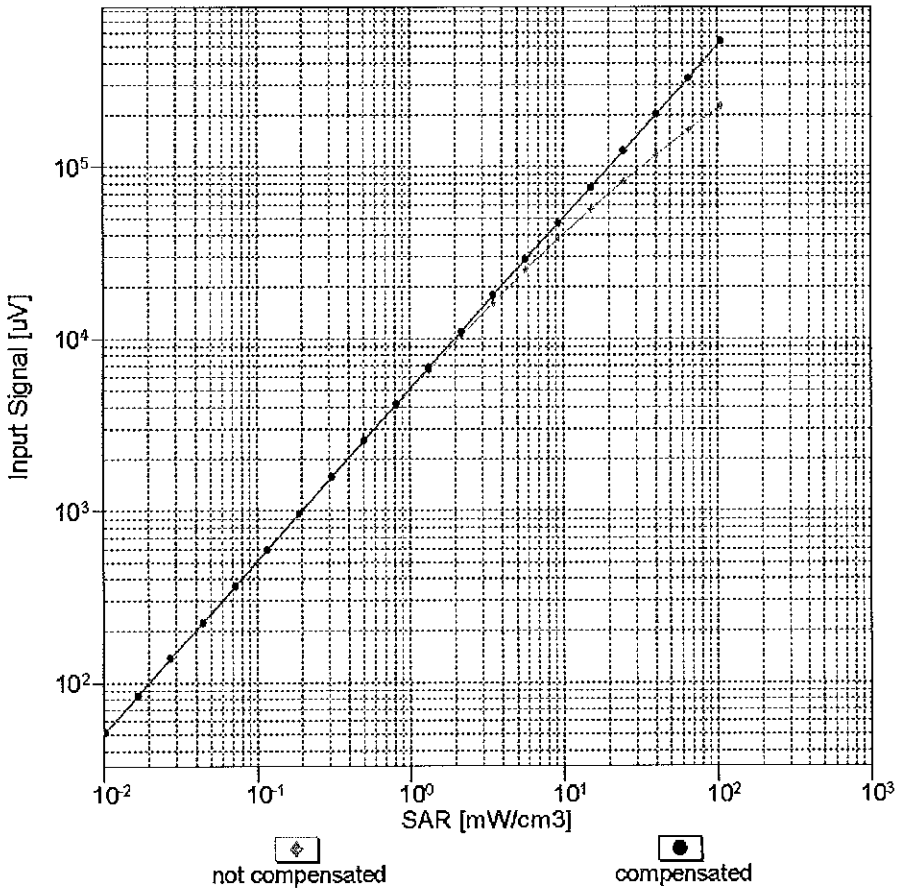
f=1800 MHz,R22

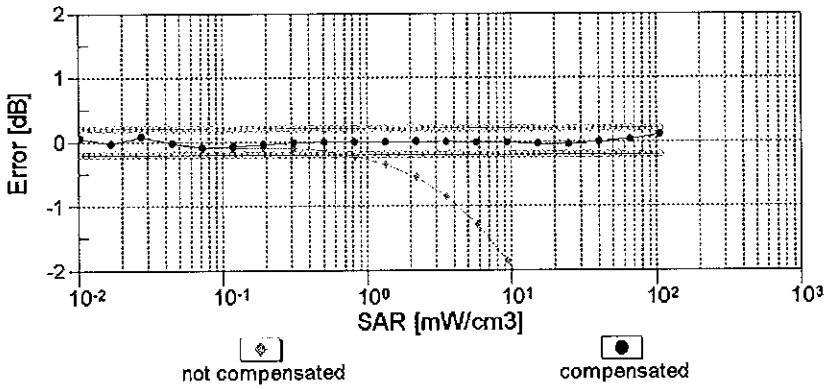




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

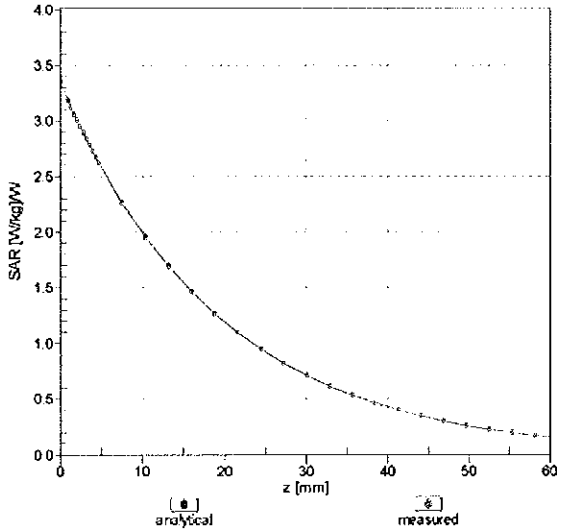




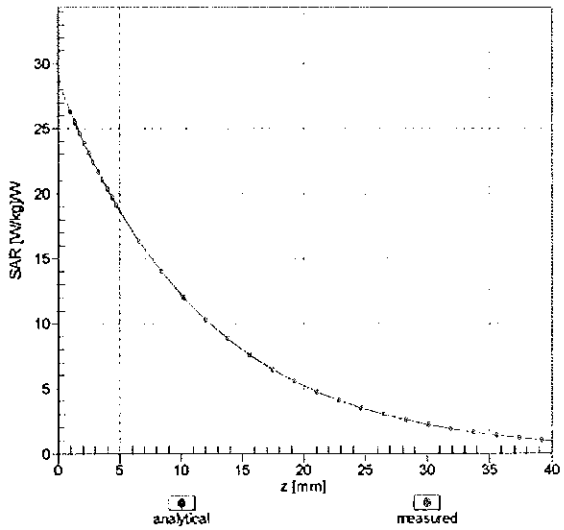
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

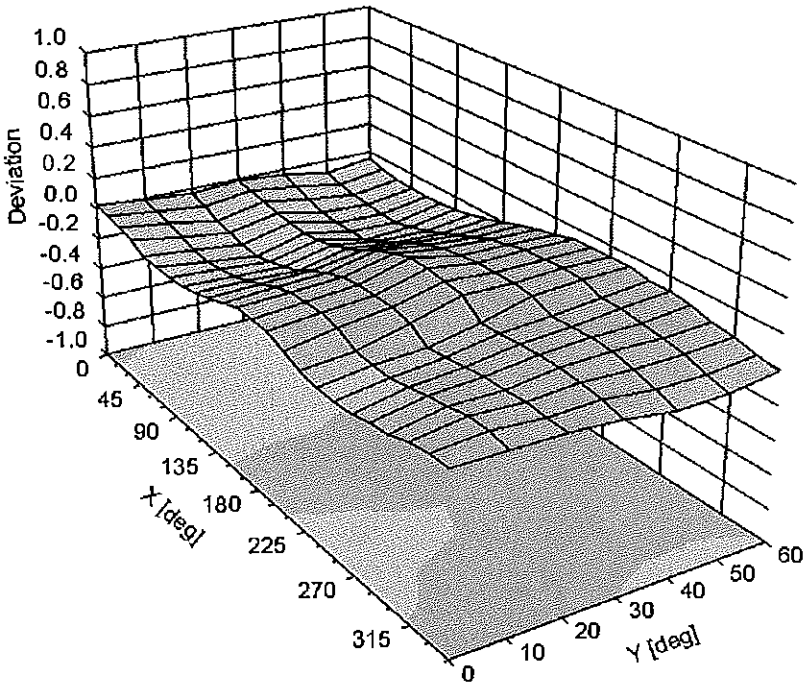


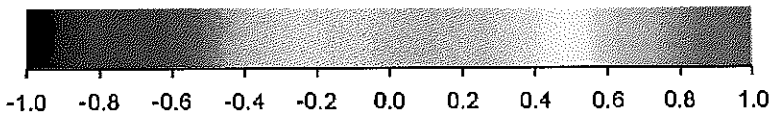
f = 1900 MHz,WGLS R22 (H_convF)



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:3914

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-24.3
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
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: ES3-3333_Nov13

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3333
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v5 Calibration procedure for dosimetric E-field probes
Calibration date:	November 22, 2013

KOK 1/7/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Sep-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: November 25, 2013

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

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
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ES3DV3

SN:3333

Manufactured: January 24, 2012
Calibrated: November 22, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3333

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.08	0.90	0.88	± 10.1 %
DCP (mV)[B]	104.9	103.3	101.7	

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	140.9	±2.2 %
		Y	0.0	0.0	1.0		132.0	
		Z	0.0	0.0	1.0		170.3	

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:3333

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 [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	6.56	6.56	6.56	0.44	1.54	± 12.0 %
850	41.5	0.92	6.30	6.30	6.30	0.46	1.48	± 12.0 %
1750	40.1	1.37	5.23	5.23	5.23	0.77	1.17	± 12.0 %
1900	40.0	1.40	5.05	5.05	5.05	0.80	1.19	± 12.0 %
2450	39.2	1.80	4.42	4.42	4.42	0.74	1.31	± 12.0 %
2600	39.0	1.96	4.28	4.28	4.28	0.80	1.30	± 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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3333

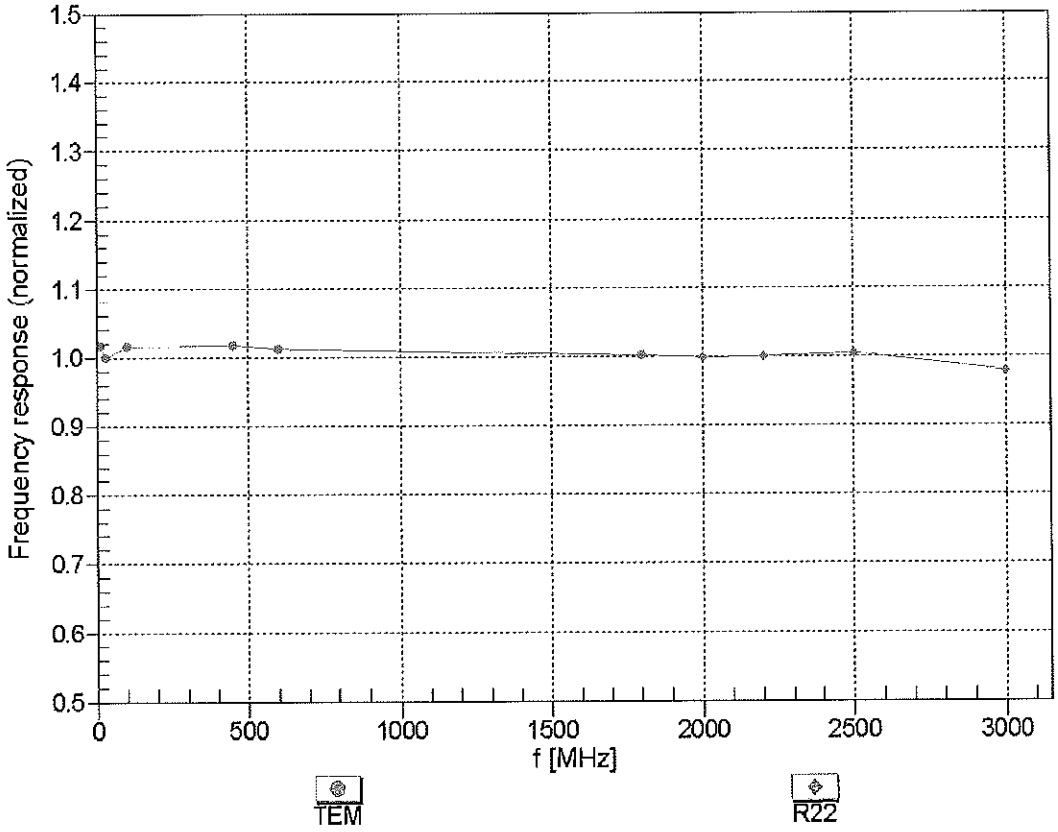
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	6.11	6.11	6.11	0.33	1.90	± 12.0 %
850	55.2	0.99	6.07	6.07	6.07	0.80	1.19	± 12.0 %
1750	53.4	1.49	4.95	4.95	4.95	0.80	1.26	± 12.0 %
1900	53.3	1.52	4.71	4.71	4.71	0.49	1.54	± 12.0 %
2450	52.7	1.95	4.22	4.22	4.22	0.80	0.95	± 12.0 %
2600	52.5	2.16	4.16	4.16	4.16	0.80	1.07	± 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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

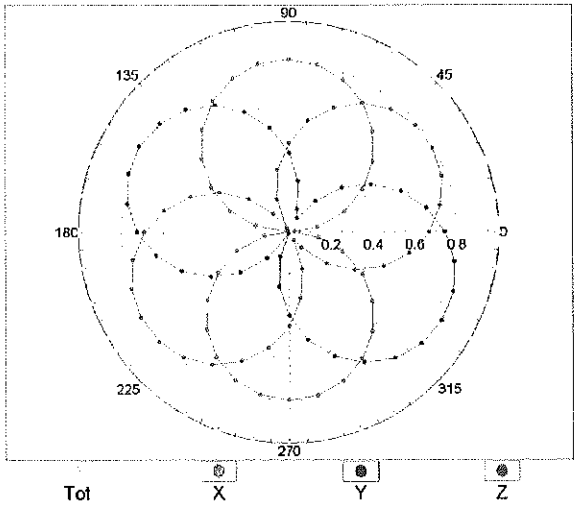
(TEM-Cell:ifi110 EXX, Waveguide: R22)



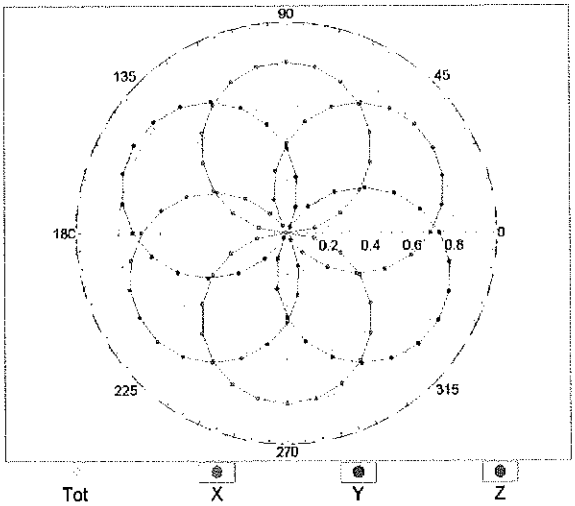
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

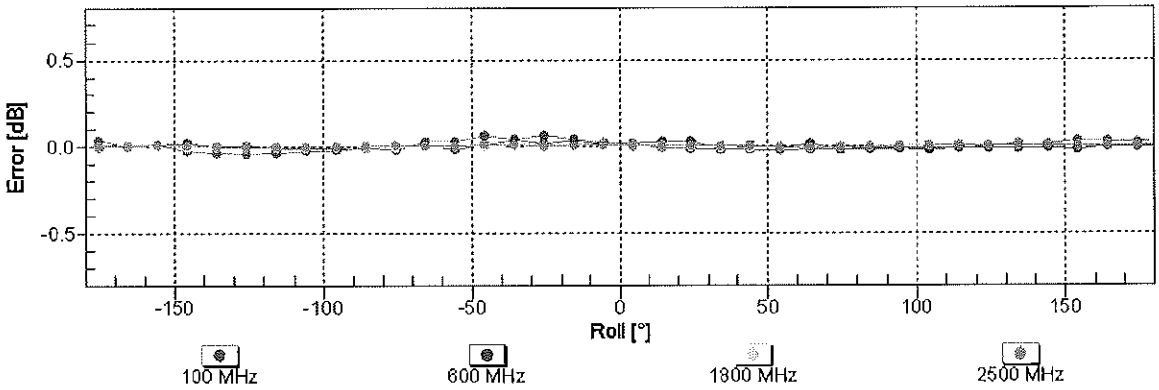
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



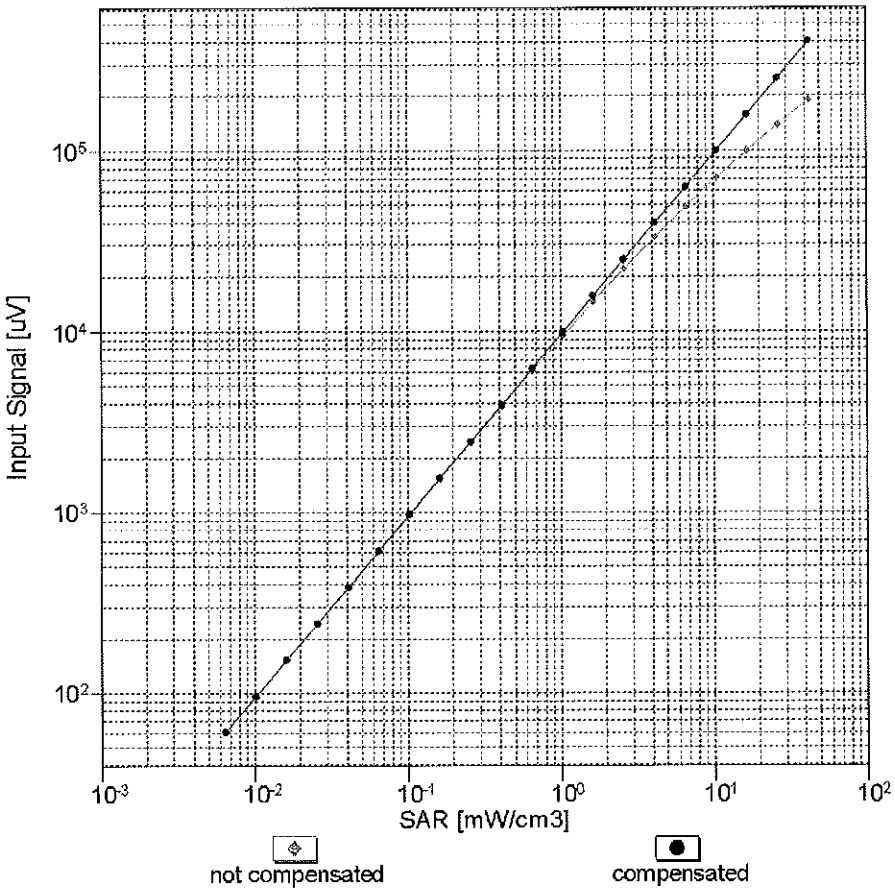
f=1800 MHz,R22

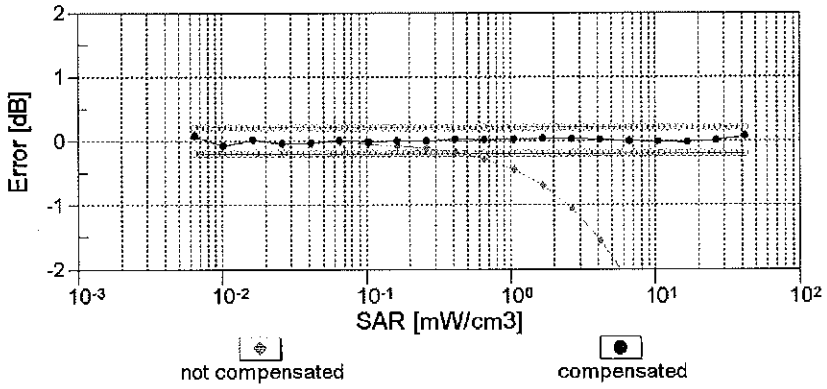




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

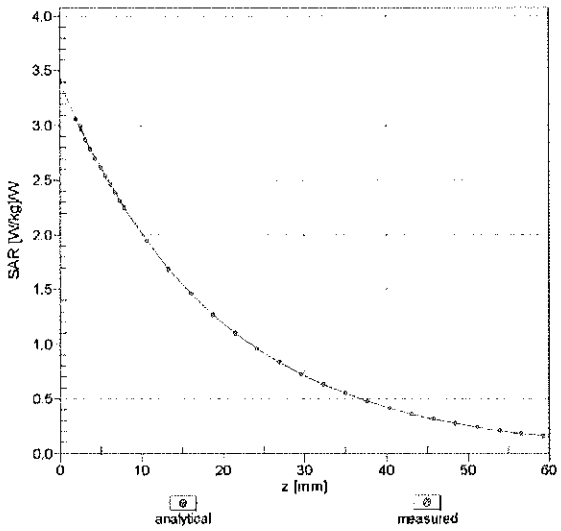




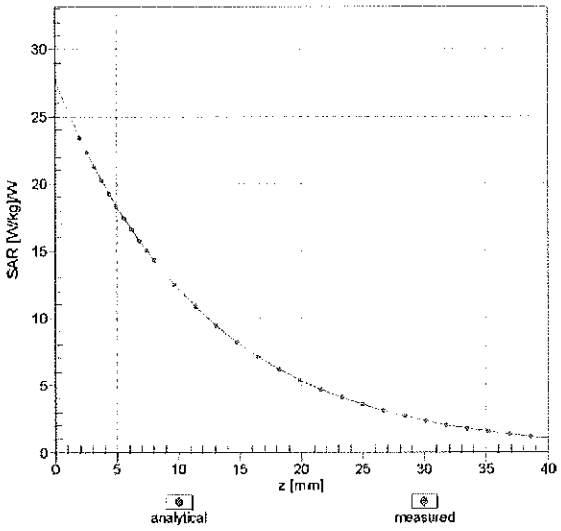
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 850 MHz,WGLS R9 (H_convF)

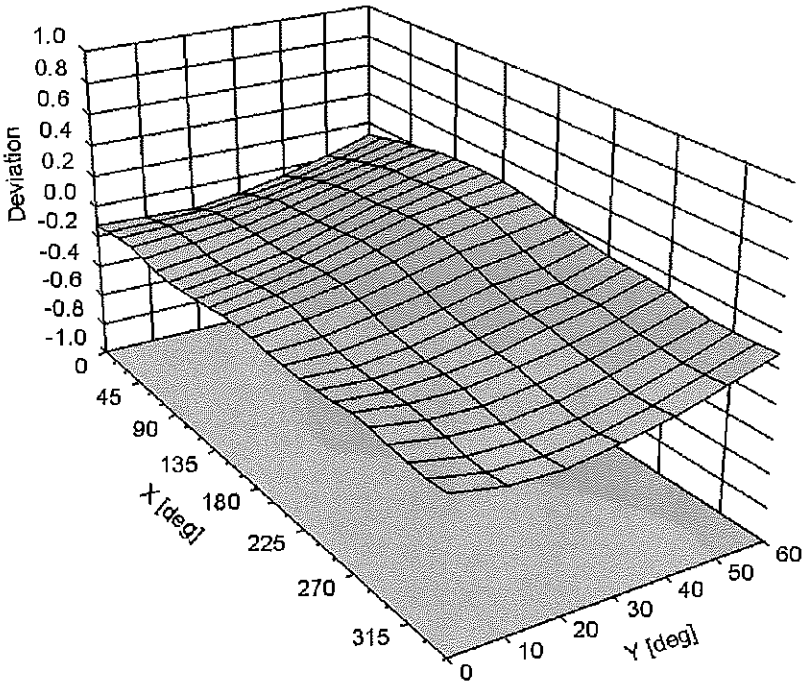


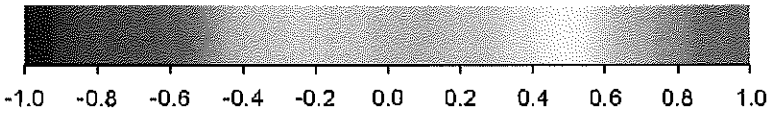
f = 1900 MHz,WGLS R22 (H_convF)



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:3333

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-35.7
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: ES3-3022_Aug13

CALIBRATION CERTIFICATE

Object	ES3DV2 - SN:3022
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	August 22, 2013

UCC 9/13/13

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 E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
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-13)	In house check: Apr-15
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: August 23, 2013

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

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 ES3DV2

SN:3022

Manufactured: April 15, 2003
Calibrated: August 22, 2013

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]	100.7	97.4	99.7	

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	178.6	±3.0 %
		Y	0.0	0.0	1.0		141.9	
		Z	0.0	0.0	1.0		134.7	

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: 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	6.21	6.21	6.21	0.19	2.37	± 12.0 %
835	41.5	0.90	6.09	6.09	6.09	0.30	1.70	± 12.0 %
1750	40.1	1.37	5.19	5.19	5.19	0.65	1.23	± 12.0 %
1900	40.0	1.40	5.03	5.03	5.03	0.51	1.43	± 12.0 %
2450	39.2	1.80	4.36	4.36	4.36	0.51	1.51	± 12.0 %
2600	39.0	1.96	4.16	4.16	4.16	0.74	1.29	± 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

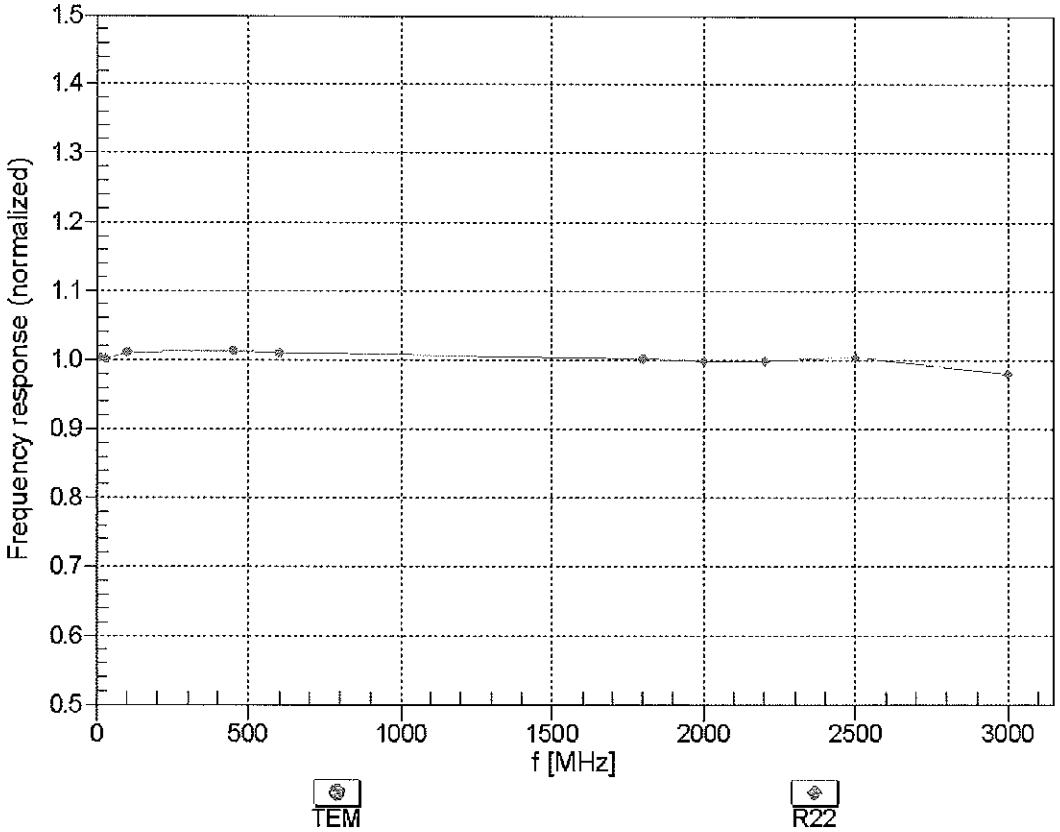
Calibration Parameter Determined in Body Tissue Simulating Media

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	5.92	5.92	5.92	0.24	1.99	± 12.0 %
835	55.2	0.97	5.91	5.91	5.91	0.29	1.85	± 12.0 %
1750	53.4	1.49	4.75	4.75	4.75	0.52	1.52	± 12.0 %
1900	53.3	1.52	4.49	4.49	4.49	0.49	1.56	± 12.0 %
2450	52.7	1.95	4.01	4.01	4.01	0.70	1.02	± 12.0 %
2600	52.5	2.16	3.85	3.85	3.85	0.58	0.90	± 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

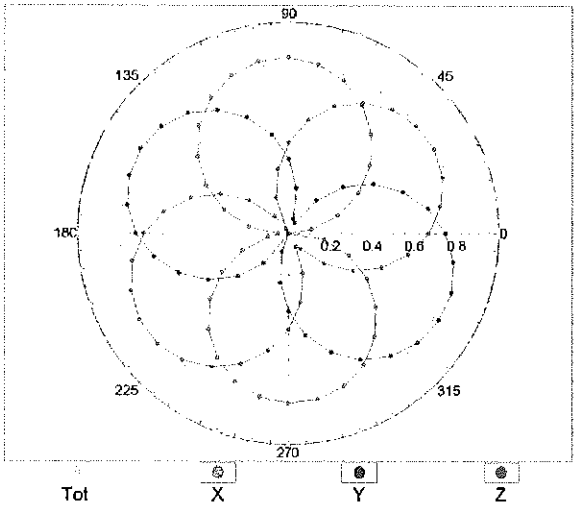
(TEM-Cell:ifi110 EXX, Waveguide: R22)



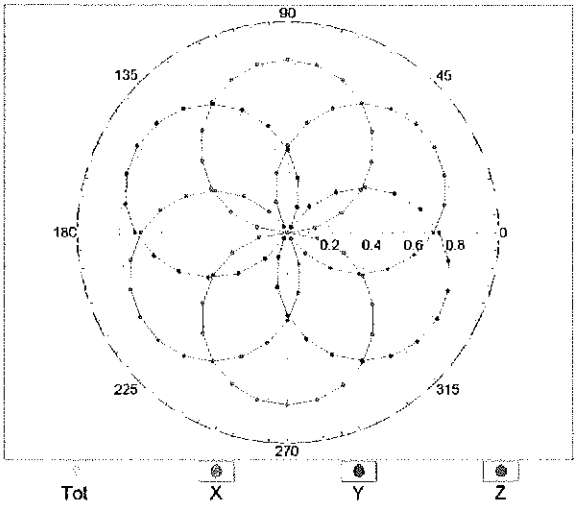
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

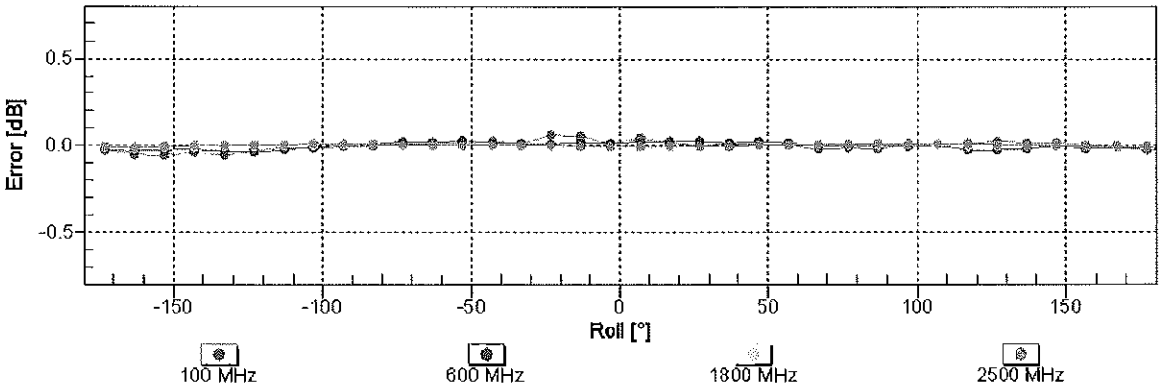
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



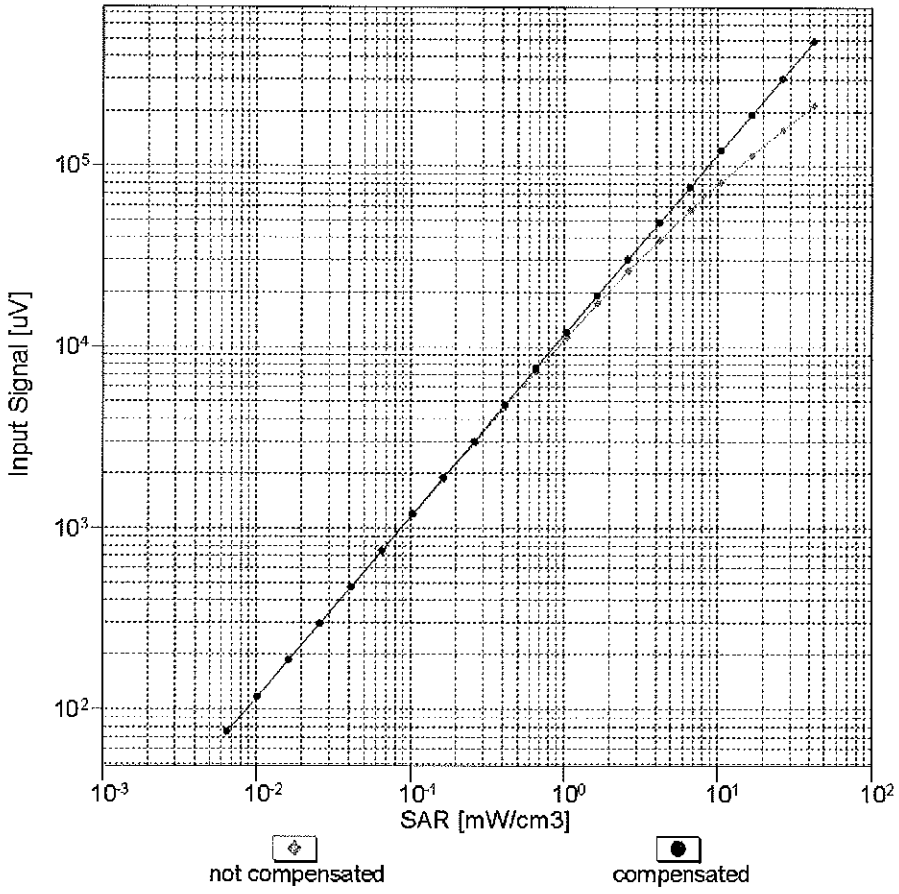
f=1800 MHz,R22

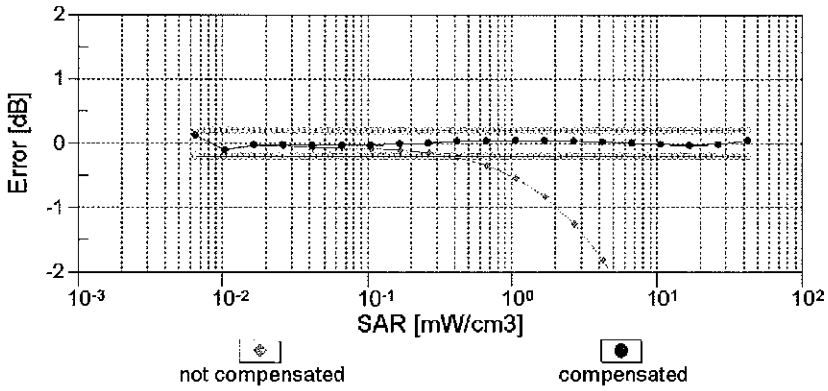




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

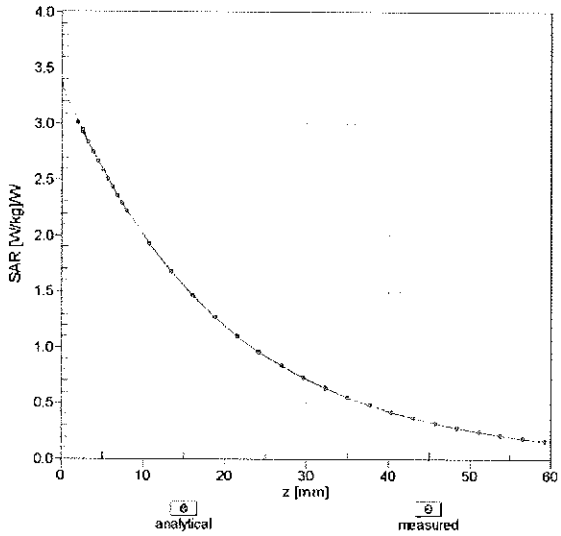




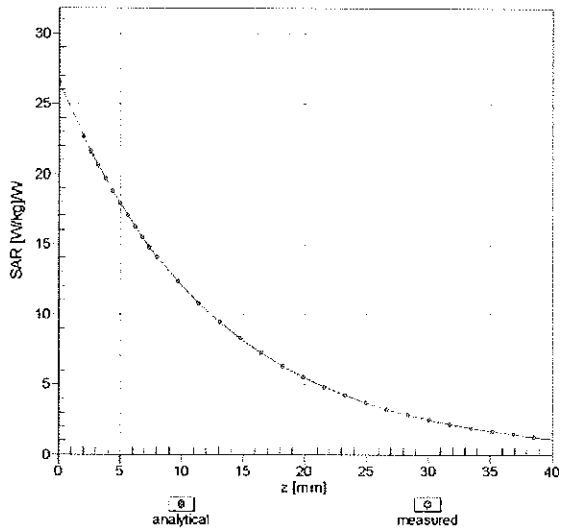
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

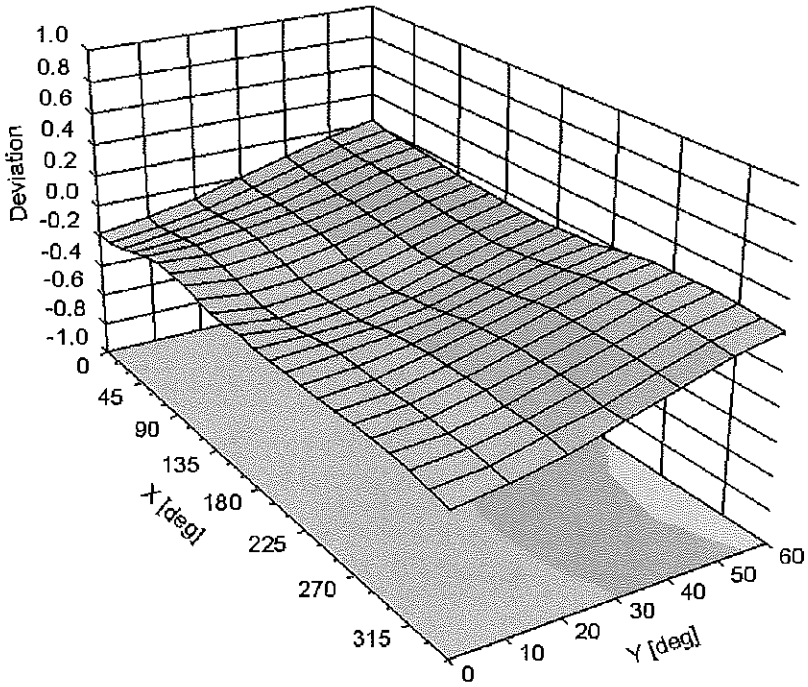


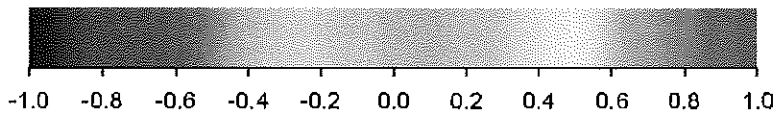
f = 1750 MHz,WGLS R22 (H_convF)



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 (°)	-83.1
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
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Accreditation No.: SCS 108

Client PC Test

Certificate No: EX3-3589_Jan14

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3589
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	January 29, 2014

CC 2/5/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: January 30, 2014

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

PCT# 783

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
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3589

Manufactured: March 30, 2006
Calibrated: January 29, 2014

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]	101.2	100.8	98.0	

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	150.4	±3.8 %
		Y	0.0	0.0	1.0		142.3	
		Z	0.0	0.0	1.0		171.7	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	6.00	69.5	14.2	10.00	42.1	±0.9 %
		Y	7.03	71.8	15.0		40.3	
		Z	3.33	64.6	12.1		44.6	
10011-CAA	UMTS-FDD (WCDMA)	X	3.26	66.2	17.8	2.91	117.6	±0.9 %
		Y	3.38	66.8	18.2		113.0	
		Z	2.79	62.4	14.7		133.2	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.77	66.8	17.4	1.87	117.4	±0.7 %
		Y	3.22	69.6	18.8		113.5	
		Z	2.22	62.0	13.8		135.2	
10021-DAA	GSM-FDD (TDMA, GMSK)	X	3.61	69.7	16.6	9.39	91.2	±1.7 %
		Y	5.48	77.1	19.6		125.1	
		Z	2.18	62.5	12.6		75.3	
10023-DAA	GPRS-FDD (TDMA, GMSK, TN 0)	X	3.01	66.4	14.9	9.57	86.1	±2.7 %
		Y	7.02	82.0	22.0		120.5	
		Z	2.13	62.9	12.7		71.4	
10024-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	18.01	91.8	22.6	6.56	132.3	±1.7 %
		Y	8.55	83.0	19.9		134.3	
		Z	4.04	72.4	15.7		139.6	
10027-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	4.70	74.7	15.9	4.80	107.5	±1.7 %
		Y	4.94	76.1	16.4		107.8	
		Z	2.97	68.7	12.8		127.1	
10028-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	67.89	99.9	21.4	3.55	114.7	±2.7 %
		Y	48.02	99.7	21.9		116.6	
		Z	1.36	61.4	7.8		134.4	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	97.41	97.0	17.7	1.16	129.2	±3.0 %
		Y	71.47	99.8	19.3		130.9	
		Z	0.29	53.5	0.9		109.2	
10039-CAA	CDMA2000 (1xRTT, RC1)	X	4.62	65.4	18.0	4.57	113.0	±1.7 %
		Y	4.74	66.1	18.4		111.5	
		Z	4.22	63.3	15.9		133.6	
10062-CAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.10	67.8	20.8	8.68	108.0	±2.7 %
		Y	10.07	68.1	21.1		108.1	
		Z	10.03	67.6	20.2		130.3	

10098-CAA	UMTS-FDD (HSUPA, Subtest 2)	X	4.53	65.7	17.8	3.98	122.5	±0.9 %
		Y	4.72	66.6	18.4		123.1	
		Z	4.38	64.5	16.7		147.3	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.32	66.5	18.8	5.67	126.9	±1.2 %
		Y	6.50	67.2	19.4		128.9	
		Z	5.80	64.3	17.3		107.2	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.22	66.1	18.8	5.80	124.2	±1.7 %
		Y	6.39	66.9	19.4		126.7	
		Z	6.10	65.2	17.7		149.4	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.94	65.8	18.7	5.75	121.3	±1.7 %
		Y	6.05	66.3	19.1		123.1	
		Z	5.80	65.0	17.7		144.5	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.01	67.7	20.3	8.10	113.9	±2.5 %
		Y	10.16	68.3	20.8		117.0	
		Z	9.96	67.5	19.8		135.3	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.07	67.9	20.4	8.07	115.2	±2.5 %
		Y	10.16	68.2	20.7		118.4	
		Z	10.02	67.7	19.9		138.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.89	68.4	21.8	9.28	108.1	±1.9 %
		Y	8.15	69.7	22.8		109.4	
		Z	7.38	66.5	20.4		123.2	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.94	65.7	18.6	5.75	122.1	±1.7 %
		Y	6.03	66.3	19.0		122.5	
		Z	5.79	65.0	17.7		144.0	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.38	66.3	18.9	5.82	126.0	±1.7 %
		Y	6.54	67.0	19.4		128.2	
		Z	6.16	65.3	17.8		146.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.17	66.5	19.2	5.73	149.7	±1.2 %
		Y	4.95	65.8	19.0		108.3	
		Z	4.64	63.9	17.1		125.3	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	6.79	70.4	23.0	9.21	120.6	±3.0 %
		Y	6.96	72.0	24.2		122.8	
		Z	6.43	69.3	22.0		136.7	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.15	66.4	19.1	5.72	143.0	±1.4 %
		Y	5.23	67.1	19.6		145.8	
		Z	4.60	63.7	17.0		121.1	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.11	66.2	19.0	5.72	141.0	±1.4 %
		Y	5.27	67.3	19.7		144.9	
		Z	4.54	63.4	16.8		119.2	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.57	67.1	20.1	8.09	102.2	±2.2 %
		Y	9.59	67.4	20.4		105.3	
		Z	9.73	67.6	20.0		129.6	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.61	67.3	20.2	8.10	104.6	±2.5 %
		Y	9.63	67.6	20.5		107.8	
		Z	9.63	67.3	19.8		130.9	

10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.61	67.5	20.3	8.03	109.2	±2.7 %
		Y	9.54	67.5	20.4		107.4	
		Z	9.53	67.2	19.7		130.7	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.00	67.8	20.4	8.06	114.1	±2.7 %
		Y	10.01	68.0	20.6		112.3	
		Z	9.96	67.6	19.9		137.1	
10225-CAA	UMTS-FDD (HSPA+)	X	7.18	66.9	19.2	5.97	137.5	±1.4 %
		Y	7.25	67.4	19.5		134.4	
		Z	6.48	64.4	17.3		114.6	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	6.93	71.0	23.5	9.21	123.5	±3.0 %
		Y	6.88	71.6	24.0		119.3	
		Z	6.63	70.1	22.4		141.3	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	8.19	70.5	23.1	9.24	142.9	±2.5 %
		Y	8.46	72.0	24.2		143.3	
		Z	7.10	67.0	20.8		119.9	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	7.83	68.1	21.6	9.30	104.2	±2.2 %
		Y	8.07	69.4	22.7		103.0	
		Z	7.49	67.2	20.9		125.2	
10274-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.96	66.2	18.3	4.87	128.1	±1.7 %
		Y	6.12	67.0	18.8		126.0	
		Z	5.31	63.8	16.4		110.2	
10275-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.30	65.5	17.8	3.96	110.5	±1.2 %
		Y	4.47	66.4	18.4		110.3	
		Z	3.92	63.1	15.6		135.7	
10291-AAA	CDMA2000, RC3, SO55, Full Rate	X	3.59	65.7	17.7	3.46	138.1	±1.2 %
		Y	3.85	67.2	18.6		146.7	
		Z	3.08	61.7	14.7		123.3	
10292-AAA	CDMA2000, RC3, SO32, Full Rate	X	3.59	66.0	17.8	3.39	144.2	±0.9 %
		Y	3.83	67.5	18.7		148.4	
		Z	3.18	63.1	15.7		128.6	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.13	65.8	18.7	5.81	116.5	±1.7 %
		Y	6.30	66.6	19.2		119.4	
		Z	6.20	65.9	18.4		145.6	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.70	66.4	19.0	6.06	122.5	±1.4 %
		Y	6.92	67.3	19.6		124.5	
		Z	6.28	65.0	17.9		103.7	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.66	66.7	17.4	1.71	109.5	±0.7 %
		Y	3.18	70.0	19.2		111.5	
		Z	2.08	61.6	13.4		134.4	
10317-AAA	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	9.78	67.4	20.4	8.36	103.5	±2.5 %
		Y	9.81	67.7	20.7		107.1	
		Z	9.86	67.6	20.3		129.5	
10400-AAA	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	9.86	67.5	20.4	8.37	104.9	±2.7 %
		Y	9.93	67.9	20.8		107.9	
		Z	9.97	67.7	20.2		134.3	

10402-AAA	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	10.47	67.9	20.5	8.53	109.9	±3.0 %
		Y	10.86	68.8	21.1		116.0	
		Z	10.68	68.2	20.4		142.5	
10403-AAA	CDMA2000 (1xEV-DO, Rev. 0)	X	4.74	67.0	17.9	3.76	114.9	±0.9 %
		Y	5.02	68.5	18.7		116.6	
		Z	4.23	64.4	15.8		145.1	
10404-AAA	CDMA2000 (1xEV-DO, Rev. A)	X	4.71	67.1	17.9	3.77	112.3	±1.4 %
		Y	4.95	68.5	18.7		115.0	
		Z	4.01	63.4	15.1		138.9	

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 8 and 9).
[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 [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	8.86	8.86	8.86	0.80	0.62	± 12.0 %
835	41.5	0.90	8.49	8.49	8.49	0.45	0.82	± 12.0 %
1750	40.1	1.37	7.31	7.31	7.31	0.80	0.60	± 12.0 %
1900	40.0	1.40	7.05	7.05	7.05	0.52	0.73	± 12.0 %
2450	39.2	1.80	6.45	6.45	6.45	0.29	1.08	± 12.0 %
2600	39.0	1.96	6.24	6.24	6.24	0.76	0.62	± 12.0 %
5200	36.0	4.66	4.78	4.78	4.78	0.30	1.80	± 13.1 %
5300	35.9	4.76	4.58	4.58	4.58	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.44	4.44	4.44	0.31	1.80	± 13.1 %
5600	35.5	5.07	4.20	4.20	4.20	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.39	4.39	4.39	0.32	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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

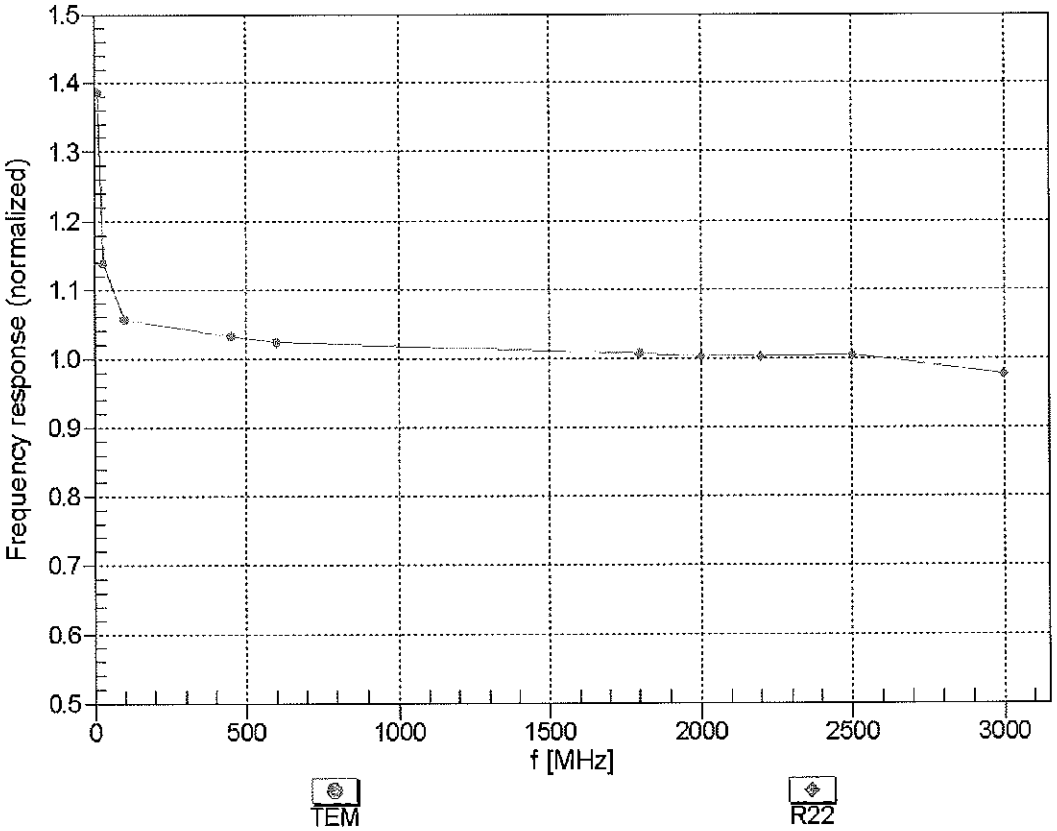
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	8.34	8.34	8.34	0.66	0.72	± 12.0 %
835	55.2	0.97	8.29	8.29	8.29	0.31	1.11	± 12.0 %
1750	53.4	1.49	6.68	6.68	6.68	0.80	0.61	± 12.0 %
1900	53.3	1.52	6.54	6.54	6.54	0.72	0.64	± 12.0 %
2450	52.7	1.95	6.26	6.26	6.26	0.80	0.57	± 12.0 %
2600	52.5	2.16	6.08	6.08	6.08	0.68	0.50	± 12.0 %
5200	49.0	5.30	4.19	4.19	4.19	0.38	1.90	± 13.1 %
5300	48.9	5.42	3.98	3.98	3.98	0.38	1.90	± 13.1 %
5500	48.6	5.65	3.76	3.76	3.76	0.42	1.90	± 13.1 %
5600	48.5	5.77	3.81	3.81	3.81	0.30	1.90	± 13.1 %
5800	48.2	6.00	3.97	3.97	3.97	0.43	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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

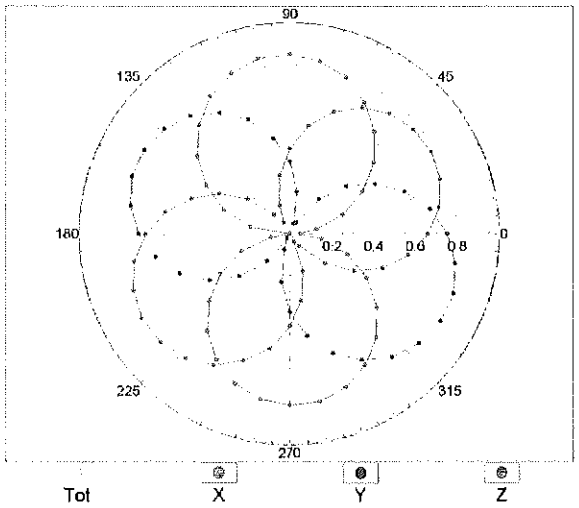
(TEM-Cell:ifi110 EXX, Waveguide: R22)



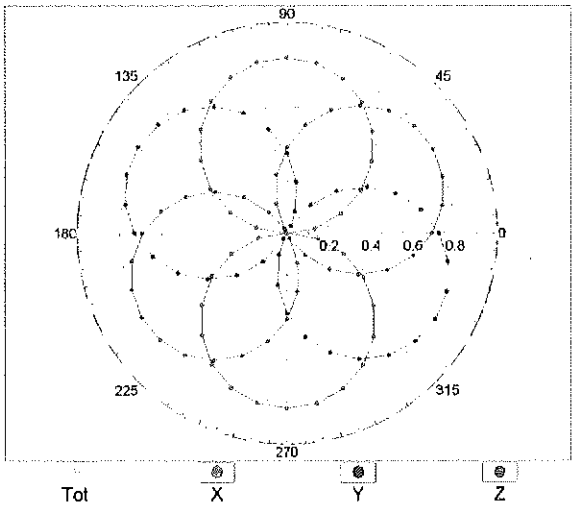
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

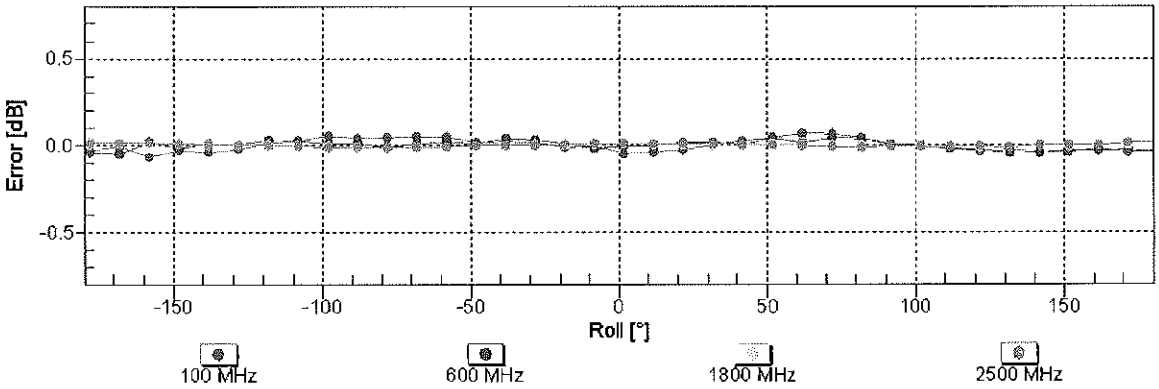
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



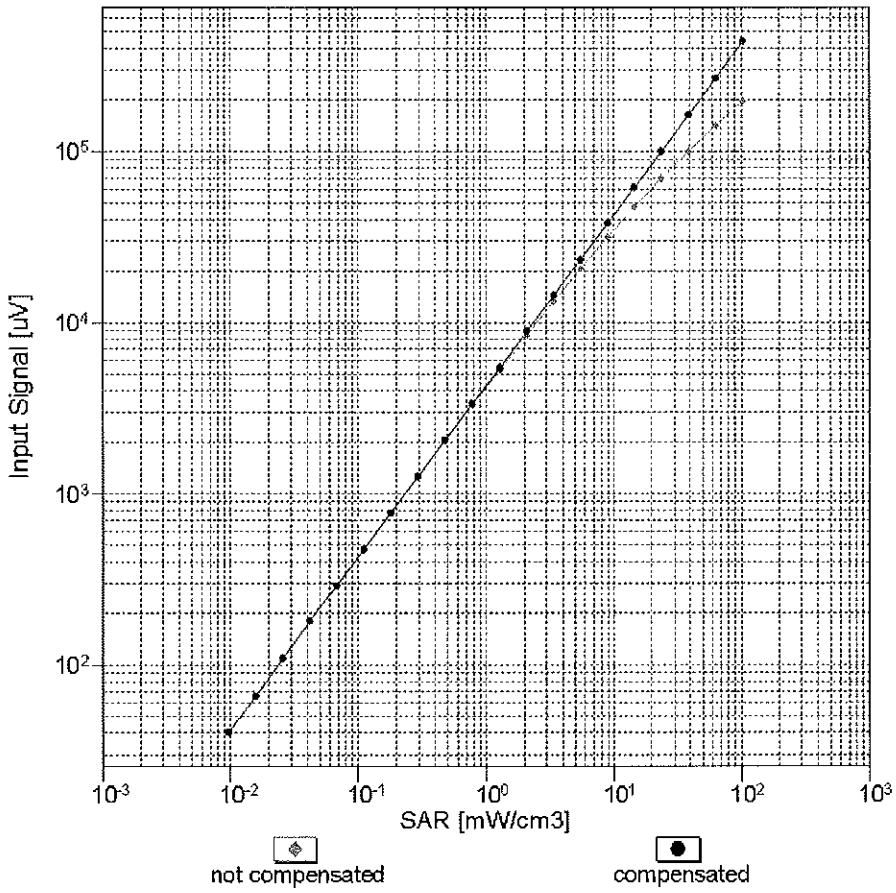
f=1800 MHz,R22

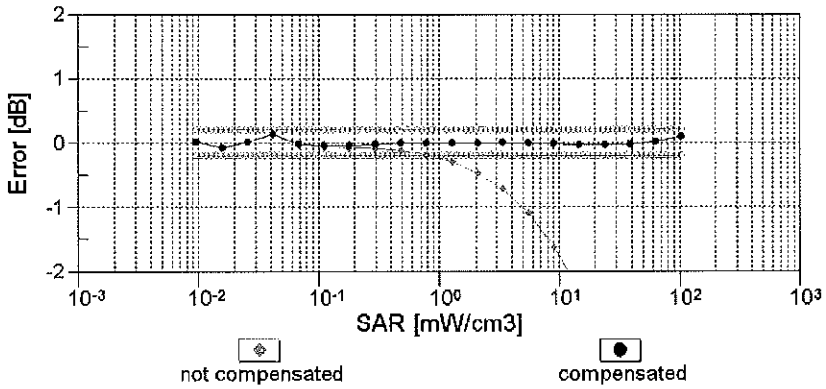




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

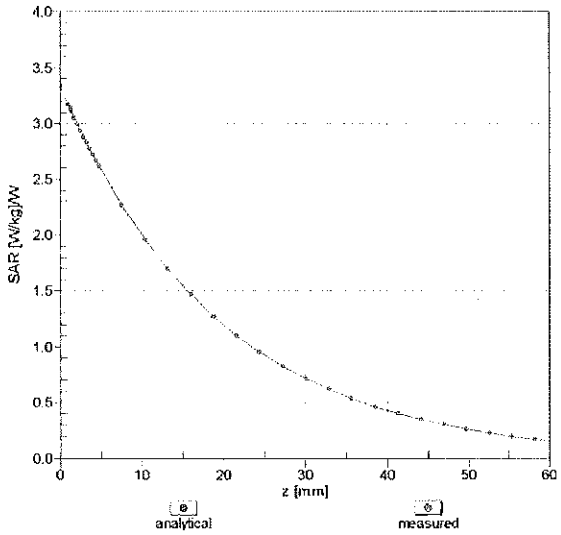




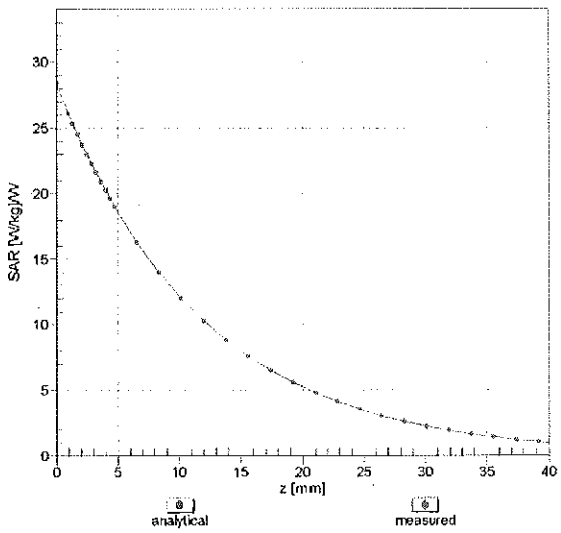
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

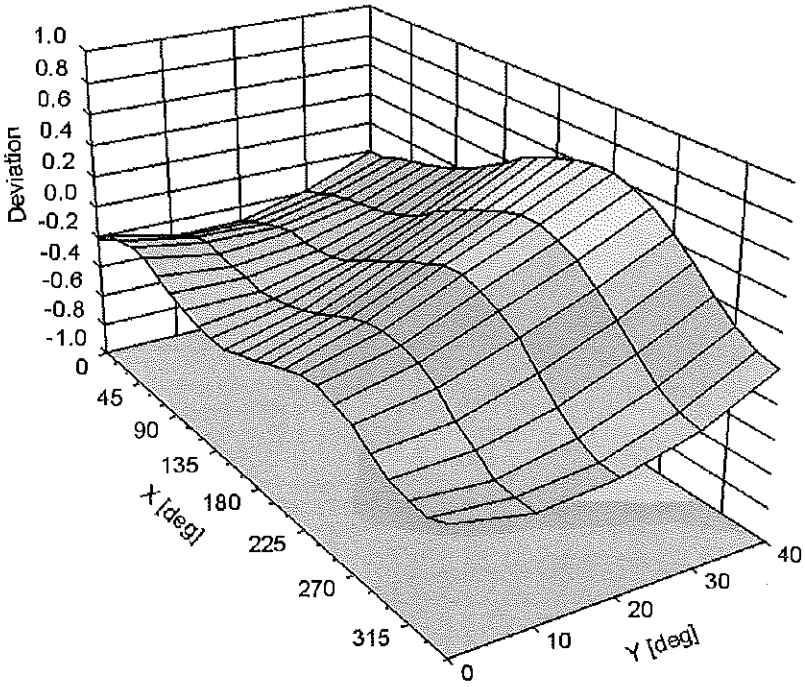


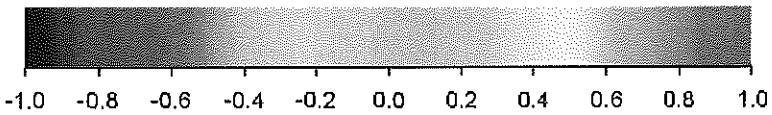
f = 1900 MHz,WGLS R22 (H_convF)



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:3589

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-38.2
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
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: EX3-3920_Dec13

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3920
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	December 18, 2013

JCC 1/12/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: December 19, 2013

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

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
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3920

Manufactured: December 18, 2012
Calibrated: December 18, 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	0.49	± 10.1 %
DCP (mV)[B]	102.9	99.5	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	182.5	±2.7 %
		Y	0.0	0.0	1.0		164.9	
		Z	0.0	0.0	1.0		153.0	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	0.76	53.8	6.5	10.00	44.1	±2.2 %
		Y	2.33	62.8	11.4		43.7	
		Z	1.15	55.6	7.5		53.0	
10011-CAA	UMTS-FDD (WCDMA)	X	3.36	66.5	17.5	2.91	142.4	±0.5 %
		Y	3.15	65.0	16.7		131.4	
		Z	3.26	66.0	17.7		121.6	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.69	66.4	16.9	1.87	138.1	±0.5 %
		Y	2.56	65.1	16.2		130.7	
		Z	2.72	66.6	17.2		121.4	
10021-DAA	GSM-FDD (TDMA, GMSK)	X	2.06	63.4	11.7	9.39	99.7	±1.9 %
		Y	2.43	66.1	14.1		94.7	
		Z	2.90	69.9	16.1		121.8	
10023-DAA	GPRS-FDD (TDMA, GMSK, TN 0)	X	1.94	62.4	11.3	9.57	95.1	±1.9 %
		Y	2.31	64.8	13.1		90.1	
		Z	2.98	70.4	16.4		117.0	
10024-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	2.19	67.1	12.2	6.56	140.1	±1.4 %
		Y	2.35	67.0	12.9		134.0	
		Z	3.45	73.5	16.1		131.4	
10027-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	1.18	61.7	8.5	4.80	121.6	±1.2 %
		Y	1.57	63.4	10.0		116.0	
		Z	1.57	65.5	11.9		109.2	
10028-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	3.80	74.5	13.3	3.55	130.3	±0.9 %
		Y	1.00	60.5	8.0		123.9	
		Z	1.58	66.1	11.1		119.0	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	0.18	55.2	3.4	1.16	111.6	±0.7 %
		Y	0.34	57.4	4.4		143.6	
		Z	0.40	59.2	5.7		136.6	
10039-CAA	CDMA2000 (1xRTT, RC1)	X	4.49	65.9	18.1	4.57	131.8	±0.9 %
		Y	4.57	65.1	17.5		123.0	
		Z	4.66	65.9	18.3		118.6	
10062-CAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.09	68.6	21.3	8.68	126.5	±2.5 %
		Y	10.31	68.5	21.1		121.9	
		Z	10.12	68.3	21.3		115.8	

10098-CAA	UMTS-FDD (HSUPA, Subtest 2)	X	4.64	66.6	18.1	3.98	144.6	±0.7 %
		Y	4.54	65.4	17.4		133.9	
		Z	4.60	66.1	18.0		128.0	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.00	65.5	18.3	5.67	104.2	±1.4 %
		Y	6.44	66.7	18.8		138.2	
		Z	6.54	67.4	19.4		134.7	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.37	67.0	19.2	5.80	149.0	±1.4 %
		Y	6.40	66.6	18.9		141.2	
		Z	6.40	66.9	19.4		132.1	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.96	66.3	18.9	5.75	142.3	±1.4 %
		Y	6.05	66.1	18.7		136.6	
		Z	6.03	66.3	19.1		128.2	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.28	68.7	20.9	8.10	137.3	±2.5 %
		Y	10.32	68.5	20.7		131.3	
		Z	10.24	68.5	20.9		124.5	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.29	68.8	20.9	8.07	138.5	±2.5 %
		Y	10.34	68.6	20.8		131.9	
		Z	10.26	68.5	20.9		125.5	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.20	67.5	21.6	9.28	118.6	±2.2 %
		Y	7.59	67.9	21.6		116.7	
		Z	7.78	69.2	22.7		110.7	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.98	66.4	18.9	5.75	142.7	±1.2 %
		Y	5.97	65.7	18.4		132.7	
		Z	6.06	66.4	19.1		128.6	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.41	66.8	19.1	5.82	147.7	±1.4 %
		Y	6.48	66.5	18.8		137.3	
		Z	6.53	67.0	19.4		134.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.59	65.5	18.6	5.73	120.3	±1.2 %
		Y	4.76	65.0	18.2		113.9	
		Z	4.82	65.6	18.9		112.0	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.77	69.3	22.7	9.21	128.1	±1.9 %
		Y	6.15	69.3	22.6		123.8	
		Z	6.22	70.3	23.6		120.8	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.62	65.6	18.7	5.72	120.2	±0.9 %
		Y	4.75	65.0	18.2		113.5	
		Z	4.80	65.6	18.8		110.7	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.57	65.4	18.6	5.72	118.9	±0.9 %
		Y	4.72	64.8	18.1		113.1	
		Z	4.81	65.6	18.8		110.4	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.77	68.3	20.8	8.09	128.1	±2.5 %
		Y	9.84	67.9	20.5		117.1	
		Z	9.80	68.1	20.8		116.6	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.78	68.4	20.8	8.10	128.4	±2.5 %
		Y	9.86	68.0	20.5		120.3	
		Z	9.82	68.1	20.9		119.1	

10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.70	68.4	20.8	8.03	128.0	±2.5 %
		Y	9.79	68.0	20.5		119.6	
		Z	9.72	68.1	20.8		118.7	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.27	68.8	20.9	8.06	137.0	±2.5 %
		Y	10.18	68.3	20.6		125.2	
		Z	10.20	68.5	20.9		124.8	
10225-CAA	UMTS-FDD (HSPA+)	X	6.64	66.1	18.7	5.97	108.8	±1.4 %
		Y	7.23	67.1	19.1		148.9	
		Z	7.31	67.7	19.7		146.5	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.82	69.6	23.0	9.21	130.2	±1.9 %
		Y	6.14	69.2	22.6		123.9	
		Z	6.25	70.4	23.7		122.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.85	67.5	21.7	9.24	112.9	±2.2 %
		Y	7.54	69.0	22.4		149.2	
		Z	7.80	70.6	23.7		147.3	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	7.23	67.6	21.6	9.30	118.3	±2.2 %
		Y	7.55	67.7	21.5		111.5	
		Z	7.79	69.2	22.7		109.6	
10274-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.64	65.9	18.1	4.87	105.5	±1.2 %
		Y	6.04	66.4	18.2		142.6	
		Z	6.09	66.9	18.7		138.4	
10275-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.42	66.3	18.1	3.96	135.8	±0.7 %
		Y	4.26	65.0	17.3		119.3	
		Z	4.40	65.9	18.0		120.4	
10291-AAA	CDMA2000, RC3, SO55, Full Rate	X	3.62	66.7	18.1	3.46	123.6	±0.7 %
		Y	3.38	64.3	16.7		112.5	
		Z	3.59	66.0	17.9		114.3	
10292-AAA	CDMA2000, RC3, SO32, Full Rate	X	3.46	66.0	17.7	3.39	127.3	±0.5 %
		Y	3.35	64.5	16.8		113.7	
		Z	3.50	65.7	17.7		115.4	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.35	66.9	19.2	5.81	145.7	±1.2 %
		Y	6.26	66.1	18.7		129.2	
		Z	6.42	67.0	19.4		131.3	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.45	65.9	18.7	6.06	103.7	±1.7 %
		Y	6.90	66.9	19.1		137.2	
		Z	7.04	67.7	19.8		137.5	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.85	67.8	17.7	1.71	135.6	±0.5 %
		Y	2.45	64.7	16.0		121.4	
		Z	2.75	67.3	17.6		122.1	
10317-AAA	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	9.93	68.5	21.0	8.36	128.1	±2.7 %
		Y	10.02	68.1	20.7		117.9	
		Z	10.01	68.3	21.1		119.4	
10400-AAA	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.09	68.8	21.2	8.37	134.9	±2.5 %
		Y	10.16	68.3	20.8		119.8	
		Z	10.14	68.5	21.2		121.0	

10402-AAA	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	11.18	69.8	21.5	8.53	147.1	±2.7 %
		Y	10.79	68.6	20.8		126.5	
		Z	11.17	69.6	21.6		131.4	
10403-AAA	CDMA2000 (1xEV-DO, Rev. 0)	X	4.83	69.6	18.9	3.76	139.6	±0.5 %
		Y	4.70	67.1	17.6		128.1	
		Z	4.90	68.4	18.6		127.8	
10404-AAA	CDMA2000 (1xEV-DO, Rev. A)	X	4.73	69.5	18.9	3.77	134.8	±0.5 %
		Y	4.62	67.1	17.7		124.9	
		Z	4.67	67.7	18.1		125.9	

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 8 and 9).
[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 [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	10.05	10.05	10.05	0.27	1.13	± 12.0 %
835	41.5	0.90	9.69	9.69	9.69	0.50	0.76	± 12.0 %
1750	40.1	1.37	7.91	7.91	7.91	0.72	0.62	± 12.0 %
1900	40.0	1.40	7.70	7.70	7.70	0.77	0.61	± 12.0 %
2450	39.2	1.80	6.98	6.98	6.98	0.37	0.86	± 12.0 %
2600	39.0	1.96	6.74	6.74	6.74	0.34	0.97	± 12.0 %
5200	36.0	4.66	4.87	4.87	4.87	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.66	4.66	4.66	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.54	4.54	4.54	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.37	4.37	4.37	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.11	4.11	4.11	0.50	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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

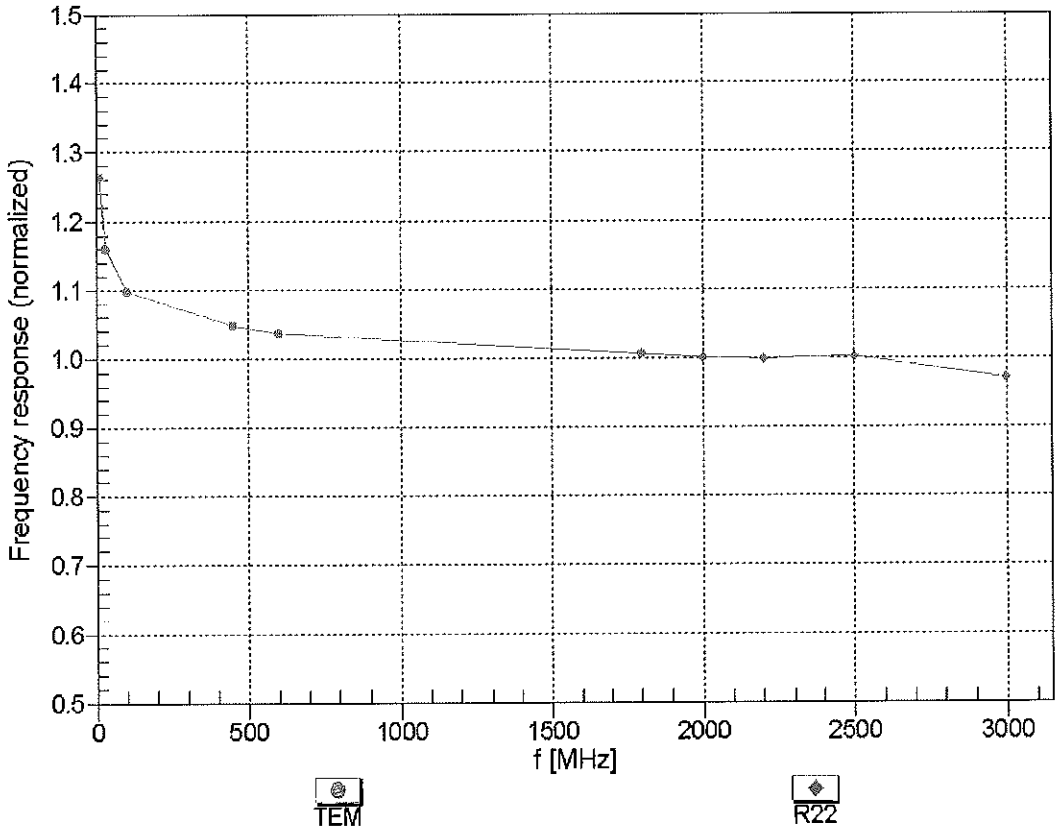
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	9.54	9.54	9.54	0.32	1.07	± 12.0 %
835	55.2	0.97	9.47	9.47	9.47	0.45	0.85	± 12.0 %
1750	53.4	1.49	7.77	7.77	7.77	0.59	0.74	± 12.0 %
1900	53.3	1.52	7.50	7.50	7.50	0.37	0.91	± 12.0 %
2450	52.7	1.95	7.18	7.18	7.18	0.80	0.56	± 12.0 %
2600	52.5	2.16	6.91	6.91	6.91	0.80	0.57	± 12.0 %
5200	49.0	5.30	4.23	4.23	4.23	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.11	4.11	4.11	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.80	3.80	3.80	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.62	3.62	3.62	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.00	4.00	4.00	0.50	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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

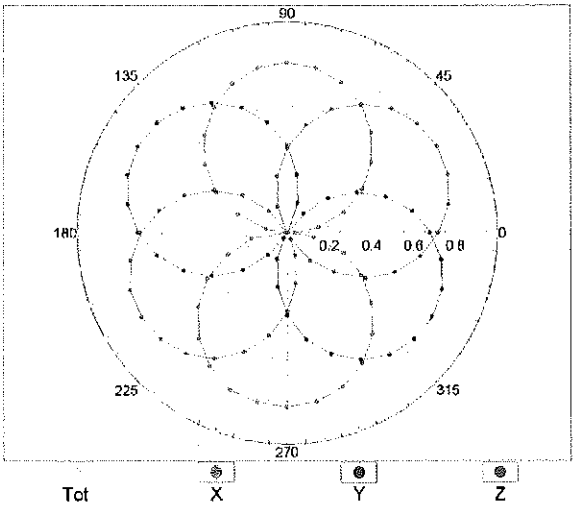
(TEM-Cell:ifi110 EXX, Waveguide: R22)



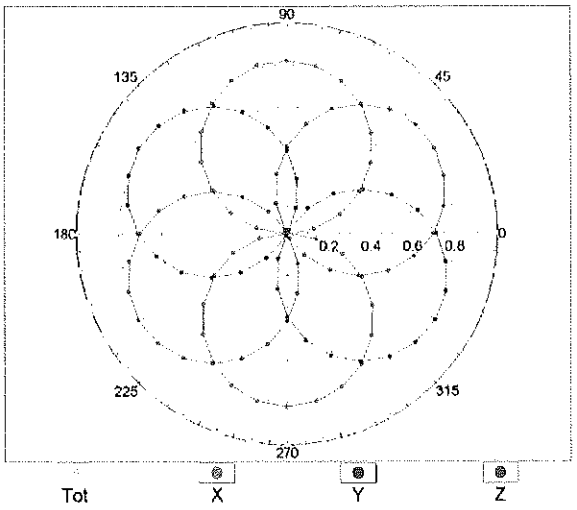
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

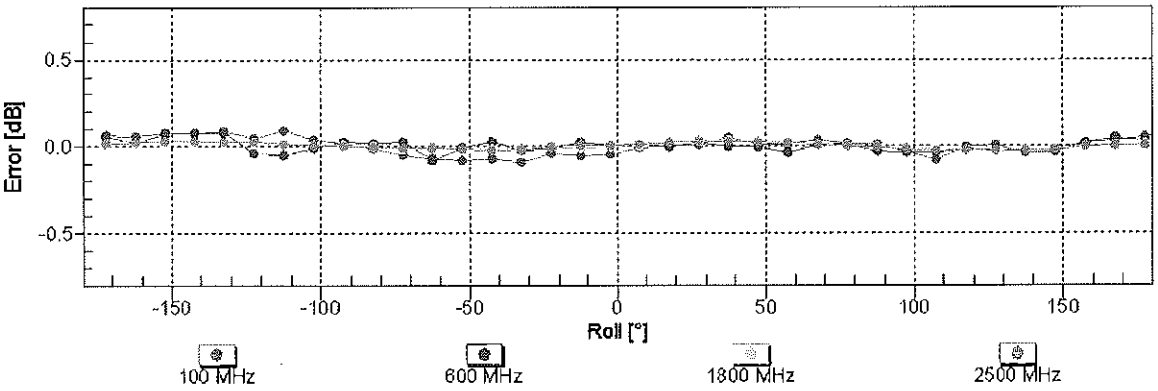
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



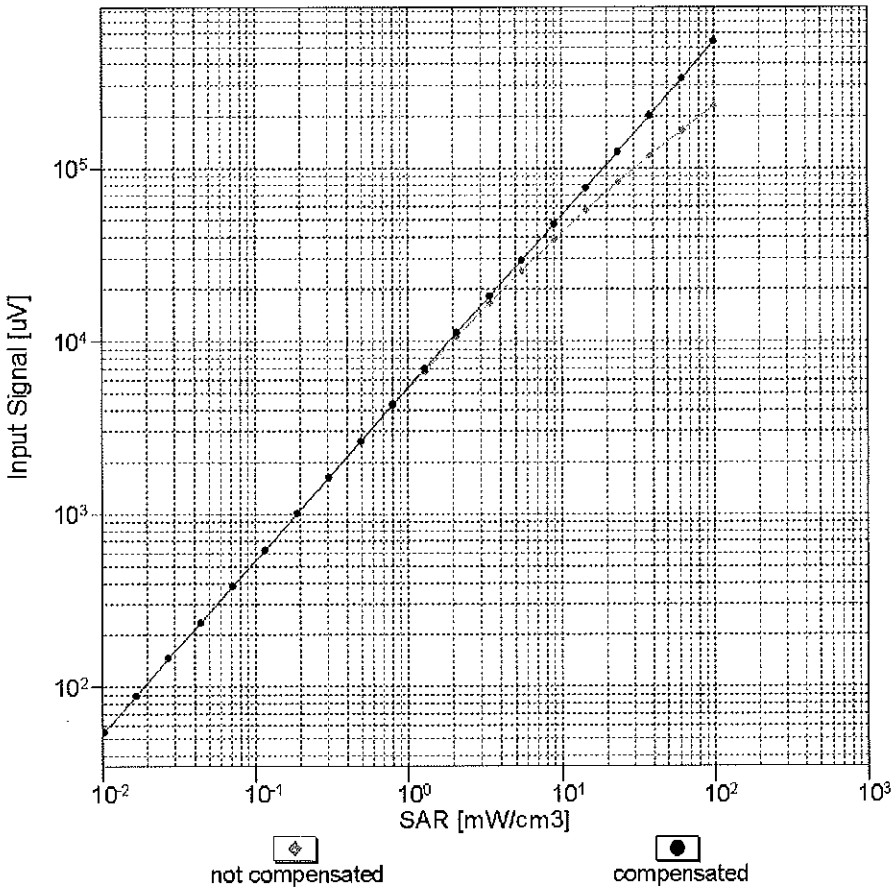
f=1800 MHz,R22

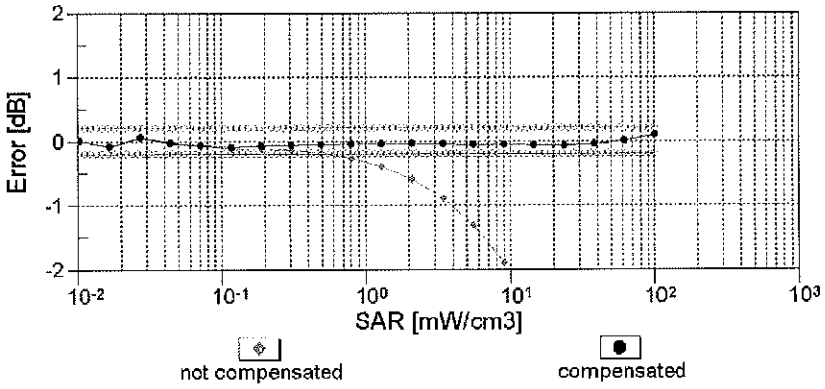




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

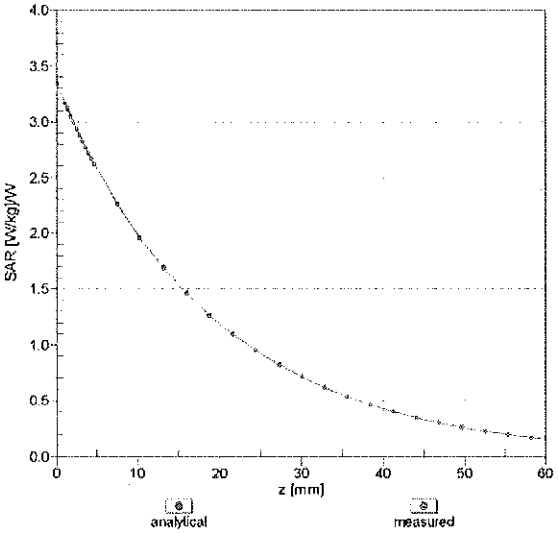




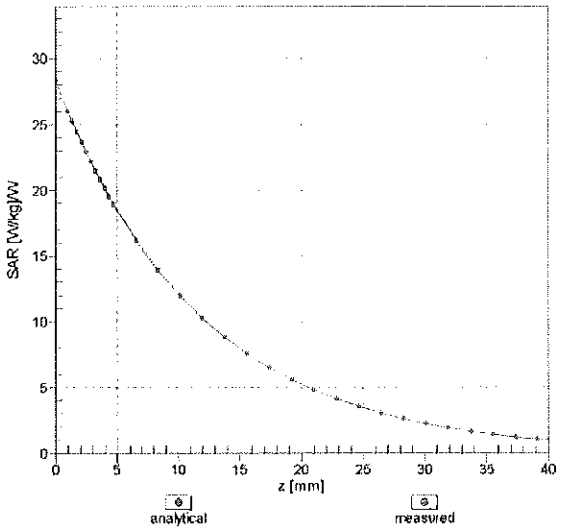
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

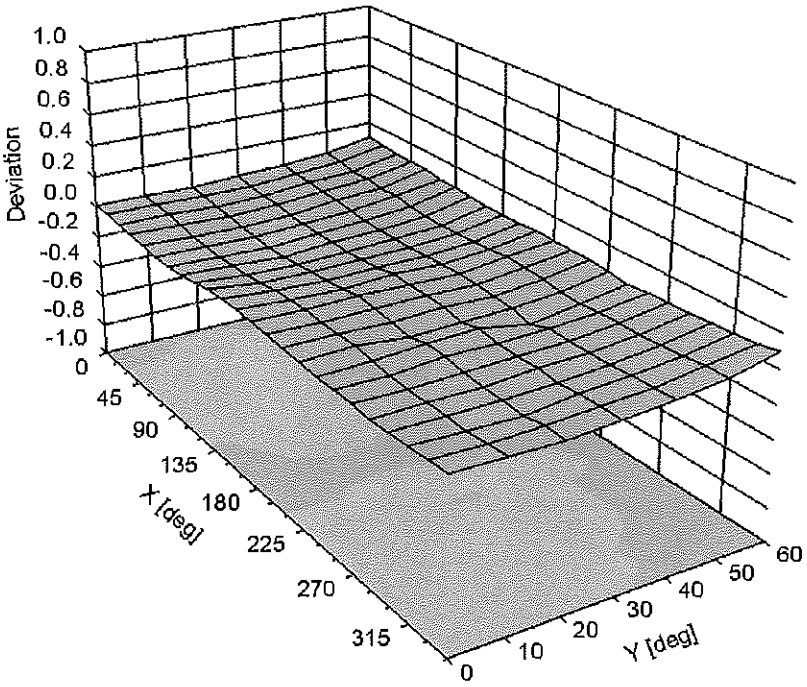


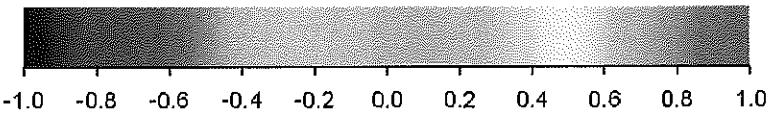
f = 1900 MHz,WGLS R22 (H_convF)



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 (°)	-22.4
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 $\varepsilon_r^{'}$ 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)	835	835	1900	1900	2450	2450	5200-5800	5200-5800
Tissue	Head	Body	Head	Body	Head	Body	Head	Body
Ingredients (% by weight)								
Bactericide	0.1	0.1			See Page 2		See Page 3	
DGBE			44.92	29.44		26.7		
HEC	1	1						
NaCl	1.45	0.94	0.18	0.39		0.1		
Sucrose	57	44.9						
Polysorbate (Tween) 80								20
Water	40.45	53.06	54.9	70.17		73.2		80

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2 Composition / Information on ingredients

The Item is composed of the following ingredients:

H2O	Water, 52 – 75%
C8H18O3	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-1
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 (HSL2450V2)**
Product No.	SL AAH 245 BA (Charge: 130212-2)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within ± 2.5% towards the target values of Methanol.

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

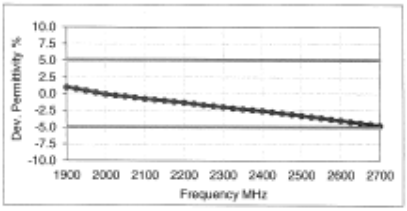
Test Condition

Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	23°C
Test Date	13-Feb-13
Operator	DI

Additional Information

TSL Density	0.988 g/cm^3
TSL Heat-capacity	3.680 kJ/(kg*K)

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e"	sigma	eps	sigma	Δ-eps	Δ-sigma
1900	40.4	11.94	1.26	40.0	1.40	1.0	-9.9
1925	40.3	12.02	1.29	40.0	1.40	0.7	-8.0
1950	40.2	12.11	1.31	40.0	1.40	0.5	-6.2
1975	40.1	12.20	1.34	40.0	1.40	0.2	-4.2
2000	40.0	12.29	1.37	40.0	1.40	-0.1	-2.3
2025	39.9	12.39	1.40	40.0	1.42	-0.2	-1.9
2050	39.8	12.49	1.42	39.9	1.44	-0.4	-1.4
2075	39.6	12.57	1.45	39.9	1.47	-0.6	-1.1
2100	39.5	12.65	1.48	39.8	1.49	-0.7	-0.7
2125	39.4	12.74	1.51	39.8	1.51	-0.9	-0.4
2150	39.3	12.82	1.53	39.7	1.53	-1.0	0.0
2175	39.2	12.89	1.56	39.7	1.56	-1.2	0.3
2200	39.1	12.97	1.59	39.6	1.58	-1.3	0.6
2225	39.0	13.04	1.61	39.6	1.60	-1.5	0.9
2250	38.9	13.11	1.64	39.6	1.62	-1.7	1.2
2275	38.8	13.20	1.67	39.5	1.64	-1.8	1.6
2300	**38.7**	**13.28**	**1.70**	**39.5**	**1.67**	**-2.0**	**2.0**
2325	38.6	13.35	1.73	39.4	1.69	-2.1	2.3
2350	38.5	13.42	1.75	39.4	1.71	-2.3	2.6
2375	38.4	13.50	1.78	39.3	1.73	-2.4	2.9
2400	38.3	13.58	1.81	39.3	1.76	-2.6	3.3
2425	38.2	13.65	1.84	39.2	1.78	-2.7	3.6
2450	**38.1**	**13.73**	**1.87**	**39.2**	**1.80**	**-2.9**	**4.0**
2475	38.0	13.79	1.90	39.2	1.83	-3.1	3.9
2500	37.9	13.85	1.93	39.1	1.85	-3.3	3.9
2525	37.8	13.94	1.96	39.1	1.88	-3.4	4.0
2550	37.7	14.02	1.99	39.1	1.91	-3.6	4.2
2575	37.6	14.09	2.02	39.0	1.94	-3.8	4.3
2600	**37.5**	**14.17**	**2.05**	**39.0**	**1.96**	**-4.0**	**4.4**
2625	37.4	14.23	2.08	39.0	1.99	-4.2	4.4
2650	37.3	14.29	2.11	38.9	2.02	-4.3	4.4
2675	37.1	14.36	2.14	38.9	2.05	-4.5	4.5
2700	37.0	14.43	2.17	38.9	2.07	-4.8	4.6



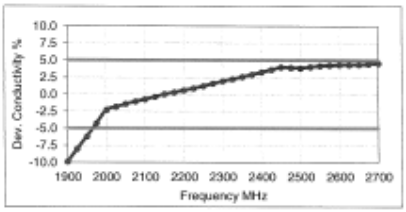


Figure D-2
2.4 GHz Head Tissue Equivalent Matter

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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-3
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

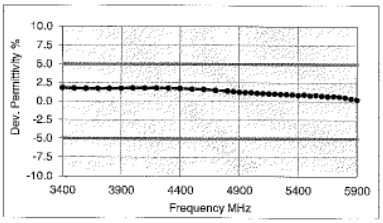
Ambient Condition	22°C ; 30% humidity
TSL Temperature	22°C
Test Date	4-Apr-12

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	-2.8
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



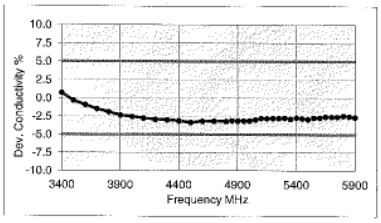


Figure D-4
5GHz Head Tissue Equivalent Matter

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APPENDIX E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01, 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 FCC KDB 865664 D01 v01 and IEEE 1528-2013. 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_i)	SENSI-TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
G	835	3/10/2014	3258	ES3DV3	835	Head	0.914	41.20	PASS	PASS	PASS	GMSK	PASS	N/A
G	1900	3/7/2014	3258	ES3DV3	1900	Head	1.448	40.49	PASS	PASS	PASS	GMSK	PASS	N/A
E	2450	12/23/2013	3914	EX3DV4	2450	Head	1.790	38.86	PASS	PASS	PASS	OFDM	N/A	PASS
E	5200	12/3/2013	3914	EX3DV4	5200	Head	4.482	34.70	PASS	PASS	PASS	OFDM	N/A	PASS
E	5300	12/3/2013	3914	EX3DV4	5300	Head	4.604	34.60	PASS	PASS	PASS	OFDM	N/A	PASS
E	5600	12/3/2013	3914	EX3DV4	5600	Head	4.907	34.13	PASS	PASS	PASS	OFDM	N/A	PASS
E	5800	12/3/2013	3914	EX3DV4	5800	Head	5.133	33.89	PASS	PASS	PASS	OFDM	N/A	PASS
K	835	12/19/2013	3333	ES3DV3	835	Body	1.006	53.18	PASS	PASS	PASS	GMSK	PASS	N/A
D	1900	9/10/2013	3022	ES3DV2	1900	Body	1.516	52.49	PASS	PASS	PASS	GMSK	PASS	N/A
H	1900	3/17/2014	3589	EX3DV4	1900	Body	1.577	52.62	PASS	PASS	PASS	GMSK	PASS	N/A
H	2450	3/10/2014	3589	EX3DV4	2450	Body	1.998	51.24	PASS	PASS	PASS	OFDM	N/A	PASS
A	5200	1/13/2014	3920	EX3DV4	5200	Body	5.344	47.27	PASS	PASS	PASS	OFDM	N/A	PASS
A	5300	1/13/2014	3920	EX3DV4	5300	Body	5.500	46.91	PASS	PASS	PASS	OFDM	N/A	PASS
A	5500	1/13/2014	3920	EX3DV4	5500	Body	5.826	46.38	PASS	PASS	PASS	OFDM	N/A	PASS
A	5600	1/13/2014	3920	EX3DV4	5600	Body	5.991	46.16	PASS	PASS	PASS	OFDM	N/A	PASS
A	5800	1/23/2014	3920	EX3DV4	5800	Body	6.282	46.05	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both a CW and modulated signals, all measurements were performed using communication systems 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 D01v01 for scenarios when CW probe calibrations are used with other signal types. 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.

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APPENDIX G: SENSOR TRIGGERING DATA SUMMARY

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A3LSMT231 Sensor Triggering Data Summary

Per FCC KDB Publication 616217 D04v01, this device was tested by the manufacturer to determine the proximity sensor triggering distances for the back and top edge of the device. The measured output power within ± 5 mm of the triggering points (or until touching the phantom) is included for back side and each applicable edge.

To ensure all production units are compliant it is necessary to test SAR at a distance 1 mm less than the smallest distance from the device and SAR phantom (determined from these triggering tests according to the KDB 616217 D04v01) with the device at maximum output power without power reduction. These SAR Tests are included in addition to the SAR tests for the device touching the SAR phantom, with reduced power.

The operational description contains information explaining how this device remains compliant in the event of a sensor malfunction.

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Back Side

Moving device toward the phantom:

KDB 616217 6.2.6 Measured Power [dBm]											
Distance[mm]	20	19	18	17	16	15	14	13	12	11	10
GSM 850	33.34	33.23	33.18	33.44	33.39	25.19	25.34	25.14	25.43	25.27	25.16
GPRS 850 1Tx	33.19	33.39	33.22	33.26	33.19	25.34	25.32	25.1	25.34	25.27	25.35
GPRS 850 2Tx	30.79	30.61	30.61	30.87	30.61	24.41	24.43	24.44	24.42	24.42	24.32
GPRS 850 3Tx	28.66	28.73	28.95	28.79	28.72	22.72	22.86	22.73	22.65	22.74	22.91
GPRS 850 4Tx	26.79	26.69	26.77	26.63	26.74	21.39	21.1	21.44	21.23	21.38	21.32
GSM 1900	30.38	30.13	30.41	30.44	30.24	23.33	23.37	23.35	23.11	23.41	23.27
GPRS 1900 1Tx	30.3	30.39	30.14	30.19	30.35	19.63	19.85	19.84	19.72	19.64	19.93
GPRS 1900 2Tx	27.91	27.86	27.76	27.72	27.71	17.85	17.65	17.79	17.66	17.88	17.74
GPRS 1900 3Tx	25.67	25.9	25.61	25.71	25.74	16.4	16.16	16.18	16.15	16.29	16.28
GPRS 1900 4Tx	23.74	23.72	23.63	23.74	23.64	14.19	14.41	14.32	14.35	14.41	14.14
WCDMA 850	23.39	23.28	23.27	23.18	23.18	18.22	18.35	18.11	18.25	18.41	18.2
WCDMA 1900	23.14	23.39	23.33	23.43	23.3	12.2	12.37	12.45	12.38	12.24	12.17

Moving device away from the phantom:

KDB 616217 6.2.8 Measured Power [dBm]											
Distance[mm]	20	19	18	17	16	15	14	13	12	11	10
GSM 850	33.42	33.29	33.36	33.33	33.42	25.25	25.31	25.17	25.45	25.28	25.12
GPRS 850 1Tx	33.33	33.34	33.45	33.43	33.21	25.24	25.43	25.21	25.44	25.18	25.22
GPRS 850 2Tx	30.74	30.83	30.95	30.82	30.67	24.25	24.33	24.42	24.23	24.31	24.16
GPRS 850 3Tx	28.8	28.86	28.82	28.88	28.81	22.71	22.7	22.63	22.63	22.69	22.93
GPRS 850 4Tx	26.62	26.85	26.84	26.95	26.66	21.31	21.11	21.45	21.29	21.22	21.13
GSM 1900	30.19	30.26	30.28	30.28	30.11	23.23	23.32	23.24	23.29	23.41	23.14
GPRS 1900 1Tx	30.39	30.25	30.29	30.39	30.45	19.85	19.6	19.91	19.84	19.8	19.84
GPRS 1900 2Tx	27.76	27.6	27.93	27.78	27.69	17.88	17.94	17.73	17.63	17.95	17.9
GPRS 1900 3Tx	25.61	25.84	25.68	25.89	25.89	16.18	16.22	16.42	16.14	16.27	16.22
GPRS 1900 4Tx	23.64	23.74	23.85	23.79	23.93	14.4	14.33	14.24	14.41	14.35	14.41
WCDMA 850	23.11	23.31	23.31	23.35	23.27	18.17	18.15	18.27	18.13	18.32	18.21
WCDMA 1900	23.23	23.4	23.21	23.3	23.34	12.14	12.13	12.11	12.25	12.4	12.22

Based on the most conservative measured triggering distance of 15 mm, additional SAR measurements were required at 14 mm from the back side.

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Top Edge

Moving device toward the phantom:

KDB 616217 6.2.6 Measured Power [dBm]											
Distance[mm]	17	16	15	14	13	12	11	10	9	8	7
GSM 850	33.45	33.43	33.23	33.27	33.32	25.2	25.39	25.15	25.3	25.33	25.29
GPRS 850 1Tx	33.17	33.2	33.42	33.1	33.2	25.32	25.28	25.34	25.39	25.38	25.25
GPRS 850 2Tx	30.82	30.79	30.83	30.74	30.94	24.15	24.2	24.44	24.33	24.13	24.23
GPRS 850 3Tx	28.71	28.9	28.71	28.6	28.95	22.64	22.76	22.76	22.78	22.81	22.95
GPRS 850 4Tx	26.65	26.66	26.63	26.73	26.77	21.33	21.28	21.31	21.38	21.23	21.41
GSM 1900	30.28	30.15	30.35	30.45	30.15	23.31	23.17	23.41	23.41	23.44	23.13
GPRS 1900 1Tx	30.45	30.24	30.41	30.41	30.33	19.68	19.91	19.81	19.71	19.84	19.7
GPRS 1900 2Tx	27.72	27.72	27.93	27.67	27.66	17.88	17.82	17.88	17.81	17.9	17.87
GPRS 1900 3Tx	25.62	25.78	25.65	25.82	25.84	16.19	16.17	16.2	16.27	16.29	16.29
GPRS 1900 4Tx	23.86	23.78	23.8	23.6	23.83	14.36	14.29	14.27	14.3	14.36	14.12
WCDMA 850	23.18	23.23	23.23	23.1	23.27	18.3	18.26	18.37	18.26	18.15	18.25
WCDMA 1900	23.34	23.24	23.25	23.13	23.15	12.35	12.23	12.1	12.25	12.29	12.1

Moving device away from the phantom:

KDB 616217 6.2.8 Measured Power [dBm]											
Distance[mm]	17	16	15	14	13	12	11	10	9	8	7
GSM 850	33.45	33.2	33.15	33.26	33.11	25.17	25.14	25.37	25.1	25.33	25.32
GPRS 850 1Tx	33.43	33.21	33.24	33.43	33.12	25.3	25.41	25.37	25.37	25.27	25.23
GPRS 850 2Tx	30.79	30.69	30.83	30.73	30.77	24.43	24.26	24.23	24.4	24.43	24.34
GPRS 850 3Tx	28.91	28.79	28.76	28.64	28.89	22.8	22.84	22.75	22.89	22.82	22.93
GPRS 850 4Tx	26.8	26.72	26.86	26.88	26.74	21.14	21.45	21.45	21.44	21.24	21.26
GSM 1900	30.26	30.23	30.41	30.37	30.45	23.35	23.1	23.34	23.23	23.45	23.15
GPRS 1900 1Tx	30.44	30.4	30.18	30.45	30.43	19.78	19.95	19.88	19.62	19.78	19.9
GPRS 1900 2Tx	27.78	27.7	27.64	27.64	27.61	17.9	17.68	17.61	17.61	17.67	17.92
GPRS 1900 3Tx	25.67	25.79	25.63	25.61	25.93	16.16	16.4	16.31	16.28	16.26	16.41
GPRS 1900 4Tx	23.87	23.78	23.82	23.91	23.64	14.39	14.39	14.21	14.28	14.31	14.2
WCDMA 850	23.3	23.4	23.16	23.24	23.25	18.1	18.12	18.4	18.16	18.13	18.34
WCDMA 1900	23.11	23.2	23.24	23.27	23.31	12.27	12.21	12.28	12.1	12.42	12.34

Based on the most conservative measured triggering distance of 12 mm, additional SAR measurements were required at 11 mm from the top edge.

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