



SAR EVALUATION REPORT

Applicant Name:

Samsung Electronics, Co. Ltd.
416 Maetan 3-Dong, Yeongtong-gu
Suwon-si, Gyeonggi-do
443-742, Republic of Korea

Date of Testing:

12/27/12 - 01/08/13

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

0Y1212201834-R1.A3L

FCC ID:

A3LGTN5100

APPLICANT:

SAMSUNG ELECTRONICS, CO. LTD.

DUT Type:

Portable Tablet

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

GT-N5100

Equipment Class	Band & Mode	Tx Frequency	Measured Conducted Power [dBm]	SAR	
				1 gm Head (W/kg)	1 gm Body (W/kg)
PCE	GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	30.49	0.32	0.69
PCE	UMTS 850	826.40 - 846.60 MHz	23.05	0.24	0.61
PCE	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	29.91	0.53	1.07
PCE	UMTS 1900	1852.4 - 1907.6 MHz	22.50	0.78	0.96
DTS	2.4 GHz WLAN	2412 - 2462 MHz	16.21	< 0.1	< 0.1
DTS	5.8 GHz WLAN	5745 - 5825 MHz	8.67	0.23	0.93
DTS	Bluetooth LE	2402 - 2480 MHz	7.03	N/A	N/A
UNII	5.2 GHz WLAN	5180 - 5240 MHz	8.23	0.17	0.41
UNII	5.3 GHz WLAN	5260 - 5320 MHz	8.31	0.20	0.49
UNII	5.5 GHz WLAN	5500 - 5700 MHz	8.76	0.25	0.98
DSS	Bluetooth	2402 - 2480 MHz	11.25	N/A	< 0.1
Simultaneous SAR per KDB 690783 D01v01r02:				0.83	1.59

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

This revised Test Report (S/N: 0Y1212201834-R1.A3L) supersedes and replaces the previously issued test report on the same subject EUT for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 1.7 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 850	Voice/Data	824.20 - 848.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
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
Bluetooth LE	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

This device uses two proximity sensors for SAR compliance. One IR sensor is activated when the device is held to the ear in voice and data operations, while the capacitive grip sensor is activated when used in close proximity to the user's body. Both the proximity sensors trigger power reduction for all voice and data modes. There are no operating conditions or exposure conditions that require the power reduction triggering of both the IR and capacitive sensors. The IR sensor is only applicable for held to ear operations and exposure conditions. The capacitive sensor is only applicable for tablet operations. 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 and Supplement C. Since the device is a full tablet size, the Body SAR was evaluated per FCC KDB Publication 616217 D04v01 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.

With power backoff: either capacitive sensor or IR sensor activated:

Mode / Band	Sensor State		Voice (dBm)	Burst Average GMSK (dBm)					Burst Average 8-PSK (dBm)			
			1 TX Slot	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots	
GSM/GPRS/EDGE 850	Active	Maximum	28.5	28.5	26.0	22.5	21.0	24.0	22.0	20.5	19.0	
		Nominal	28.0	28.0	25.5	22.0	20.5	23.5	21.5	20.0	18.5	
GSM/GPRS/EDGE 1900	Active	Maximum	23.5	23.5	20.0	18.5	17.5	22.0	19.5	18.0	17.0	
		Nominal	23.0	23.0	19.5	18.0	17.0	21.5	19.0	17.5	16.5	

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Mode / Band	Sensor State		Modulated Average (dBm)		
			3GPP RMC	3GPP HSDPA	3GPP HSUPA
UMTS Band 5 (850 MHz)	Active	Maximum	17.5	17.5	17.5
		Nominal	17.0	17.0	17.0
UMTS Band 2 (1900 MHz)	Active	Maximum	15.5	15.5	15.5
		Nominal	15.0	15.0	15.0

Max power with capacitive sensor and IR sensor inactivated for body SAR testing configurations:

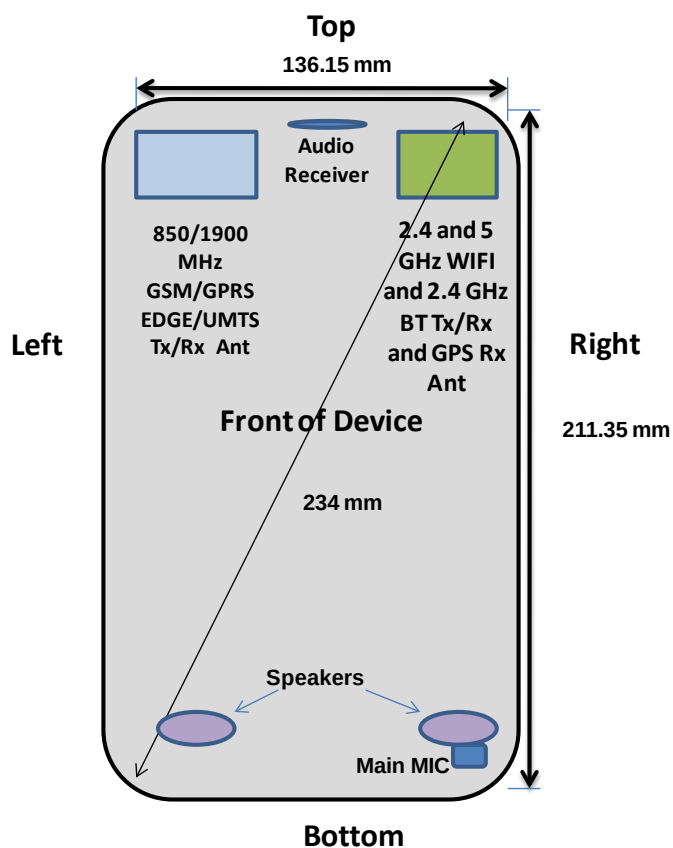
Mode / Band	Sensor State		Voice (dBm)	Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
			1 TX Slot	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots
GSM/GPRS/EDGE 850	Inactive	Maximum	33.0	33.0	30.5	27.0	26.0	27.5	27.0	26.0	24.0
		Nominal	32.5	32.5	30	26.5	25.5	27	26.5	25.5	23.5
GSM/GPRS/EDGE 1900	Inactive	Maximum	30.0	30.0	26.0	24.5	23.0	26.5	26.5	25.5	23.5
		Nominal	29.5	29.5	25.5	24	22.5	26	26	25	23

Mode / Band	Sensor State		Modulated Average (dBm)		
			3GPP RMC	3GPP HSDPA	3GPP HSUPA
UMTS Band 5 (850 MHz)	Inactive	Maximum	23.5	23.5	23.5
		Nominal	23.0	23.0	23.0
UMTS Band 2 (1900 MHz)	Inactive	Maximum	22.5	22.5	22.5
		Nominal	22.0	22.0	22.0

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	16.5
	Nominal	16.0
IEEE 802.11g (2.4 GHz)	Maximum	12.0
	Nominal	11.5
IEEE 802.11n (2.4 GHz)	Maximum	11.0
	Nominal	10.5
IEEE 802.11a (5 GHz)	Maximum	9.0
	Nominal	8.5
IEEE 802.11n (5.2 and 5.3 GHz)	Maximum	8.5
	Nominal	8.0
IEEE 802.11n (5.5 and 5.8 GHz)	Maximum	8.0
	Nominal	7.5
Bluetooth	Maximum	11.5
	Nominal	11.0
Bluetooth LE	Maximum	7.5
	Nominal	7.0

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1.4 DUT Antenna Locations



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

Figure 1-1
DUT Antenna Locations

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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 1-1
Simultaneous Transmission Scenarios

Ref.	Simultaneous Transmit Configurations	Head	Body	Note
		IEEE 1528, Supp C	FCC KDB 616217	
1	GSM850 Voice + 2.4 GHz WIFI	Yes		
2	GSM850 Voice + 5 GHz WIFI	Yes		
3	GSM1900 Voice + 2.4 GHz WIFI	Yes		
4	GSM1900 Voice + 5 GHz WIFI	Yes		
5	UMTS 850 Voice + 2.4 GHz WIFI	Yes		
6	UMTS 1900 Voice + 2.4 GHz WIFI	Yes		
7	UMTS 850 Voice + 5 GHz WIFI	Yes		
8	UMTS 1900 Voice + 5 GHz WIFI	Yes		
9	UMTS 850 Data + 2.4 GHz WIFI	Yes	Yes	3G Hotspot
10	UMTS 1900 Data + 2.4 GHz WIFI	Yes	Yes	3G Hotspot
11	GPRS/EDGE 850 Data + 2.4 GHz WIFI		Yes	2G Hotspot
12	GPRS/EDGE 1900 Data + 2.4 GHz WIFI		Yes	2G Hotspot
13	UMTS 850 Data + 5 GHz WIFI	Yes	Yes	5 GHz WIFI Direct
14	UMTS 1900 Data + 5 GHz WIFI	Yes	Yes	5 GHz WIFI Direct
15	GPRS/EDGE 850 Data + 5 GHz WIFI		Yes	5 GHz WIFI Direct
16	GPRS/EDGE 1900 Data + 5 GHz WIFI		Yes	5 GHz WIFI Direct
17	UMTS 850 Voice+ Bluetooth			
18	UMTS 1900 Voice+Bluetooth			
19	GSM 850 Voice+Bluetooth			
20	GSM 1900 Voice +Bluetooth			
21	UMTS 850 Data + Bluetooth		Yes	
22	UMTS 1900 Data + Bluetooth		Yes	
23	GPRS/EDGE 850 Data + Bluetooth		Yes	
24	GPRS/EDGE 1900 Data + Bluetooth		Yes	
Notes:				
1. Bluetooth and 2.4 GHz WLAN and 5 GHz share the same antenna path and cannot transmit simultaneously.				

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.

Per FCC KDB 616217 D04 4.3, when voice mode is limited to speaker mode or headset operations only, additional SAR testing for tablet voice use is not required. Therefore Voice standalone and simultaneous combinations are not evaluated for body configurations.

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1.6 SAR Test Exclusions Applied

(A) WIFI/BT

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

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

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

Based on the maximum conducted power of Bluetooth LE and the antenna to use separation distance, Bluetooth SAR was not required; $[(6/5) * \sqrt{2.441}] = 1.9 < 3.0$.

(B) Licensed Transmitter(s)

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

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

1.7 Guidance Applied

- FCC KDB Publication 941225 D01-D04 (2G/3G)
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)
- IEEE 1528-2003
- FCC KDB Publication 616217 D04v01 (Tablet SAR Considerations)
- FCC KDB Publication 447498 D01v05 (General SAR Guidance)

1.8 Device Serial Numbers

Several samples were used with identical hardware to support SAR testing. When the device is touching the user, the proximity sensors activate and hence the device is limited to a reduced output power level. Additional samples were used for the SAR Testing that were limited to the reduced levels (via manufacturer proprietary tools) and are indicated in the below table.

	Head SAR Serial Number	Body SAR Max Power Serial Number	Body SAR Reduced Power Serial Number
GSM/GPRS/EDGE 850	78799	78666	78872
UMTS 850	78799	78666	78872
GSM/GPRS/EDGE 1900	78799	78666	78872
UMTS 1900	78799	78666	78872
2.4 GHz WLAN	354416050077478	354416050077478	-
5 GHz WLAN	354416050078799	354416050078799	-
Bluetooth	-	354416050077478	-

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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 [24]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields,” Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

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/m³)
- E = Total RMS electric field strength (V/m)

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

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3 DOSIMETRIC ASSESSMENT

3.1 Measurement Procedure

The evaluation was performed using the following procedure:

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

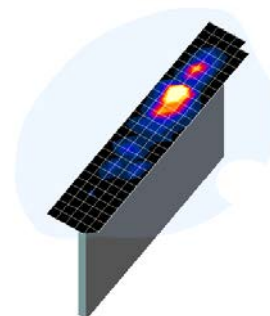


Figure 3-1
Sample SAR Area Scan

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

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

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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) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (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].

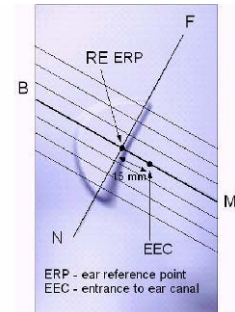


Figure 4-1
Close-Up Side view
of ERP

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 “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (See Figure 4-3). The “test device reference point” was then located at the same level as the center of the ear reference point. The test device was positioned so that the “vertical centerline” was bisecting the front surface of the handset at its top and bottom edges, positioning the “ear reference point” on the outer surface of the both the left and right head phantoms on the ear reference point.



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

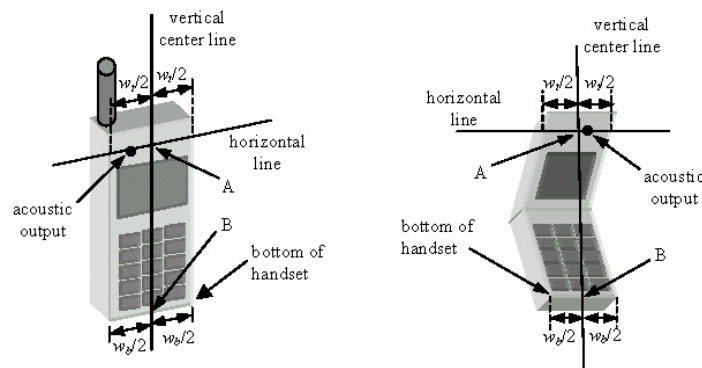


Figure 4-3
Handset Vertical Center & Horizontal Line Reference Points

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5 TEST CONFIGURATION POSITIONS

5.1 Device Holder

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

Due to the width of the grips on the device holder, the DUT could not be gripped using the standard holder grip setup but instead the device was supported by the device holder with the grips supporting the bottom of the device.

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.

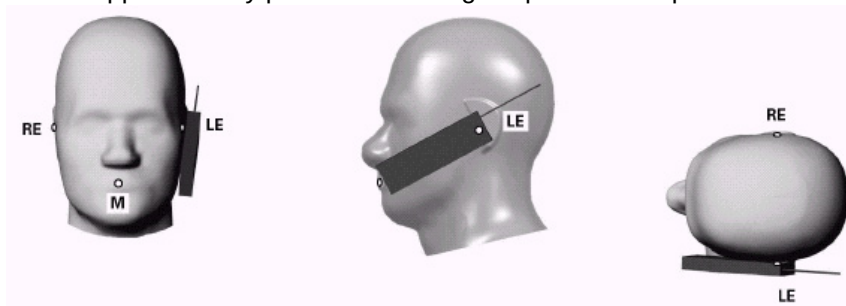


Figure 5-1 Front, Side and Top View of Cheek Position

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

5.3 Positioning for Ear / 15° Tilt

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

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

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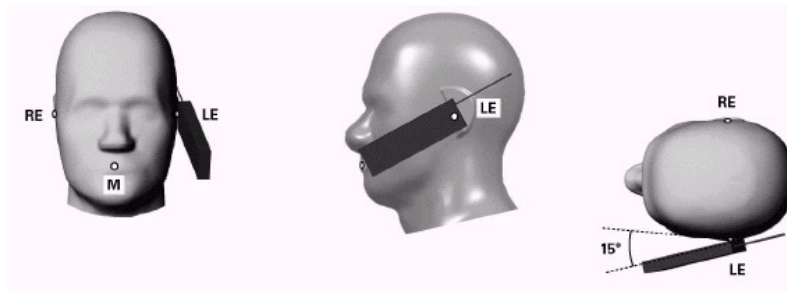


Figure 5-2 Front, Side and Top View of Ear/15° Tilt Position

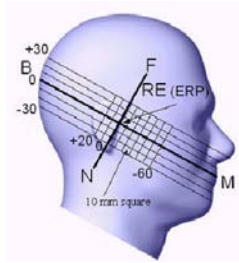


Figure 5-3
Side view w/ relevant markings

5.4 SAR Testing for Tablet per KDB Publication 616217 D04v01

This device can be used also 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 is touching the user on the antenna, the proximity sensors activate and thus reduce the maximum output power allowed. However, when the device is moved beyond the sensor triggering distance, the sensors de-activate and thus 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 grip sensor activation distance for the back side of the device is 7 mm, a conservative distance of 6 mm was tested for SAR on the back side, at maximum power. Also, since the grip sensor activation distance was 6 mm for the top edge, a conservative distance of 5 mm was tested for SAR on the top edge, at maximum power. Sensor triggering distance summary data is included in Appendix G. The capacitive proximity sensor does not trigger power reduction from the front of the device.

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 <i>General Population</i> (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT <i>Occupational</i> (W/kg) or (mW/g)
SPATIAL PEAK SAR Brain	1.6	8.0
SPATIAL AVERAGE SAR Whole Body	0.08	0.4
SPATIAL PEAK SAR Hands, Feet, Ankles, Wrists	4.0	20

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

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7.1 Measured and Reported SAR

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

7.2 Procedures Used to Establish RF Signal for SAR

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

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

7.3 SAR Measurement Conditions for UMTS

7.3.1 Output Power Verification

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

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

7.3.2 Head SAR Measurements for Handsets

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

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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 DPCCCH. 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.

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 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	$\beta_{hs}^{(1)}$	β_{cc}	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 $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCCH, HS-DPCCCH, E-DPDCH and E-DPCCCH 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 $\beta_c = 10/15$ and $\beta_d = 15/15$.

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 $\beta_c = 14/15$ and $\beta_d = 15/15$.

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.

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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 [27]

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

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

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

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8 RF CONDUCTED POWERS

8.1 GSM Conducted Powers

Table 8-1
Reduced GSM Average RF Conducted Powers
(Representing either Capacitive Sensor or IR Sensor Active)

		Maximum Burst-Averaged Output Power								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	28.06	27.95	25.67	22.15	20.77	23.42	21.92	20.31	18.64
	190	28.14	28.05	25.78	22.25	20.87	23.55	21.97	20.45	18.73
	251	28.13	28.12	25.86	22.19	20.79	23.50	22.00	20.49	18.79
GSM 1900	512	22.96	22.95	19.87	18.36	17.36	21.63	19.20	17.71	16.71
	661	23.06	23.05	19.98	18.45	17.46	21.76	19.31	17.81	16.78
	810	23.18	22.96	19.90	18.37	17.39	21.65	19.22	17.77	16.69
		Calculated Maximum Frame-Averaged Output Power								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	19.03	18.92	19.65	17.89	17.76	14.39	15.90	16.05	15.63
	190	19.11	19.02	19.76	17.99	17.86	14.52	15.95	16.19	15.72
	251	19.10	19.09	19.84	17.93	17.78	14.47	15.98	16.23	15.78
GSM 1900	512	13.93	13.92	13.85	14.10	14.35	12.60	13.18	13.45	13.70
	661	14.03	14.02	13.96	14.19	14.45	12.73	13.29	13.55	13.77
	810	14.15	13.93	13.88	14.11	14.38	12.62	13.20	13.51	13.68

Table 8-2
Maximum GPRS/EDGE Average RF Conducted Powers
(Representing both Capacitive Sensor and IR Sensor Inactive)

		Maximum Burst-Averaged Output Power								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	32.99	32.94	30.41	26.93	25.43	26.84	26.85	25.79	23.76
	190	32.95	32.93	30.49	26.99	25.51	26.94	26.88	25.84	23.86
	251	33.00	32.98	30.50	26.98	25.56	27.05	26.96	25.90	23.93
GSM 1900	512	30.00	29.90	25.93	24.45	22.92	26.15	26.12	25.07	23.42
	661	29.97	29.91	25.95	24.48	22.96	26.11	26.10	25.06	23.38
	810	29.98	29.86	25.94	24.45	22.92	26.14	26.13	25.08	23.39
		Calculated Maximum Frame-Averaged Output Power								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	23.96	23.91	24.39	22.67	22.42	17.81	20.83	21.53	20.75
	190	23.92	23.90	24.47	22.73	22.50	17.91	20.86	21.58	20.85
	251	23.97	23.95	24.48	22.72	22.55	18.02	20.94	21.64	20.92
GSM 1900	512	20.97	20.87	19.91	20.19	19.91	17.12	20.10	20.81	20.41
	661	20.94	20.88	19.93	20.22	19.95	17.08	20.08	20.80	20.37
	810	20.95	20.83	19.92	20.19	19.91	17.11	20.11	20.82	20.38

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Notes:

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

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



Figure 8-1
Power Measurement Setup

8.2 UMTS Conducted Powers

Table 8-5
Reduced UMTS Average RF Conducted Powers
(Representing either Capacitive Sensor or IR Sensor Active)

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	17.31	17.18	17.17	15.47	15.42	15.45	-
99		12.2 kbps AMR	17.34	17.15	17.16	15.49	15.42	15.50	-
6	HSDPA	Subtest 1	17.48	17.37	17.47	15.38	15.27	15.37	0
6		Subtest 2	17.38	17.16	17.18	15.20	15.10	15.12	0
6		Subtest 3	17.21	17.07	17.03	14.99	14.88	14.92	0.5
6		Subtest 4	16.97	16.81	16.78	14.66	14.64	14.67	0.5
6	HSUPA	Subtest 1	16.73	16.54	16.55	14.72	14.52	14.66	0
6		Subtest 2	15.28	15.33	15.27	13.19	13.03	13.18	2
6		Subtest 3	16.47	16.34	16.28	14.21	14.14	14.26	1
6		Subtest 4	15.49	15.50	15.50	13.47	13.45	13.45	2
6		Subtest 5	17.39	17.15	17.19	14.19	14.06	14.28	0

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Table 8-6
Maximum UMTS Average RF Conducted Powers
(Representing both Capacitive Sensor and IR Sensor Inactive)

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	23.25	23.05	23.02	22.45	22.49	22.50	-
99		12.2 kbps AMR	23.28	23.04	23.03	22.16	22.10	22.24	-
6	HSDPA	Subtest 1	22.29	21.98	21.94	22.49	22.50	22.46	0
6		Subtest 2	22.49	22.37	22.33	22.31	22.32	22.37	0
6		Subtest 3	22.23	22.07	22.05	22.10	22.11	22.10	0.5
6		Subtest 4	22.02	21.86	21.85	21.85	21.88	21.91	0.5
6	HSUPA	Subtest 1	22.42	22.10	22.29	22.25	22.33	21.96	0
6		Subtest 2	20.50	20.31	20.30	20.54	20.85	20.87	2
6		Subtest 3	21.08	21.07	21.06	21.31	21.33	21.39	1
6		Subtest 4	20.72	20.62	20.51	20.94	21.04	21.10	2
6		Subtest 5	22.31	22.50	22.30	22.16	22.20	22.48	0

Notes:

1. 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.
2. This device does not support DC-HSDPA.
3. It is expected by the manufacturer that MPR for some HSUPA 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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8.3 802.11 Transmitters Conducted Powers

Table 8-7
IEEE 802.11b Average RF Power

Mode	Freq [MHz]	Channel	802.11b (2.4 GHz) Conducted Power [dBm]			
			Data Rate [Mbps]			
			1	2	5.5	11
802.11b	2412	1*	16.08	16.07	16.11	16.17
802.11b	2437	6*	16.17	16.19	16.27	16.10
802.11b	2462	11*	16.21	16.17	16.21	16.17

Table 8-8
IEEE 802.11g Average RF Power

Mode	Freq [MHz]	Channel	802.11g (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11g	2412	1	11.63	11.60	11.53	11.58	11.65	11.57	11.57	11.54
802.11g	2437	6	11.67	11.68	11.66	11.63	11.74	11.71	11.69	11.65
802.11g	2462	11	11.75	11.66	11.73	11.75	11.74	11.66	11.71	11.67

Table 8-9
IEEE 802.11n Average RF Power

Mode	Freq [MHz]	Channel	802.11n (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	20	26	39	52	58	65
802.11n	2412	1	10.42	10.34	10.45	10.37	10.37	10.38	10.42	10.36
802.11n	2437	6	10.44	10.52	10.52	10.45	10.46	10.60	10.41	10.55
802.11n	2462	11	10.57	10.54	10.51	10.51	10.47	10.50	10.52	10.52

Table 8-10
IEEE 802.11a Average RF Power

Mode	Freq [MHz]	Channel	802.11a (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11a	5180	36*	8.10	8.03	7.98	8.09	7.98	8.01	7.94	7.94
802.11a	5200	40	8.06	7.98	7.92	8.05	7.88	7.95	7.88	7.95
802.11a	5220	44	8.15	7.99	7.96	8.09	7.92	8.00	7.95	8.02
802.11a	5240	48*	8.23	8.11	8.07	8.11	8.02	8.07	8.04	8.05
802.11a	5260	52*	8.16	8.15	8.14	8.13	8.14	8.04	7.96	7.93
802.11a	5280	56	8.22	8.21	8.20	8.11	8.13	8.08	8.01	7.98
802.11a	5300	60	8.19	8.18	8.17	8.10	8.15	8.09	7.96	8.03
802.11a	5320	64*	8.31	8.28	8.29	8.21	8.17	8.17	8.11	8.15
802.11a	5500	100	8.23	8.24	8.17	8.10	8.04	8.14	8.04	8.02
802.11a	5520	104*	8.31	8.30	8.28	8.30	8.13	8.24	8.15	8.11
802.11a	5540	108	8.35	8.33	8.32	8.32	8.22	8.30	8.23	8.15
802.11a	5560	112	8.42	8.36	8.35	8.40	8.32	8.38	8.33	8.26
802.11a	5580	116*	8.54	8.46	8.43	8.41	8.33	8.32	8.36	8.31
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	8.65	8.61	8.57	8.48	8.45	8.47	8.51	8.44
802.11a	5680	136*	8.76	8.71	8.70	8.67	8.65	8.71	8.68	8.66
802.11a	5700	140	8.75	8.71	8.68	8.71	8.61	8.66	8.65	8.64
802.11a	5745	149*	8.59	8.55	8.58	8.56	8.44	8.49	8.42	8.41
802.11a	5765	153	8.57	8.55	8.40	8.45	8.48	8.36	8.42	8.32
802.11a	5785	157*	8.62	8.51	8.50	8.44	8.50	8.51	8.53	8.50
802.11a	5805	161*	8.62	8.61	8.56	8.54	8.58	8.48	8.45	8.43
802.11a	5825	165	8.67	8.65	8.66	8.64	8.60	8.58	8.56	8.58

Per FCC KDB Publication 443999 and RSS-210 A9.2(3), transmission on channels which overlap the 5600-5650 MHz is prohibited as a client. This device does not transmit any beacons or initiate any transmissions in 5.3 and 5.5 GHz Band. (*) – indicates default channels per KDB Publication 248227 D01v01r02. When the adjacent channels are higher in power than the default channels, these “required channels” are considered for SAR testing instead of the default channels.

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

Mode	Freq [MHz]	Channel	20MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	20	26	39	52	58	65
802.11n	5180	36	8.05	8.02	8.04	7.98	8.00	8.04	7.92	7.86
802.11n	5200	40	8.04	8.01	7.98	8.03	7.98	7.95	8.00	7.94
802.11n	5220	44	7.92	7.87	7.89	7.78	7.91	7.81	7.79	7.78
802.11n	5240	48	7.97	7.95	7.93	7.91	7.90	7.88	7.82	7.81
802.11n	5260	52	7.99	7.97	7.98	7.96	7.95	7.91	7.93	7.90
802.11n	5280	56	8.02	8.01	8.00	7.96	7.98	7.92	7.91	8.01
802.11n	5300	60	8.04	8.00	7.96	7.93	8.02	7.99	7.97	7.96
802.11n	5320	64	8.05	8.03	8.01	7.98	7.94	8.00	8.01	8.02
802.11n	5500	100	7.55	7.54	7.51	7.49	7.50	7.48	7.45	7.49
802.11n	5520	104	7.50	7.49	7.45	7.40	7.39	7.35	7.33	7.30
802.11n	5540	108	7.57	7.55	7.52	7.56	7.52	7.50	7.52	7.49
802.11n	5560	112	7.61	7.59	7.48	7.54	7.50	7.55	7.53	7.52
802.11n	5580	116	7.63	7.58	7.62	7.61	7.58	7.61	7.58	7.59
802.11a	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5660	132	7.83	7.81	7.78	7.73	7.69	7.67	7.67	7.66
802.11n	5680	136	7.90	7.89	7.86	7.85	7.81	7.80	7.74	7.72
802.11n	5700	140	7.92	7.91	7.89	7.86	7.82	7.80	7.71	7.70
802.11n	5745	149	7.78	7.75	7.68	7.77	7.68	7.69	7.76	7.64
802.11n	5765	153	7.76	7.71	7.74	7.74	7.69	7.70	7.68	7.65
802.11n	5785	157	7.86	7.83	7.84	7.85	7.84	7.82	7.82	7.81
802.11n	5805	161	7.84	7.83	7.81	7.80	7.79	7.82	7.78	7.83
802.11n	5825	165	7.93	7.91	7.89	7.87	7.87	7.86	7.81	7.73

Table 8-12
IEEE 802.11n Average RF Power – 40 MHz Bandwidth

Mode	Freq [MHz]	Channel	40MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			13.5/15	27/30	40.5/45	54/60	81/90	108/120	121.5/135	135/150
802.11n	5190	38	8.17	8.15	8.13	8.11	8.05	8.09	8.08	7.96
802.11n	5230	46	8.02	8.00	8.01	7.96	7.98	8.00	7.99	8.00
802.11n	5270	54	8.02	8.00	7.97	7.86	7.91	7.88	7.84	7.82
802.11n	5310	62	8.04	7.97	7.98	7.90	7.92	7.89	7.88	7.87
802.11n	5510	102	7.51	7.50	7.49	7.42	7.43	7.42	7.36	7.30
802.11n	5550	110	7.61	7.58	7.57	7.54	7.52	7.48	7.40	7.38
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	7.92	7.87	7.86	7.81	7.73	7.74	7.74	7.73
802.11n	5755	151	7.86	7.84	7.81	7.80	7.74	7.68	7.57	7.54
802.11n	5795	159	7.97	7.95	7.94	7.89	7.82	7.81	7.74	7.72

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.

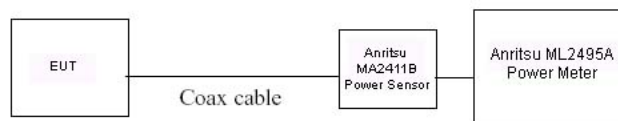


Figure 8-3: Power Measurement Setup

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Table 8-13
Bluetooth Conducted Powers

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Peak Conducted Power		Avg Conducted Power	
			[dBm]	[mW]	[dBm]	[mW]
2402	1.0	0	11.34	13.614	11.25	13.323
2441	1.0	39	11.08	12.832	10.97	12.515
2480	1.0	78	10.80	12.020	10.66	11.644
2402	2.0	0	11.05	12.732	9.10	8.124
2441	2.0	39	11.08	12.826	8.96	7.876
2480	2.0	78	10.67	11.663	8.28	6.730
2402	3.0	0	11.45	13.967	9.17	8.264
2441	3.0	39	11.32	13.558	9.04	8.017
2480	3.0	78	10.99	12.572	8.42	6.945

Table 8-14
Bluetooth LE Conducted Powers

Frequency [MHz]	Channel No.	Bluetooth Mode	Peak Conducted Power		Average Conducted Power	
			[dBm]	[mW]	[dBm]	[mW]
2402	0	LE	8.59	7.224	6.58	4.548
2440	19	LE	9.04	8.019	7.03	5.048
2480	39	LE	8.76	7.523	6.75	4.736

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and April 2010 FCC/TCB Meeting Notes:

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

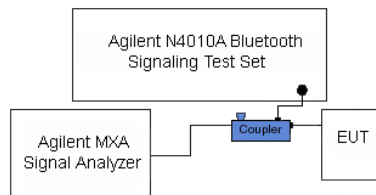


Figure 8-3
Power Measurement Setup

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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
1/7/2013	835H	20.5	820	0.882	42.46	0.898	41.571	-1.78%	2.14%
			835	0.908	42.24	0.900	41.500	0.89%	1.78%
			850	0.925	42.12	0.916	41.500	0.98%	1.49%
12/27/2012	1900H	22.1	1850	1.398	38.61	1.400	40.000	-0.14%	-3.48%
			1880	1.433	38.47	1.400	40.000	2.36%	-3.83%
			1910	1.463	38.37	1.400	40.000	4.50%	-4.08%
1/3/2013	2450H	22.2	2401	1.764	39.36	1.758	39.298	0.34%	0.16%
			2450	1.835	39.21	1.800	39.200	1.94%	0.03%
			2499	1.904	39.01	1.852	39.135	2.81%	-0.32%
1/5/2013	5200H-5800H	22.4	5180	4.721	36.45	4.639	36.020	1.77%	1.19%
			5200	4.740	36.36	4.660	36.000	1.72%	1.00%
			5240	4.794	36.25	4.700	35.960	2.00%	0.81%
			5280	4.847	36.19	4.740	35.920	2.26%	0.75%
			5300	4.874	36.14	4.760	35.900	2.39%	0.67%
			5320	4.862	37.09	4.780	35.880	1.72%	3.37%
			5500	5.115	35.57	4.965	35.650	3.02%	-0.22%
			5540	5.158	35.55	5.007	35.590	3.02%	-0.11%
			5580	5.197	35.46	5.049	35.530	2.93%	-0.20%
			5600	5.231	35.36	5.070	35.500	3.18%	-0.39%
			5680	5.324	35.26	5.150	35.420	3.38%	-0.45%
			5745	5.405	35.01	5.215	35.355	3.64%	-0.98%
			5785	5.457	34.96	5.255	35.315	3.84%	-1.01%
			5800	5.474	34.94	5.270	35.300	3.87%	-1.02%
			5825	5.496	34.87	5.296	35.275	3.78%	-1.15%
12/28/2012	835B	22.1	820	0.976	54.29	0.969	55.258	0.72%	-1.75%
			835	1.007	54.18	0.970	55.200	3.81%	-1.85%
			850	1.017	53.66	0.988	55.154	2.94%	-2.71%
1/2/2013	1900B	22.9	1850	1.459	51.23	1.520	53.300	-4.01%	-3.88%
			1880	1.495	51.14	1.520	53.300	-1.64%	-4.05%
			1910	1.527	51.06	1.520	53.300	0.46%	-4.20%
1/4/2013	2450B	22.4	2401	1.947	51.10	1.903	52.765	2.31%	-3.16%
			2450	2.014	50.83	1.950	52.700	3.28%	-3.55%
			2499	2.093	50.82	2.019	52.638	3.67%	-3.45%
1/8/2013	2450B	20.4	2401	1.873	51.19	1.903	52.765	-1.58%	-2.98%
			2450	1.938	51.17	1.950	52.700	-0.62%	-2.90%
			2499	1.986	50.90	2.019	52.638	-1.63%	-3.30%
1/8/2013	5200B-5800B	23.2	5180	5.172	49.15	5.276	49.041	-1.97%	0.22%
			5200	5.192	49.10	5.299	49.014	-2.02%	0.18%
			5220	5.217	48.96	5.323	48.987	-1.99%	-0.06%
			5240	5.228	48.87	5.346	48.933	-2.21%	-0.13%
			5280	5.341	48.76	5.393	48.879	-0.96%	-0.24%
			5300	5.377	48.78	5.416	48.851	-0.72%	-0.15%
			5320	5.379	48.81	5.439	48.607	-1.10%	0.42%
			5500	5.629	48.27	5.650	48.580	-0.37%	-0.64%
			5540	5.735	48.18	5.696	48.526	0.68%	-0.71%
			5580	5.780	48.19	5.743	48.471	0.64%	-0.58%
			5600	5.795	48.08	5.766	48.444	0.50%	-0.75%
			5680	5.951	47.89	5.860	48.336	1.55%	-0.92%
			5745	6.026	47.76	5.936	48.248	1.52%	-1.01%
			5785	6.099	47.56	5.982	48.242	1.96%	-1.41%
			5800	6.130	47.54	6.000	48.200	2.17%	-1.37%
			5825	6.186	47.60	6.029	48.132	2.60%	-1.11%

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

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9.2 Test System Verification

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

Table 9-2
System Verification Results

System Verification TARGET & MEASURED											
Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR _{1g} (W/kg)	1 W Target SAR _{1g} (W/kg)	1 W Normalized SAR _{1g} (W/kg)	Deviation (%)
835	HEAD	01/07/2013	23.4	20.5	0.090	4d047	3288	0.858	9.410	9.533	1.31%
1900	HEAD	12/27/2012	23.4	22.3	0.100	502	3209	4.020	39.200	40.200	2.55%
2450	HEAD	01/03/2013	20.8	20.3	0.100	882	3288	5.330	53.500	53.300	-0.37%
5200	HEAD	01/05/2013	20.4	19.6	0.100	1007	3561	7.550	79.800	75.500	-5.39%
5300	HEAD	01/05/2013	20.0	19.5	0.100	1007	3561	8.090	83.100	80.900	-2.65%
5500	HEAD	01/05/2013	20.6	19.7	0.100	1007	3561	8.100	84.900	81.000	-4.59%
5600	HEAD	01/05/2013	23.2	20.2	0.105	1007	3561	8.090	84.500	77.048	-8.82%
5800	HEAD	01/05/2013	23.6	20.4	0.100	1007	3561	7.820	79.800	78.200	-2.01%
835	BODY	12/28/2012	23.2	21.7	0.100	4d119	3258	0.996	9.560	9.960	4.18%
1900	BODY	01/02/2013	23.9	22.0	0.100	5d141	3022	3.780	40.600	37.800	-6.90%
2450	BODY	01/04/2013	23.4	22.5	0.100	719	3209	5.280	51.600	52.800	2.33%
2450	BODY	01/08/2013	24.4	21.1	0.100	882	3263	4.720	50.300	47.200	-6.16%
5200	BODY	01/08/2013	24.0	22.4	0.100	1007	3561	7.300	73.300	73.000	-0.41%
5300	BODY	01/08/2013	24.1	24.2	0.100	1007	3561	7.500	75.600	75.000	-0.79%
5500	BODY	01/08/2013	24.3	24.2	0.100	1007	3561	7.880	78.500	78.800	0.38%
5600	BODY	01/08/2013	24.4	22.8	0.100	1007	3561	8.550	80.000	85.500	6.88%
5800	BODY	01/08/2013	24.5	22.8	0.100	1007	3561	7.600	74.300	76.000	2.29%

A summary of validation status and results is included in appendix E.

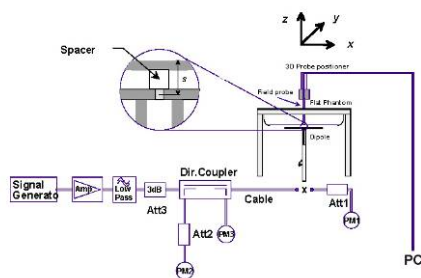


Figure 9-1
System Verification Setup Diagram



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	28.5	28.14	0.04	Right	Cheek	78799	1:8.3	0.294	1.086	0.319	A1
836.60	190	GSM 850	GSM	28.5	28.14	0.02	Right	Tilt	78799	1:8.3	0.289	1.086	0.314	
836.60	190	GSM 850	GSM	28.5	28.14	0.02	Left	Cheek	78799	1:8.3	0.059	1.086	0.064	
836.60	190	GSM 850	GSM	28.5	28.14	0.07	Left	Tilt	78799	1:8.3	0.067	1.086	0.073	
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
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	17.5	17.18	0.01	Right	Cheek	78799	1:1	0.226	1.076	0.243	A2
836.60	4183	UMTS 850	RMC	17.5	17.18	0.00	Right	Tilt	78799	1:1	0.220	1.076	0.237	
836.60	4183	UMTS 850	RMC	17.5	17.18	-0.01	Left	Cheek	78799	1:1	0.065	1.076	0.070	
836.60	4183	UMTS 850	RMC	17.5	17.18	0.02	Left	Tilt	78799	1:1	0.070	1.076	0.075	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 10-3
GSM 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	661	GSM 1900	GSM	23.5	23.06	0.17	Right	Cheek	78799	1:8.3	0.475	1.107	0.526	A3
1880.00	661	GSM 1900	GSM	23.5	23.06	-0.01	Right	Tilt	78799	1:8.3	0.455	1.107	0.504	
1880.00	661	GSM 1900	GSM	23.5	23.06	-0.02	Left	Cheek	78799	1:8.3	0.142	1.107	0.157	
1880.00	661	GSM 1900	GSM	23.5	23.06	-0.07	Left	Tilt	78799	1:8.3	0.150	1.107	0.166	
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 10-4
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	15.5	15.42	0.06	Right	Cheek	78799	1:1	0.761	1.019	0.775	A4
1880.00	9400	UMTS 1900	RMC	15.5	15.42	0.12	Right	Tilt	78799	1:1	0.690	1.019	0.703	
1880.00	9400	UMTS 1900	RMC	15.5	15.42	0.08	Left	Cheek	78799	1:1	0.224	1.019	0.228	
1880.00	9400	UMTS 1900	RMC	15.5	15.42	-0.01	Left	Tilt	78799	1:1	0.243	1.019	0.248	
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 10-5
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)	
2462	11	IEEE 802.11b	DSSS	16.5	16.21	0.00	Right	Cheek	354416050077478	1	1:1	0.001	1.069	0.001	
2462	11	IEEE 802.11b	DSSS	16.5	16.21	0.00	Right	Tilt	354416050077478	1	1:1	0.001	1.069	0.001	
2462	11	IEEE 802.11b	DSSS	16.5	16.21	0.20	Left	Cheek	354416050077478	1	1:1	0.012	1.069	0.013	A5
2462	11	IEEE 802.11b	DSSS	16.5	16.21	-0.20	Left	Tilt	354416050077478	1	1:1	0.010	1.069	0.011	
5825	165	IEEE 802.11a	OFDM	9.0	8.67	0.14	Right	Cheek	354416050078799	6	1:1	0.046	1.079	0.050	
5825	165	IEEE 802.11a	OFDM	9.0	8.67	0.16	Right	Tilt	354416050078799	6	1:1	0.063	1.079	0.068	
5825	165	IEEE 802.11a	OFDM	9.0	8.67	0.13	Left	Cheek	354416050078799	6	1:1	0.216	1.079	0.233	A6
5825	165	IEEE 802.11a	OFDM	9.0	8.67	0.15	Left	Tilt	354416050078799	6	1:1	0.214	1.079	0.231	
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	8.23	0.14	Right	Cheek	354416050078799	6	1:1	0.004	1.194	0.005	
5240	48	IEEE 802.11a	OFDM	9.0	8.23	0.16	Right	Tilt	354416050078799	6	1:1	0.040	1.194	0.048	
5240	48	IEEE 802.11a	OFDM	9.0	8.23	0.13	Left	Cheek	354416050078799	6	1:1	0.139	1.194	0.166	
5240	48	IEEE 802.11a	OFDM	9.0	8.23	0.14	Left	Tilt	354416050078799	6	1:1	0.130	1.194	0.155	
5320	64	IEEE 802.11a	OFDM	9.0	8.31	0.18	Right	Cheek	354416050078799	6	1:1	0.034	1.172	0.040	
5320	64	IEEE 802.11a	OFDM	9.0	8.31	0.06	Right	Tilt	354416050078799	6	1:1	0.049	1.172	0.057	
5320	64	IEEE 802.11a	OFDM	9.0	8.31	0.18	Left	Cheek	354416050078799	6	1:1	0.169	1.172	0.198	
5320	64	IEEE 802.11a	OFDM	9.0	8.31	0.15	Left	Tilt	354416050078799	6	1:1	0.147	1.172	0.172	
5680	136	IEEE 802.11a	OFDM	9.0	8.76	0.20	Right	Cheek	354416050078799	6	1:1	0.047	1.057	0.049	
5680	136	IEEE 802.11a	OFDM	9.0	8.76	0.06	Right	Tilt	354416050078799	6	1:1	0.076	1.057	0.080	
5680	136	IEEE 802.11a	OFDM	9.0	8.76	0.06	Left	Cheek	354416050078799	6	1:1	0.219	1.057	0.231	
5680	136	IEEE 802.11a	OFDM	9.0	8.76	0.15	Left	Tilt	354416050078799	6	1:1	0.237	1.057	0.251	A7
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
GPRS/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	30.5	30.49	0.03	6 mm	78666	2	1:4.15	back	0.414	1.002	0.415	A8
836.60	190	GSM 850	GPRS	26.0	25.78	0.00	0 mm	78872	2	1:4.15	back	0.518	1.052	0.545	
836.60	190	GSM 850	GPRS	30.5	30.49	0.00	5 mm	78666	2	1:4.15	top	0.684	1.002	0.685	
836.60	190	GSM 850	GPRS	26.0	25.78	-0.04	0 mm	78872	2	1:4.15	top	0.272	1.052	0.286	
836.60	190	GSM 850	GPRS	30.5	30.49	0.13	0 mm	78666	2	1:4.15	left	0.183	1.002	0.183	
836.60	4183	UMTS 850	RMC	23.5	23.05	-0.01	6 mm	78666	N/A	1:1	back	0.460	1.090	0.510	A9
836.60	4183	UMTS 850	RMC	17.5	17.18	0.01	0 mm	78872	N/A	1:1	back	0.246	1.076	0.265	
836.60	4183	UMTS 850	RMC	23.5	23.05	-0.06	5 mm	78666	N/A	1:1	top	0.548	1.109	0.608	
846.60	4233	UMTS 850	RMC	17.5	17.18	-0.01	0 mm	78872	N/A	1:1	top	0.130	1.076	0.140	
836.60	4183	UMTS 850	RMC	23.5	23.05	-0.03	0 mm	78666	N/A	1:1	left	0.150	1.109	0.166	
1850.20	512	GSM 1900	GPRS	30.0	29.90	0.01	6 mm	78666	1	1:8.3	back	0.941	1.023	0.963	A10
1880.00	661	GSM 1900	GPRS	30.0	29.91	-0.03	6 mm	78666	1	1:8.3	back	1.010	1.021	1.031	
1909.80	810	GSM 1900	GPRS	30.0	29.86	-0.01	6 mm	78666	1	1:8.3	back	1.040	1.033	1.074	
1880.00	661	GSM 1900	GPRS	17.5	17.46	0.02	0 mm	78872	4	1:2.076	back	0.718	1.009	0.724	
1850.20	512	GSM 1900	GPRS	30.0	29.90	-0.15	5 mm	78666	1	1:8.3	top	0.845	1.023	0.864	
1880.00	661	GSM 1900	GPRS	30.0	29.91	-0.14	5 mm	78666	1	1:8.3	top	0.867	1.021	0.885	
1909.80	810	GSM 1900	GPRS	30.0	29.86	-0.20	5 mm	78666	1	1:8.3	top	0.894	1.033	0.924	
1880.00	661	GSM 1900	GPRS	17.5	17.46	0.00	0 mm	78872	4	1:2.076	top	0.655	1.009	0.661	
1880.00	661	GSM 1900	GPRS	30.0	29.91	-0.08	0 mm	78666	1	1:8.3	left	0.313	1.021	0.320	
1909.80	810	GSM 1900	GPRS	30.0	29.86	-0.04	6 mm	78666	1	1:8.3	back	1.010	1.033	1.043	
1852.40	9262	UMTS 1900	RMC	22.5	22.45	0.04	6 mm	78666	N/A	1:1	back	0.738	1.012	0.747	A11
1880.00	9400	UMTS 1900	RMC	22.5	22.49	-0.06	6 mm	78666	N/A	1:1	back	0.777	1.002	0.779	
1907.60	9538	UMTS 1900	RMC	22.5	22.50	0.02	6 mm	78666	N/A	1:1	back	0.963	1.000	0.963	
1880.00	9400	UMTS 1900	RMC	15.5	15.42	-0.06	0 mm	78872	N/A	1:1	back	0.596	1.019	0.607	
1880.00	9400	UMTS 1900	RMC	22.5	22.49	-0.06	5 mm	78666	N/A	1:1	top	0.746	1.002	0.747	
1880.00	9400	UMTS 1900	RMC	15.5	15.42	0.01	0 mm	78872	N/A	1:1	top	0.634	1.019	0.646	
1880.00	9400	UMTS 1900	RMC	22.5	22.49	-0.06	0 mm	78666	N/A	1:1	left	0.211	1.002	0.211	
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: Data highlighted in blue is collected for variability purposes; see section 12 for more details.

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Table 10-8
DTS Body SAR Data

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)	
2462	11	IEEE 802.11b	DSSS	16.5	16.21	-0.15	0 mm	354416050077478	1	back	1:1	0.080	1.069	0.086	A12
2462	11	IEEE 802.11b	DSSS	16.5	16.21	0.08	0 mm	354416050077478	1	top	1:1	0.038	1.069	0.040	
2462	11	IEEE 802.11b	DSSS	16.5	16.21	0.16	0 mm	354416050077478	1	right	1:1	0.013	1.069	0.014	
5745	149	IEEE 802.11a	OFDM	9.0	8.59	0.09	0 mm	354416050078799	6	back	1:1	0.823	1.099	0.904	
5785	157	IEEE 802.11a	OFDM	9.0	8.62	0.05	0 mm	354416050078799	6	back	1:1	0.837	1.091	0.913	
5825	165	IEEE 802.11a	OFDM	9.0	8.67	0.12	0 mm	354416050078799	6	back	1:1	0.856	1.079	0.924	
5745	149	IEEE 802.11a	OFDM	9.0	8.59	-0.18	0 mm	354416050078799	6	top	1:1	0.623	1.099	0.685	
5785	157	IEEE 802.11a	OFDM	9.0	8.62	-0.11	0 mm	354416050078799	6	top	1:1	0.616	1.091	0.672	
5825	165	IEEE 802.11a	OFDM	9.0	8.67	-0.11	0 mm	354416050078799	6	top	1:1	0.647	1.079	0.698	
5825	165	IEEE 802.11a	OFDM	9.0	8.67	-0.14	0 mm	354416050078799	6	right	1:1	0.132	1.079	0.142	
5825	165	IEEE 802.11a	OFDM	9.0	8.67	-0.15	0 mm	354416050078799	6	back	1:1	0.865	1.079	0.933	A13
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

Note: Data highlighted in blue is collected for variability purposes; see section 12 for more details.

Table 10-9
NII Body SAR Data

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	8.10	0.14	0 mm	354416050078799	6	back	1:1	0.319	1.230	0.392	
5240	48	IEEE 802.11a	OFDM	9.0	8.23	0.13	0 mm	354416050078799	6	back	1:1	0.344	1.194	0.411	
5240	48	IEEE 802.11a	OFDM	9.0	8.23	-0.20	0 mm	354416050078799	6	top	1:1	0.232	1.194	0.277	
5240	48	IEEE 802.11a	OFDM	9.0	8.23	0.18	0 mm	354416050078799	6	right	1:1	0.165	1.194	0.197	
5280	56	IEEE 802.11a	OFDM	9.0	8.22	0.13	0 mm	354416050078799	6	back	1:1	0.374	1.197	0.448	
5320	64	IEEE 802.11a	OFDM	9.0	8.31	0.19	0 mm	354416050078799	6	back	1:1	0.414	1.172	0.485	
5320	64	IEEE 802.11a	OFDM	9.0	8.31	-0.14	0 mm	354416050078799	6	top	1:1	0.288	1.172	0.338	
5320	64	IEEE 802.11a	OFDM	9.0	8.31	-0.13	0 mm	354416050078799	6	right	1:1	0.188	1.172	0.220	
5540	108	IEEE 802.11a	OFDM	9.0	8.35	0.17	0 mm	354416050078799	6	back	1:1	0.452	1.161	0.525	
5580	116	IEEE 802.11a	OFDM	9.0	8.54	0.14	0 mm	354416050078799	6	back	1:1	0.885	1.112	0.984	A14
5680	136	IEEE 802.11a	OFDM	9.0	8.76	0.01	0 mm	354416050078799	6	back	1:1	0.853	1.057	0.902	
5540	108	IEEE 802.11a	OFDM	9.0	8.35	-0.13	0 mm	354416050078799	6	top	1:1	0.530	1.161	0.615	
5580	116	IEEE 802.11a	OFDM	9.0	8.54	-0.11	0 mm	354416050078799	6	top	1:1	0.746	1.112	0.830	
5680	136	IEEE 802.11a	OFDM	9.0	8.76	-0.13	0 mm	354416050078799	6	top	1:1	0.815	1.057	0.861	
5680	136	IEEE 802.11a	OFDM	9.0	8.76	0.18	0 mm	354416050078799	6	right	1:1	0.138	1.057	0.146	
5580	116	IEEE 802.11a	OFDM	9.0	8.54	0.15	0 mm	354416050078799	6	back	1:1	0.790	1.112	0.878	
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: Data highlighted in blue is collected for variability purposes; see section 12 for more details.

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Table 10-10
DSS Body SAR Data

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	11.5	11.25	0.14	0 mm	354416050077478	1	back	1:1	0.008	1.059	0.008	A15
2402	0	Bluetooth	FHSS	11.5	11.25	0.11	0 mm	354416050077478	1	top	1:1	0.002	1.059	0.002	
2402	0	Bluetooth	FHSS	11.5	11.25	0.15	0 mm	354416050077478	1	right	1:1	0.000	1.059	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 FCC KDB Publication 616217 D04.
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 top and right edge for the BT/WLAN antenna.
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. This device uses an IR sensor to reduce powers of voice/data modes in held-to-ear configurations. Therefore, all head SAR tests were performed at reduced power levels for GSM/UMTS.

GSM Test Notes:

1. Justification for reduced test configurations per KDB Publication 941225 D03v01: The source-based time-averaged output power was evaluated for all multi-slot operations. The multi-slot configuration with the highest frame averaged output power was evaluated for SAR.
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 $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel must be used.

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UMTS Notes:

1. UMTS mode in Body SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v02. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.
2. Per FCC KDB Publication 447498 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 $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel must be used.

IEEE 802.11 Notes:

1. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and April 2010 FCC/TCB Meeting Notes for 2.4 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11b. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
2. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and April 2010 FCC/TCB Meeting Notes for 5 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11a. Other IEEE 802.11 modes (including 802.11n 20 MHz and 40 MHz bandwidths) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
3. WIFI transmission was verified using an uncalibrated spectrum analyzer.
4. Since the maximum extrapolated peak SAR of the zoom scan for the maximum output channel was greater 1.6 W/kg or the reported 1g averaged SAR was greater than 0.8 W/kg, SAR testing on other default (or corresponding) channels were required for SAR.
5. There is no power reduction mechanism applied for WIFI/BT modes.

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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, 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.

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

Table 11-1

Estimated SAR for Bluetooth LE at Separation Distances of 6 mm (Back SAR) 5 mm (Top, Right Edges, and Back Touching) and >50 mm (Bottom and Left Edge)

Mode	Configuration	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
		[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth LE	Top, Right Edge and Back Touching	2441	7.50	5	0.250
Bluetooth LE	Back	2441	7.50	6	0.208
Bluetooth LE	Bottom and Left Edge	2440	7.50	>50	0.400

For configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion since the test separation distance was >50 mm.

11.3 Head SAR Simultaneous Transmission Analysis

Table 11-1

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)	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.319	0.001	0.320	Head SAR	Right Cheek	0.243	0.001	0.244
	Right Tilt	0.314	0.001	0.315		Right Tilt	0.237	0.001	0.238
	Left Cheek	0.064	0.013	0.077		Left Cheek	0.070	0.013	0.083
	Left Tilt	0.073	0.011	0.084		Left Tilt	0.075	0.011	0.086
Simult Tx	Configuration	GSM 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.526	0.001	0.527	Head SAR	Right Cheek	0.775	0.001	0.776
	Right Tilt	0.504	0.001	0.505		Right Tilt	0.703	0.001	0.704
	Left Cheek	0.157	0.013	0.170		Left Cheek	0.228	0.013	0.241
	Left Tilt	0.166	0.011	0.177		Left Tilt	0.248	0.011	0.259

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Table 11-2
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)	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.319	0.050	0.369	Head SAR	Right Cheek	0.243	0.050	0.293
	Right Tilt	0.314	0.068	0.382		Right Tilt	0.237	0.068	0.305
	Left Cheek	0.064	0.233	0.297		Left Cheek	0.070	0.233	0.303
	Left Tilt	0.073	0.251	0.324		Left Tilt	0.075	0.251	0.326
Simult Tx	Configuration	GSM 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.526	0.050	0.576	Head SAR	Right Cheek	0.775	0.050	0.825
	Right Tilt	0.504	0.068	0.572		Right Tilt	0.703	0.068	0.771
	Left Cheek	0.157	0.233	0.390		Left Cheek	0.228	0.233	0.461
	Left Tilt	0.166	0.251	0.417		Left Tilt	0.248	0.251	0.499

11.4 Body SAR Simultaneous Transmission Analysis

Table 11-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body at 0 mm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.545	0.086	0.631	Body SAR	Back	0.265	0.086	0.351
	Top	0.286	0.040	0.326		Top	0.140	0.040	0.180
	Bottom	0.400	0.400	0.800		Bottom	0.400	0.400	0.800
	Right	0.400	0.014	0.414		Right	0.400	0.014	0.414
	Left	0.183	0.400	0.583		Left	0.166	0.400	0.566
Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.724	0.086	0.810	Body SAR	Back	0.607	0.086	0.693
	Top	0.661	0.040	0.701		Top	0.646	0.040	0.686
	Bottom	0.400	0.400	0.800		Bottom	0.400	0.400	0.800
	Right	0.400	0.014	0.414		Right	0.400	0.014	0.414
	Left	0.320	0.400	0.720		Left	0.211	0.400	0.611

Table 11-5
Simultaneous Transmission Scenario with 5 GHz WLAN (Body at 0 mm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	5 GHz WLAN SAR (W/Kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/Kg)	Σ SAR (W/kg)
Body SAR	Back	0.545	0.984	1.529	Body SAR	Back	0.265	0.984	1.249
	Top	0.286	0.861	1.147		Top	0.140	0.861	1.001
	Bottom	0.400	0.400	0.800		Bottom	0.400	0.400	0.800
	Right	0.400	0.220	0.620		Right	0.400	0.220	0.620
	Left	0.183	0.400	0.583		Left	0.166	0.400	0.566

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/Kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/Kg)	Σ SAR (W/kg)
Body SAR	Back	0.724	0.984	See Note 1	<.03	Body SAR	Back	0.607	0.984	1.591
	Top	0.661	0.861	1.522	N/A		Top	0.646	0.861	1.507
	Bottom	0.400	0.400	0.800	N/A		Bottom	0.400	0.400	0.800
	Right	0.400	0.220	0.620	N/A		Right	0.400	0.220	0.620
	Left	0.320	0.400	0.720	N/A		Left	0.211	0.400	0.611

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Table 11-6
Simultaneous Transmission Scenario with Bluetooth (Body at 0 mm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/Kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	Bluetooth SAR (W/Kg)	Σ SAR (W/kg)
Body SAR	Back	0.545	0.250	0.795	Body SAR	Back	0.265	0.250	0.515
	Top	0.286	0.250	0.536		Top	0.140	0.250	0.390
	Bottom	0.400	0.400	0.800		Bottom	0.400	0.400	0.800
	Right	0.400	0.250	0.650		Right	0.400	0.250	0.650
	Left	0.183	0.400	0.583		Left	0.166	0.400	0.566
Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/Kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	Bluetooth SAR (W/Kg)	Σ SAR (W/kg)
Body SAR	Back	0.724	0.250	0.974	Body SAR	Back	0.607	0.250	0.857
	Top	0.661	0.250	0.911		Top	0.646	0.250	0.896
	Bottom	0.400	0.400	0.800		Bottom	0.400	0.400	0.800
	Right	0.400	0.250	0.650		Right	0.400	0.250	0.650
	Left	0.320	0.400	0.720		Left	0.211	0.400	0.611

Note: Estimated Bluetooth LE SAR at 5 mm for back, top and right was used to evaluate the simultaneous sums, see table 11-1. For bottom and left edges, which are configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion since the test separation distance was >50 mm.

Table 11-7
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body Back Side at 6 mm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.415	<0.086	<0.501
Back Side	UMTS 850	0.510	<0.086	<0.596
Back Side	GSM 1900	1.074	<0.086	<1.160
Back Side	UMTS 1900	0.963	<0.086	<1.049

Table 11-8
Simultaneous Transmission Scenario with 5 GHz WLAN (Body Back Side at 6 mm)

Configuration	Mode	2G/3G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GSM 850	0.415	<0.984	<1.399	N/A
Back Side	UMTS 850	0.510	<0.984	<1.494	N/A
Back Side	GSM 1900	1.074	<0.984	See Note 1	<.04
Back Side	UMTS 1900	0.963	<0.984	See Note 1	<.03

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Table 11-9
Simultaneous Transmission Scenario with Bluetooth (Body Back Side at 6 mm)

Configuration	Mode	2G/3G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.415	0.208	0.623
Back Side	UMTS 850	0.510	0.208	0.718
Back Side	GSM 1900	1.074	0.208	1.282
Back Side	UMTS 1900	0.963	0.208	1.171

Note: Estimated Bluetooth LE SAR at 6 mm for back was used to evaluate the simultaneous sums, see table 11-1.

Table 11-10
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body Top Edge at 5 mm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Top Side	GSM 850	0.685	<0.04	<0.725
Top Side	UMTS 850	0.608	<0.04	<0.648
Top Side	GSM 1900	0.924	<0.04	<0.964
Top Side	UMTS 1900	0.747	<0.04	<0.787

Table 11-11
Simultaneous Transmission Scenario with 5 GHz WLAN (Body Top Edge at 5 mm)

Configuration	Mode	2G/3G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Side	GSM 850	0.685	<0.861	<1.546	N/A
Top Side	UMTS 850	0.608	<0.861	<1.469	N/A
Top Side	GSM 1900	0.924	<0.861	See Note 1	<.03
Top Side	UMTS 1900	0.747	<0.861	See Note 1	<.03

Table 11-12
Simultaneous Transmission Scenario with Bluetooth (Body Top Edge at 5 mm)

Configuration	Mode	2G/3G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Top Side	GSM 850	0.685	0.250	0.935
Top Side	UMTS 850	0.608	0.250	0.858
Top Side	GSM 1900	0.924	0.250	1.174
Top Side	UMTS 1900	0.747	0.250	0.997

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Notes:

1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was below 0.04 per FCC KDB 447498 D01v05. See Section 11.5 for detailed SPLS ratio analysis.
2. For configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion since the test separation distance was >50 mm.
3. For SAR summations for body top edge at 5 mm, WLAN SAR values for 0.0 cm were used since the 0.0 cm test distance for WLAN was more conservative. "<" denotes that the 0.0 cm WLAN SAR values were used for summation purposes.
4. For SAR summations for body back at 6 mm, WLAN SAR values for 0.0 cm were used since the 0.0 cm test distance for WLAN was more conservative. "<" denotes that the 0.0 cm WLAN SAR values were used for summation purposes.
5. Estimated SAR for Bluetooth LE was used in Table 11-6, 11-9 and 11-12, instead of measured Bluetooth SAR, since estimated SAR for Bluetooth LE represent the worst case scenarios during simultaneous transmission.
6. Per FCC KDB 616217 D04 4.3, when voice mode is limited to speaker mode or headset operations only, 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.

$$\text{Distance}_{\text{Tx1} - \text{Tx2}} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$

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

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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 6 mm with GPRS 1900 antenna operating at maximum output power with 5 GHz WIFI.

Table 11-13
Peak SAR Locations for Body Back Side at 6 mm GPRS 1900 and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)	z (mm)
IEEE 802.11a	-69.03	98.00	-207.65
GPRS 1900	11.00	107.00	-199.00

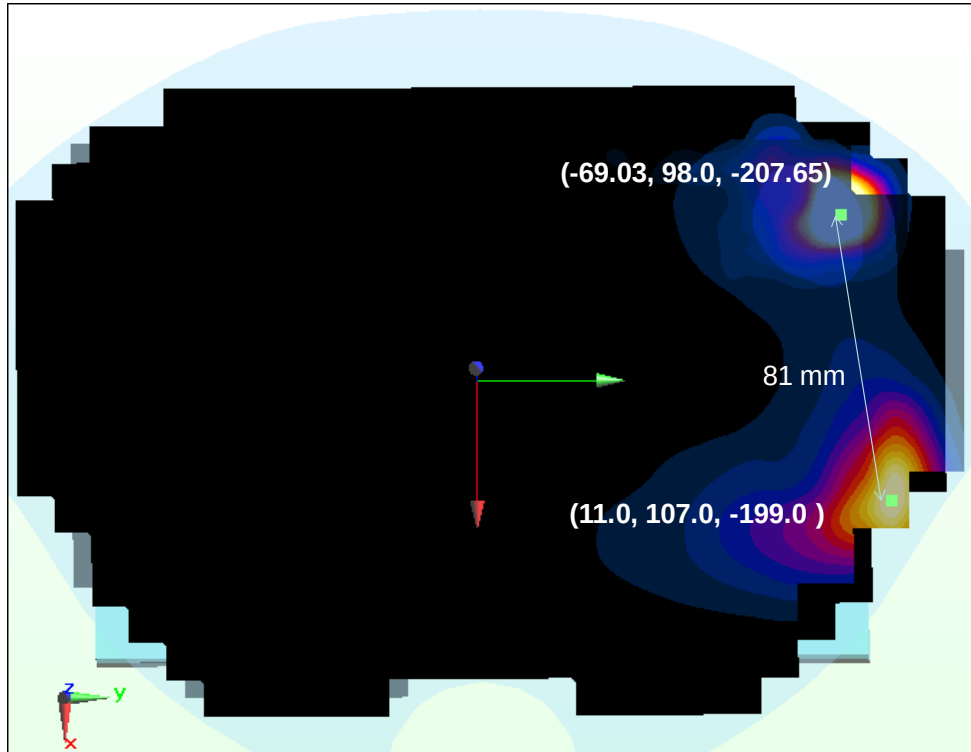


Figure 11-1
Peak SAR Locations of 5 GHz WLAN and GPRS 1900

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}
IEEE 802.11a	GPRS 1900	<.984	1.074	<2.058	81	<0.04

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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 operating at reduced output power with 5 GHz WIFI.

Table 11-15
Peak SAR Locations for Body Back Side at 0 mm GPRS 1900 and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)	z (mm)
IEEE 802.11a	-69.03	98.00	-207.65
GPRS 1900	2.97	115.00	-199.00

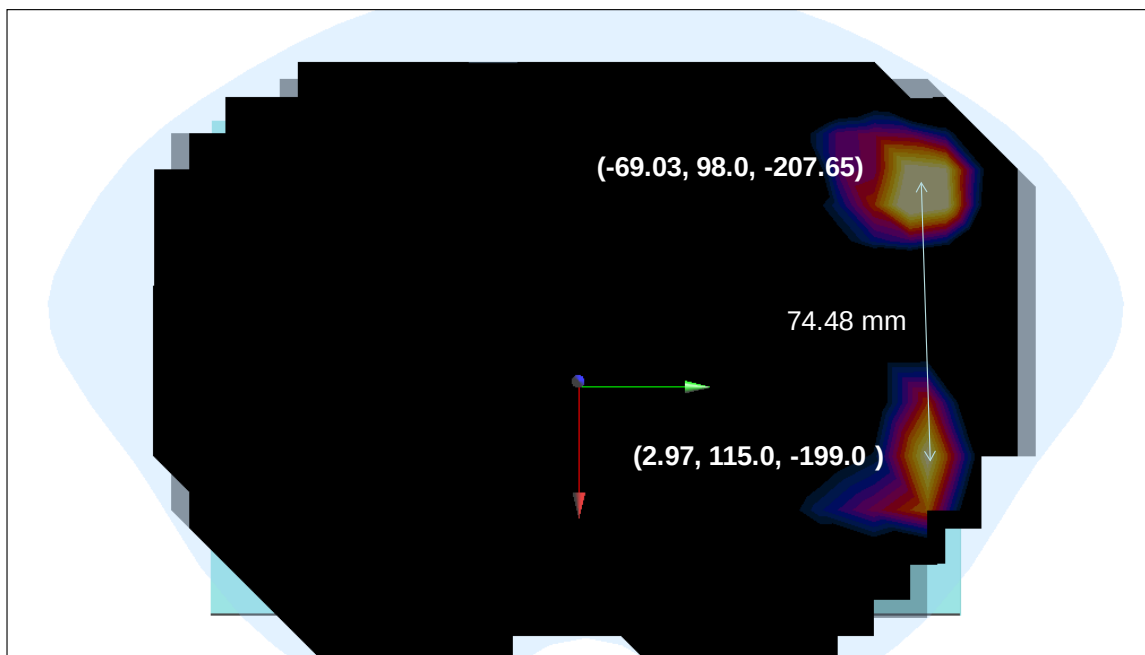


Figure 11-2
Peak SAR Locations of 5 GHz WLAN and GPRS 1900

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}	$(a+b)^{1.5}/D_{a-b}$
IEEE 802.11a	GPRS 1900	0.984	0.724	1.708	74.48	<0.03

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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 6 mm with UMTS 1900 operating at maximum output power with 5 GHz WIFI.

Table 11-17
Peak SAR Locations for Body Back Side at 6 mm UMTS 1900 and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)	z (mm)
IEEE 802.11a	-69.03	98.00	-207.65
UMTS 1900	15.00	95.00	-199.00

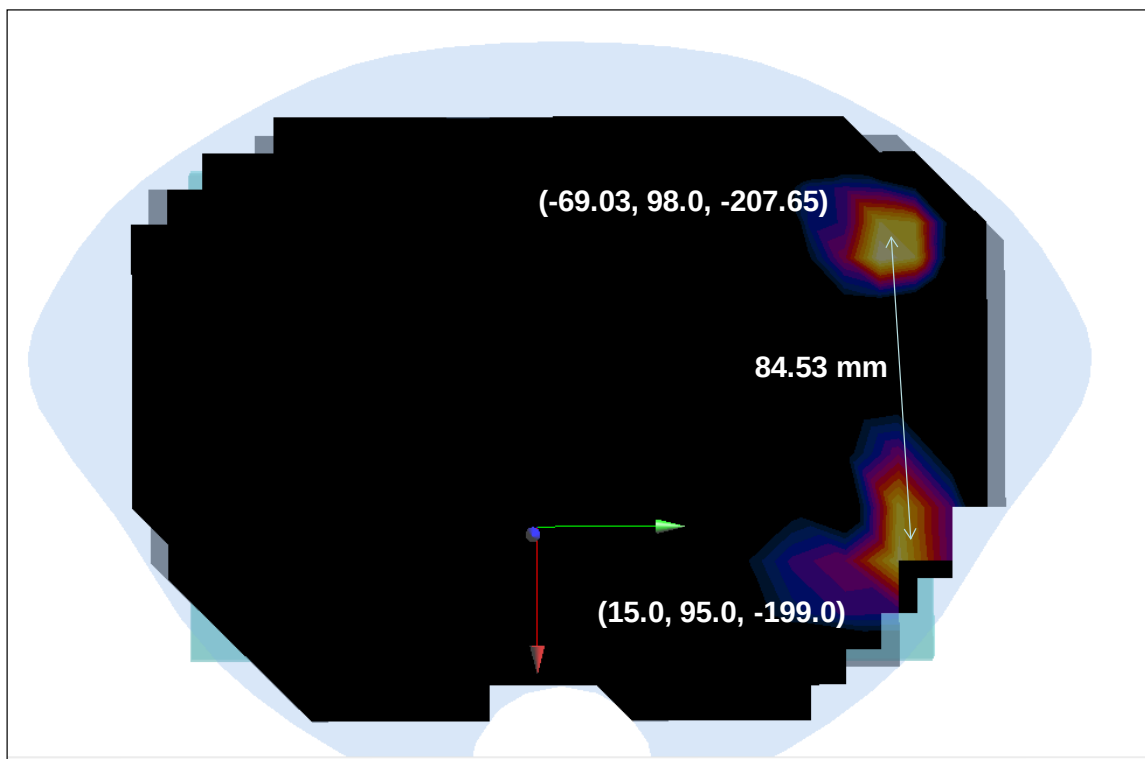


Figure 11-3
Peak SAR Locations of 5 GHz WLAN and UMTS 1900

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}	$(a+b)^{1.5}/D_{a-b}$
IEEE 802.11a	UMTS 1900	<.984	0.963	<1.947	84.53	<0.03

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Top Edge configuration at a separation distance of 5 mm with GPRS 1900 operating at maximum output power with 5 GHz WIFI.

Table 11-19
Peak SAR Locations for Body Top Edge at 5 mm GPRS 1900 and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)	z (mm)
IEEE 802.11a	-18.00	43.00	-207.00
GPRS 1900	-19.00	-31.50	-199.00

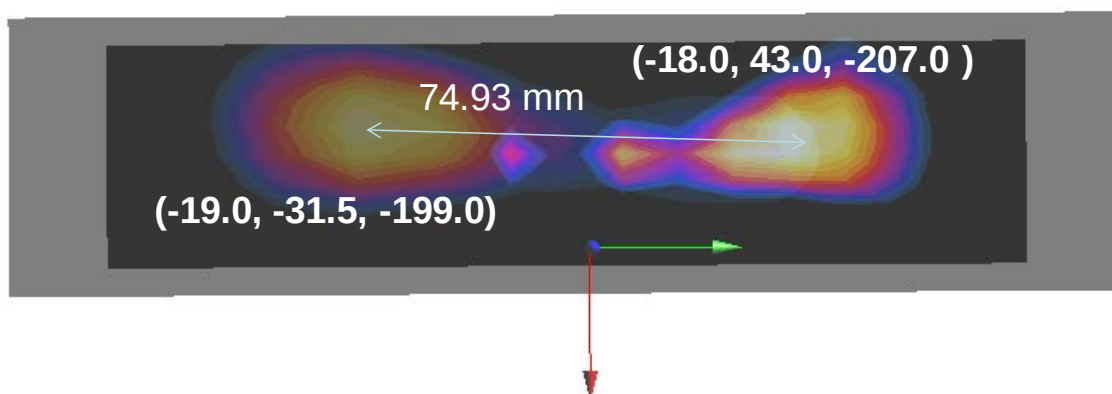


Figure 11-4
Peak SAR Locations of 5 GHz WLAN and GPRS 1900

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}	$(a+b)^{1.5}/D_{a-b}$
IEEE 802.11a	GPRS 1900	<.861	0.924	<1.785	74.93	<0.03

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Top Edge configuration at a separation distance of 5 mm with UMTS 1900 operating at maximum output power with 5 GHz WIFI.

Table 11-21
Peak SAR Locations for Body Top Edge at 5 mm UMTS 1900 and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)	z (mm)
IEEE 802.11a	-18.00	43.00	-207.00
UMTS 1900	-19.99	-34.49	-198.92

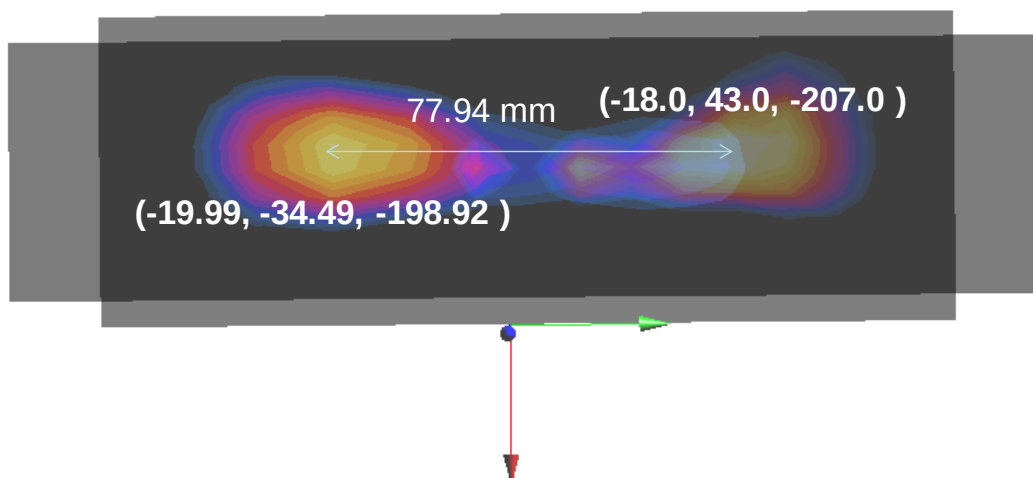


Figure 11-5
Peak SAR Locations of 5 GHz WLAN and UMTS 1900

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}
IEEE 802.11a	UMTS 1900	<.861	0.747	<1.608	77.94	<0.03

11.6 Simultaneous Transmission Conclusion

The above numerical summed SAR results and SPLSR analysis are sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01_v05.

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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 performed 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															
Tissue	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 Body	1909.80	810	GSM 1900	GPRS	1	N/A	back	6 mm	1.040	1.010	1.0	N/A	N/A	N/A	N/A
5800 Body	5825.00	165	IEEE 802.11a	OFDM	N/A	6	back	0 mm	0.856	0.865	1.0	N/A	N/A	N/A	N/A
5600 Body	5580.00	116	IEEE 802.11a	OFDM	N/A	6	back	0 mm	0.885	0.790	1.1	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body							
Spatial Peak								1.6 W/kg (mW/g)							
Uncontrolled Exposure/General Population								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 standard 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	8648D	(9kHz-4GHz) Signal Generator	10/10/2012	Annual	10/10/2013	3613A00315
Agilent	8753E	(30kHz-6GHz) Network Analyzer	4/4/2012	Annual	4/4/2013	JP38020182
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/5/2012	Annual	4/5/2013	MY45470194
Agilent	8753E	(30kHz-6GHz) Network Analyzer	4/3/2012	Annual	4/3/2013	US37390350
Agilent	85070E	Dielectric Probe Kit	3/8/2012	Annual	3/8/2013	MY44300633
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00579
Agilent	MA24106A	USB Power Sensor	12/7/2012	Annual	12/7/2013	1244524
Agilent	MA24106A	USB Power Sensor	12/7/2012	Annual	12/7/2013	1244515
Amplifier Research	551G4	5W, 800MHz-4.2GHz	CBT	N/A	CBT	21910
Anritsu	MA2411B	Power Sensor	3/5/2012	Annual	3/5/2013	846215
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	5318
Anritsu	ML2438A	Power Meter	2/14/2012	Annual	2/14/2013	1190013
Anritsu	ML2438A	Power Meter	2/14/2012	Annual	2/14/2013	98150041
Anritsu	MT8820C	Radio Communication Tester	11/6/2012	Annual	11/6/2013	6200901190
Anritsu	MA24106A	USB Power Sensor	8/22/2012	Annual	8/22/2013	1231538
Anritsu	ML2496A	Power Meter	11/28/2012	Annual	11/28/2013	1138001
Anritsu	MA2411B	Pulse Power Sensor	12/5/2012	Annual	12/5/2013	1126066
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
COMTECH	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M155A00-009
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	5/22/2012	Annual	5/22/2013	109892
Rohde & Schwarz	NRVD	Dual Channel Power Meter	10/12/2012	Biennial	10/12/2014	101695
Rohde & Schwarz	NRV-232	Peak Power Sensor	10/12/2012	Biennial	10/12/2014	836019/013
Rohde & Schwarz	SMIQ03B	Signal Generator	4/5/2012	Annual	4/5/2013	DE27259
Seekonk	NC-100	Torque Wrench (8" lb)	3/5/2012	Triennial	3/5/2015	N/A
SPEAG	D1900V2	1900 MHz SAR Dipole	2/22/2012	Annual	2/22/2013	502
SPEAG	D2450V2	2450 MHz SAR Dipole	8/23/2012	Annual	8/23/2013	719
SPEAG	D5GH2V2	5 GHz SAR Dipole	10/30/2012	Annual	10/30/2013	1007
SPEAG	D835V2	835 MHz SAR Dipole	1/25/2012	Annual	1/25/2013	4d047
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/20/2012	Annual	2/20/2013	649
SPEAG	ES3DV2	SAR Probe	8/28/2012	Annual	8/28/2013	3022
SPEAG	EX3DV4	SAR Probe	7/26/2012	Annual	7/26/2013	3561
SPEAG	ES3DV3	SAR Probe	3/16/2012	Annual	3/16/2013	3209
SPEAG	ES3DV3	SAR Probe	2/21/2012	Annual	2/21/2013	3258
SPEAG	ES3DV3	SAR Probe	5/18/2012	Annual	5/18/2013	3263
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/18/2012	Annual	1/18/2013	1272
SPEAG	D1900V2	1900 MHz SAR Dipole	4/26/2012	Annual	4/26/2013	5d141
SPEAG	D835V2	835 MHz SAR Dipole	4/20/2012	Annual	4/20/2013	4d119
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/19/2012	Annual	9/19/2013	1323
SPEAG	ES3DV3	SAR Probe	9/20/2012	Annual	9/20/2013	3288
SPEAG	D2450V2	2450 MHz SAR Dipole	2/7/2012	Annual	2/7/2013	882
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/13/2012	Annual	11/13/2013	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/24/2012	Annual	8/24/2013	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/7/2012	Annual	5/7/2013	1334
SPEAG	DAK-3.5	Dielectric Assessment Kit	6/19/2012	Annual	6/19/2013	1070
SPEAG	DAK-3.5	Dielectric Assessment Kit	12/11/2012	Annual	12/11/2013	1091
Tektronix	RSA-6114A	Real Time Spectrum Analyzer	4/5/2012	Annual	4/5/2013	B010177
VWR	36934-158	Wall-Mounted Thermometer	1/21/2011	Biennial	1/21/2013	111286445
VWR	36934-158	Wall-Mounted Thermometer	1/21/2011	Biennial	1/21/2013	111286460
VWR	62344-925	Mini-Thermometer	10/24/2011	Biennial	10/24/2013	111886443
VWR	62344-925	Mini-Thermometer	10/24/2011	Biennial	10/24/2013	111886414
VWR	23226-658	Long Stem Thermometer	7/11/2012	Biennial	7/11/2014	122389330
VWR	23226-658	Long Stem Thermometer	5/16/2012	Biennial	5/16/2014	122295544

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

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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
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
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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 78799

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 0.91 \text{ mho/m}$; $\epsilon_r = 42.227$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-07-2013; Ambient Temp: 23.4°C; Tissue Temp: 20.5°C

Probe: ES3DV3 - SN3288; ConvF(6.41, 6.41, 6.41); Calibrated: 9/20/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

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

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

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

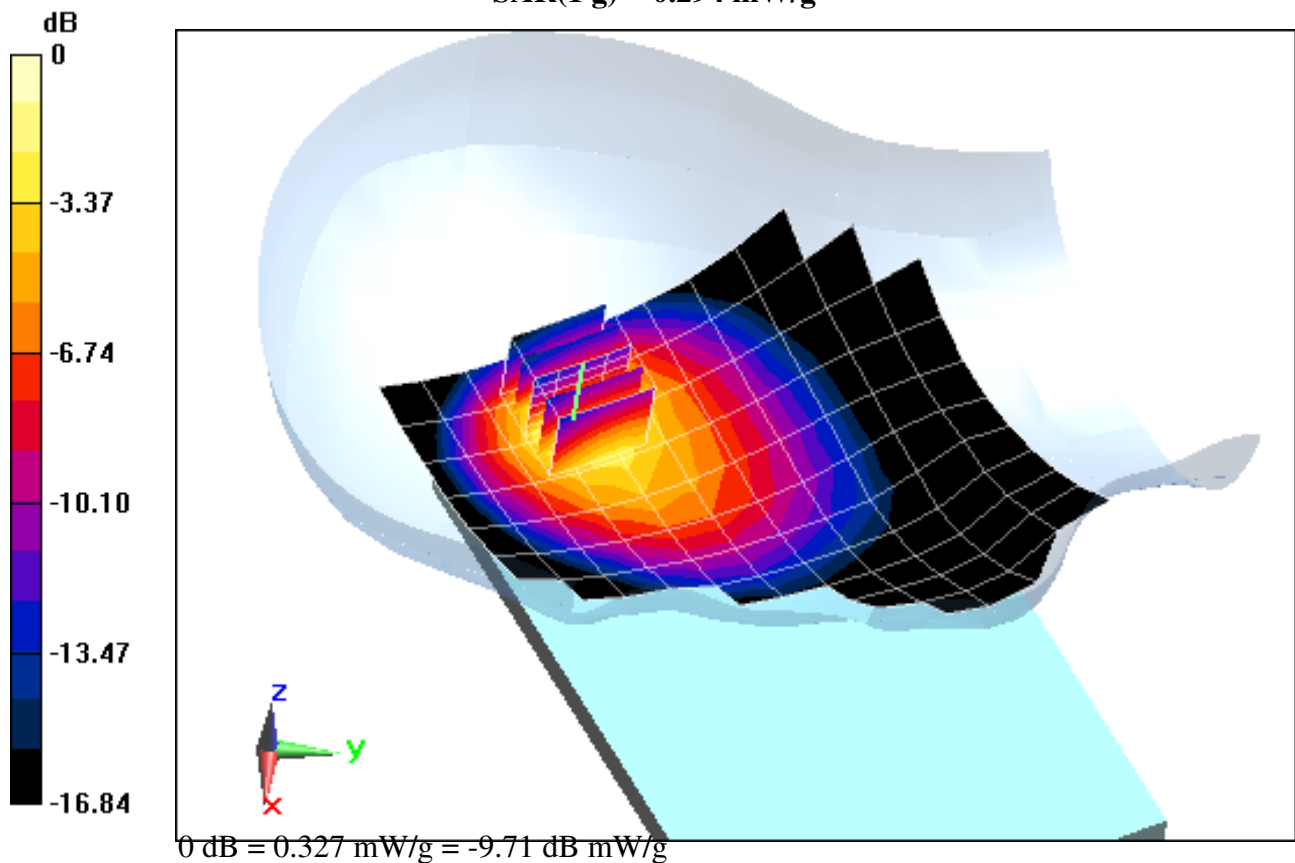
Area Scan (12x16x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 17.051 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.566 mW/g

SAR(1 g) = 0.294 mW/g



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 78799

Communication System: UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 0.91 \text{ mho/m}$; $\epsilon_r = 42.227$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-07-2013; Ambient Temp: 23.4°C; Tissue Temp: 20.5°C

Probe: ES3DV3 - SN3288; ConvF(6.41, 6.41, 6.41); Calibrated: 9/20/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

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

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

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

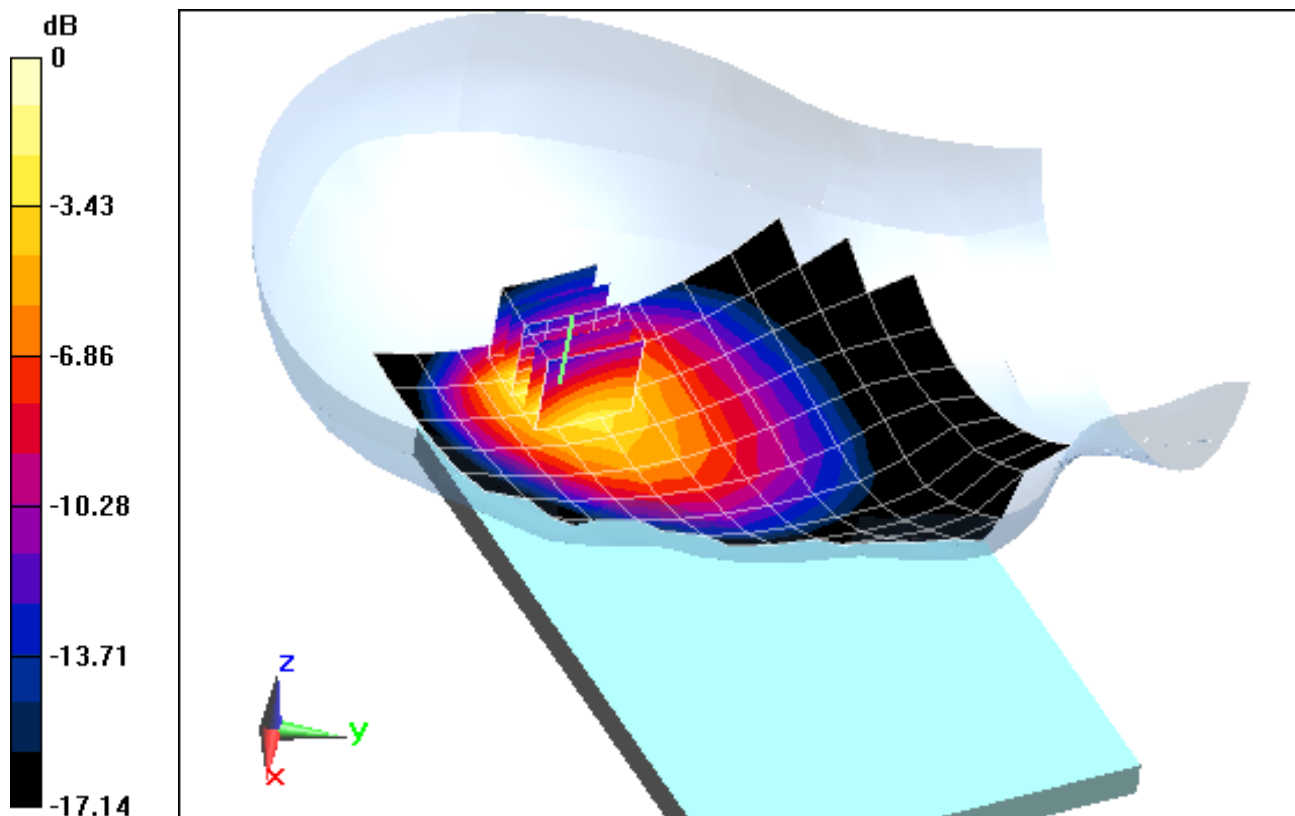
Area Scan (12x16x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 14.374 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.434 mW/g

SAR(1 g) = 0.226 mW/g



0 dB = 0.260 mW/g = -11.70 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 78799

Communication System: GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium: 1900 Head Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.433 \text{ mho/m}$; $\epsilon_r = 38.47$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 12-27-2012; Ambient Temp: 23.4°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3209; ConvF(5.15, 5.15, 5.15); Calibrated: 3/16/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626

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

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

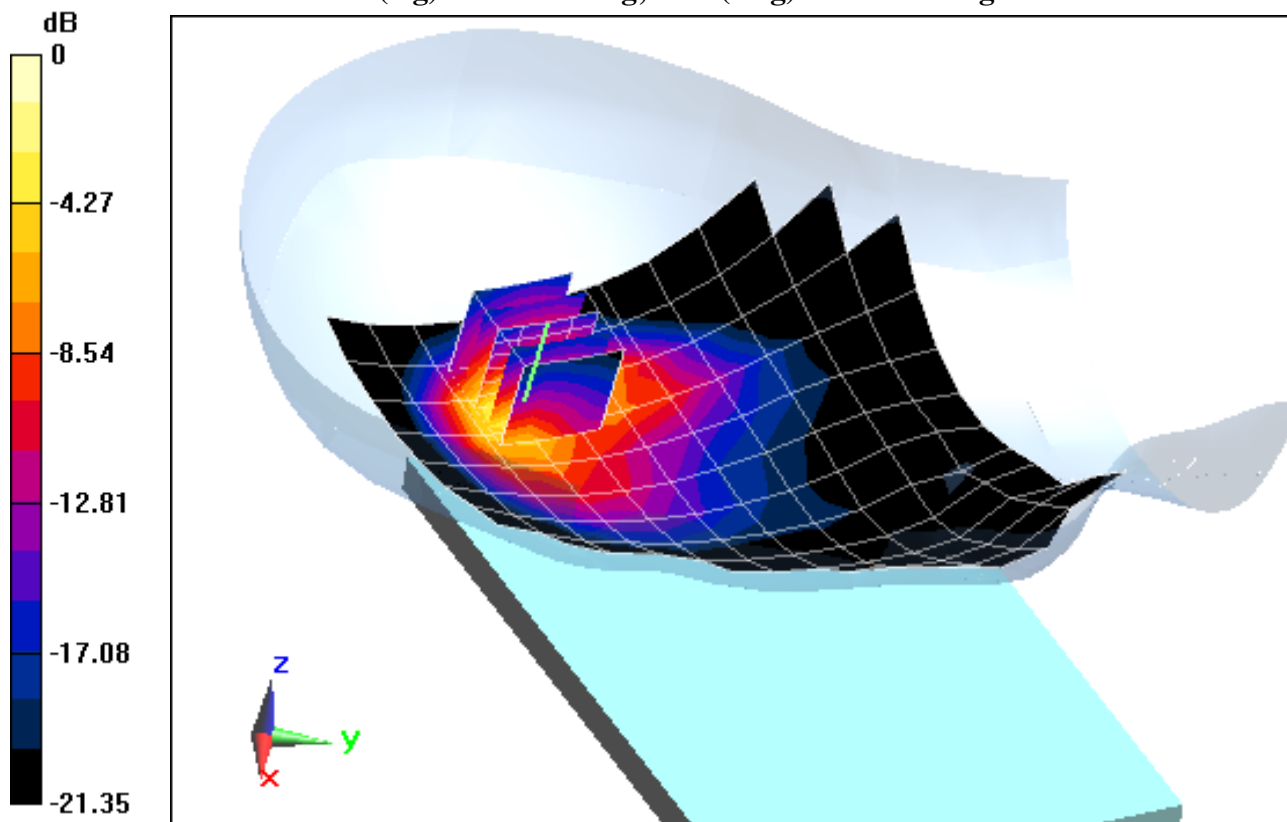
Area Scan (12x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 16.734 V/m; Power Drift = 0.17 dB

Peak SAR (extrapolated) = 0.965 mW/g

SAR(1 g) = 0.475 mW/g; SAR(10 g) = 0.219 mW/g



0 dB = 0.551 mW/g = -5.18 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 78799

Communication System: WCDMA1900; Frequency: 1907.6 MHz; Duty Cycle: 1:1

Medium: Medium parameters used (interpolated):

$f = 1907.6 \text{ MHz}$; $\sigma = 1.461 \text{ mho/m}$; $\epsilon_r = 38.378$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 12-27-2012; Ambient Temp: 23.4°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3209; ConvF(5.15, 5.15, 5.15); Calibrated: 3/16/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626

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

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

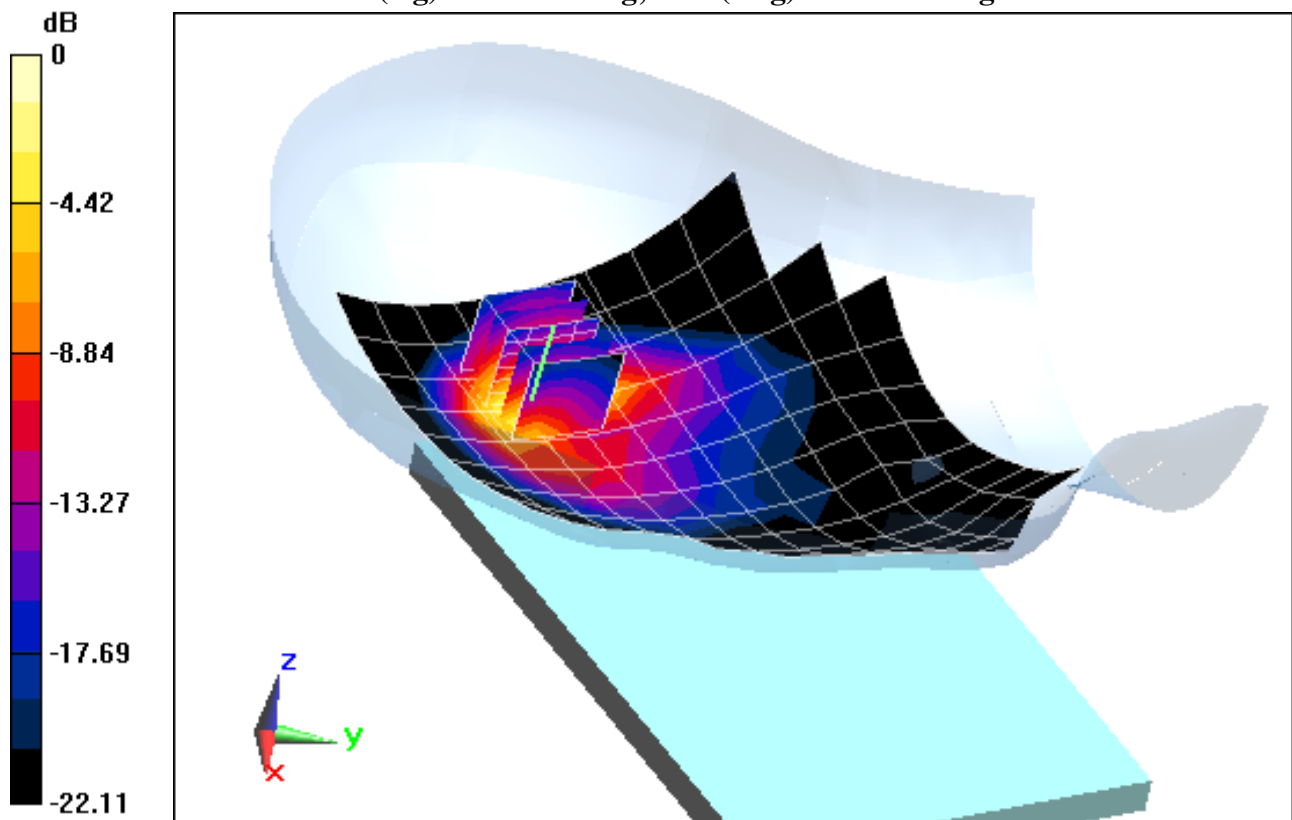
Area Scan (12x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 25.284 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 1.824 mW/g

SAR(1 g) = 0.907 mW/g; SAR(10 g) = 0.415 mW/g



0 dB = 1.06 mW/g = 0.51 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 354416050077478

Communication System: IEEE 802.11b; Frequency: 2462 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used (interpolated):

$f = 2462 \text{ MHz}$; $\sigma = 1.852 \text{ mho/m}$; $\epsilon_r = 39.161$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-03-2013; Ambient Temp: 20.8°C; Tissue Temp: 20.3°C

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

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

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

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

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

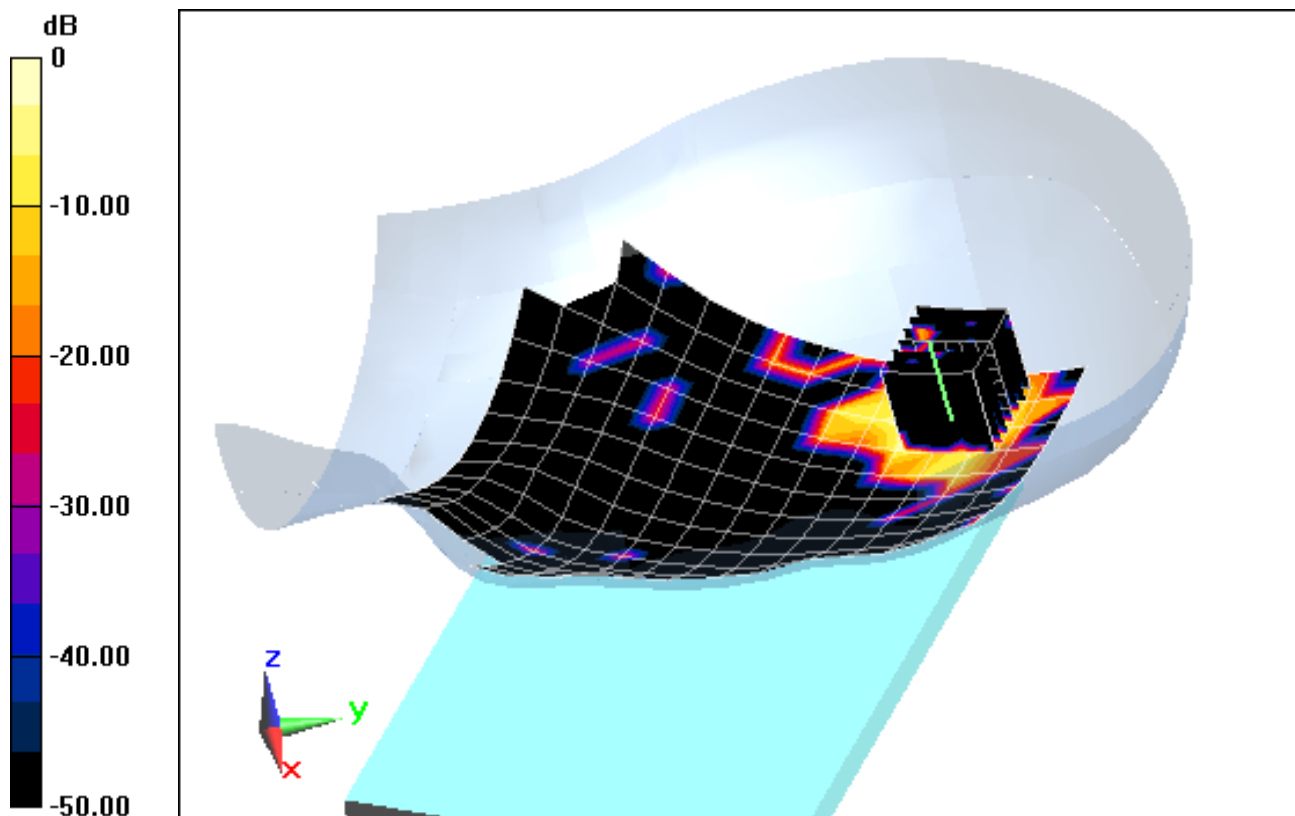
Area Scan (15x16x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 2.650 V/m; Power Drift = 0.20 dB

Peak SAR (extrapolated) = 0.034 mW/g

SAR(1 g) = 0.012 mW/g



0 dB = 0.0170 mW/g = -35.39 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 354416050078799

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

Medium: 5 GHz Head Medium parameters used:

$f = 5825 \text{ MHz}$; $\sigma = 5.496 \text{ mho/m}$; $\epsilon_r = 34.87$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-05-2013; Ambient Temp: 23.6°C; Tissue Temp: 20.4°C

Probe: EX3DV4 - SN3561; ConvF(3.92, 3.92, 3.92); Calibrated: 7/26/2012;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

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

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

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

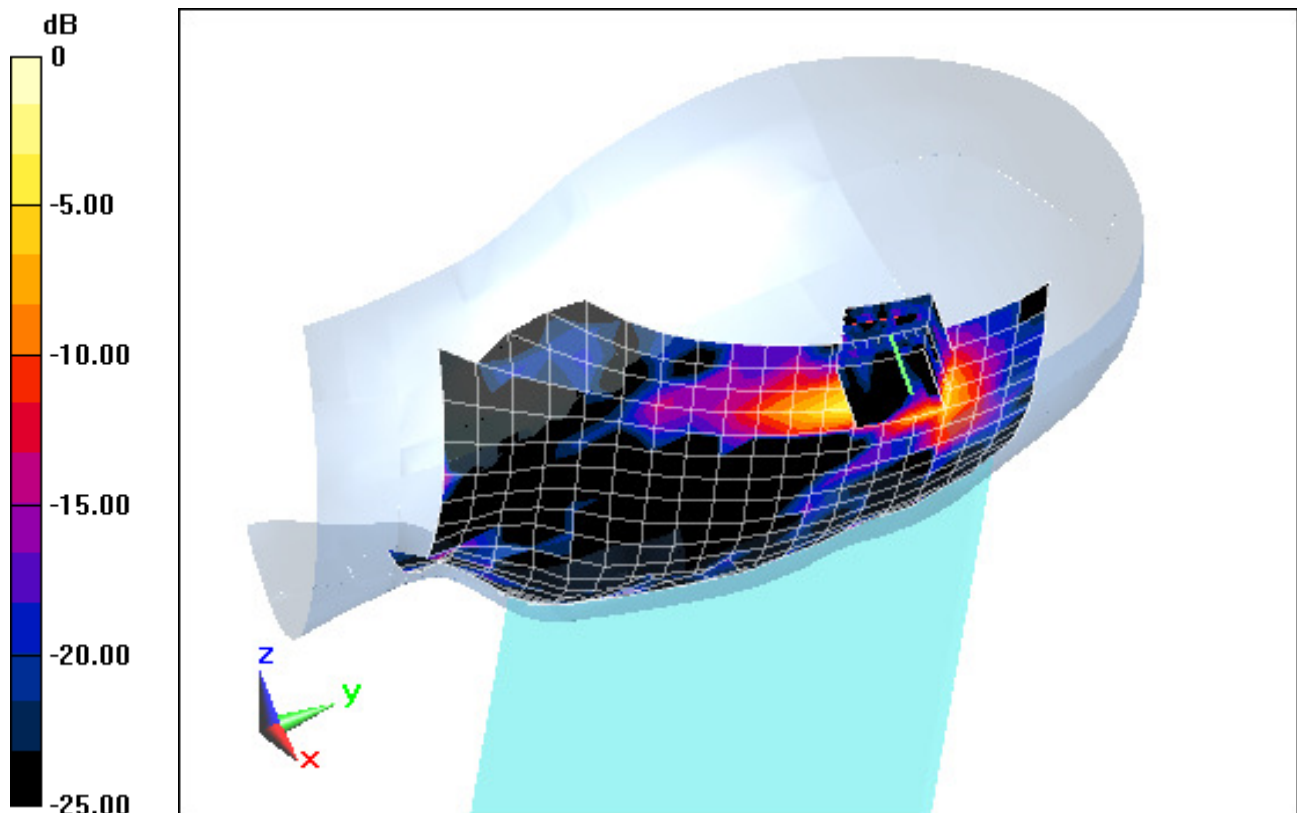
Area Scan (19x27x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio 1:4

Reference Value = 6.165 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 1.393 mW/g

SAR(1 g) = 0.216 mW/g; SAR(10 g) = 0.066 mW/g



0 dB = 0.585 mW/g = -4.66 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 354416050078799

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5680 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5680 \text{ MHz}$; $\sigma = 5.324 \text{ mho/m}$; $\epsilon_r = 35.26$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-05-2013; Ambient Temp: 23.2°C; Tissue Temp: 20.2°C

Probe: EX3DV4 - SN3561; ConvF(4, 4, 4); Calibrated: 7/26/2012,

Sensor-Surface: Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

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

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

Mode: IEEE 802.11a, 5.5 GHz Left Head, Tilt, Ch 136, 6 Mbps

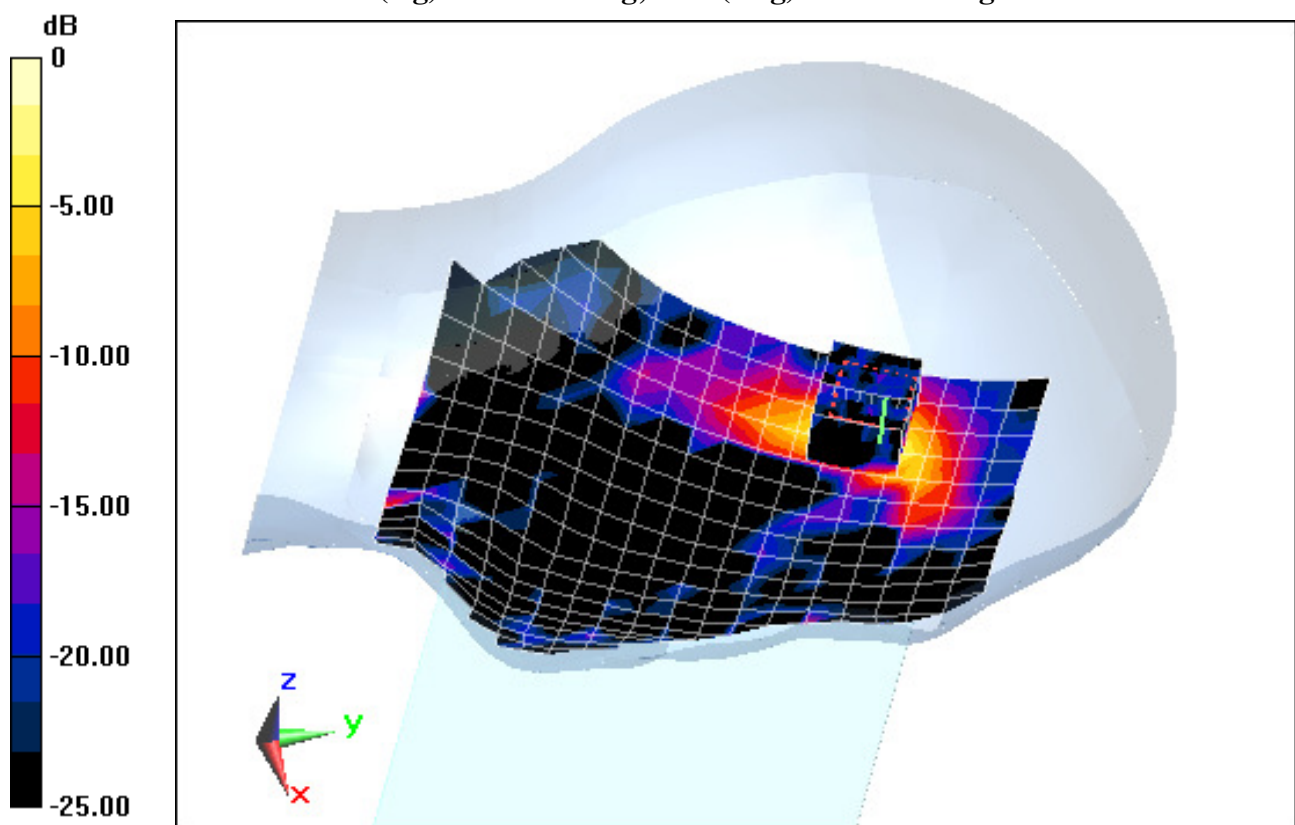
Area Scan (11x17x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio 1:4

Reference Value = 6.374 V/m; Power Drift = 0.15 dB

Peak SAR (extrapolated) = 1.182 mW/g

SAR(1 g) = 0.237 mW/g; SAR(10 g) = 0.075 mW/g



0 dB = 0.631 mW/g = -4.00 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 78666

Communication System: GSM 850 GPRS; 2 Tx slots; Frequency: 836.6 MHz; Duty Cycle: 1:4.15

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 1.008 \text{ mho/m}$; $\epsilon_r = 54.125$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 5 mm

Test Date: 12-28-2012; Ambient Temp: 23.2°C; Tissue Temp: 21.7°C

Probe: ES3DV3 - SN3258; ConvF(6.06, 6.06, 6.06); Calibrated: 2/21/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

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

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

Mode: GPRS 850, Body SAR, Top Edge, Mid.ch, 2 Tx Slots

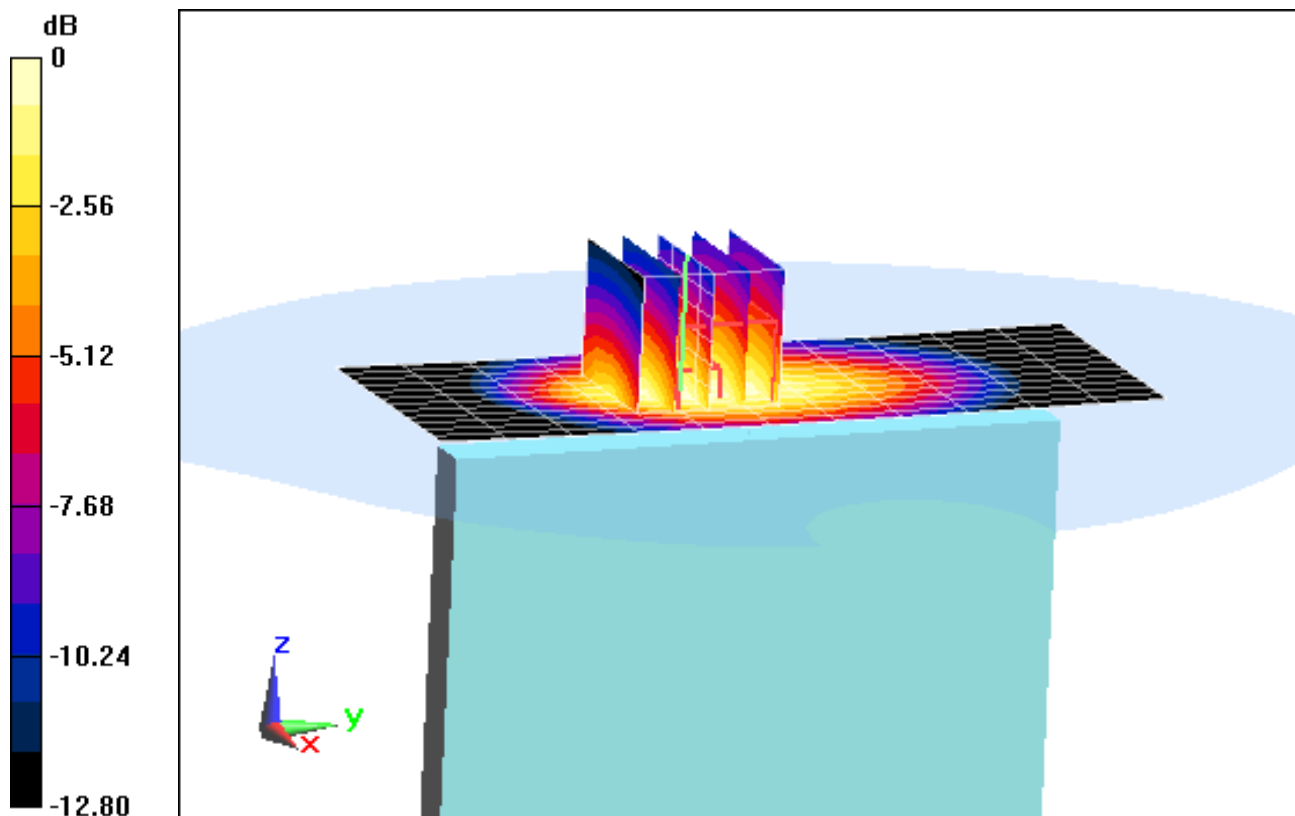
Area Scan (13x12x1): Measurement grid: $dx=5\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 27.107 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 1.042 mW/g

SAR(1 g) = 0.684 mW/g; SAR(10 g) = 0.440 mW/g



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 78666

Communication System: WCDMA850; Frequency: 836.6 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 1.008 \text{ mho/m}$; $\epsilon_r = 54.125$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space 5 mm

Test Date: 12-28-2012; Ambient Temp: 23.2°C; Tissue Temp: 21.7°C

Probe: ES3DV3 - SN3258; ConvF(6.06, 6.06, 6.06); Calibrated: 2/21/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

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

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

Mode: UMTS 850, Body SAR, Top Edge, Mid.ch

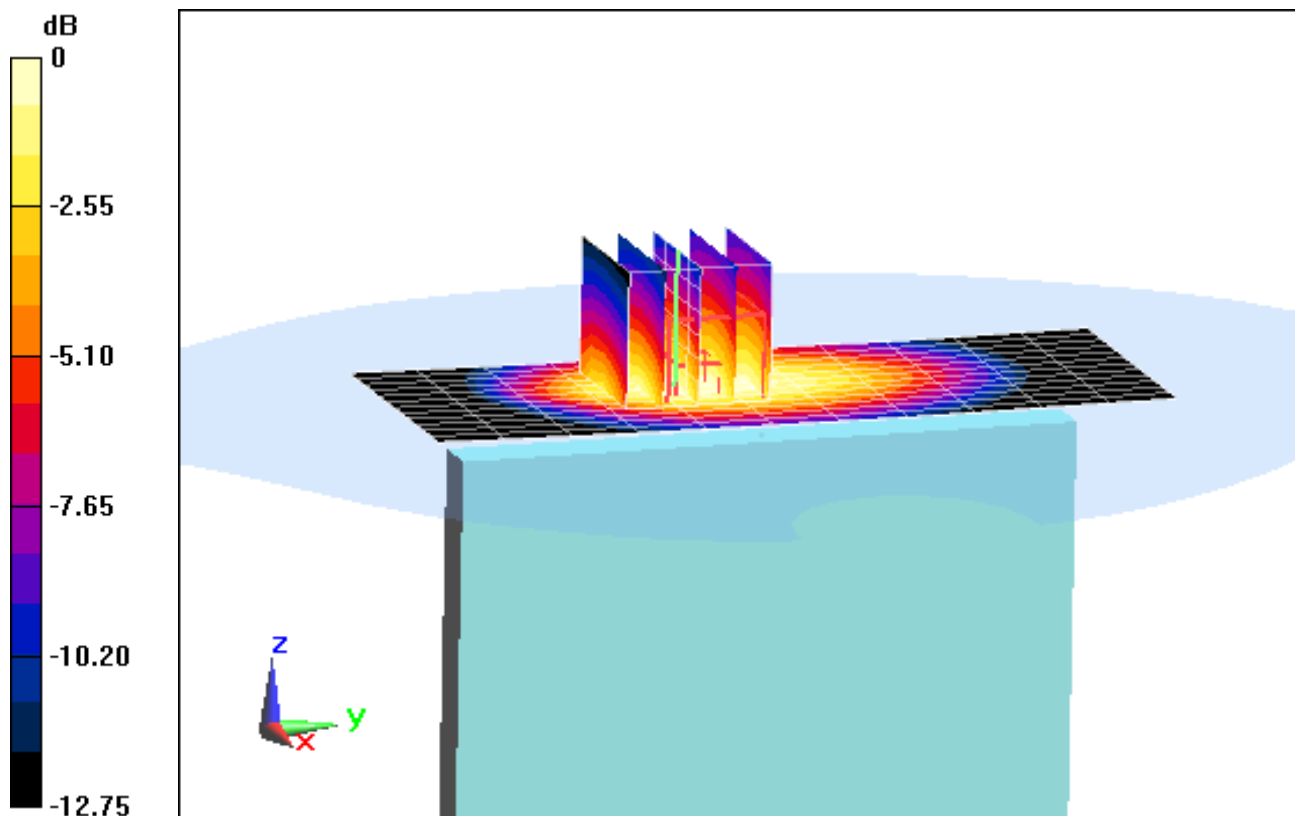
Area Scan (13x12x1): Measurement grid: $dx=5\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 24.263 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.829 mW/g

SAR(1 g) = 0.548 mW/g; SAR(10 g) = 0.354 mW/g



0 dB = 0.591 mW/g = -4.57 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 78666

Communication System: GSM1900 GPRS; 1 Tx slots; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3

Medium: 1900 Body Medium parameters used:

$f = 1910 \text{ MHz}$; $\sigma = 1.527 \text{ mho/m}$; $\epsilon_r = 51.06$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 6 mm

Test Date: 01-02-2013; Ambient Temp: 23.9°C; Tissue Temp: 22.0°C

Probe: ES3DV2 - SN3022; ConvF(4.43, 4.43, 4.43); Calibrated: 8/28/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

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

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

Mode: GPRS 1900, Body SAR, Back side, High ch, 1 Tx Slots

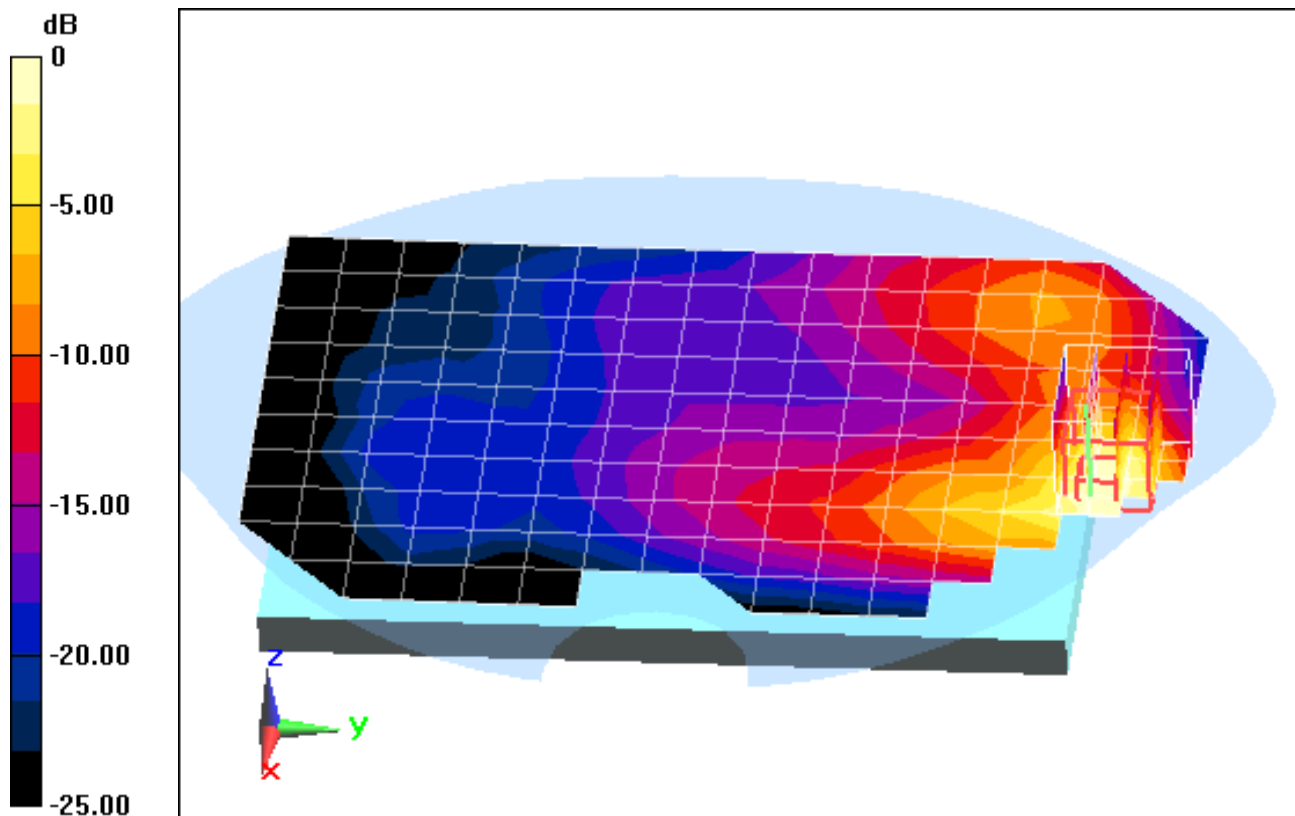
Area Scan (11x17x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 24.624 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 1.855 mW/g

SAR(1 g) = 1.04 mW/g; SAR(10 g) = 0.484 mW/g



0 dB = 1.15 mW/g = 1.21 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 78666

Communication System: WCDMA1900; Frequency: 1907.6 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1907.6 \text{ MHz}$; $\sigma = 1.524 \text{ mho/m}$; $\epsilon_r = 51.066$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 6 mm

Test Date: 01-02-2013; Ambient Temp: 23.9°C; Tissue Temp: 22.0°C

Probe: ES3DV2 - SN3022; ConvF(4.43, 4.43, 4.43); Calibrated: 8/28/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

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

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

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

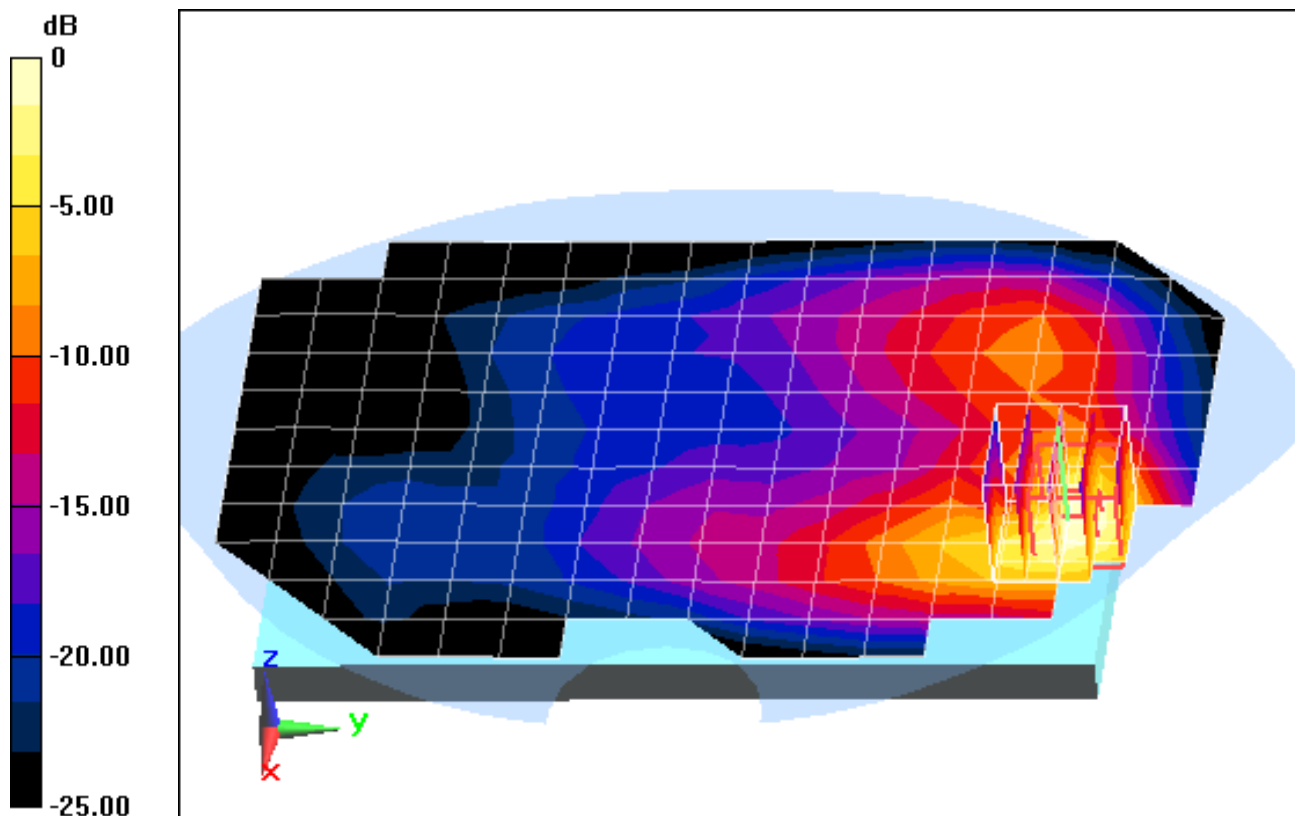
Area Scan (12x17x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 28.920 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 1.852 mW/g

SAR(1 g) = 0.963 mW/g; SAR(10 g) = 0.462 mW/g



0 dB = 1.06 mW/g = 0.51 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 354416050077478

Communication System: IEEE 802.11b; Frequency: 2462 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2462 \text{ MHz}$; $\sigma = 2.033 \text{ mho/m}$; $\epsilon_r = 50.828$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-04-2013; Ambient Temp: 23.4°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3209; ConvF(4.23, 4.23, 4.23); Calibrated: 3/16/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626

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

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

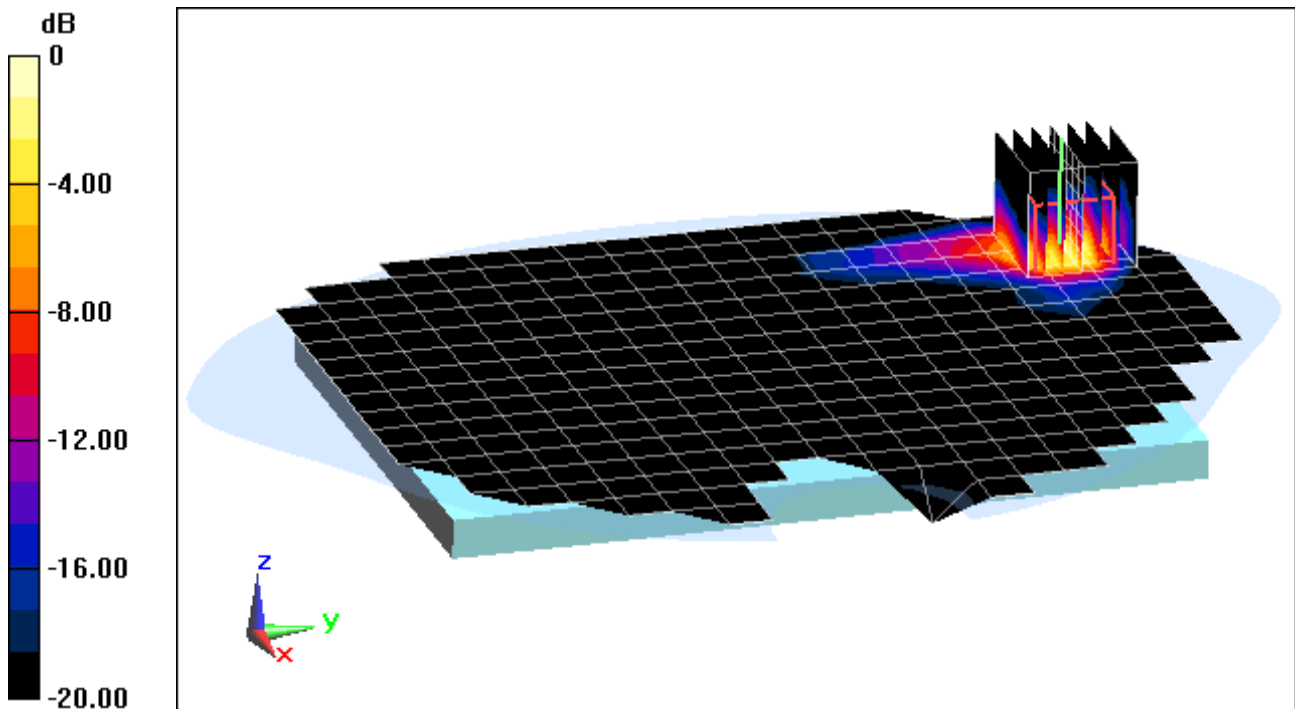
Area Scan (17x21x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 6.880 V/m; Power Drift = -0.15 dB

Peak SAR (extrapolated) = 0.264 mW/g

SAR(1 g) = 0.080 mW/g; SAR(10 g) = 0.029 mW/g



0 dB = 0.119 mW/g = -18.49 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 354416050078799

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

Medium: 5 GHz Body Medium parameters used:

$f = 5825 \text{ MHz}$; $\sigma = 6.186 \text{ mho/m}$; $\epsilon_r = 47.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 01-08-2013; Ambient Temp: 24.5°C; Tissue Temp: 22.8°C

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

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406

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

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

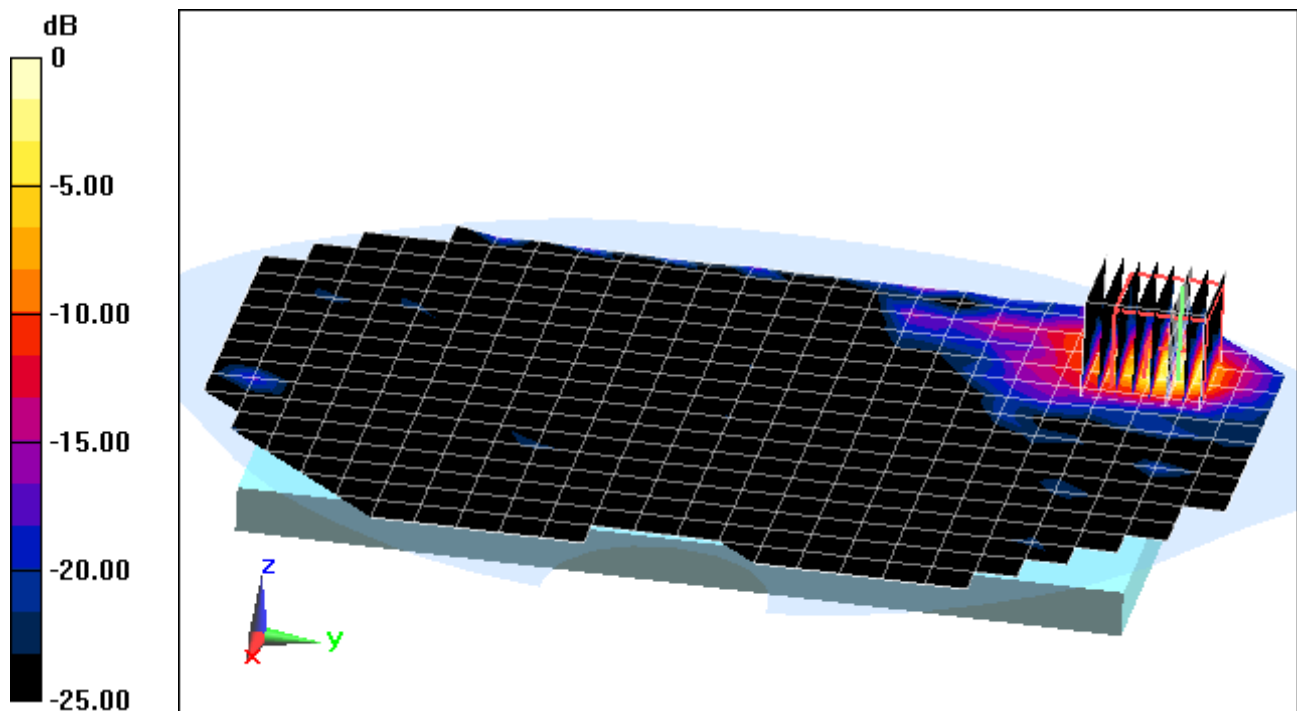
Area Scan (18x25x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4

Reference Value = 10.503 V/m; Power Drift = -0.15 dB

Peak SAR (extrapolated) = 4.204 mW/g

SAR(1 g) = 0.865 mW/g; SAR(10 g) = 0.229 mW/g



0 dB = 2.28 mW/g = 7.16 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 354416050078799

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5580 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5580 \text{ MHz}$; $\sigma = 5.78 \text{ mho/m}$; $\epsilon_r = 48.19$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 01-08-2013; Ambient Temp: 24.4°C; Tissue Temp: 22.8°C

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

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406

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

Mode: IEEE 802.11a, 5.5 GHz, Body SAR, Ch 116, 6 Mbps, Back Side

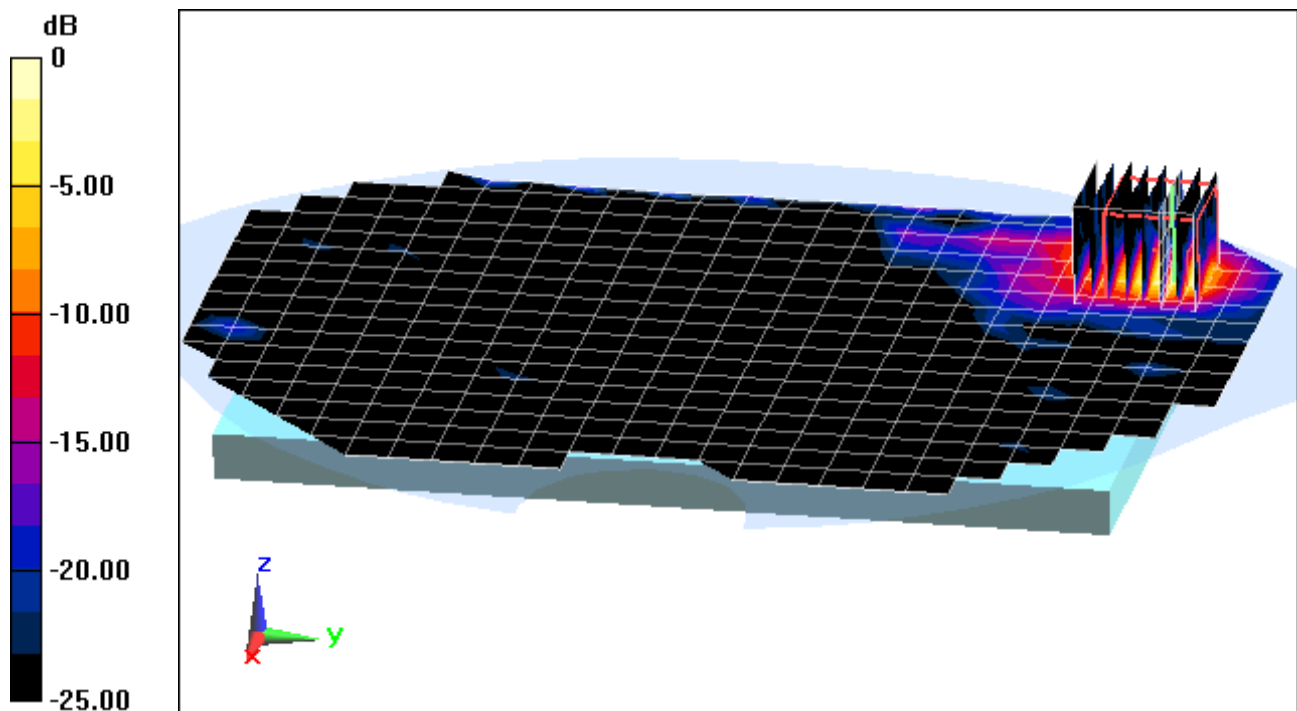
Area Scan (18x25x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$, Graded Ratio: 1.4

Reference Value = 10.897 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 4.179 mW/g

SAR(1 g) = 0.885 mW/g; SAR(10 g) = 0.244 mW/g



0 dB = 2.34 mW/g = 7.38 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LGTN5100; Type: Portable Tablet; Serial: 354416050077478

Communication System: Bluetooth; Frequency: 2402 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2402 \text{ MHz}$; $\sigma = 1.874 \text{ mho/m}$; $\epsilon_r = 51.19$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 01-08-2013; Ambient Temp: 24.4°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3263; ConvF(4.35, 4.35, 4.35); Calibrated: 5/18/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

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

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

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

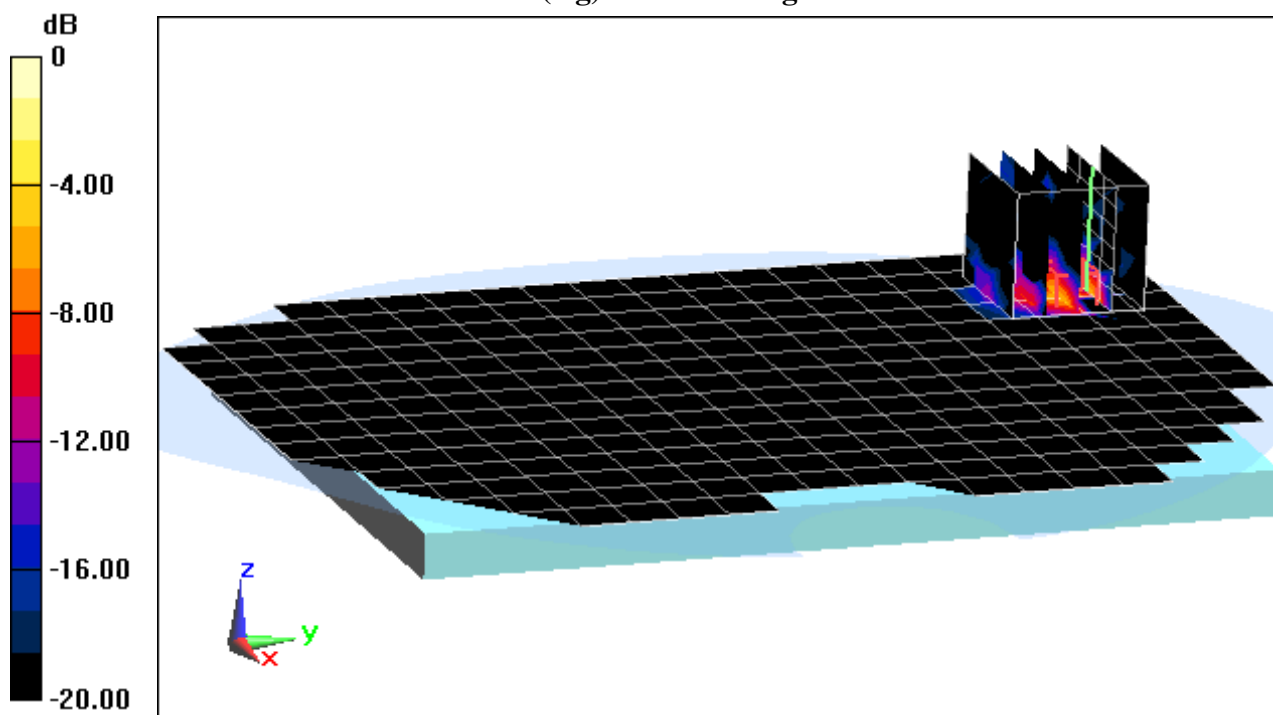
Area Scan (15x21x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 2.224 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 0.019 mW/g

SAR(1 g) = 0.008 mW/g



0 dB = 0.0302 mW/g = -30.40 dB mW/g

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 835 MHz; Type: D835V2; Serial: 4d047

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

Medium: 835 Head Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.908 \text{ mho/m}$; $\epsilon_r = 42.24$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.5 cm

Test Date: 01-07-2013; Ambient Temp: 23.4°C; Tissue Temp: 20.5°C

Probe: ES3DV3 - SN3288; ConvF(6.41, 6.41, 6.41); Calibrated: 9/20/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

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

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

835 MHz System Verification

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

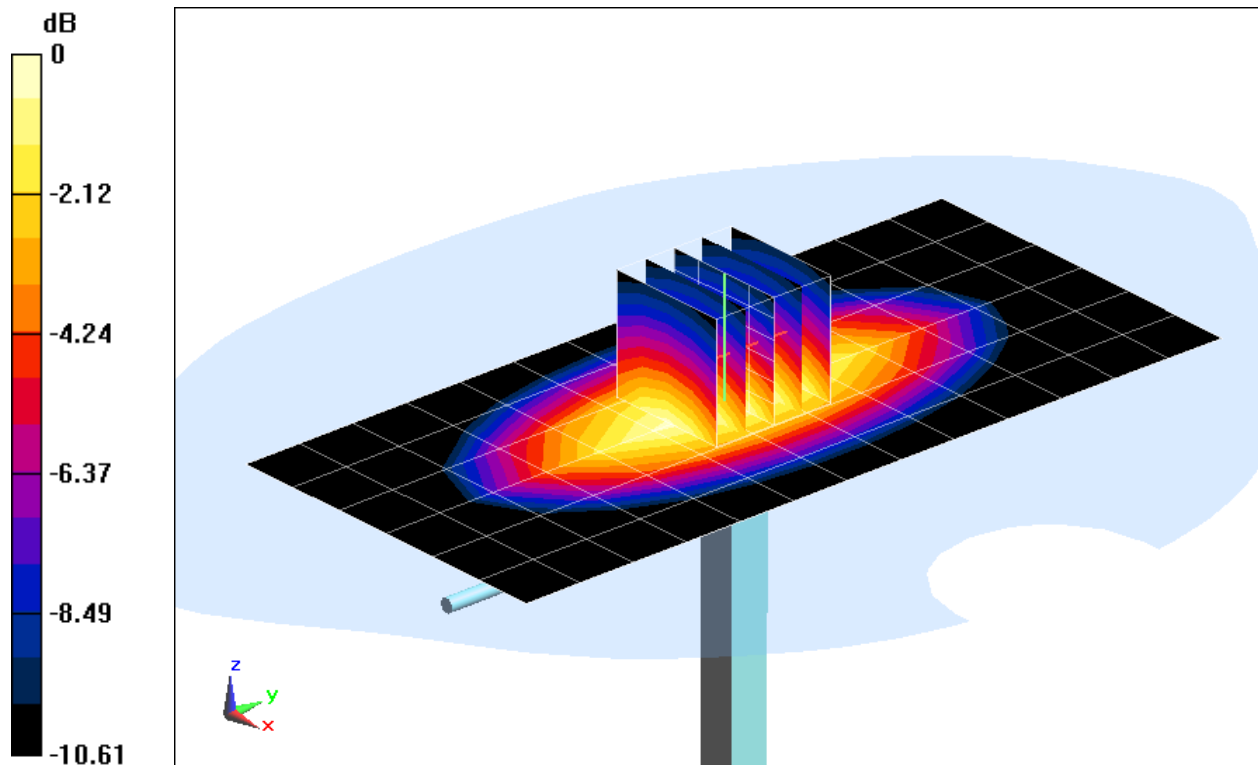
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power: 19.54 dBm (90 mW)

Peak SAR (extrapolated) = 1.28 W/kg

SAR(1 g) = 0.858 W/kg; SAR(10 g) = 0.559 W/kg

Deviation: 1.31%



0 dB = 0.928 W/kg = -0.32 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 1900 MHz; Type: D1900V2; Serial: 502

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

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.453 \text{ mho/m}$; $\epsilon_r = 38.403$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.0 cm

Test Date: 12-27-2012; Ambient Temp: 23.4°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3209; ConvF(5.15, 5.15, 5.15); Calibrated: 3/16/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626

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

1900MHz System Verification

Area Scan (5x7x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

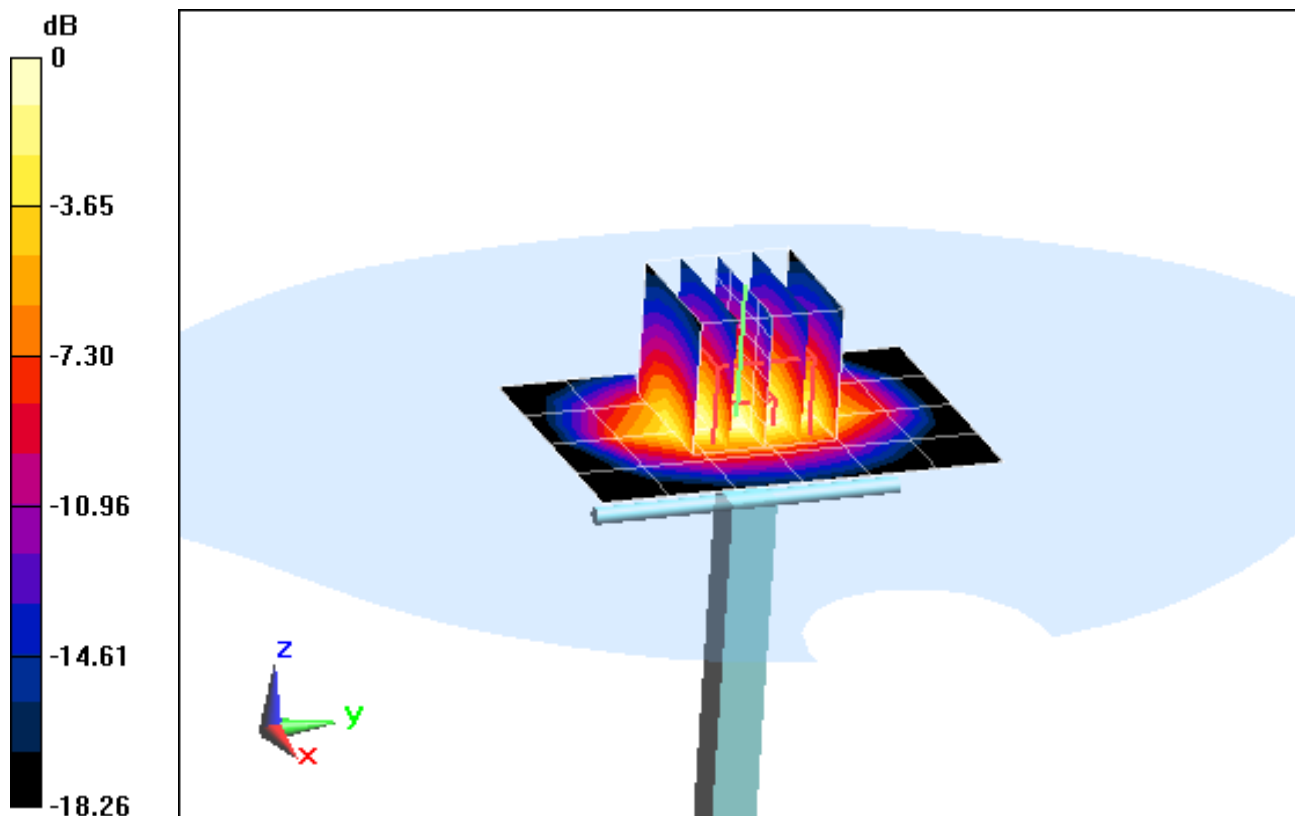
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power= 20 dBm (100 mW)

Peak SAR (extrapolated) = 7.478 mW/g

SAR(1 g) = 4.02 mW/g; SAR(10 g) = 2.08 mW/g

Deviation: 2.55%



0 dB = 4.51 mW/g = 13.08 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 2450 Head Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.835 \text{ mho/m}$; $\epsilon_r = 39.21$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 01-03-2013; Ambient Temp: 20.8°C; Tissue Temp: 20.3°C

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

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

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

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

2450 MHz System Verification

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

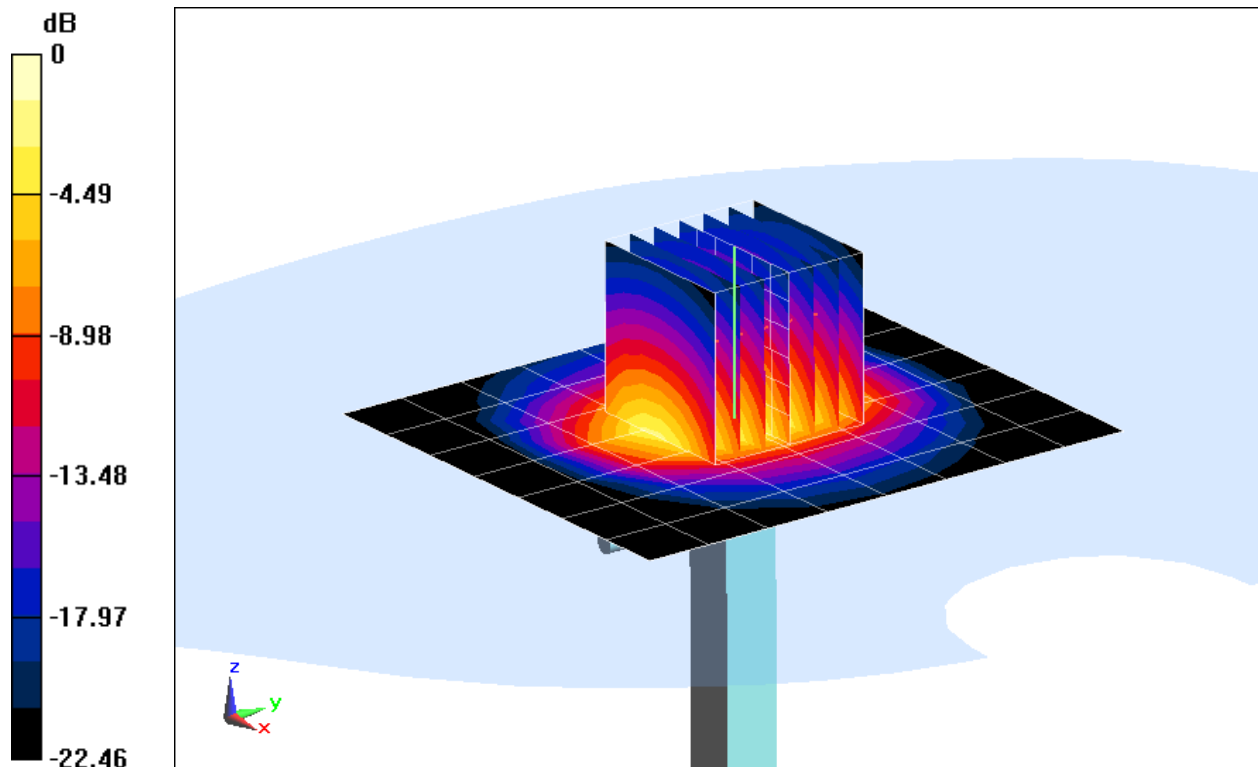
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 11.1 W/kg

SAR(1 g) = 5.33 W/kg; SAR(10 g) = 2.46 W/kg

Deviation: -0.37%



PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5GHz Head Medium parameters used:

$f = 5200 \text{ MHz}$; $\sigma = 4.74 \text{ mho/m}$; $\epsilon_r = 36.36$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-05-2013; Ambient Temp: 20.4°C; Tissue Temp: 19.6°C

Probe: EX3DV4 - SN3561; ConvF(4.45, 4.45, 4.45); Calibrated: 7/26/2012;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

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

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

5200MHz System Verification

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

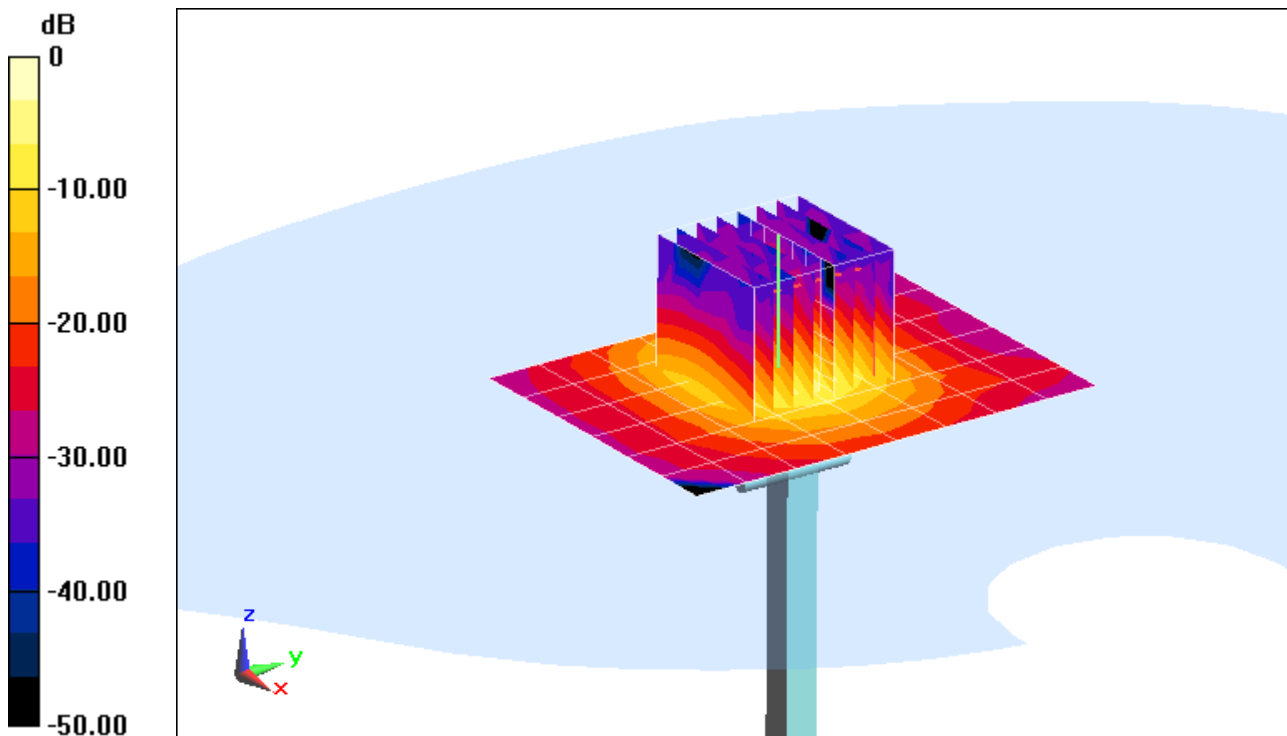
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 30.0 W/kg

SAR(1 g) = 7.55 W/kg; SAR(10 g) = 2.18 W/kg

Deviation: -5.39%



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

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5GHz Head Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 4.874 \text{ mho/m}$; $\epsilon_r = 36.14$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section: Space: 1.0 cm

Test Date: 01-05-2013; Ambient Temp: 20.0°C; Tissue Temp: 19.5°C

Probe: EX3DV4 - SN3561; ConvF(4.16, 4.16, 4.16); Calibrated: 7/26/2012;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

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

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

5300MHz System Verification

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

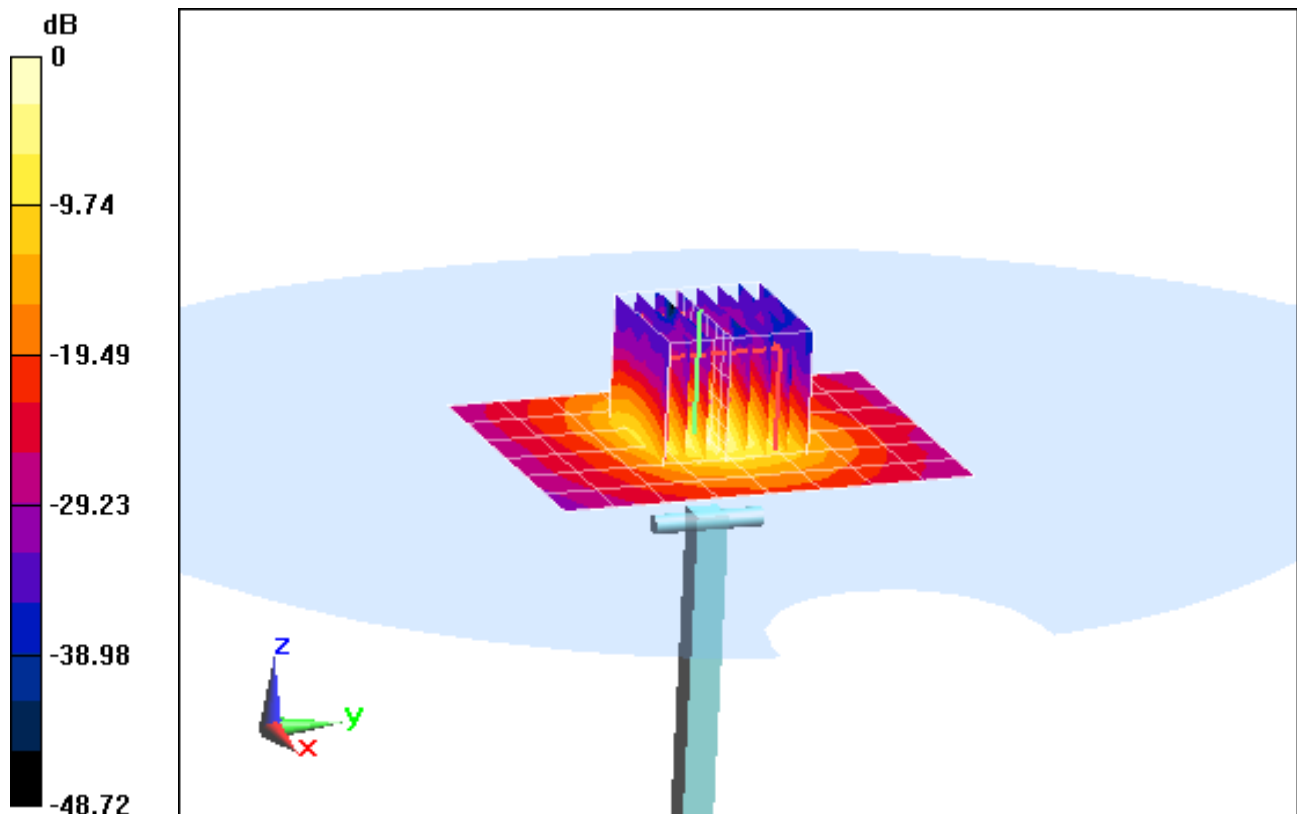
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio:1.4

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 35.880 mW/g

SAR(1 g) = 8.09 mW/g; SAR(10 g) = 2.29 mW/g

Deviation: -2.65%



0 dB = 20.2 mW/g = 26.11 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5GHz Head Medium parameters used:

$f = 5500 \text{ MHz}$; $\sigma = 5.115 \text{ mho/m}$; $\epsilon_r = 35.57$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-05-2013; Ambient Temp: 20.6°C; Tissue Temp: 19.7°C

Probe: EX3DV4 - SN3561; ConvF(4.18, 4.18, 4.18); Calibrated: 7/26/2012;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

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

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

5500MHz System Verification

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

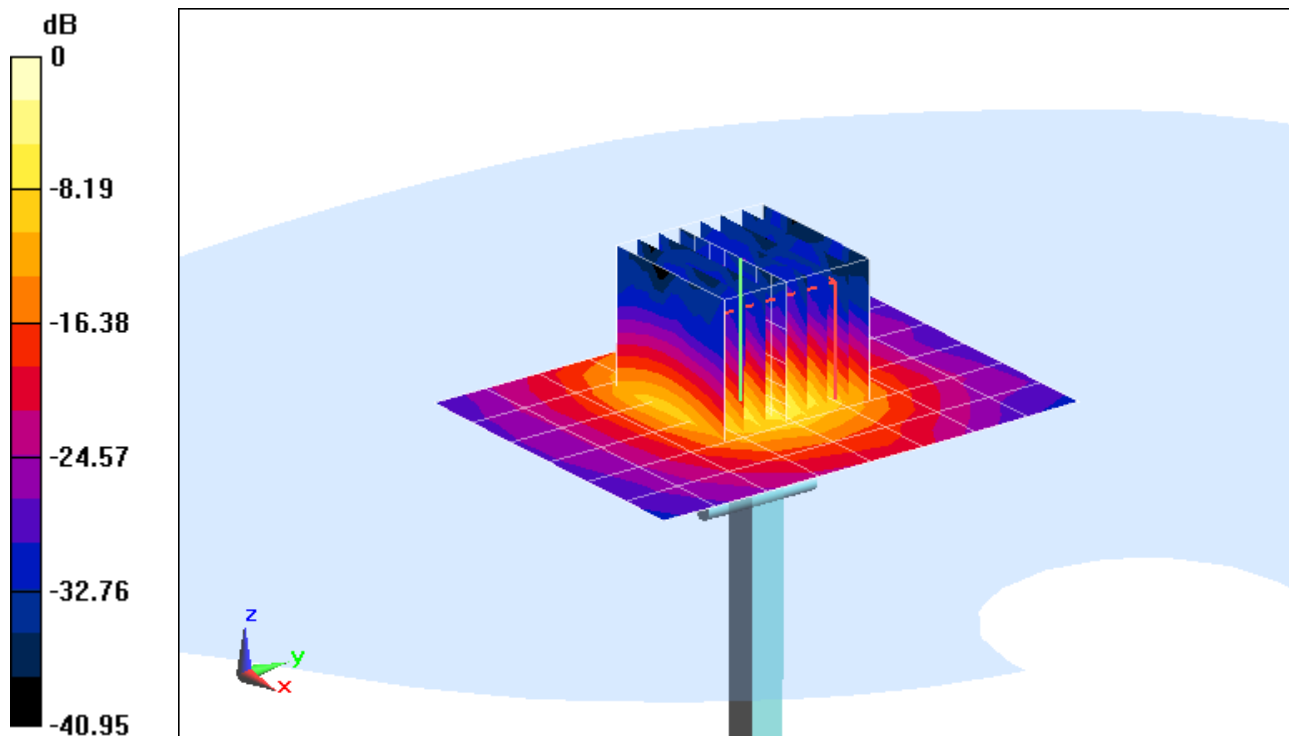
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 38.7 W/kg

SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.3 W/kg

Deviation: -4.59%



PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5GHz Head Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.231 \text{ mho/m}$; $\epsilon_r = 35.36$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.0 cm

Test Date: 01-05-2013; Ambient Temp: 23.2°C; Tissue Temp: 20.2°C

Probe: EX3DV4 - SN3561; ConvF(4, 4, 4); Calibrated: 7/26/2012;

Sensor-Surface: Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

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

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

5600MHz System Verification

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

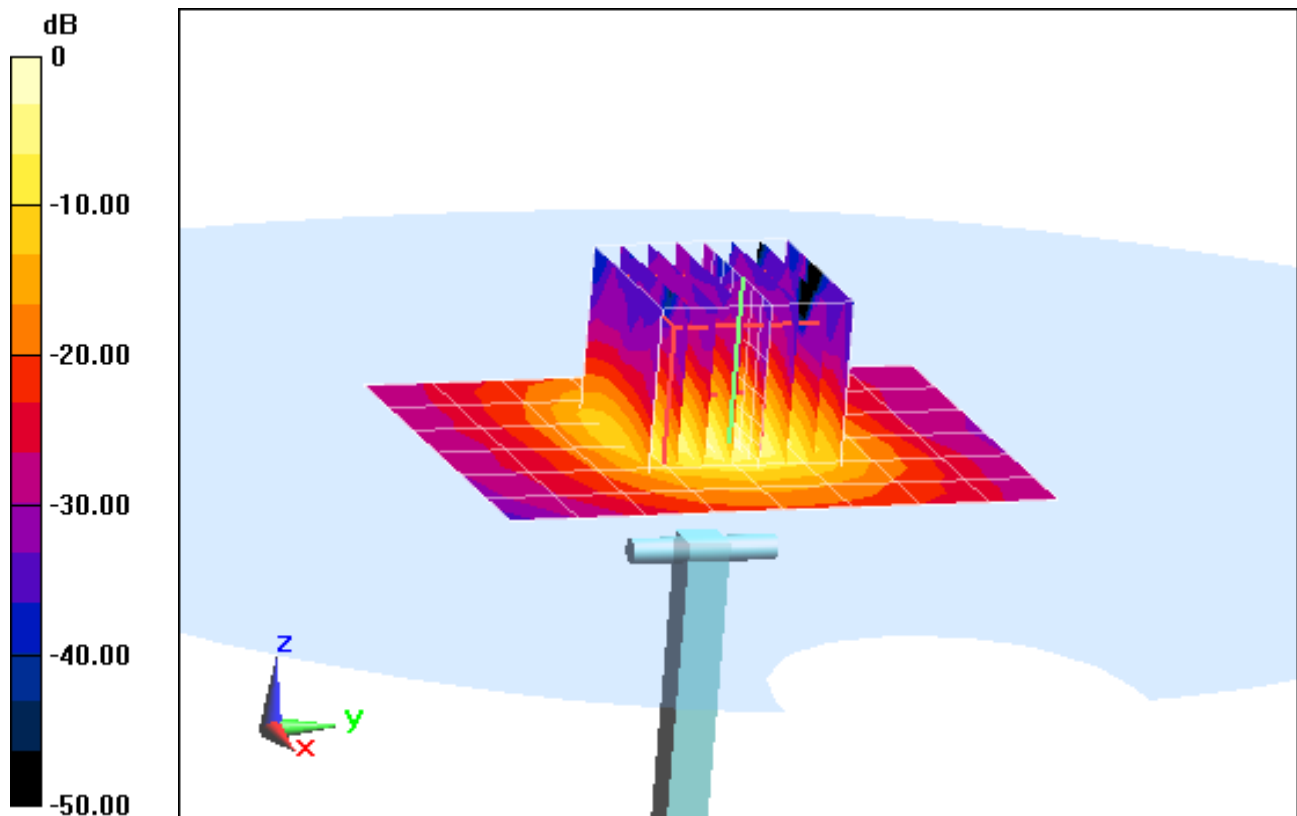
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio 1:4

Input Power: 20.2 dBm (105 mW)

Peak SAR (extrapolated) = 40.794 mW/g

SAR(1 g) = 8.09 mW/g; SAR(10 g) = 2.3 mW/g

Deviation: -8.82%



0 dB = 19.6 mW/g = 25.85 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5GHz Head Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 5.474 \text{ mho/m}$; $\epsilon_r = 34.94$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-05-2013; Ambient Temp: 23.6°C Tissue Temp: 20.4°C

Probe: EX3DV4 - SN3561; ConvF(3.92, 3.92, 3.92); Calibrated: 7/26/2012;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

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

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

5800MHz System Verification

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

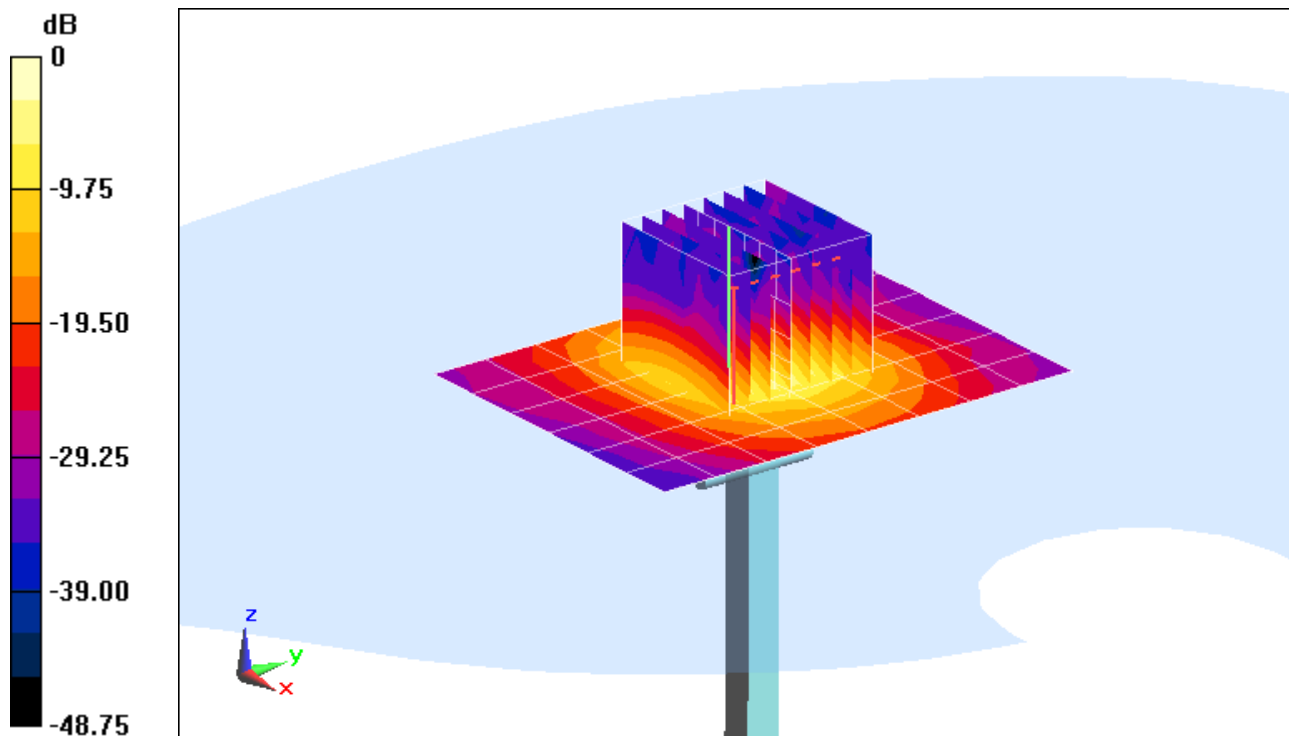
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 38.1 W/kg

SAR(1 g) = 7.82 W/kg; SAR(10 g) = 2.22 W/kg

Deviation: -2.01%



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

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 835 Body Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 1.007 \text{ mho/m}$; $\epsilon_r = 54.18$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.5 cm

Test Date: 12-28-2012; Ambient Temp: 23.2°C; Tissue Temp: 21.7°C

Probe: ES3DV3 - SN3258; ConvF(6.06, 6.06, 6.06); Calibrated: 2/21/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

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

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

835MHz System Verification

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

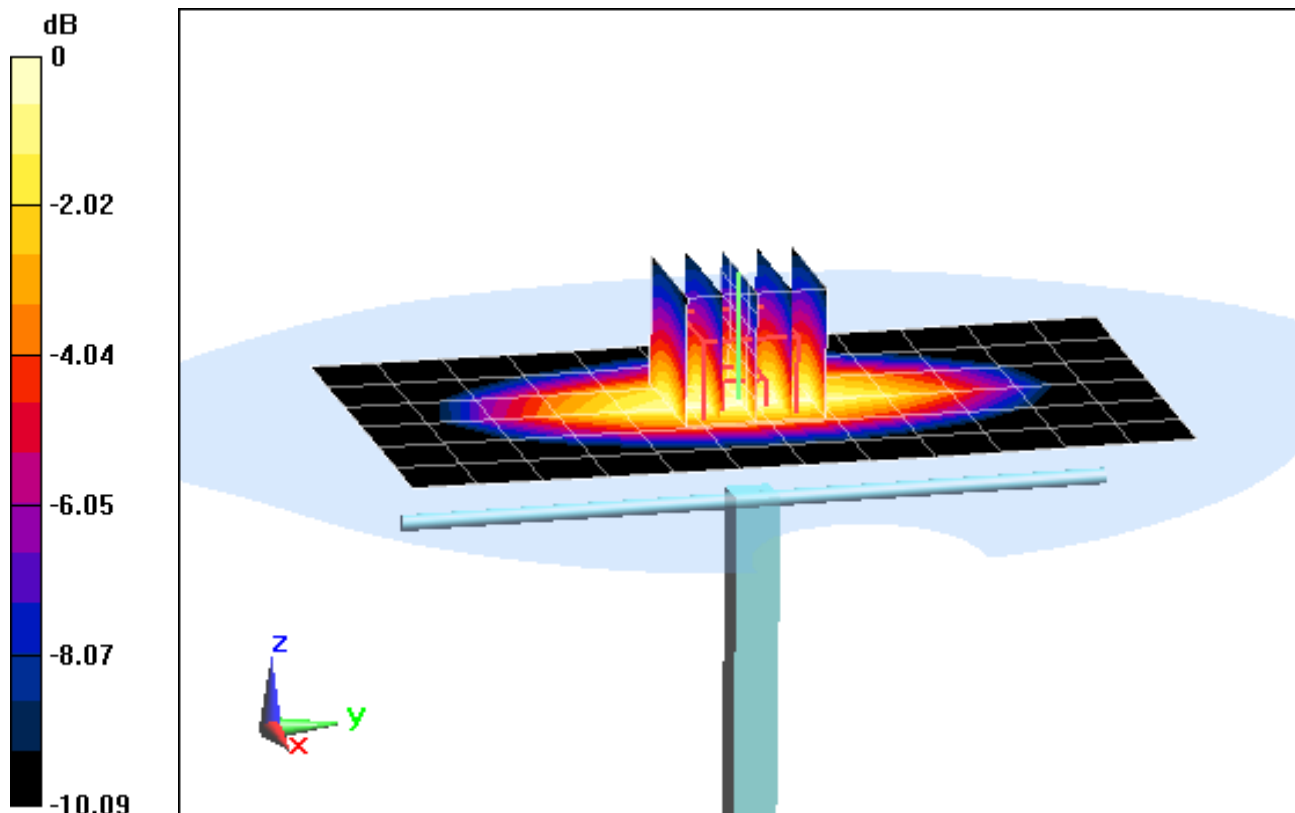
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.448 mW/g

SAR(1 g) = 0.996 mW/g; SAR(10 g) = 0.658 mW/g

Deviation: 4.18%



0 dB = 1.08 mW/g = 0.67 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 1900 MHz; Type: D1900V2; Serial: 5d141

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

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.516 \text{ mho/m}$; $\epsilon_r = 51.087$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-02-2013; Ambient Temp: 23.9°C; Tissue Temp: 22.0°C

Probe: ES3DV2 - SN3022; ConvF(4.43, 4.43, 4.43); Calibrated: 8/28/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

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

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

1900MHz System Verification

Area Scan (5x7x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

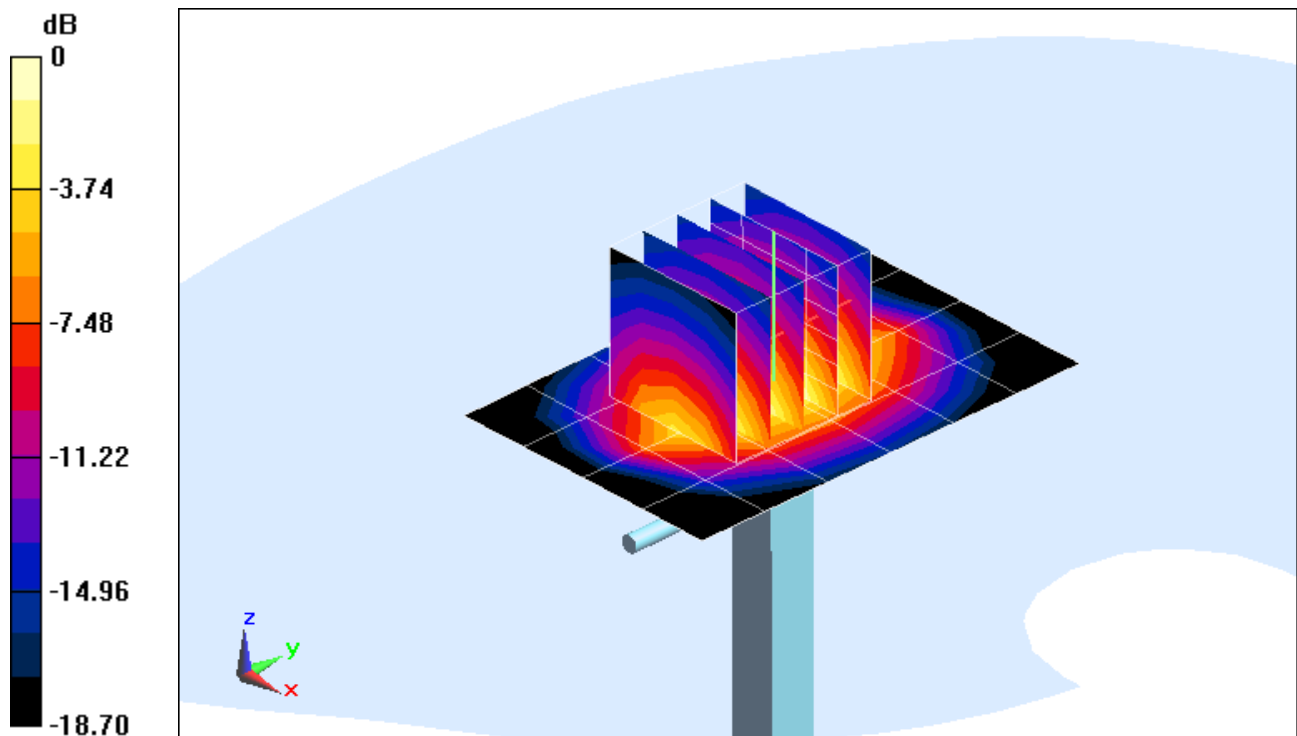
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 6.87 W/kg

SAR(1 g) = 3.78 W/kg; SAR(10 g) = 1.96 W/kg

Deviation: -6.90%



0 dB = 4.22 W/kg = 6.25 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 2.014 \text{ mho/m}$; $\epsilon_r = 50.83$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-04-2013; Ambient Temp: 23.4°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3209; ConvF(4.23, 4.23, 4.23); Calibrated: 3/16/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626

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

2450MHz System Verification

Area Scan (6x8x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

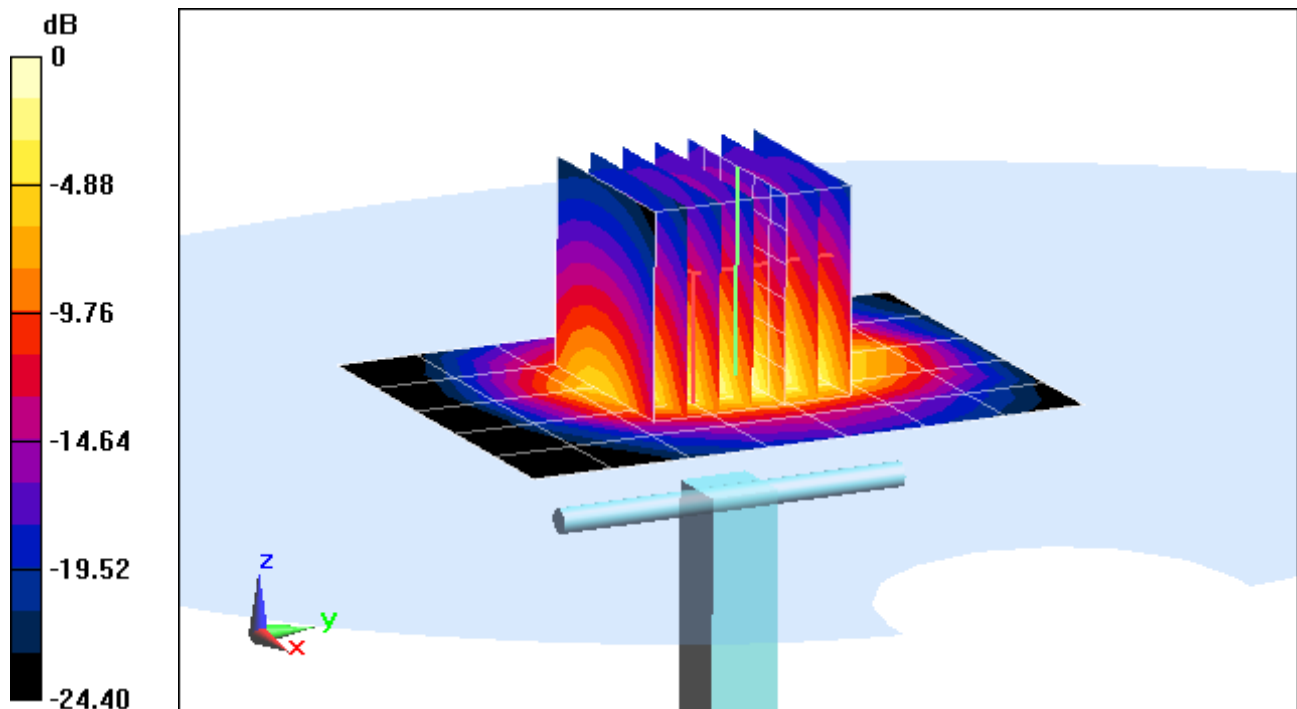
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 11.335 mW/g

SAR(1 g) = 5.28 mW/g; SAR(10 g) = 2.44 mW/g

Deviation = 2.33%



0 dB = 6.81 mW/g = 16.66 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 2450 Body; Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.938 \text{ mho/m}$; $\epsilon_r = 51.17$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2013; Ambient Temp: 24.4°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3263; ConvF(4.35, 4.35, 4.35); Calibrated: 5/18/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

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

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

2450 MHz System Verification

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

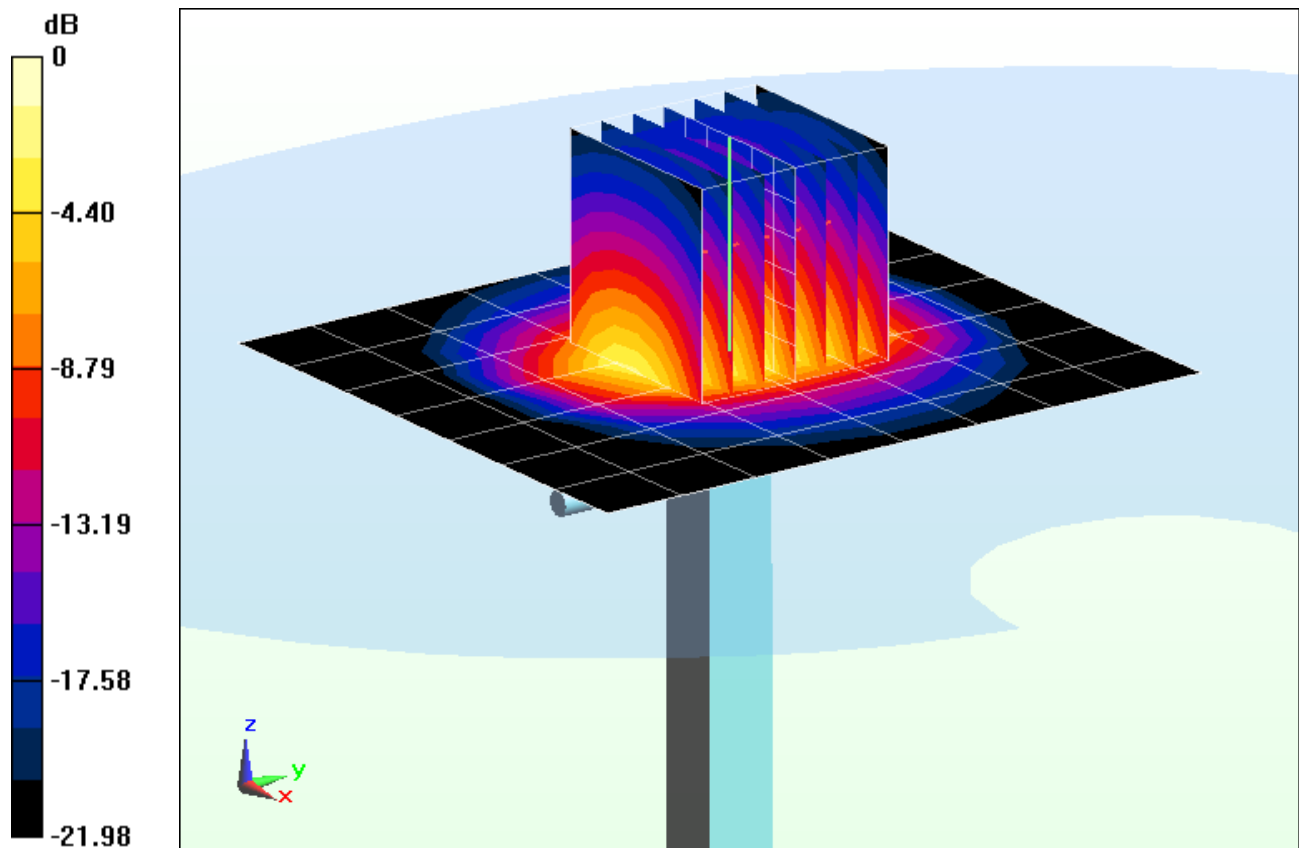
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 9.94 W/kg

SAR(1 g) = 4.72 W/kg; SAR(10 g) = 2.16 W/kg

Deviation = -6.16%



PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Body Medium parameters used:

$f = 5200 \text{ MHz}$; $\sigma = 5.192 \text{ mho/m}$; $\epsilon_r = 49.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2013; Ambient Temp: 24.0°C; Tissue Temp: 22.4°C

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

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406

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

5200MHz System Verification

Area Scan (7x9x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

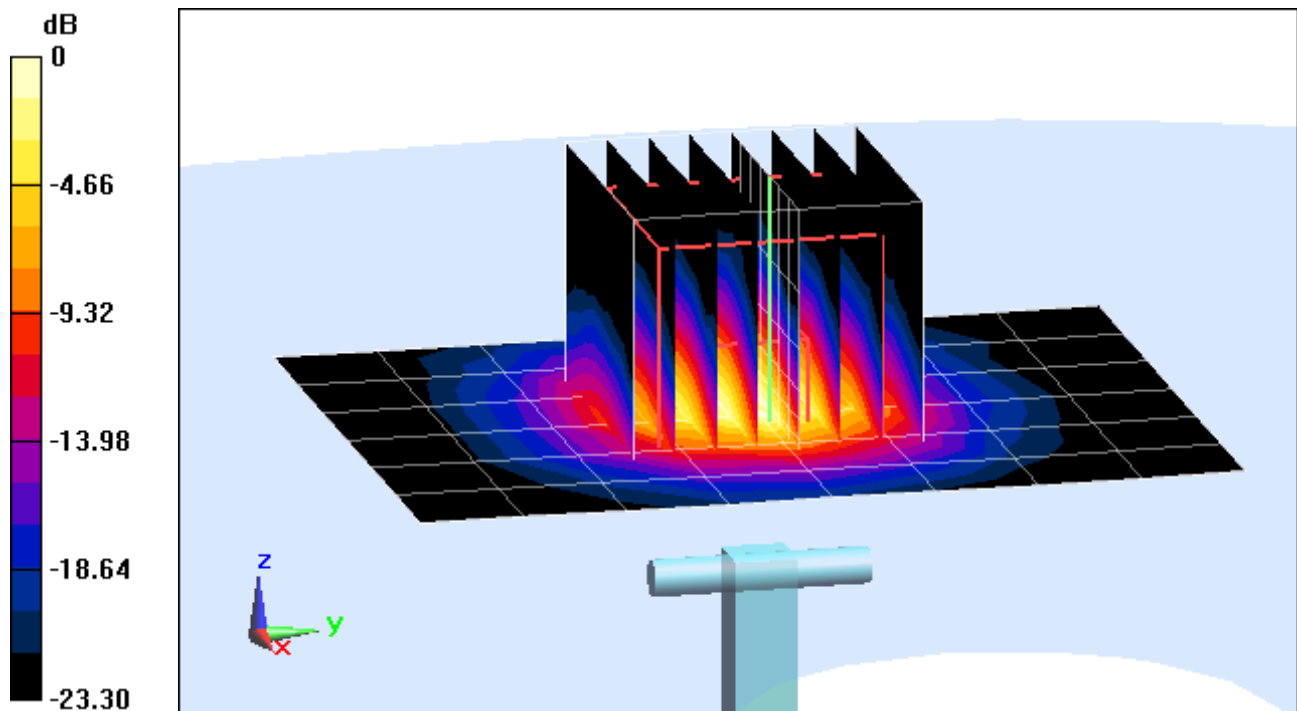
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$, Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 28.850 mW/g

SAR(1 g) = 7.3 mW/g; SAR(10 g) = 2.1 mW/g

Deviation = -0.41%



0 dB = 16.7 mW/g = 24.45 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Body Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 5.377 \text{ mho/m}$; $\epsilon_r = 48.78$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2013; Ambient Temp: 24.1°C; Tissue Temp: 24.2°C

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

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406

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

5300MHz System Verification

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

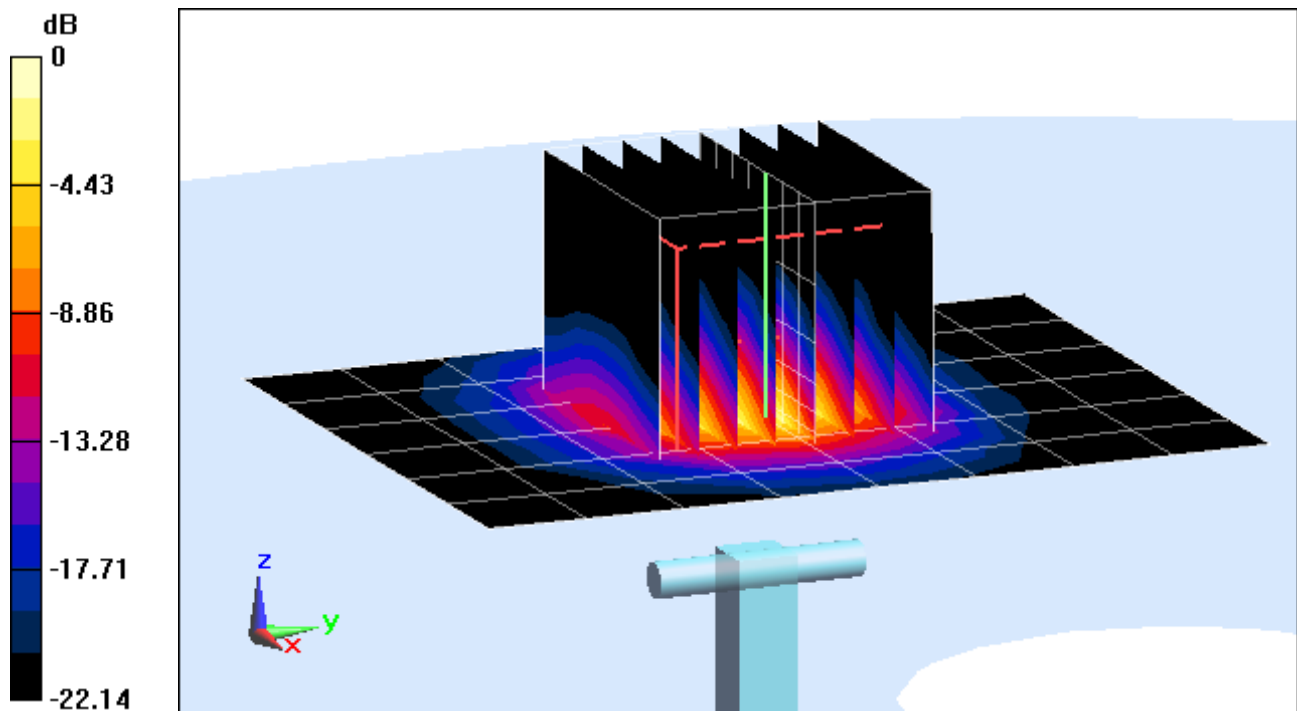
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 28.776 mW/g

SAR(1 g) = 7.5 mW/g; SAR(10 g) = 2.12 mW/g

Deviation = -0.79%



0 dB = 17.4 mW/g = 24.81 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Body Medium parameters used:

$f = 5500 \text{ MHz}$; $\sigma = 5.629 \text{ mho/m}$; $\epsilon_r = 48.27$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2013; Ambient Temp: 24.3°C; Tissue Temp: 24.2°C

Probe: EX3DV4 - SN3561; ConvF(3.33, 3.33, 3.33); Calibrated: 7/26/2012;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406

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

5500MHz System Verification

Area Scan (7x9x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

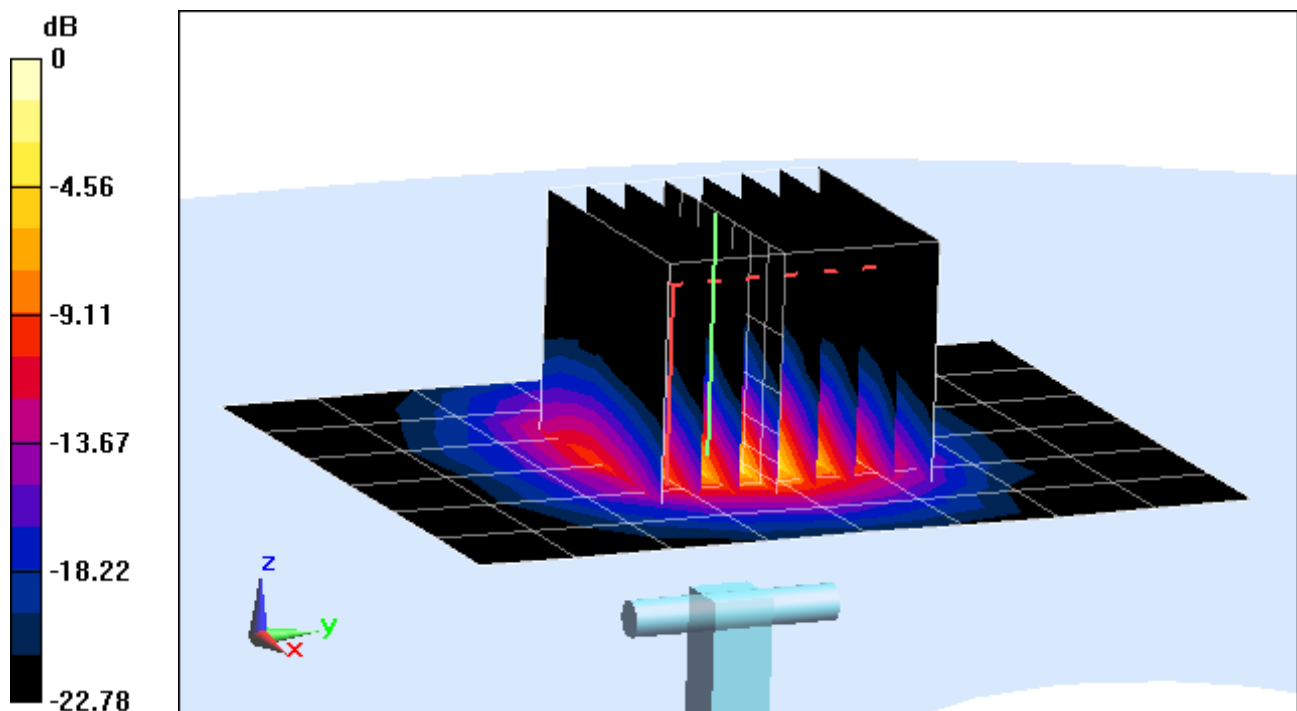
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$, Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 31.675 mW/g

SAR(1 g) = 7.88 mW/g; SAR(10 g) = 2.24 mW/g

Deviation = 0.38%



0 dB = 19.7 mW/g = 25.89 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Body Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.795 \text{ mho/m}$; $\epsilon_r = 48.08$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2013; Ambient Temp: 24.4°C; Tissue Temp: 22.8°C

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

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406

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

5600MHz System Verification

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

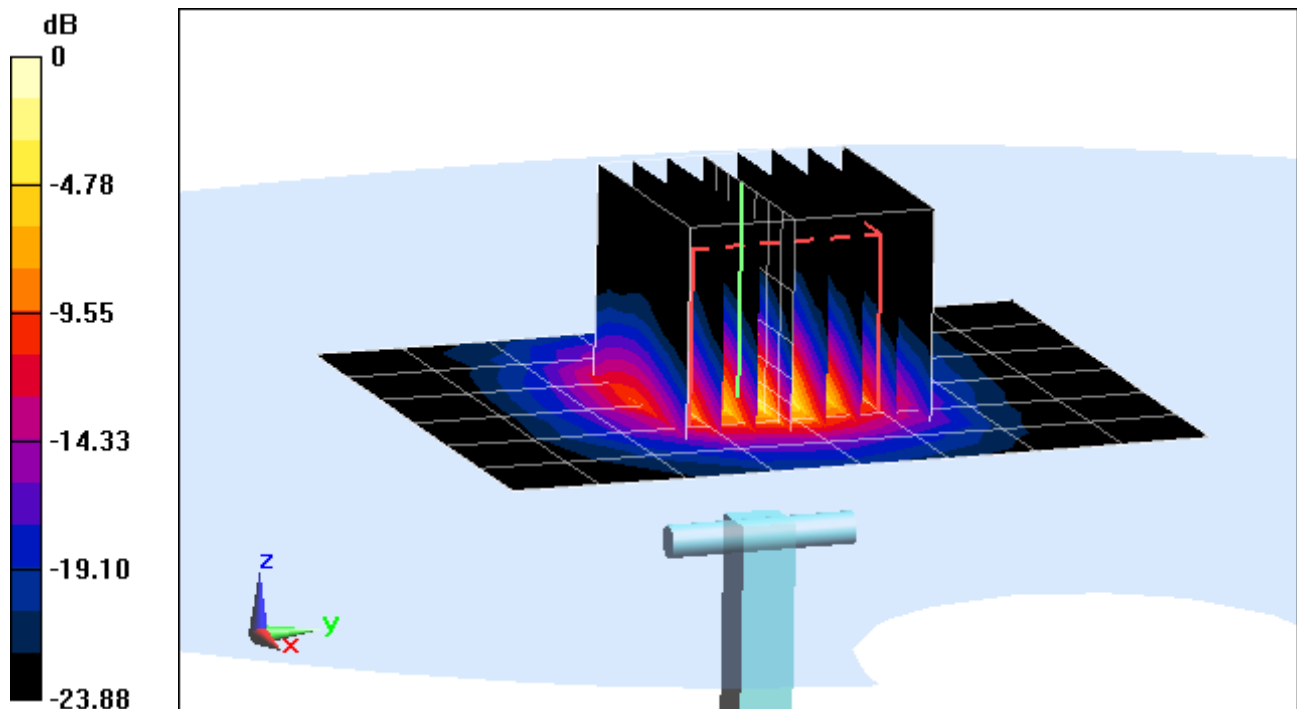
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 36.210 mW/g

SAR(1 g) = 8.55 mW/g; SAR(10 g) = 2.41 mW/g

Deviation = 6.88%



0 dB = 21.9 mW/g = 26.81 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Body Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 6.13 \text{ mho/m}$; $\epsilon_r = 47.54$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2013; Ambient Temp: 24.5°C; Tissue Temp: 22.8°C

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

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406

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

5800MHz System Verification

Area Scan (7x9x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

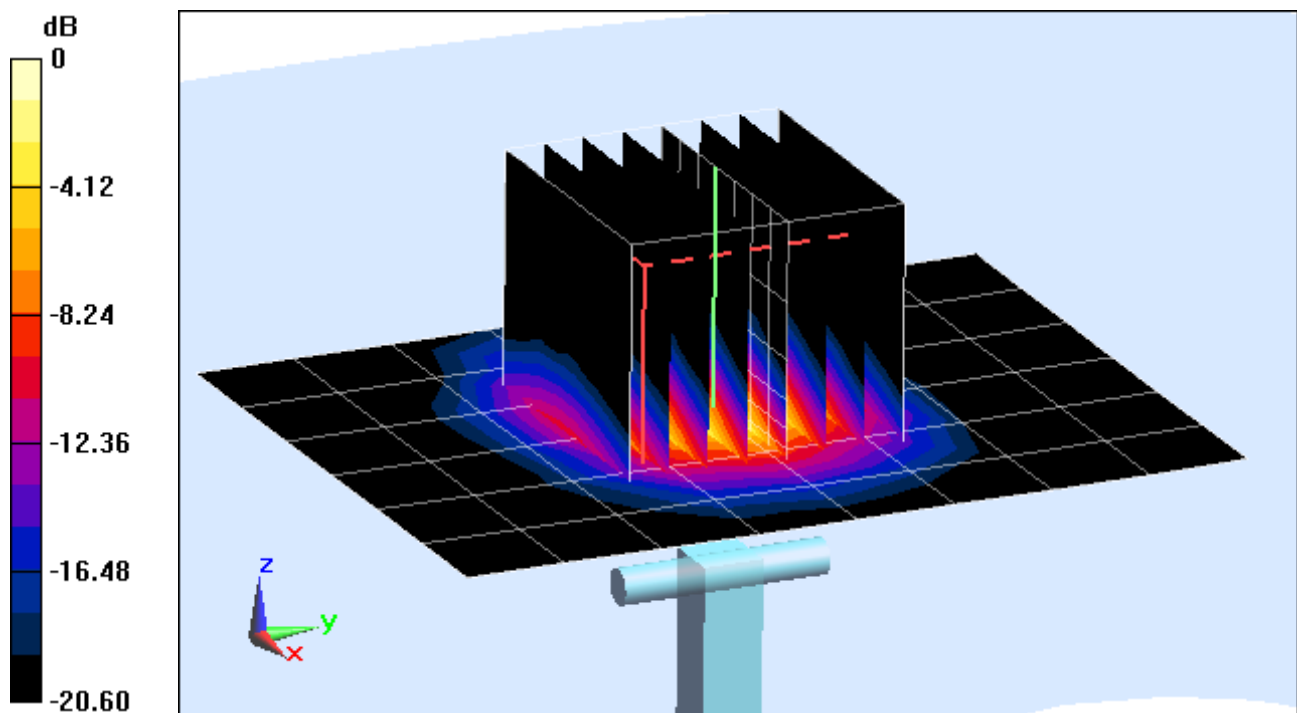
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$, Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 31.839 mW/g

SAR(1 g) = 7.6 mW/g; SAR(10 g) = 2.15 mW/g

Deviation = 2.29%



0 dB = 18.8 mW/g = 25.48 dB mW/g

APPENDIX C: PROBE CALIBRATION



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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d141_Apr12**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d141**

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

Calibration date: **April 26, 2012**

✓ KOK
5/4/12

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: April 26, 2012

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.8 $\pm$ 6 %	1.37 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.78 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.8 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.16 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.9 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.3 $\pm$ 6 %	1.51 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.6 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.33 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.4 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.5 \Omega + 6.2 j\Omega$
Return Loss	- 23.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.5 \Omega + 6.5 j\Omega$
Return Loss	- 23.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 26.04.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d141

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.37$ mho/m; $\epsilon_r = 40.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

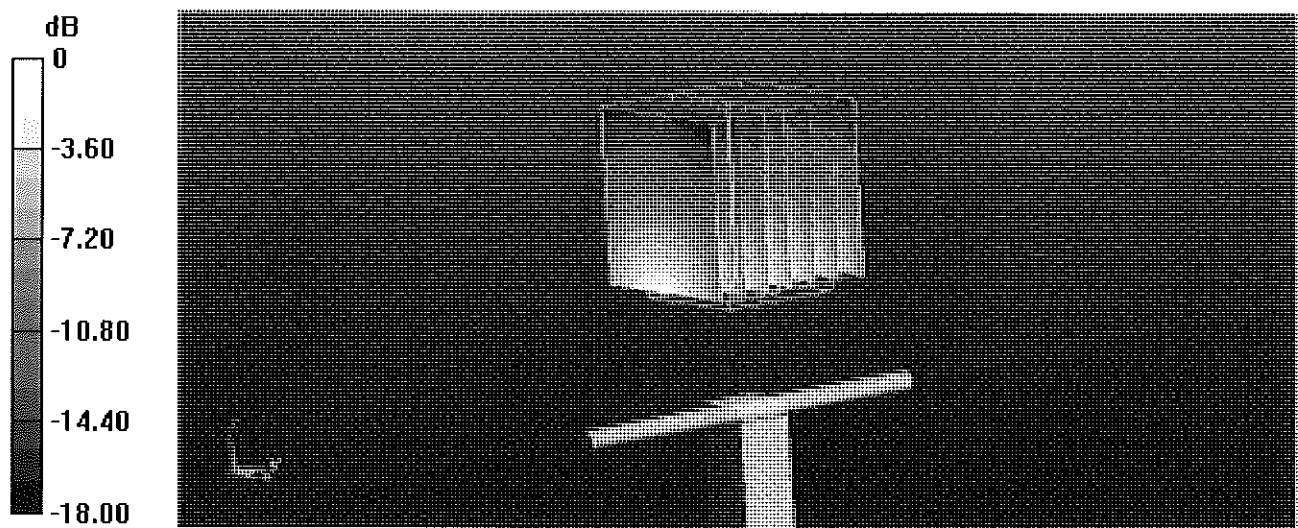
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.885 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 17.383 mW/g

SAR(1 g) = 9.78 mW/g; SAR(10 g) = 5.16 mW/g

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

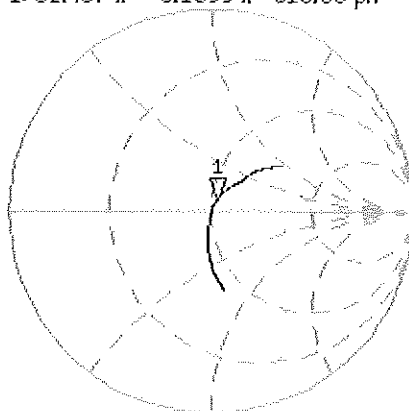


0 dB = 12.2 mW/g = 21.73 dB mW/g

Impedance Measurement Plot for Head TSL

26 Apr 2012 09:46:19
 [CH1] S11 1 U FS 1: 52.467 Ω 6.1699 Ω 516.83 μH 1 900.000 000 MHz

*
 Del
 Cor



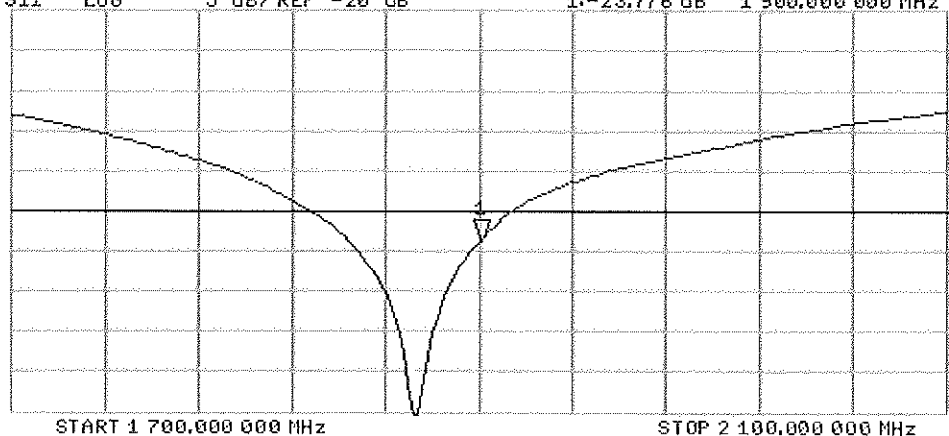
Avg
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-23.776 dB 1 900.000 000 MHz

Cor

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 26.04.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d141

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.51$ mho/m; $\epsilon_r = 53.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

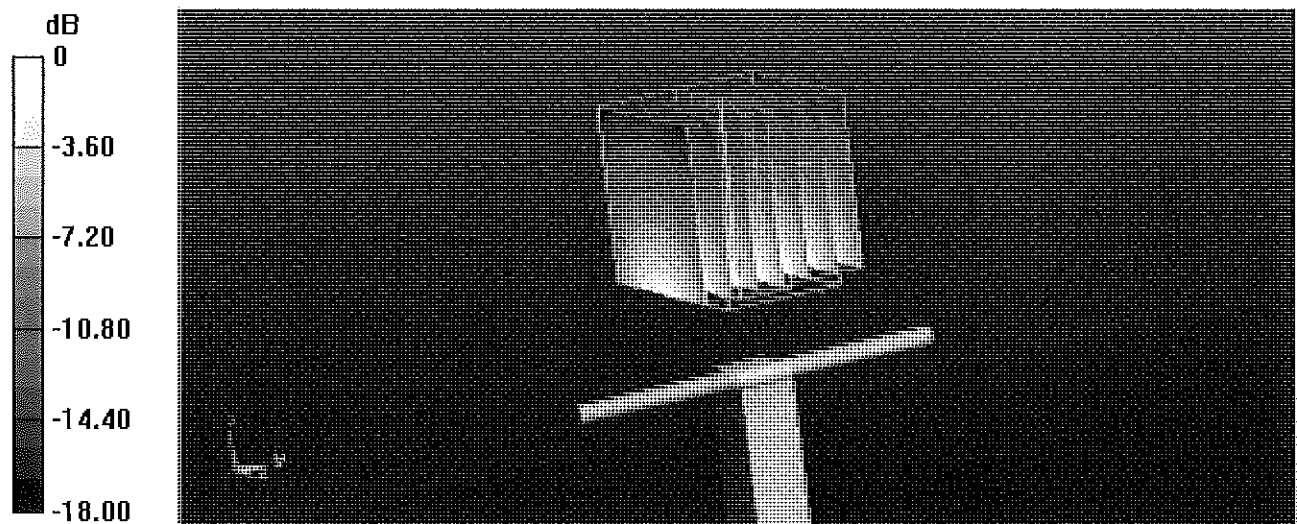
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.754 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 17.621 mW/g

SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.33 mW/g

Maximum value of SAR (measured) = 12.7 mW/g

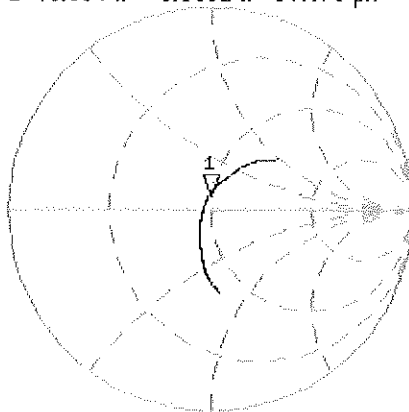


0 dB = 12.7 mW/g = 22.08 dB mW/g

Impedance Measurement Plot for Body TSL

26 Apr 2012 09:45:27
 [CH1] S11 1 U FS 1: 48.504 Ω 6.5391 Ω 547.75 μH 1 900.000 000 MHz

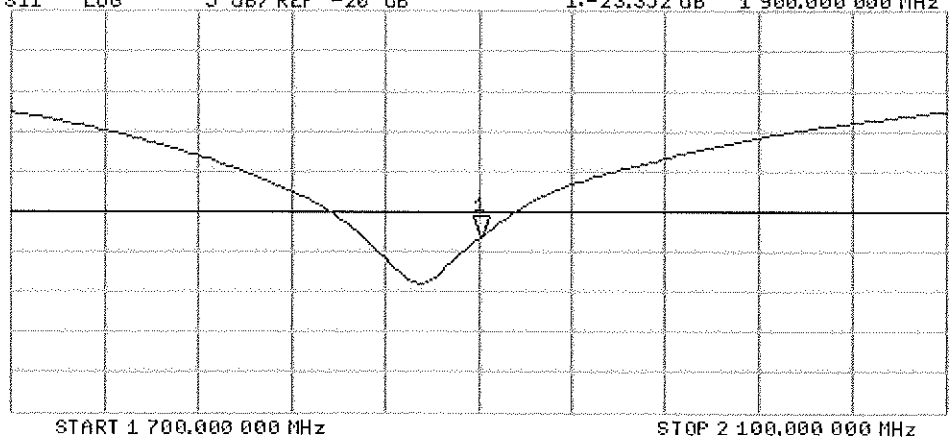
*
 Del
 Cor



Avg
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-23.352 dB 1 900.000 000 MHz

Cor
 Avg
 16
 H1d





Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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 Multilateral Agreement for the recognition of calibration certificates

Client **PC Test**

Certificate No: **D1900V2-502_Feb12**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 502**

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

Calibration date: **February 22, 2012**

KOK
2/27/12

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: February 22, 2012

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Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.4 $\pm$ 6 %	1.40 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.79 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.2 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.17 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.7 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.0 $\pm$ 6 %	1.56 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.88 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	38.9 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.17 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.5 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$51.7 \Omega + 7.2 j\Omega$
Return Loss	- 22.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$47.2 \Omega + 7.6 j\Omega$
Return Loss	- 21.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.206 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 14, 1998

DASY5 Validation Report for Head TSL

Date: 22.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 502

Communication System: CW; Frequency: 1900 MHz

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

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

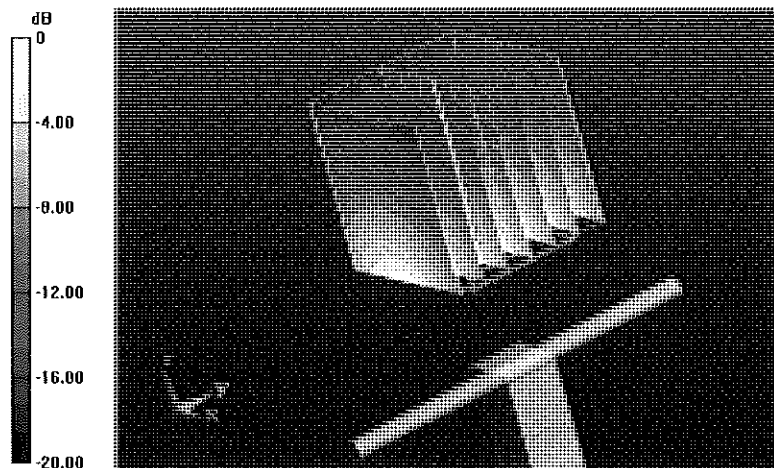
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.315 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 17.4000

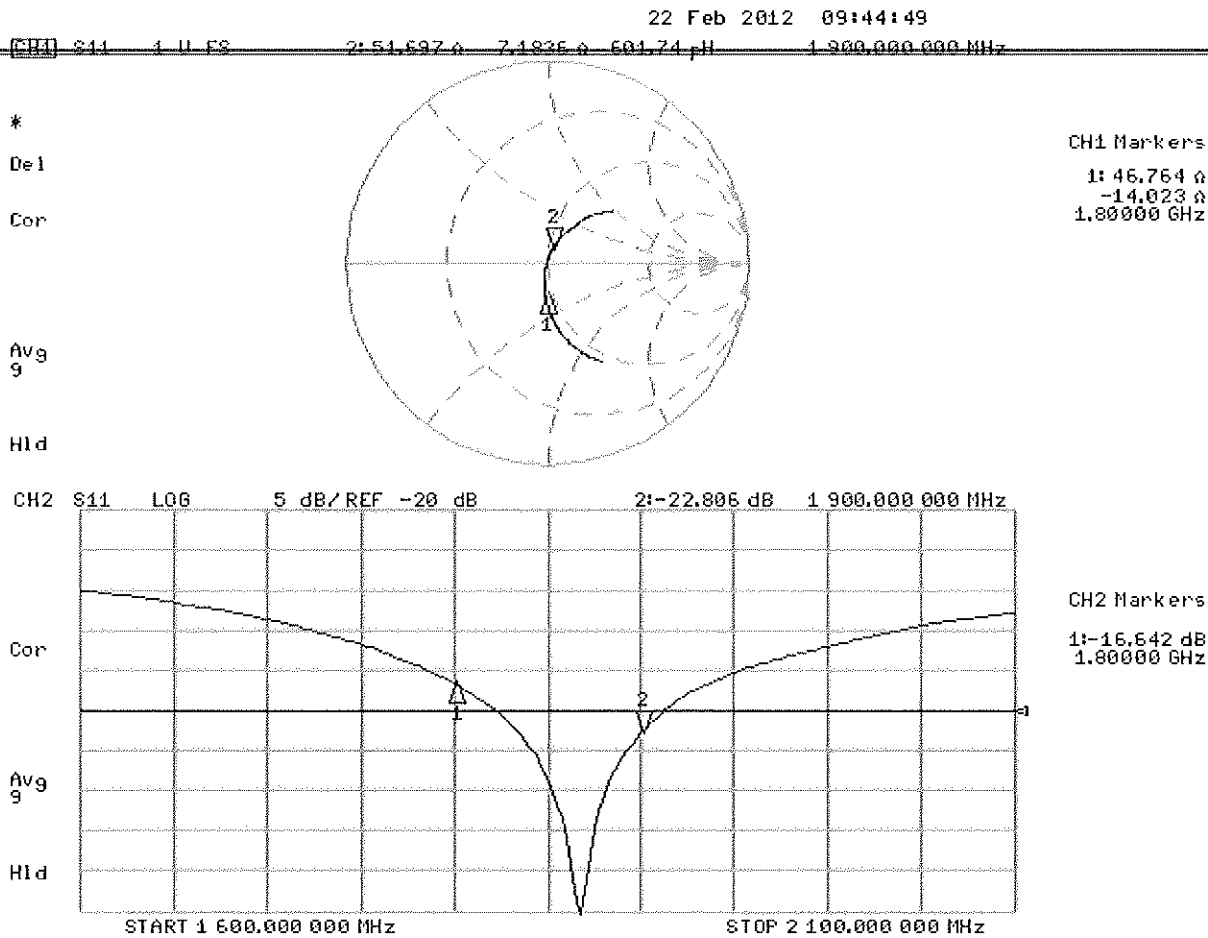
SAR(1 g) = 9.79 mW/g; SAR(10 g) = 5.17 mW/g

Maximum value of SAR (measured) = 12.015 mW/g



0 dB = 12.020mW/g = 21.60 dB mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 22.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 502

Communication System: CW; Frequency: 1900 MHz

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

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

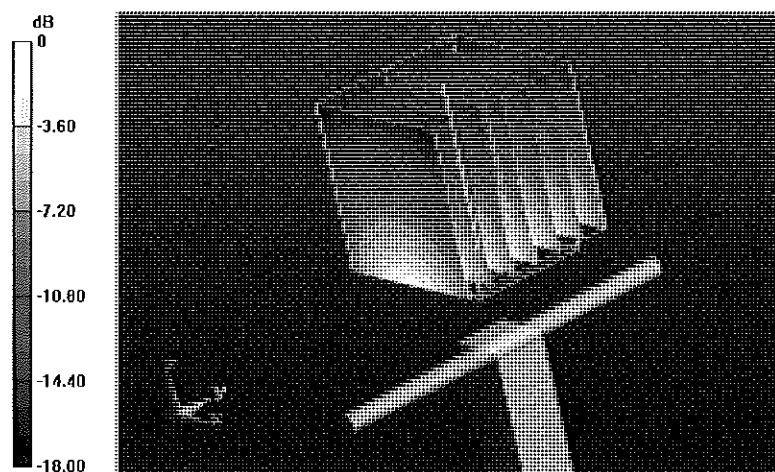
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.607 V/m; Power Drift = 0.0093 dB

Peak SAR (extrapolated) = 17.4260

SAR(1 g) = 9.88 mW/g; SAR(10 g) = 5.17 mW/g

Maximum value of SAR (measured) = 12.532 mW/g



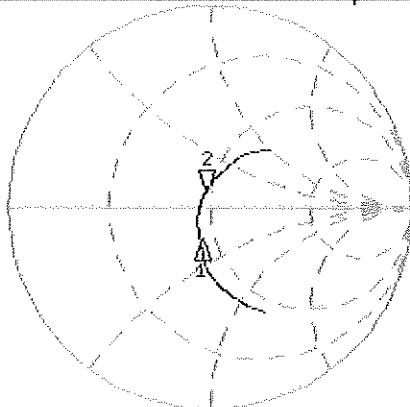
0 dB = 12.530mW/g = 21.96 dB mW/g

Impedance Measurement Plot for Body TSL

22 Feb 2012 09:44:23

[CH3] S11 1 U FS 2: 47.184 Ω 2: 6133 Ω 637.73 μ H 1 900.000 000 MHz

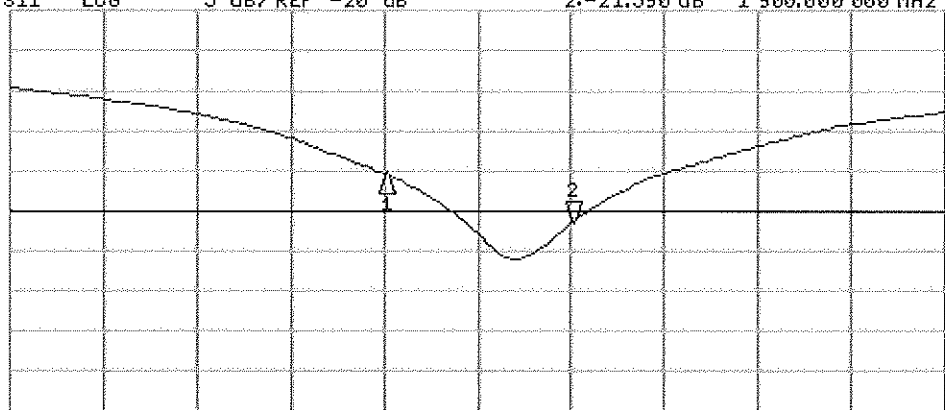
*
Del
Cor
Avg
16
H1d



CH1 Markers
1: 43.225 Ω
-14.492 Ω
1.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 2: -21.590 dB 1 900.000 000 MHz

Cor
Avg
16
H1d



CH2 Markers
1: -15.413 dB
1.80000 GHz

START 1 600.000 000 MHz

STOP 2 100.000 000 MHz



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Accreditation No.: **SCS 108**

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 Multilateral Agreement for the recognition of calibration certificates

Client **PC Test**

Certificate No: **D2450V2-882_Feb12**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 882**

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

Calibration date: **February 07, 2012**

LOK
4/6/12

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: February 15, 2012

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.9 $\pm$ 6 %	1.86 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

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

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.27 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.8 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.3 $\pm$ 6 %	2.02 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

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

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.7 \Omega + 1.1 j\Omega$
Return Loss	- 28.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$51.0 \Omega + 3.2 j\Omega$
Return Loss	- 29.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.156 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 06, 2011

DASY5 Validation Report for Head TSL

Date: 07.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

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

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

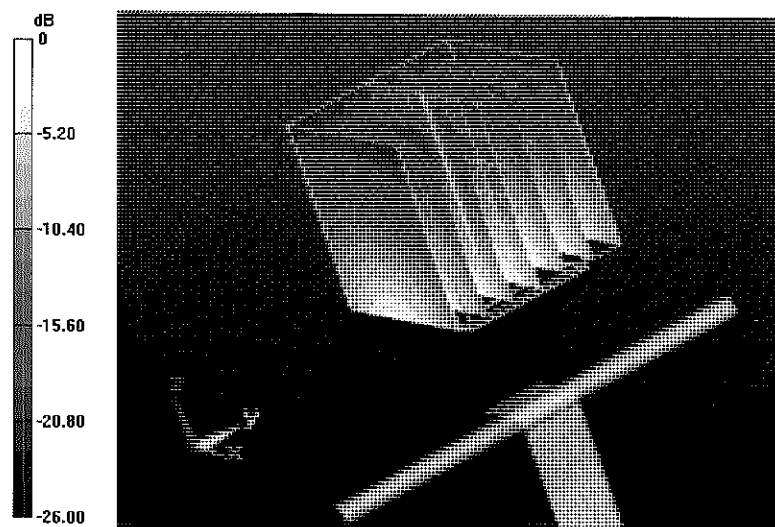
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 28.3920

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

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

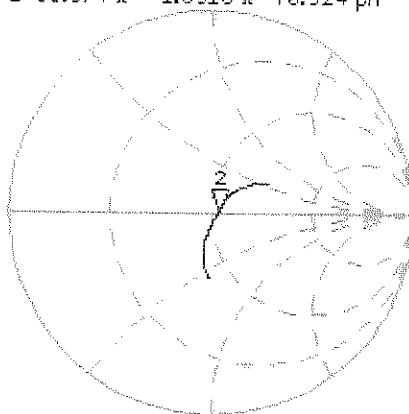


0 dB = 17.600mW/g = 24.91 dB mW/g

Impedance Measurement Plot for Head TSL

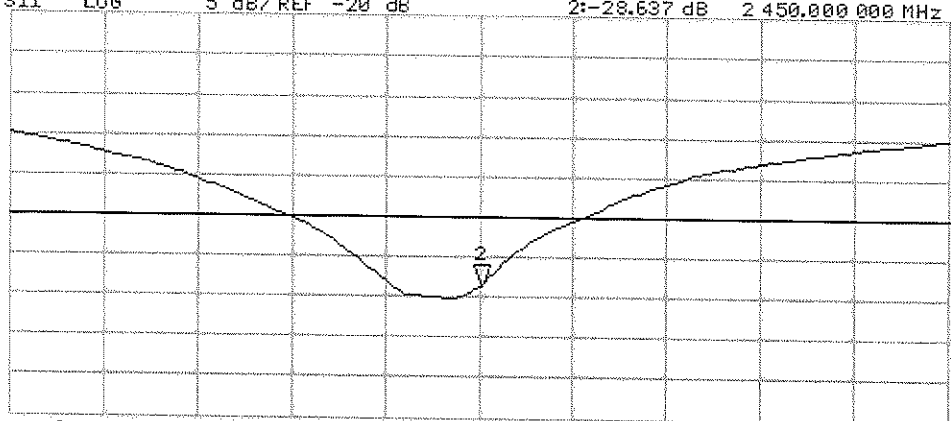
7 Feb 2012 11:30:04
 CH1 S11 1 U FS 2: 53.674 Ω 1.0918 Ω 70.924 μH 2 450.000 000 MHz

*
 Del
 CA
 Avg
 15
 H1 d



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

CA
 Avg
 15
 H1 d



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 07.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

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

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

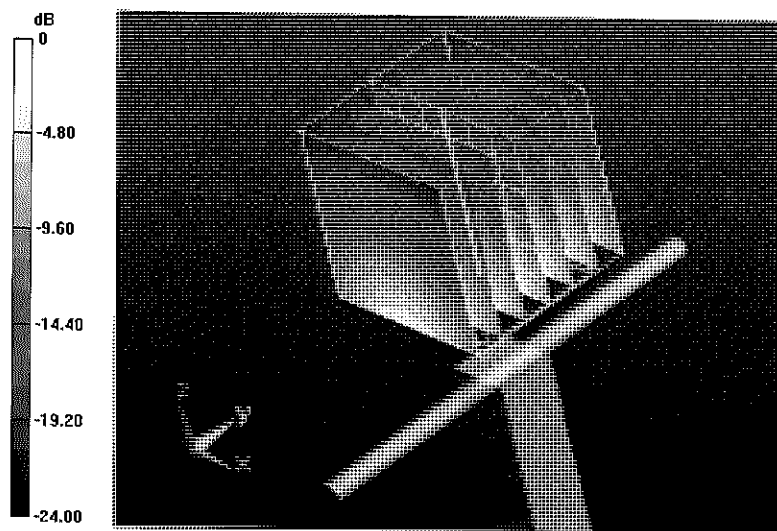
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 26.2610

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

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

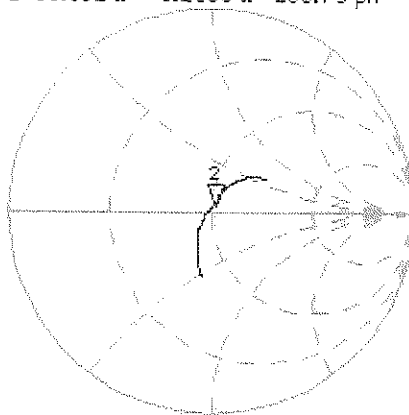


0 dB = 16.900mW/g = 24.56 dB mW/g

Impedance Measurement Plot for Body TSL

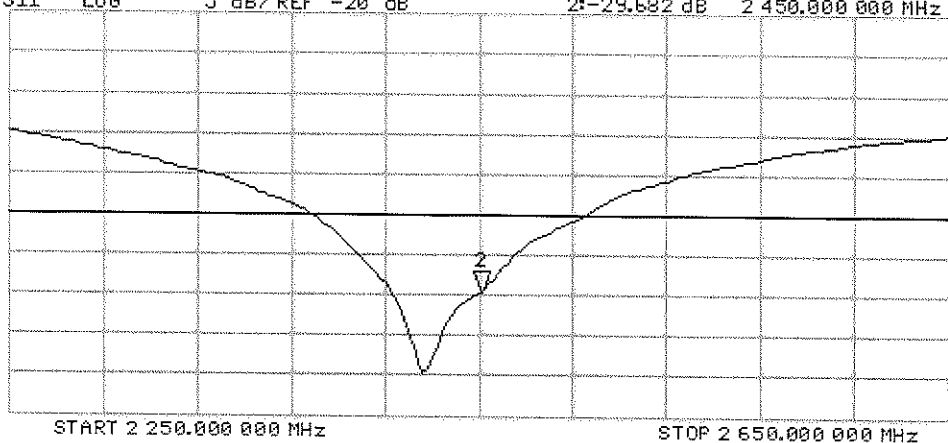
7 Feb 2012 11:28:39
 CH1 S11 1 U FS 2: 50.982 Ω 3.1680 Ω 205.79 μ H 2 450.000 000 MHz

*
 Del
 CA
 Avg
 16
 H1 d



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

CA
 Avg
 16
 H1 d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d119_Apr12**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d119**

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

Calibration date: **April 20, 2012**

✓ KOK
5/4/12

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: April 20, 2012

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Accreditation No.: **SCS 108**

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

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

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.36 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.42 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.55 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.19 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.5 $\pm$ 6 %	1.01 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.47 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.56 mW / g $\pm$ 17.0 % (k=2)

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.3 Ω - 2.2 j Ω
Return Loss	- 32.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.8 Ω - 4.3 j Ω
Return Loss	- 25.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.386 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 29, 2010

DASY5 Validation Report for Head TSL

Date: 20.04.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.9$ mho/m; $\epsilon_r = 41.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

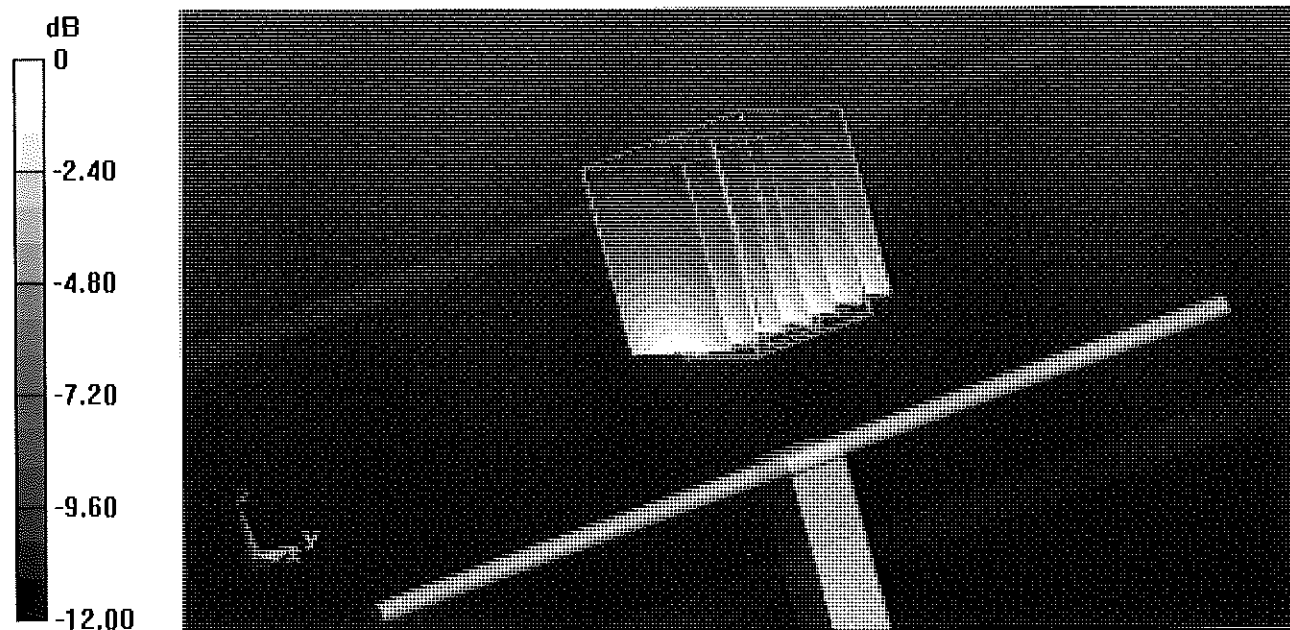
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.041 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 3.480 mW/g

SAR(1 g) = 2.36 mW/g; SAR(10 g) = 1.55 mW/g

Maximum value of SAR (measured) = 2.75 mW/g



0 dB = 2.75 mW/g = 8.79 dB mW/g

Impedance Measurement Plot for Head TSL

20 Apr 2012 09:34:14
[CH1] S11 1 U FS 1: 51.279 Ω -2.1582 Ω 88.316 pF 835.000 000 MHz

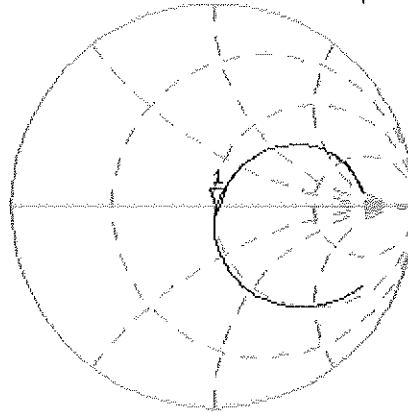
*

De1

Cor

Avg
16

H1d

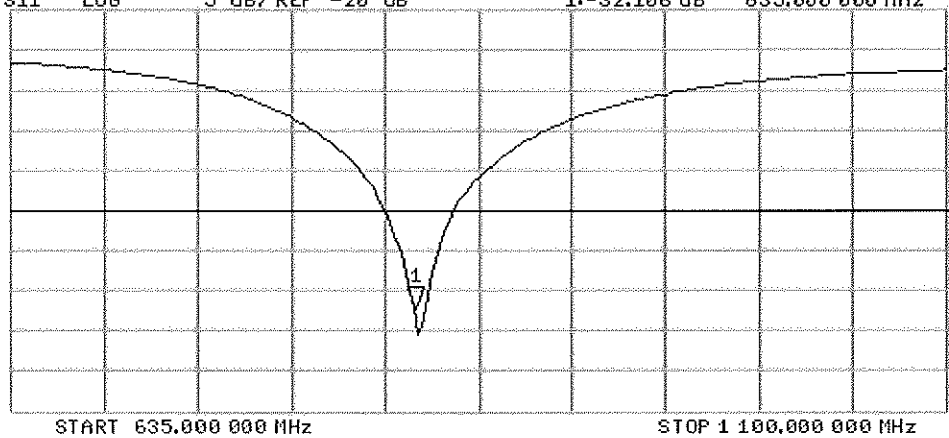


CH2 S11 LOG 5 dB/REF -20 dB 1: -32.106 dB 835.000 000 MHz

Cor

Avg
16

H1d



DASY5 Validation Report for Body TSL

Date: 19.04.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 1.01$ mho/m; $\epsilon_r = 54.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

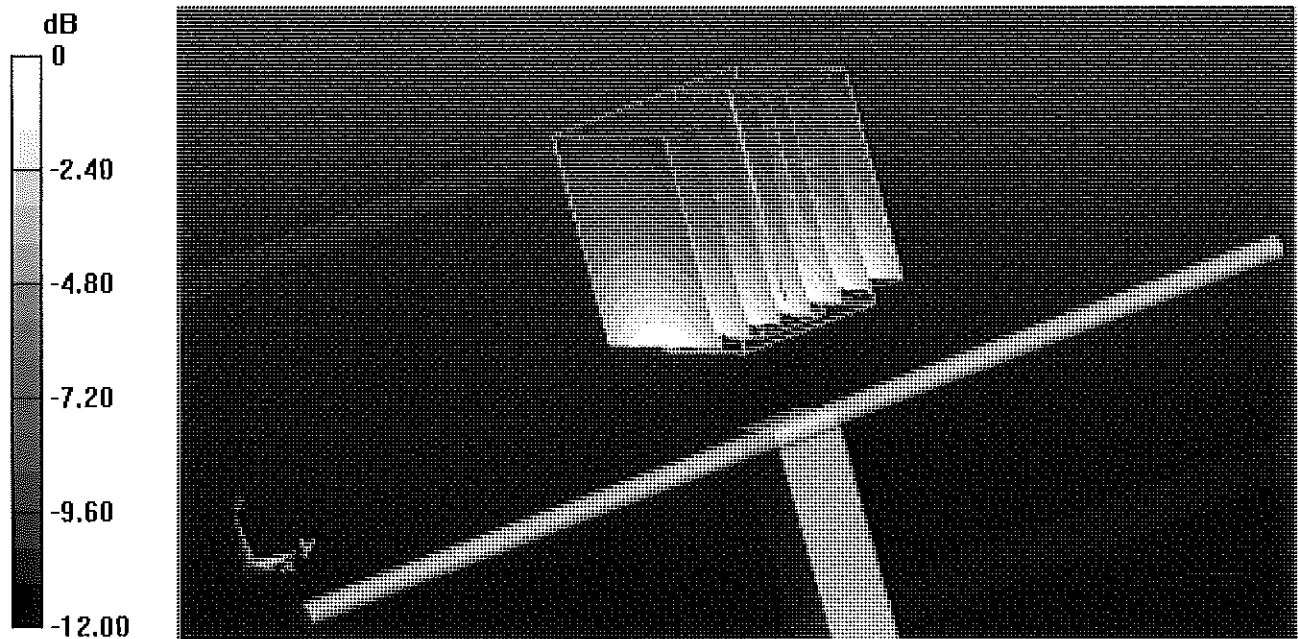
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.253 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.571 mW/g

SAR(1 g) = 2.47 mW/g; SAR(10 g) = 1.62 mW/g

Maximum value of SAR (measured) = 2.87 mW/g

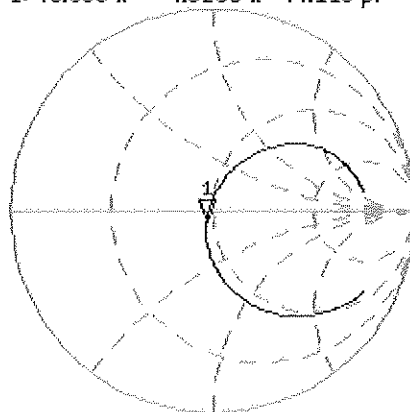


0 dB = 2.87 mW/g = 9.16 dB mW/g

Impedance Measurement Plot for Body TSL

19 Apr 2012 10:20:53
 [CH1] S11 1 U FS 1: 46.836 Ω -4.3203 Ω 44.118 pF 835.000 000 MHz

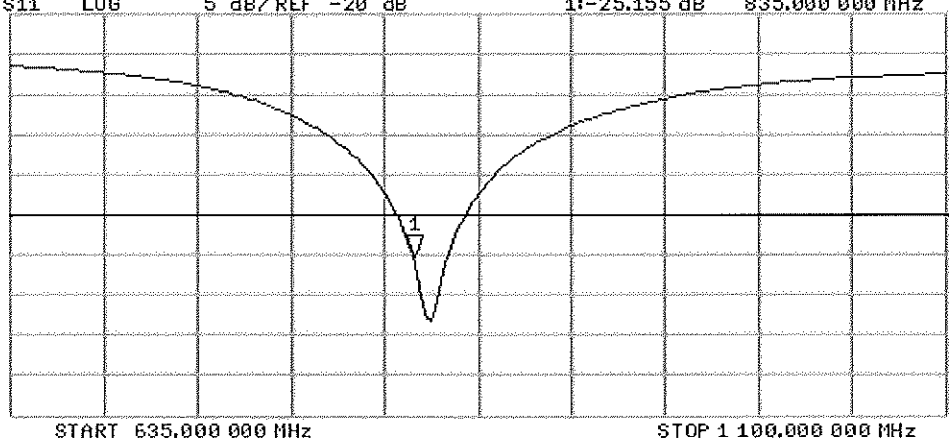
*
 Del
 Cor



Avg
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-25.155 dB 835.000 000 MHz

Cor
 Avg
 16
 H1d





Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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 Multilateral Agreement for the recognition of calibration certificates

Client **PC Test**

Certificate No: **D835V2-4d047_Jan12**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d047**

Calibration procedure(s) **QA CAL-15-V8**
 Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **January 25, 2012**

✓ KOK
2/6/12

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: January 25, 2012

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Accreditation No.: **SCS 108**

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.8 $\pm$ 6 %	0.89 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.33 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.41 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.17 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.3 $\pm$ 6 %	0.98 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.39 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.41 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.21 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 Ω - 3.0 j Ω
Return Loss	- 29.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.8 Ω - 5.0 j Ω
Return Loss	- 25.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.386 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 16, 2006

DASY5 Validation Report for Head TSL

Date: 25.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d047

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.89$ mho/m; $\epsilon_r = 41.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

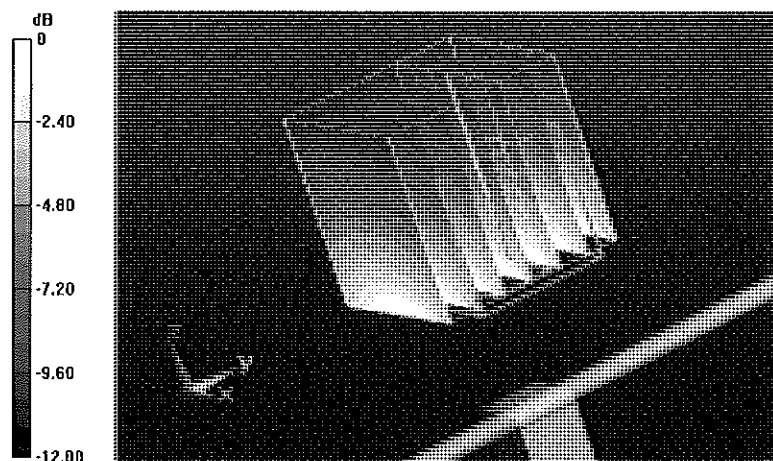
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.752 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.4130

SAR(1 g) = 2.33 mW/g; SAR(10 g) = 1.53 mW/g

Maximum value of SAR (measured) = 2.709 mW/g



0 dB = 2.710mW/g = 8.66 dB mW/g

Impedance Measurement Plot for Head TSL

25 Jan 2012 15:57:44

[CH1] S11 1 U FS 1: 51.688 Ω -3.0098 Ω 53.329 pF 835.000 000 MHz

*

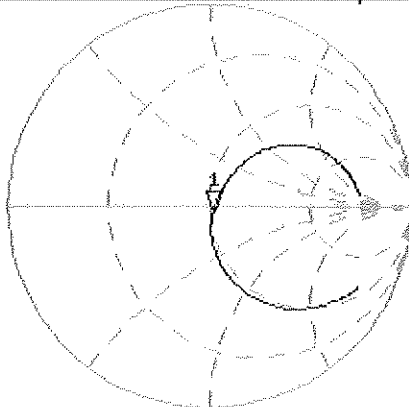
Del

Cor

Avg

16

H1d



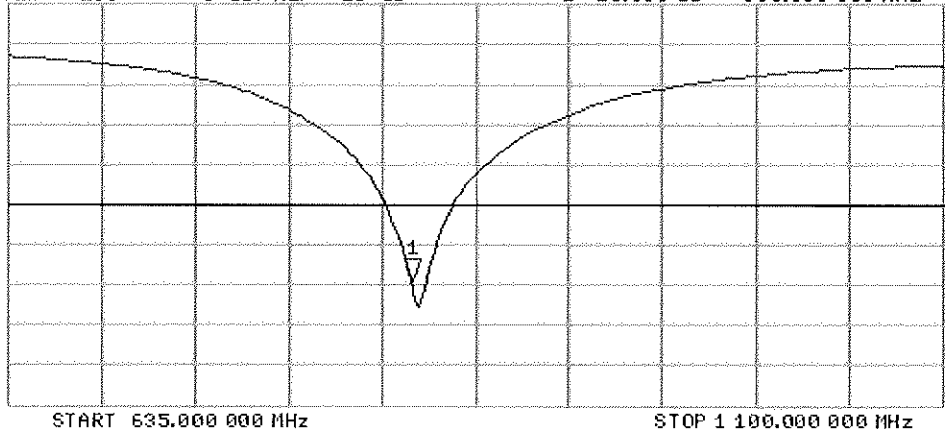
CH2 S11 LOG 5 dB/REF -20 dB 1:-29.390 dB 835.000 000 MHz

Cor

Avg

16

H1d



DASY5 Validation Report for Body TSL

Date: 25.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d047

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.98 \text{ mho/m}$; $\epsilon_r = 53.3$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

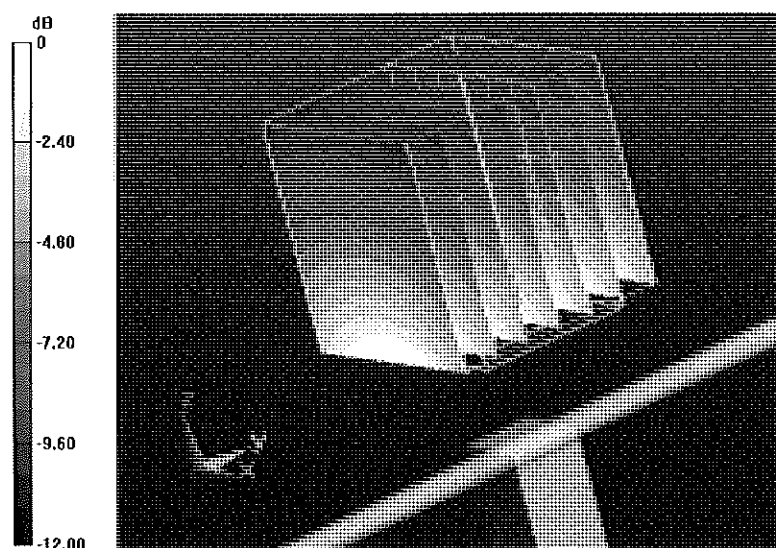
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 54.995 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.4790

SAR(1 g) = 2.39 mW/g; SAR(10 g) = 1.57 mW/g

Maximum value of SAR (measured) = 2.767 mW/g

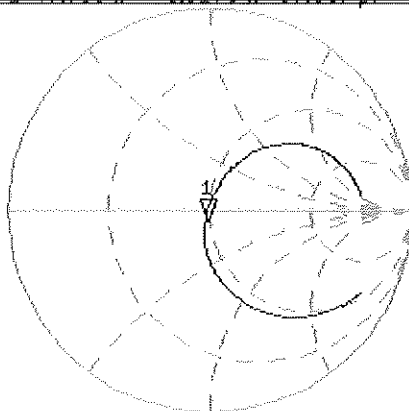


0 dB = 2.770mW/g = 8.85 dB mW/g

Impedance Measurement Plot for Body TSL

25 Jan 2012 11:09:13
 [CH1] S11 1 U FS 1:47.783 Ω -5.0175 Ω 37.987 pF 835.000 000 MHz

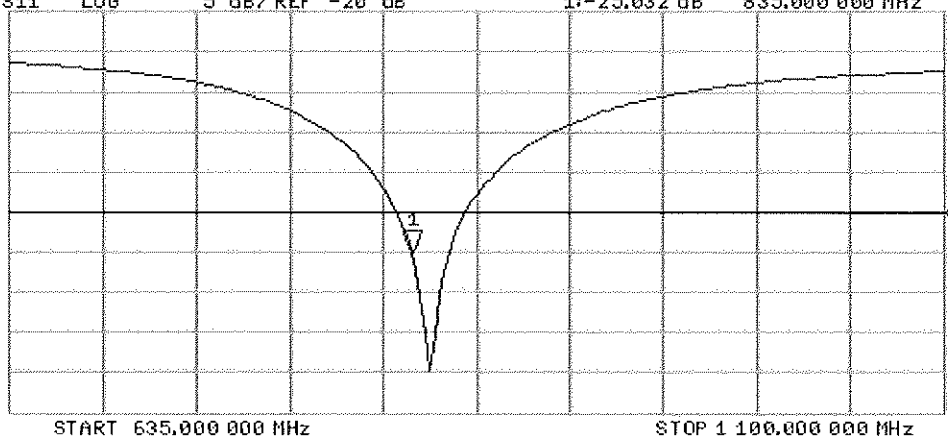
*
 Del
 Cor



Avg
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-25.032 dB 835.000 000 MHz

Cor
 Avg
 16
 H1d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D2450V2-719_Aug12**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 719**

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

Calibration date: **August 23, 2012**

✓ KOK
9/17/12

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Approved by: **Katja Pokovic** Technical Manager

Signature

Israe El-Naouq
Katja Pokovic

Issued: August 23, 2012

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Accredited by the Swiss Accreditation Service (SAS)
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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

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

SAR result with Head TSL

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

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

Body TSL parameters

The following parameters and calculations were applied.

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

SAR result with Body TSL

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

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$54.4 \Omega + 3.8 j\Omega$
Return Loss	- 25.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.7 \Omega + 5.9 j\Omega$
Return Loss	- 24.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.150 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.81$ mho/m; $\epsilon_r = 39.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

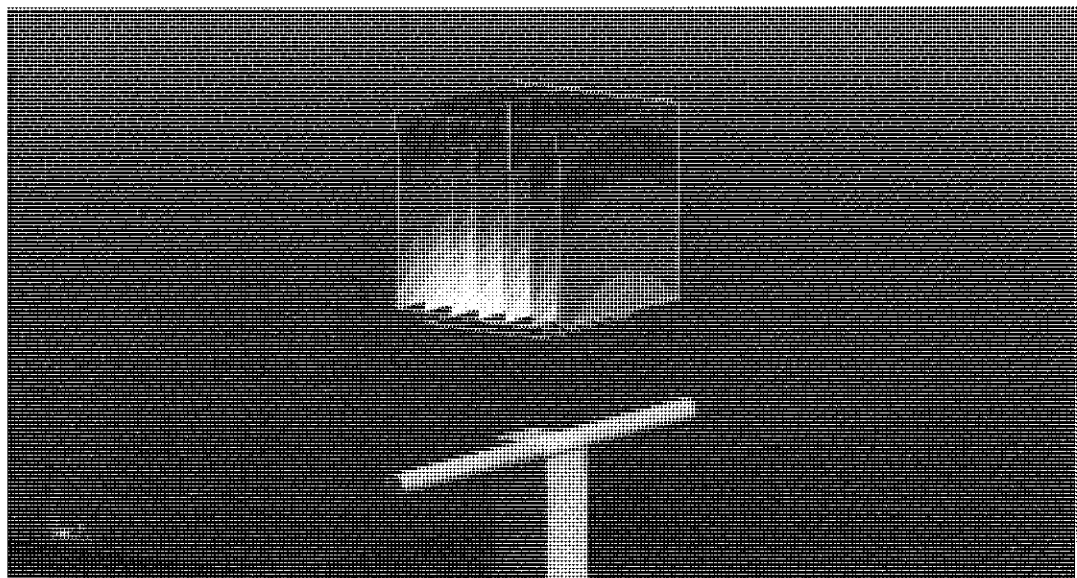
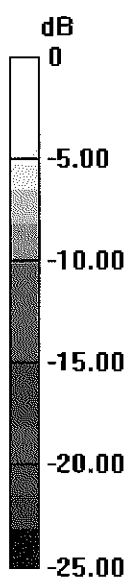
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.219 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 26.633 mW/g

SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.19 mW/g

Maximum value of SAR (measured) = 16.5 W/kg

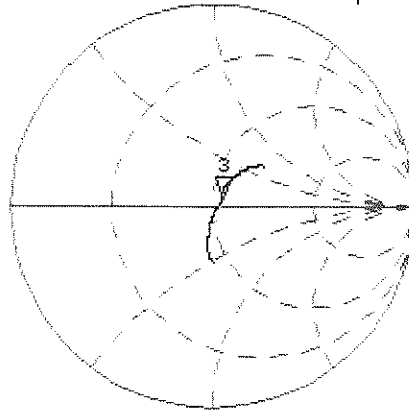


0 dB = 16.5 W/kg = 24.35 dB W/kg

Impedance Measurement Plot for Head TSL

22 Aug 2012 15:39:08
 [CH1] S11 1 U FS 3: 54.416 Ω 3.7656 Ω 244.62 pH 2 450.000 000 MHz

*
 Del
 CA



Avg
 16

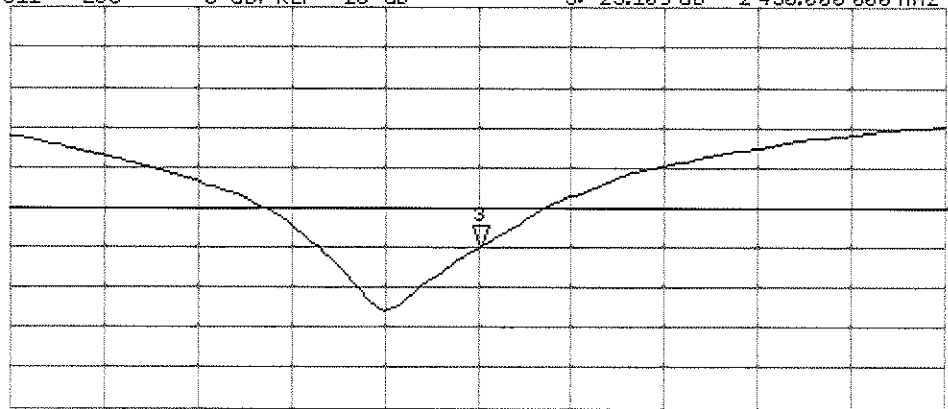
H1d

CH2 S11 LOG 5 dB/REF -20 dB 3: -25.109 dB 2 450.000 000 MHz

CA

Avg
 16

H1d



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 22.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 51.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

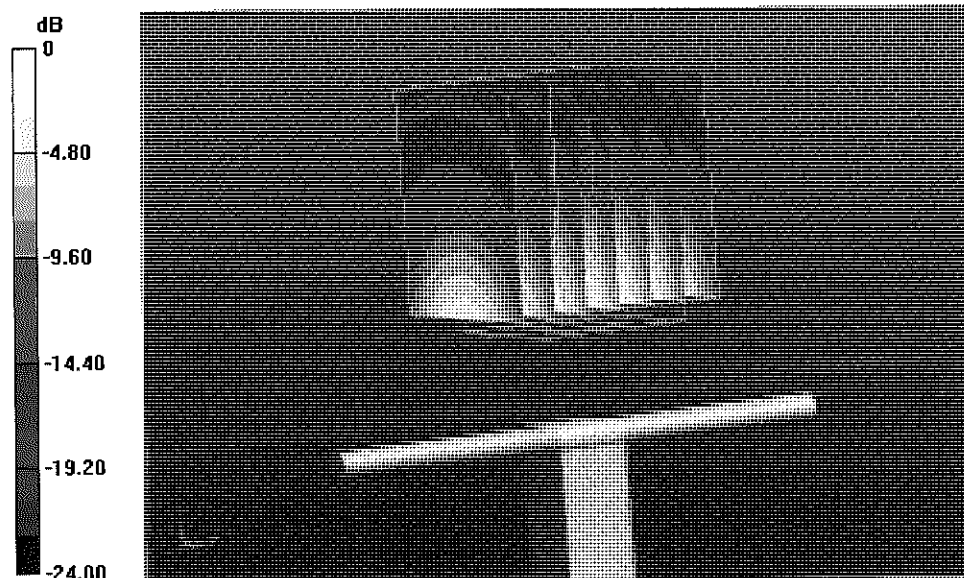
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.970 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 26.692 mW/g

SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.16 mW/g

Maximum value of SAR (measured) = 17.1 W/kg

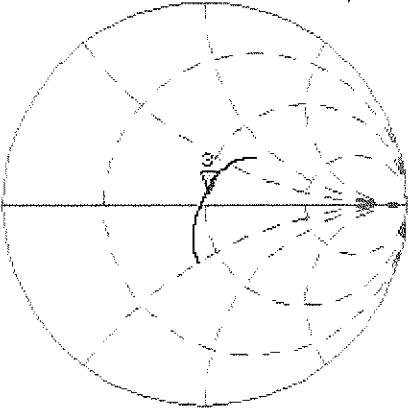


0 dB = 17.1 W/kg = 24.66 dB W/kg

Impedance Measurement Plot for Body TSL

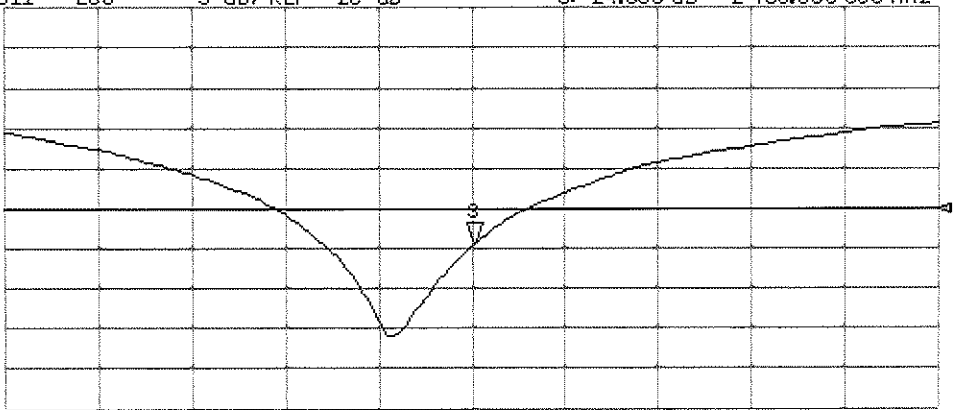
22 Aug 2012 15:38:22
[CH1] S11 1 U FS 3: 50.709 Ω 5.8906 Ω 382.66 pF 2 450.000 000 MHz

*
Del
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 3:-24.605 dB 2 450.000 000 MHz

CA
Avg
16
H1d



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D5GHzV2-1007_Oct12**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1007**

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

Calibration date: **October 30, 2012**

✓ KOK
11/15/12

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe EX3DV4	SN: 3503	30-Dec-11 (No. EX3-3503_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

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

Signature

Israe El-Naouq
Katja Pokovic

Issued: October 31, 2012

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.3
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz $\pm$ 1 MHz 5300 MHz $\pm$ 1 MHz 5500 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.8 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.9 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.1 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.9 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5500 MHz

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

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

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5600 MHz

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

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

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	73.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.6 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.63 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.92 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	78.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.8 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5800 MHz

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

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

Appendix

Antenna Parameters with Head TSL at 5200 MHz

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

Antenna Parameters with Head TSL at 5300 MHz

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

Antenna Parameters with Head TSL at 5500 MHz

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

Antenna Parameters with Head TSL at 5600 MHz

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

Antenna Parameters with Head TSL at 5800 MHz

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

Antenna Parameters with Body TSL at 5200 MHz

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

Antenna Parameters with Body TSL at 5300 MHz

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

Antenna Parameters with Body TSL at 5500 MHz

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

Antenna Parameters with Body TSL at 5600 MHz

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

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	$59.7 \Omega + 4.5 j\Omega$
Return Loss	- 20.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 28, 2003

DASY5 Validation Report for Head TSL

Date: 30.10.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

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

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

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

Peak SAR (extrapolated) = 29.8 W/kg

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

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

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

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

Peak SAR (extrapolated) = 31.8 W/kg

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

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

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

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

Peak SAR (extrapolated) = 33.8 W/kg

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

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

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

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

Peak SAR (extrapolated) = 33.9 W/kg

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

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

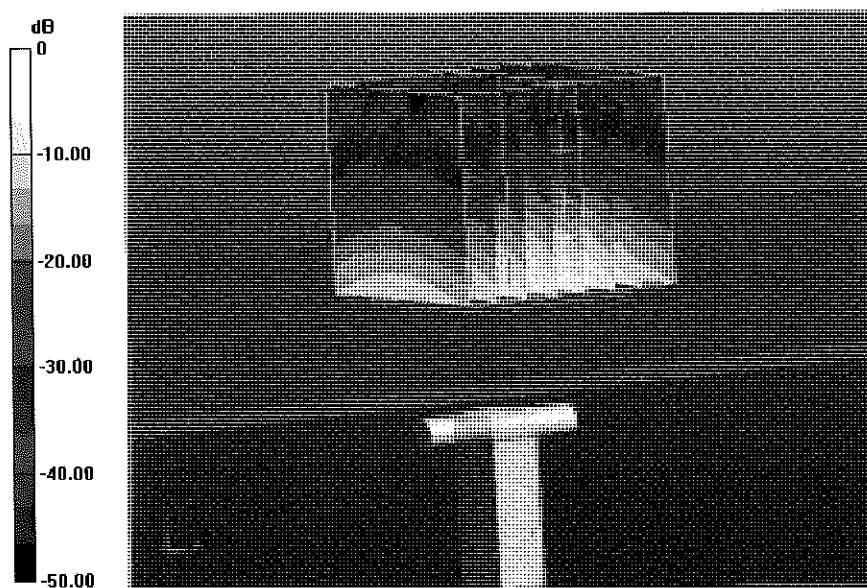
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

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

Peak SAR (extrapolated) = 33.5 W/kg

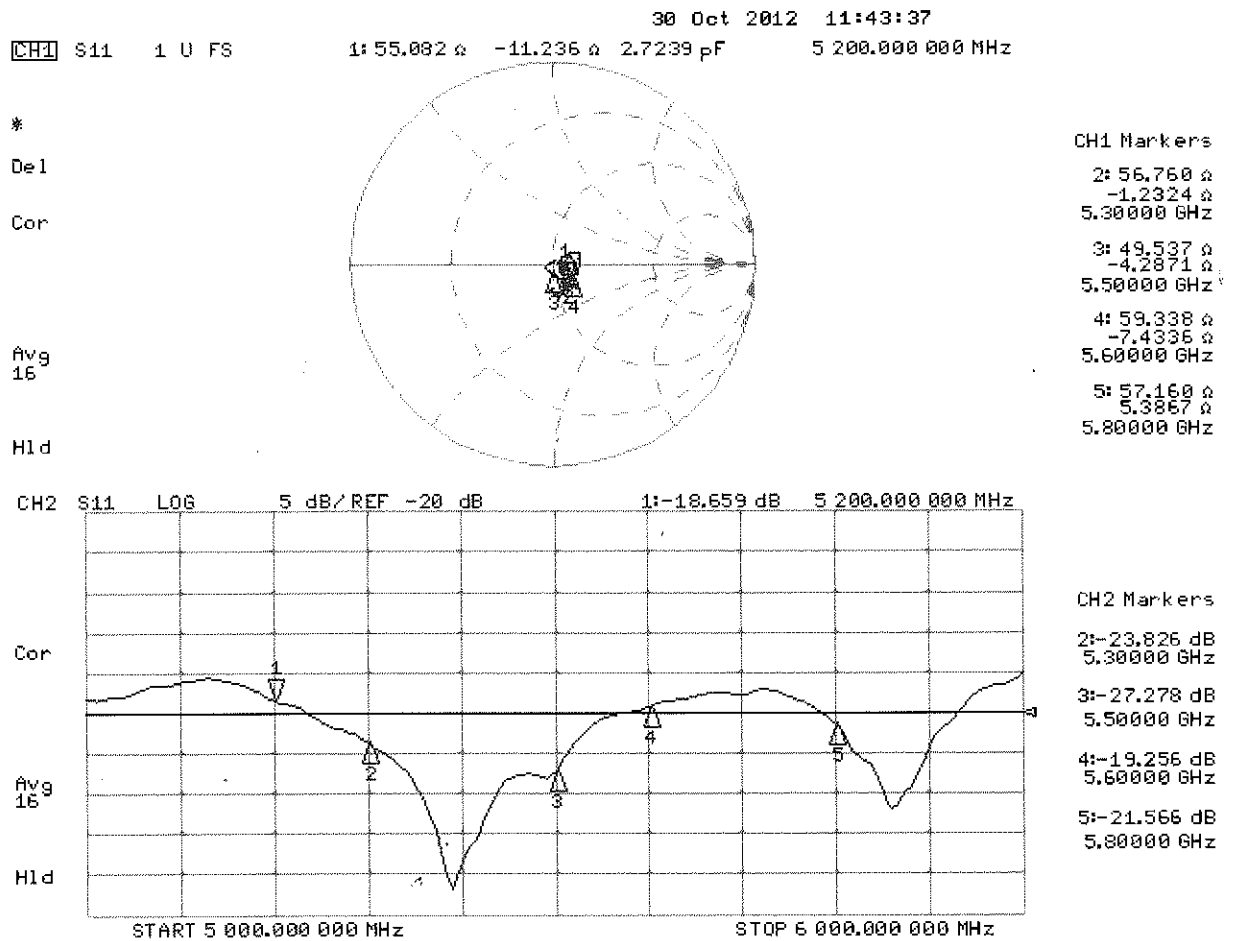
SAR(1 g) = 8.05 W/kg; SAR(10 g) = 2.29 W/kg

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



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 30.10.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

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

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

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

Peak SAR (extrapolated) = 29.4 W/kg

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

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

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

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

Peak SAR (extrapolated) = 31.3 W/kg

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

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

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

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

Peak SAR (extrapolated) = 34.4 W/kg

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

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

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

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

Peak SAR (extrapolated) = 35.9 W/kg

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

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

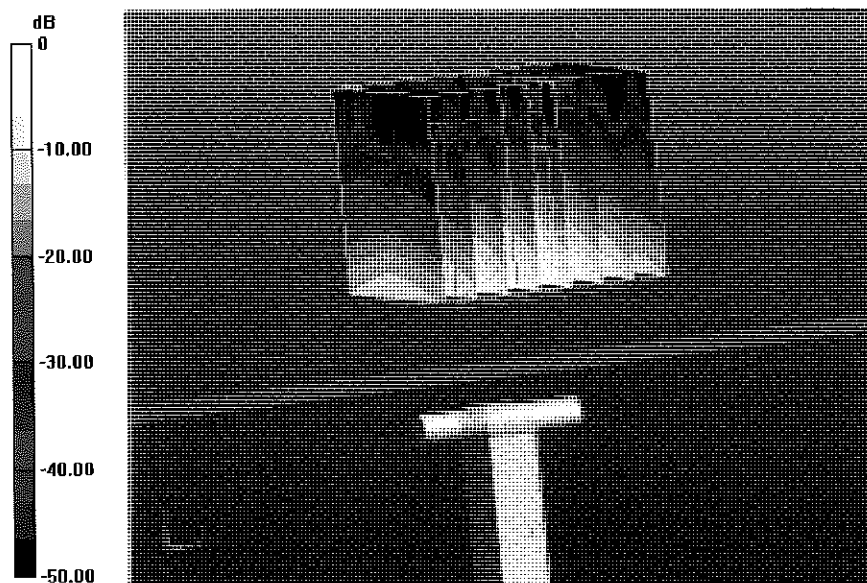
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

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

Peak SAR (extrapolated) = 35.4 W/kg

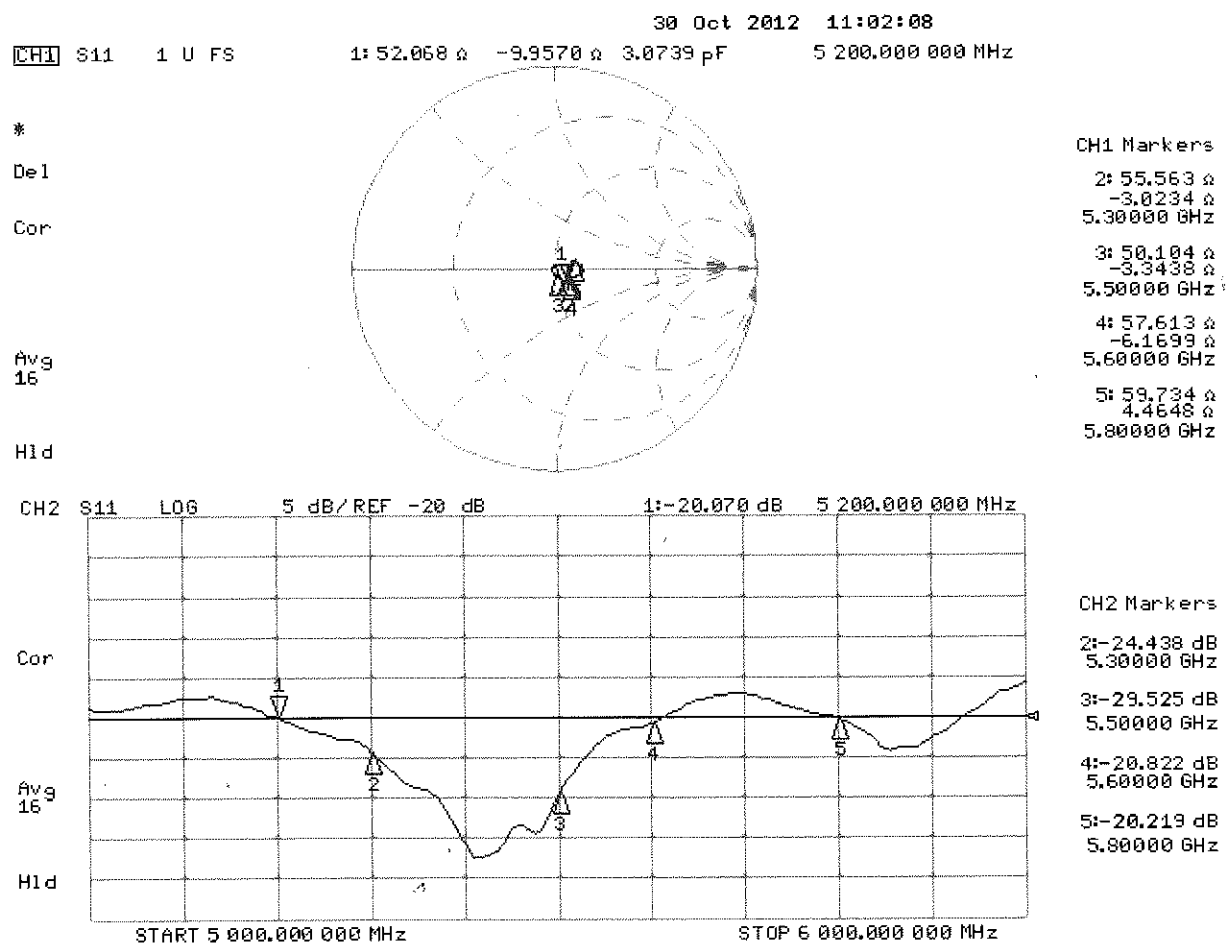
SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.08 W/kg

Maximum value of SAR (measured) = 18.9 W/kg



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

Impedance Measurement Plot for Body TSL





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_Aug12**

CALIBRATION CERTIFICATE

Object **ES3DV2 - SN:3022**

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

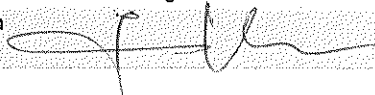
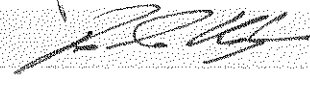
Calibration date: **August 28, 2012**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 
			Issued: August 28, 2012
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Accreditation No.: **SCS 108**

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 Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}**: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV2

SN:3022

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

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

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

Basic Calibration Parameters

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

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
0	CW	0.00	X	0.00	0.00	1.00	133.3	$\pm 2.7 \%$
			Y	0.00	0.00	1.00	140.3	
			Z	0.00	0.00	1.00	178.9	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.30	6.30	6.30	0.30	1.72	± 12.0 %
835	41.5	0.90	6.03	6.03	6.03	0.35	1.63	± 12.0 %
1750	40.1	1.37	5.07	5.07	5.07	0.32	1.89	± 12.0 %
1900	40.0	1.40	4.86	4.86	4.86	0.40	1.57	± 12.0 %
2450	39.2	1.80	4.23	4.23	4.23	0.59	1.44	± 12.0 %
2600	39.0	1.96	4.10	4.10	4.10	0.67	1.37	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

Calibration Parameter Determined in Body Tissue Simulating Media

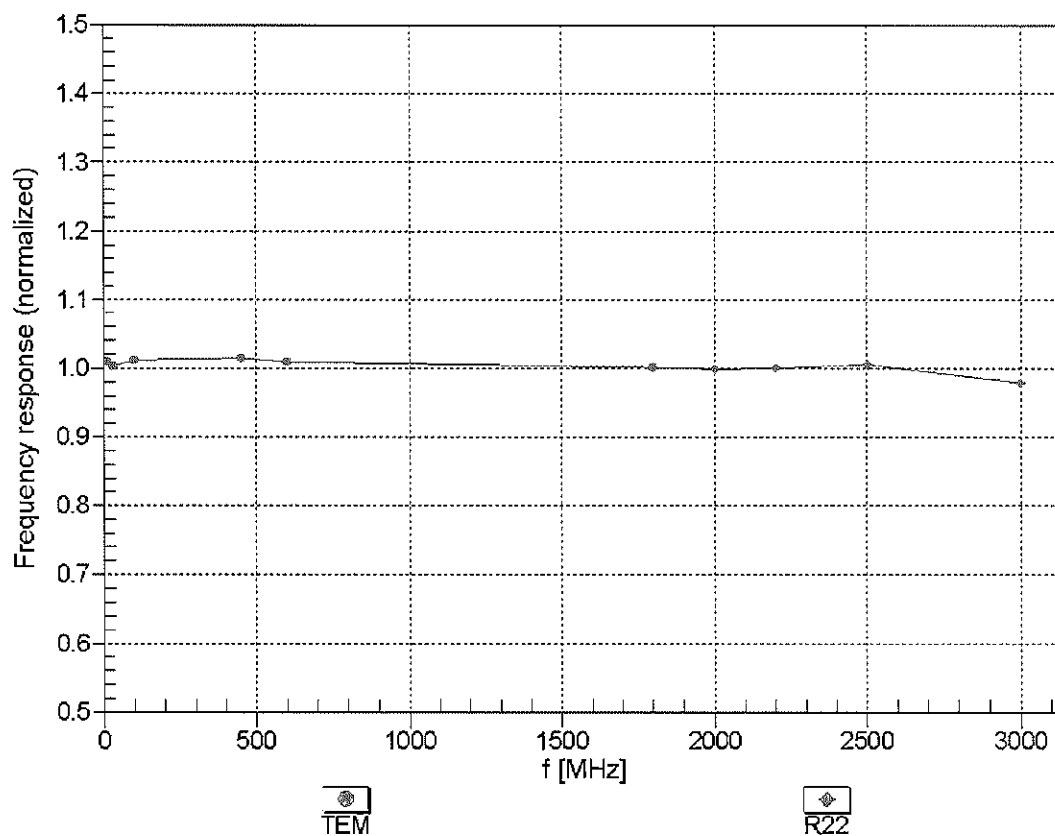
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.07	6.07	6.07	0.23	2.09	± 12.0 %
835	55.2	0.97	6.02	6.02	6.02	0.47	1.44	± 12.0 %
1750	53.4	1.49	4.70	4.70	4.70	0.46	1.55	± 12.0 %
1900	53.3	1.52	4.43	4.43	4.43	0.36	1.87	± 12.0 %
2450	52.7	1.95	3.97	3.97	3.97	0.65	1.06	± 12.0 %
2600	52.5	2.16	3.80	3.80	3.80	0.54	0.75	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

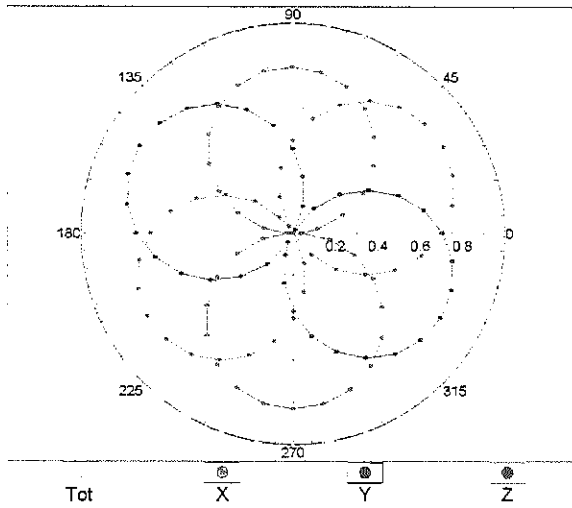
(TEM-Cell: ifi110 EXX, Waveguide: R22)



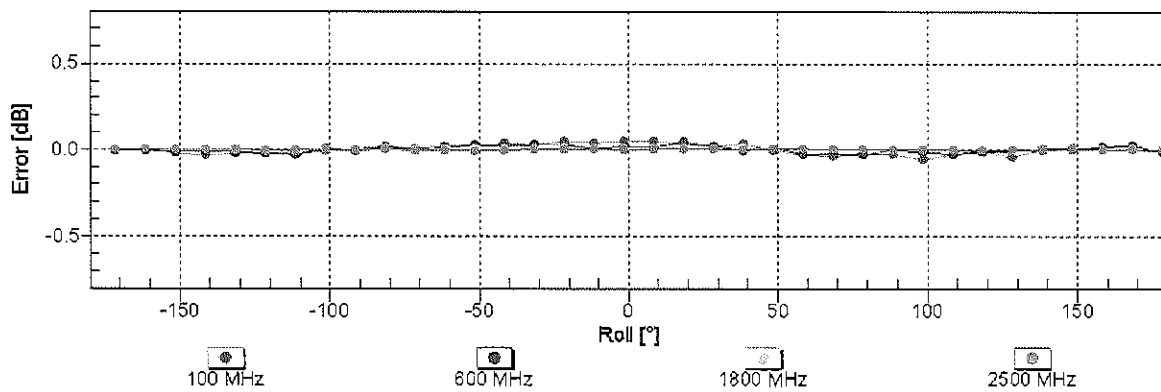
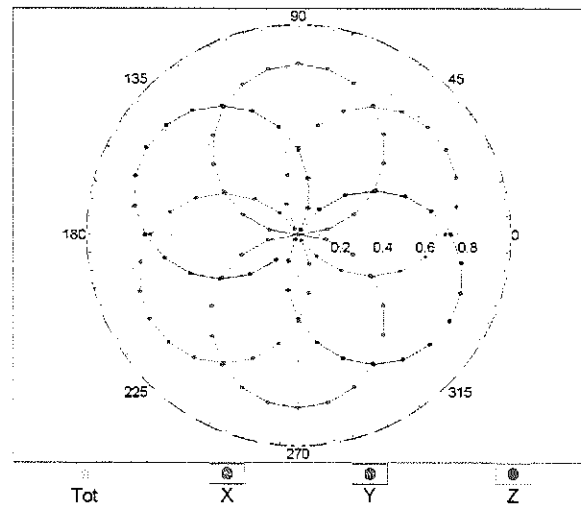
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz, TEM

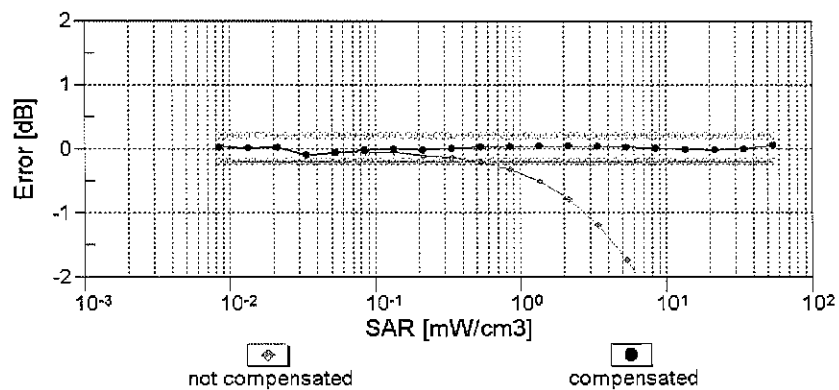
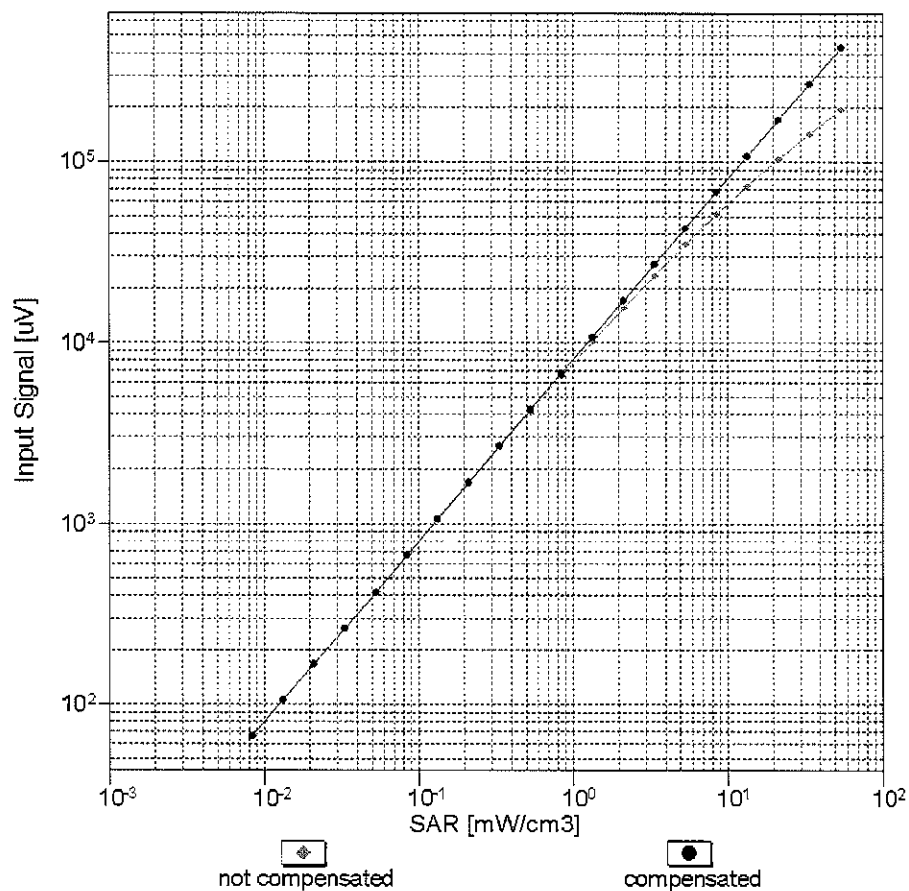


f=1800 MHz, R22



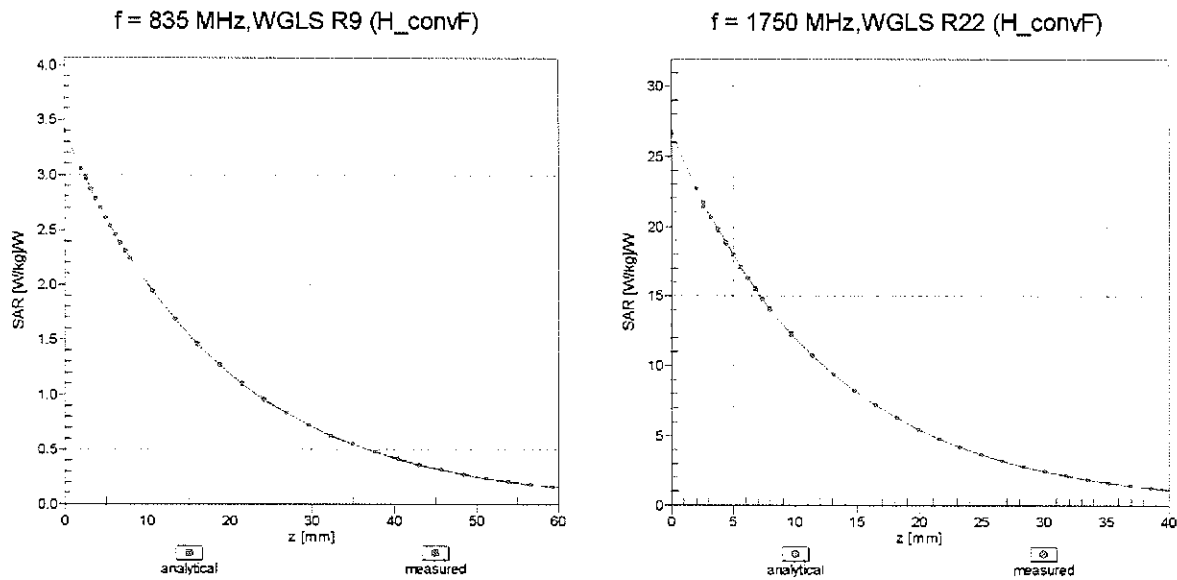
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



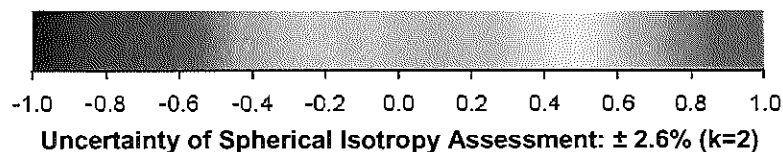
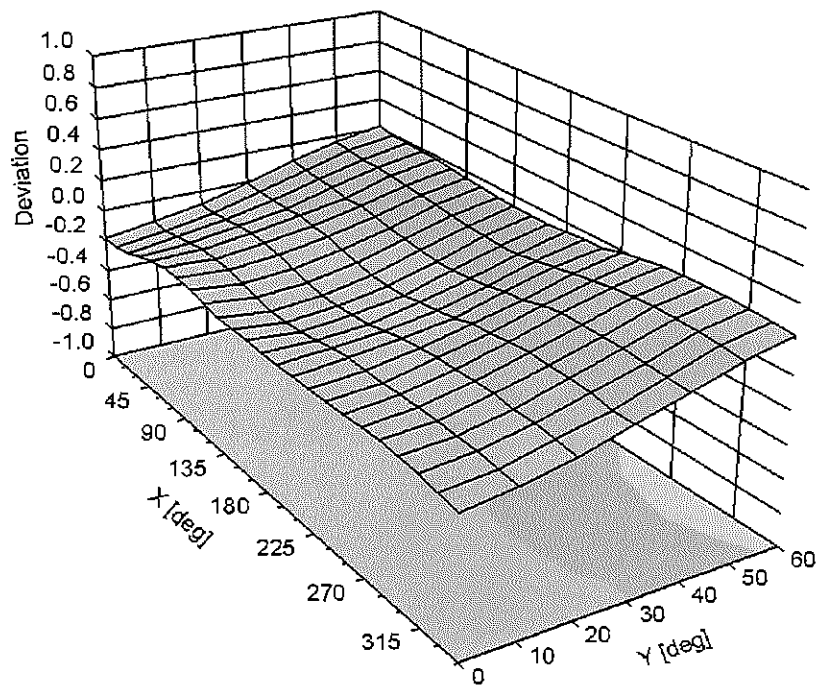
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	98.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3209_Mar12**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3209**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-12.v7, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **March 16, 2012**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: March 19, 2012

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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * *frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}; A, B, C** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * *ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3209

Manufactured: October 14, 2008
Calibrated: March 16, 2012

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.36	1.34	1.15	$\pm 10.1 \%$
DCP (mV) ^B	98.2	97.4	98.7	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	119.2	$\pm 3.5 \%$
			Y	0.00	0.00	1.00	89.3	
			Z	0.00	0.00	1.00	111.5	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.47	6.47	6.47	0.37	1.61	± 12.0 %
835	41.5	0.90	6.22	6.22	6.22	0.24	2.24	± 12.0 %
1640	40.3	1.29	5.38	5.38	5.38	0.41	1.56	± 12.0 %
1750	40.1	1.37	5.26	5.26	5.26	0.41	1.60	± 12.0 %
1900	40.0	1.40	5.15	5.15	5.15	0.80	1.16	± 12.0 %
2450	39.2	1.80	4.46	4.46	4.46	0.64	1.39	± 12.0 %
2600	39.0	1.96	4.30	4.30	4.30	0.69	1.42	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Calibration Parameter Determined in Body Tissue Simulating Media

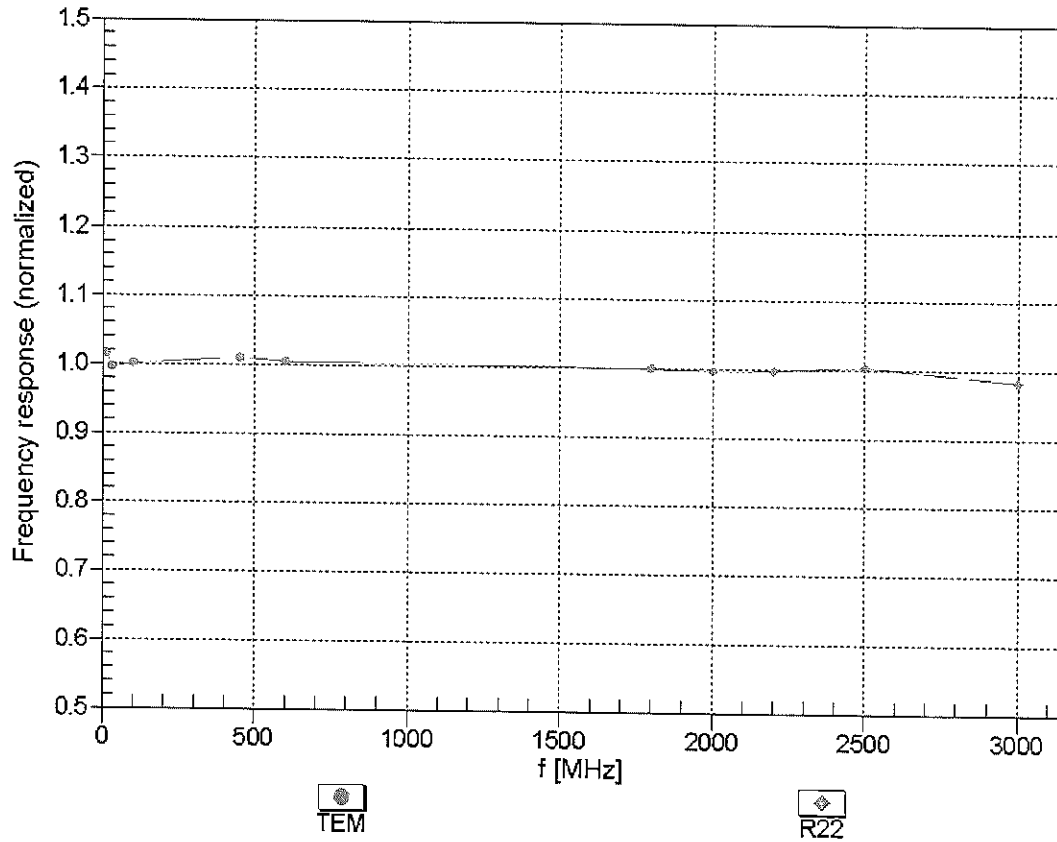
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	56.7	0.94	7.11	7.11	7.11	0.07	1.00	± 13.4 %
750	55.5	0.96	6.23	6.23	6.23	0.54	1.40	± 12.0 %
835	55.2	0.97	6.13	6.13	6.13	0.24	2.27	± 12.0 %
1640	53.8	1.40	5.21	5.21	5.21	0.72	1.29	± 12.0 %
1750	53.4	1.49	4.83	4.83	4.83	0.59	1.44	± 12.0 %
1900	53.3	1.52	4.63	4.63	4.63	0.57	1.50	± 12.0 %
2450	52.7	1.95	4.23	4.23	4.23	0.80	1.00	± 12.0 %
2600	52.5	2.16	4.02	4.02	4.02	0.62	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

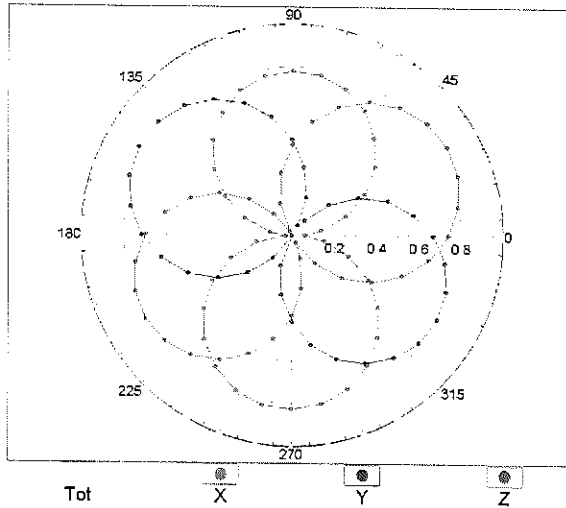
(TEM-Cell: ifi110 EXX, Waveguide: R22)



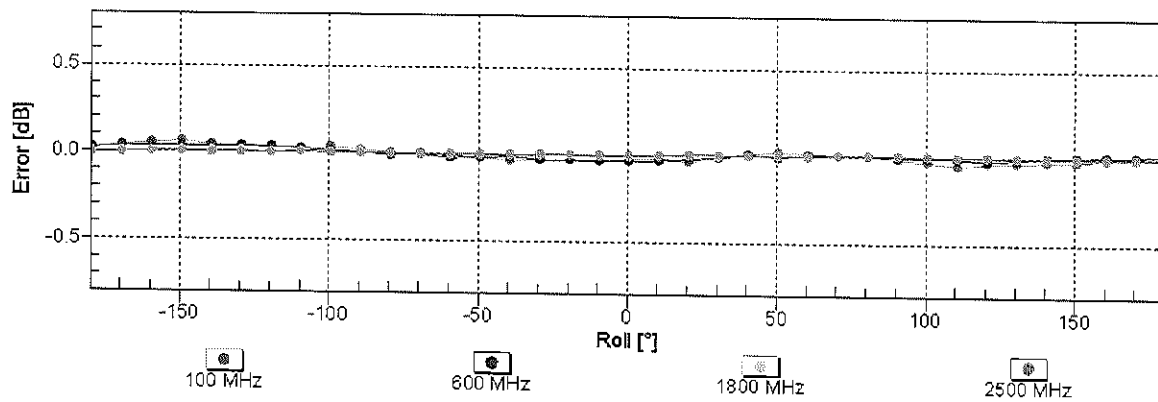
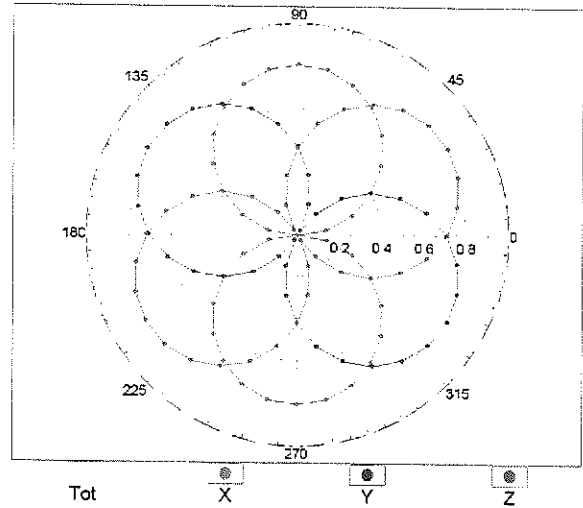
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$

f=600 MHz, TEM

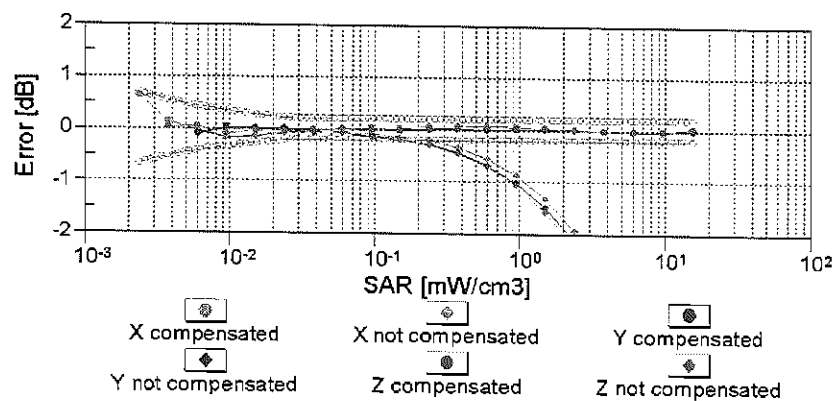
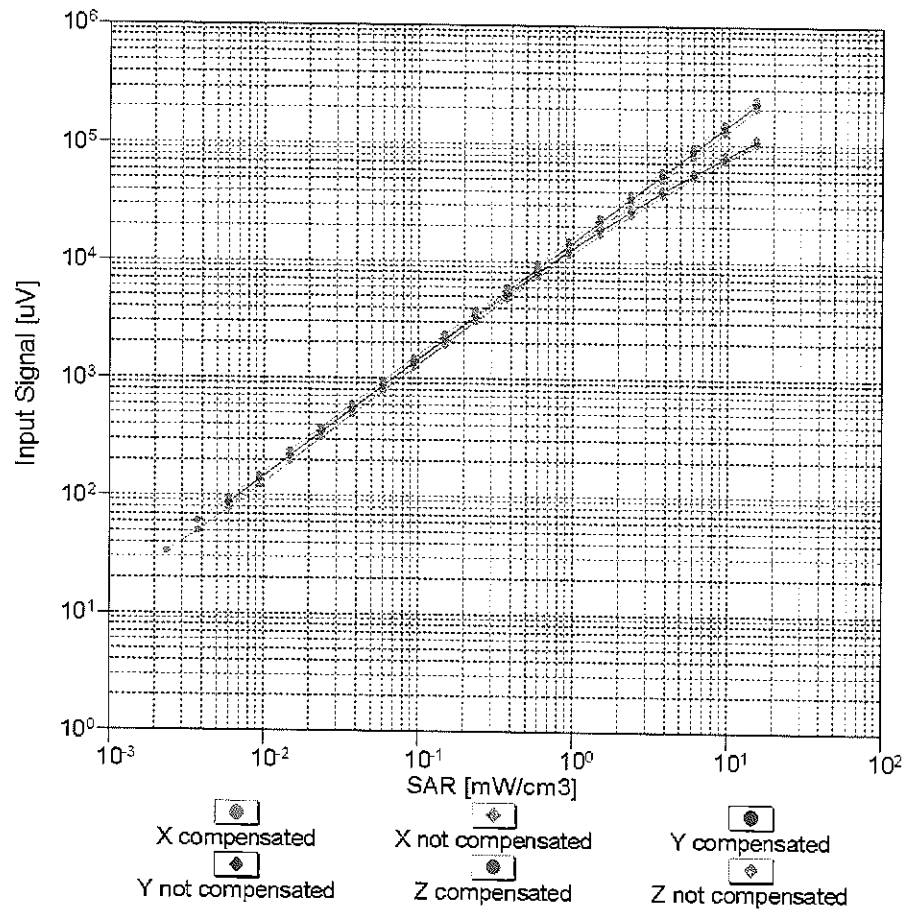


f=1800 MHz, R22



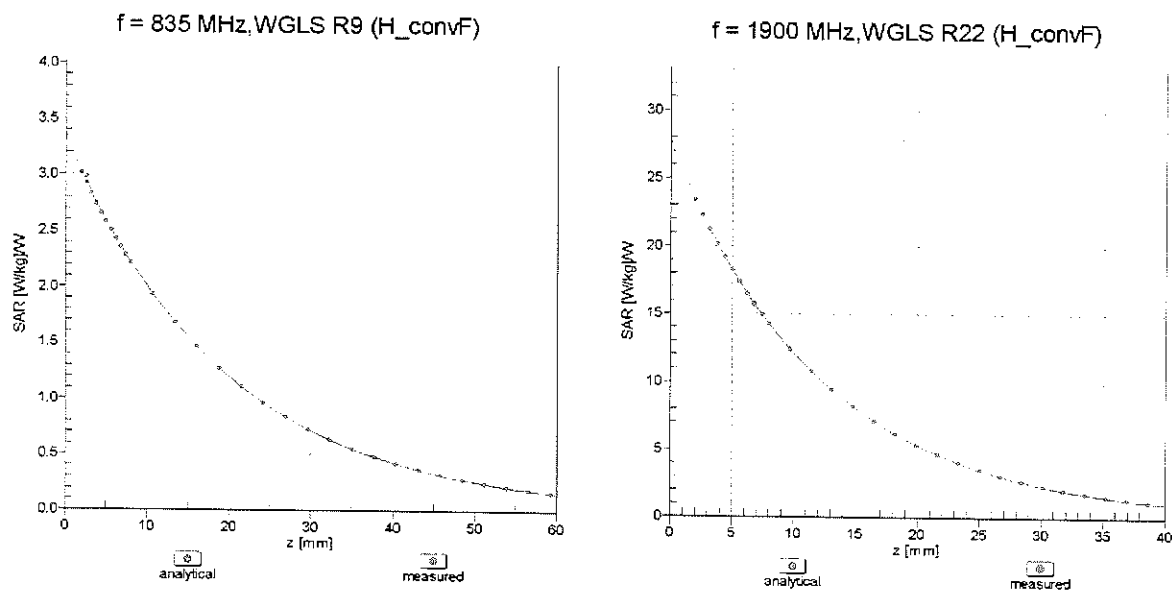
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



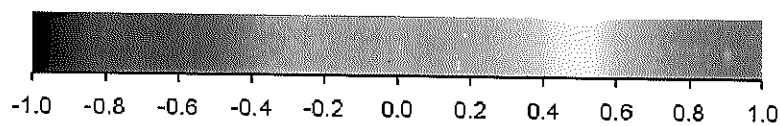
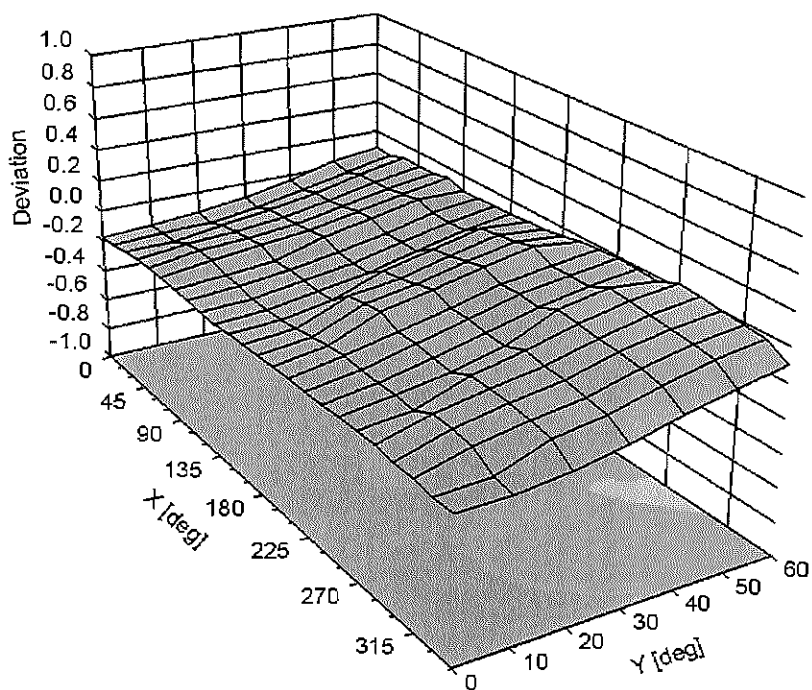
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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Client **PC Test**

Certificate No: **ES3-3258_Feb12**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3258**

Calibration procedure(s) **QA CAL-01 vs. QA CAL-23-w, QA CAL-25-w
 Calibration procedure for doimetric E-field probes**

Calibration date: **February 21, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	
Issued: February 23, 2012			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}**: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3258

Manufactured: January 25, 2010
Calibrated: February 21, 2012

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 ($\mu\text{V}/(\text{V/m})^2$) ^A	1.29	1.18	1.23	$\pm 10.1 \%$
DCP (mV) ^B	101.6	105.0	100.8	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	115.9	$\pm 3.0 \%$
			Y	0.00	0.00	1.00	107.9	
			Z	0.00	0.00	1.00	115.8	

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: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	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.26	6.26	6.26	0.43	1.49	± 12.0 %
835	41.5	0.90	6.01	6.01	6.01	0.45	1.48	± 12.0 %
1640	40.3	1.29	5.46	5.46	5.46	0.61	1.30	± 12.0 %
1750	40.1	1.37	5.30	5.30	5.30	0.67	1.30	± 12.0 %
1900	40.0	1.40	5.17	5.17	5.17	0.79	1.23	± 12.0 %
2450	39.2	1.80	4.46	4.46	4.46	0.67	1.40	± 12.0 %
2600	39.0	1.96	4.31	4.31	4.31	0.80	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.

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

Calibration Parameter Determined in Body Tissue Simulating Media

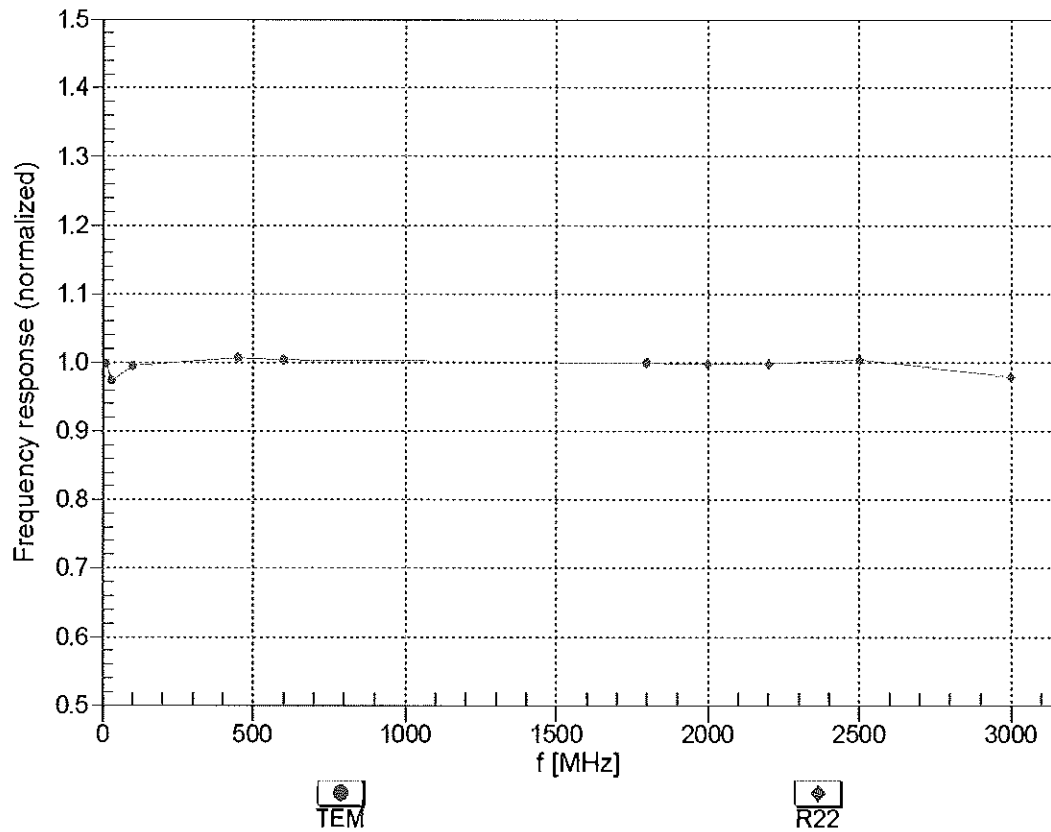
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.21	6.21	6.21	0.80	1.13	± 12.0 %
835	55.2	0.97	6.06	6.06	6.06	0.50	1.46	± 12.0 %
1640	53.8	1.40	5.45	5.45	5.45	0.80	1.23	± 12.0 %
1750	53.4	1.49	4.99	4.99	4.99	0.60	1.48	± 12.0 %
1900	53.3	1.52	4.70	4.70	4.70	0.56	1.57	± 12.0 %
2450	52.7	1.95	4.28	4.28	4.28	0.80	1.08	± 12.0 %
2600	52.5	2.16	4.05	4.05	4.05	0.80	1.02	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

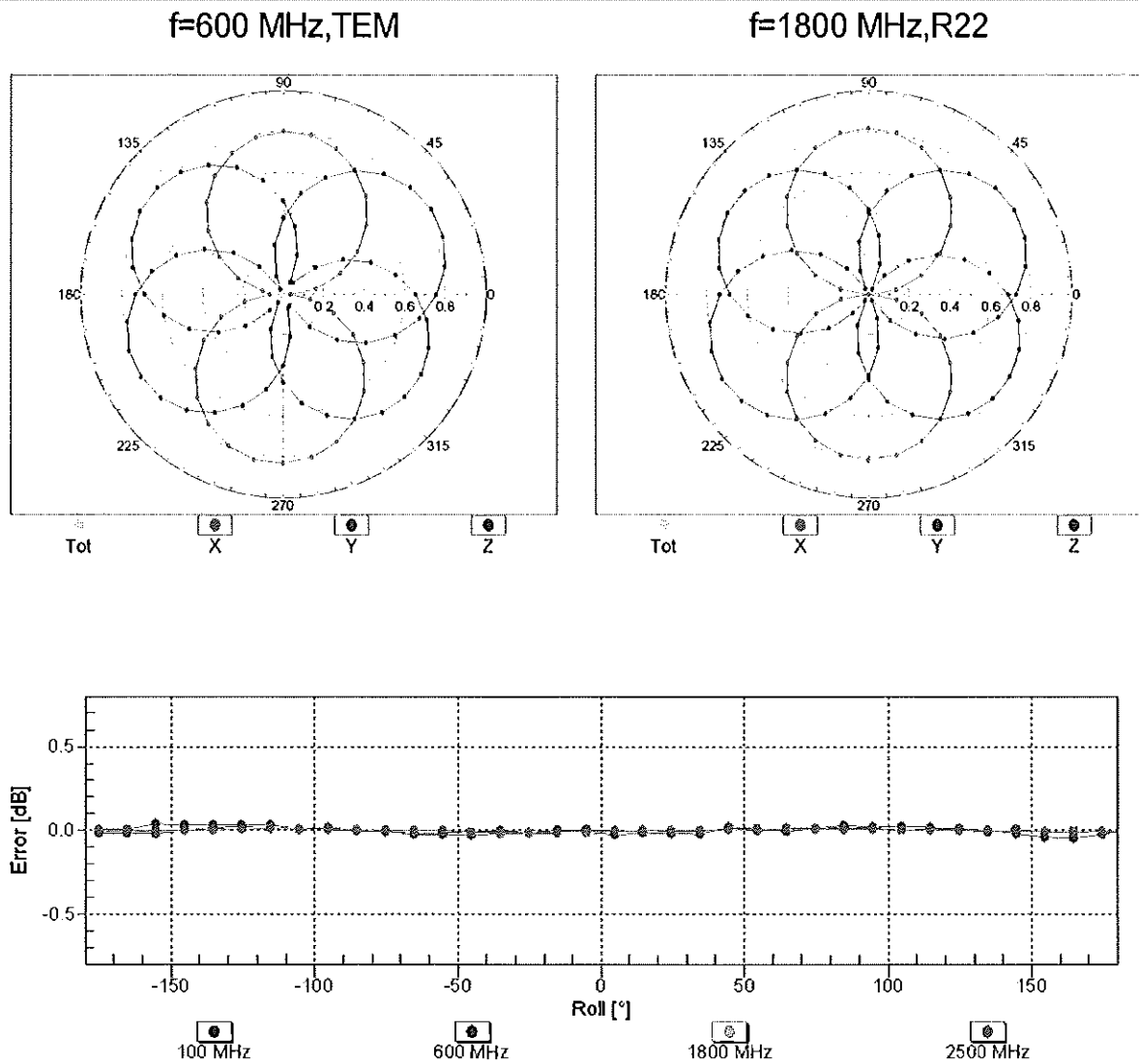
Frequency Response of E-Field

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



Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

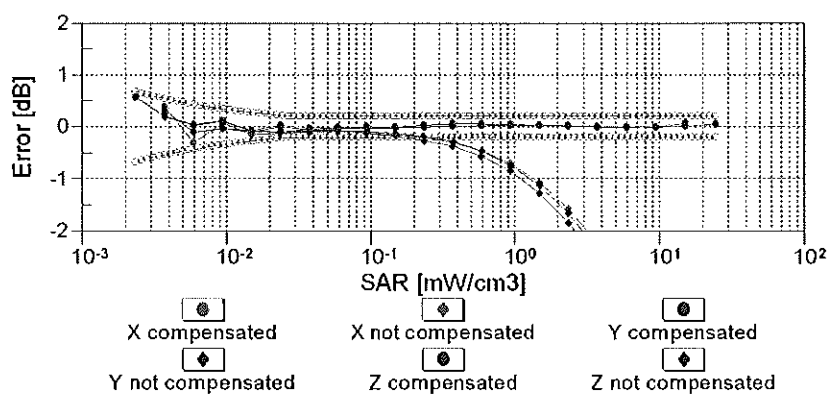
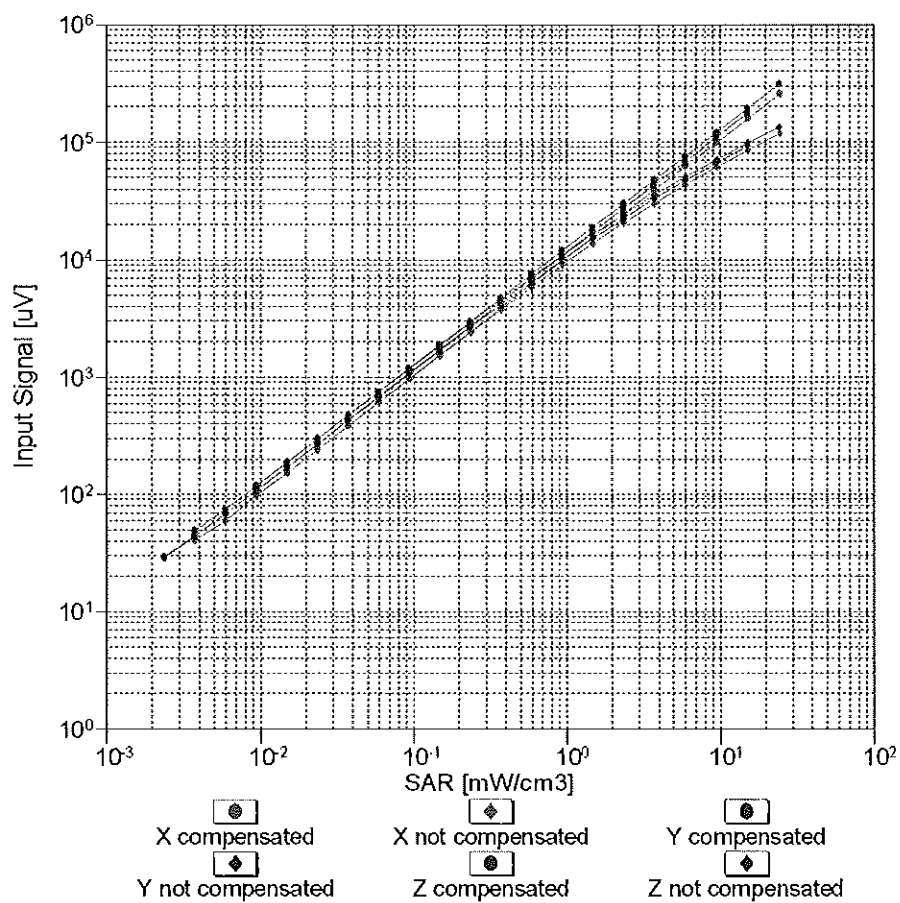
Receiving Pattern (ϕ), $\theta = 0^\circ$



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

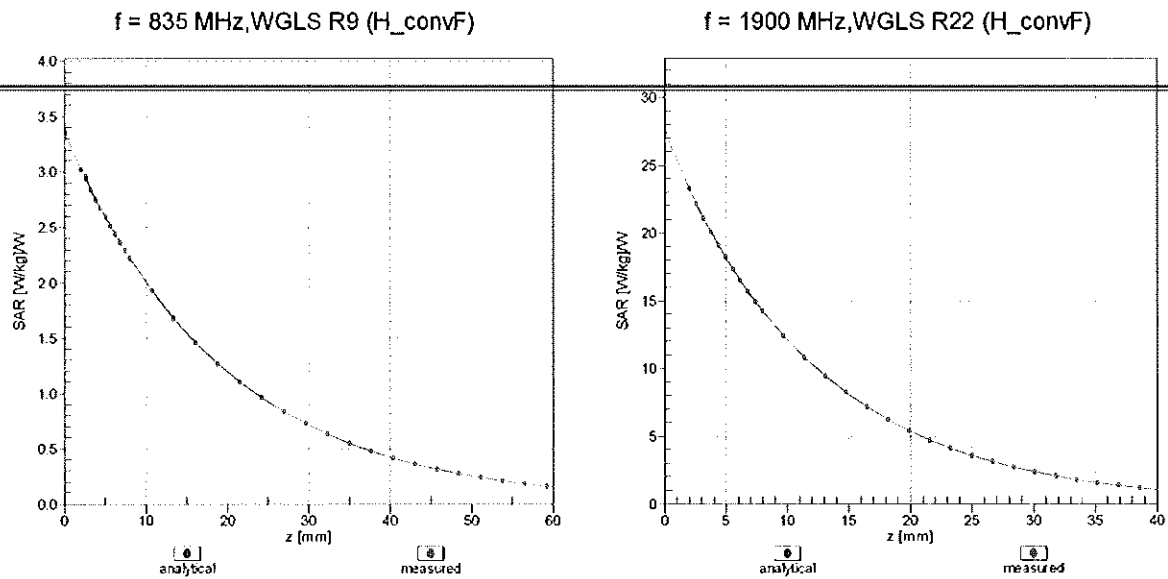
Dynamic Range $f(\text{SAR}_{\text{head}})$

(TEM cell , $f = 900 \text{ MHz}$)



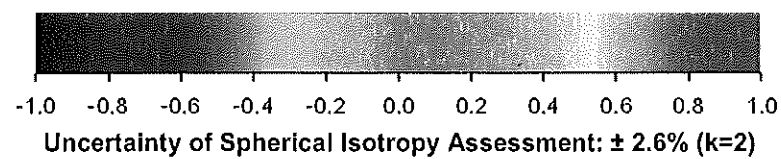
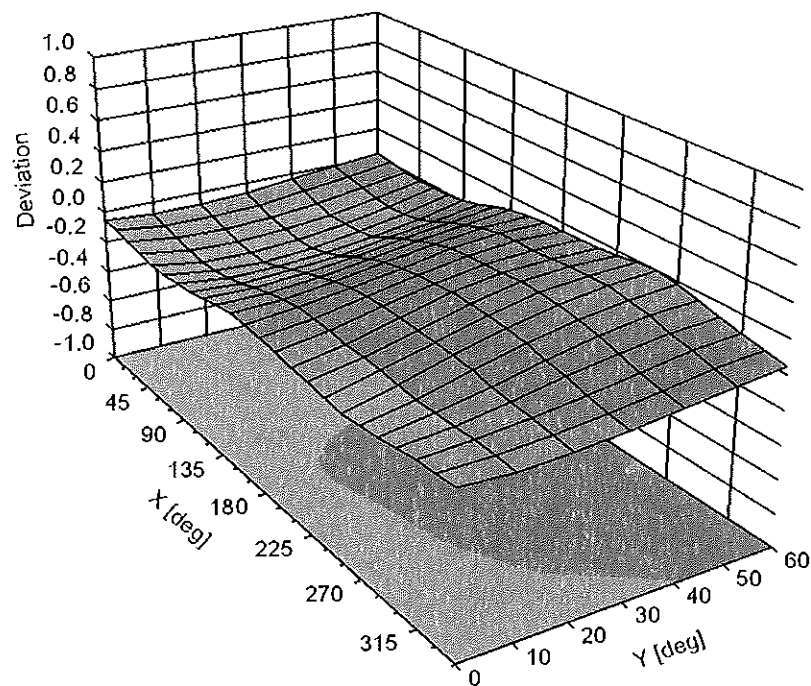
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3263_May12**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3263**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-12.v7, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **May 18, 2012**

✓
Kok
6/5/12

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	10-Jan-12 (No. DAE4-660_Jan12)	Jan-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by:	Name Jeton Kastrali	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			Issued: May 21, 2012



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Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}**: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3263

Manufactured: January 25, 2010
Calibrated: May 18, 2012

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3263

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.21	1.23	1.12	$\pm 10.1 \%$
DCP (mV) ^B	100.1	99.6	104.5	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
0	CW	0.00	X	0.00	0.00	1.00	153.9	$\pm 4.4 \%$
			Y	0.00	0.00	1.00	159.2	
			Z	0.00	0.00	1.00	150.3	

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:3263

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.40	6.40	6.40	0.32	1.73	± 12.0 %
835	41.5	0.90	6.16	6.16	6.16	0.40	1.54	± 12.0 %
1640	40.3	1.29	5.46	5.46	5.46	0.53	1.37	± 12.0 %
1750	40.1	1.37	5.30	5.30	5.30	0.47	1.50	± 12.0 %
1900	40.0	1.40	5.09	5.09	5.09	0.55	1.35	± 12.0 %
2450	39.2	1.80	4.45	4.45	4.45	0.77	1.27	± 12.0 %
2600	39.0	1.96	4.34	4.34	4.34	0.76	1.34	± 12.0 %

^c Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3263

Calibration Parameter Determined in Body Tissue Simulating Media

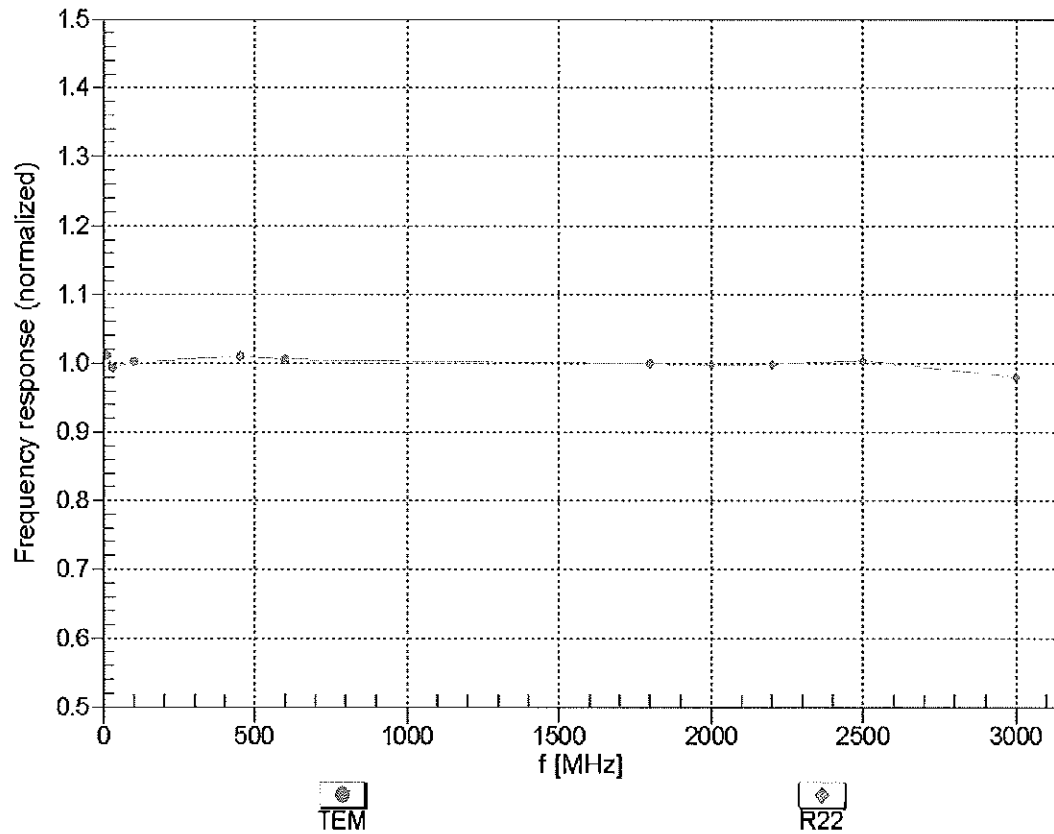
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	56.7	0.94	7.05	7.05	7.05	0.08	1.15	± 13.4 %
750	55.5	0.96	6.26	6.26	6.26	0.68	1.24	± 12.0 %
835	55.2	0.97	6.15	6.15	6.15	0.40	1.65	± 12.0 %
1640	53.8	1.40	5.33	5.33	5.33	0.74	1.27	± 12.0 %
1750	53.4	1.49	4.96	4.96	4.96	0.62	1.41	± 12.0 %
1900	53.3	1.52	4.76	4.76	4.76	0.54	1.48	± 12.0 %
2450	52.7	1.95	4.35	4.35	4.35	0.80	1.15	± 12.0 %
2600	52.5	2.16	4.16	4.16	4.16	0.80	1.00	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

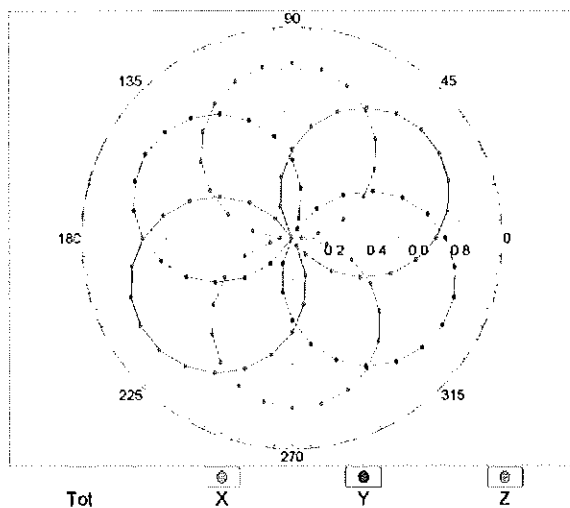
(TEM-Cell:ifi110 EXX, Waveguide: R22)



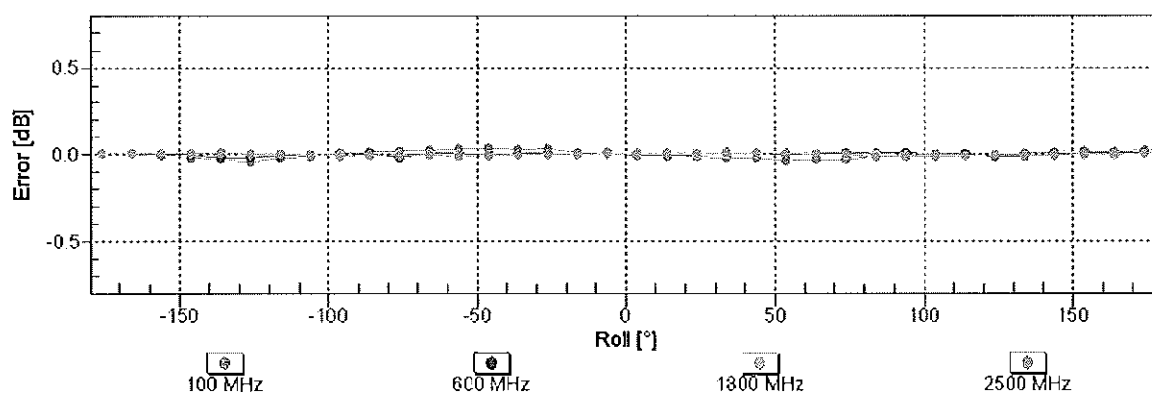
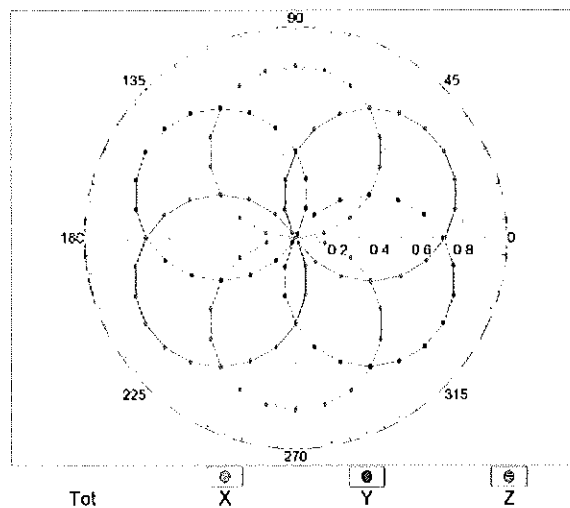
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

Receiving Pattern (ϕ), $\theta = 0^\circ$

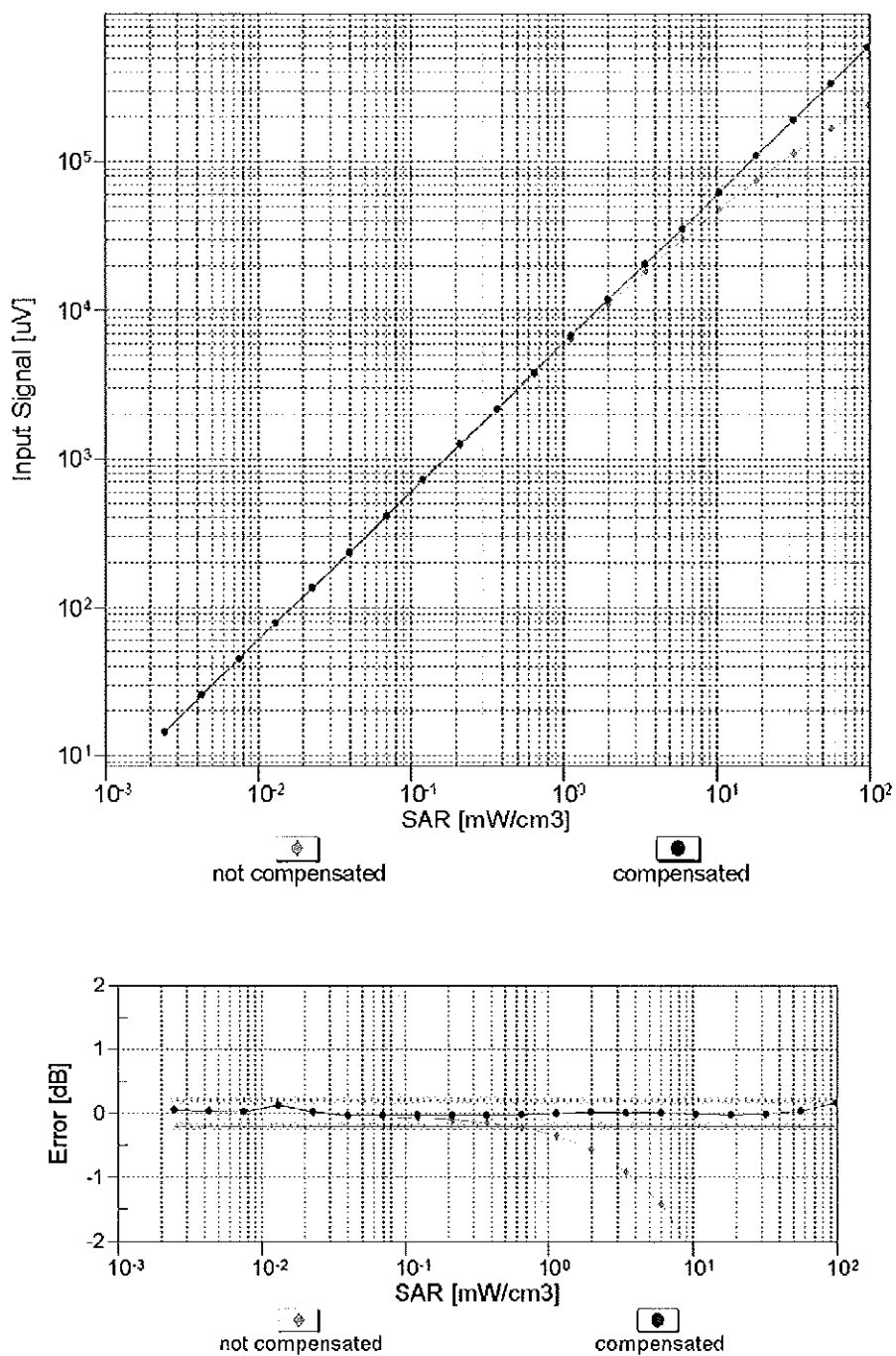
f=600 MHz,TEM



f=1800 MHz,R22

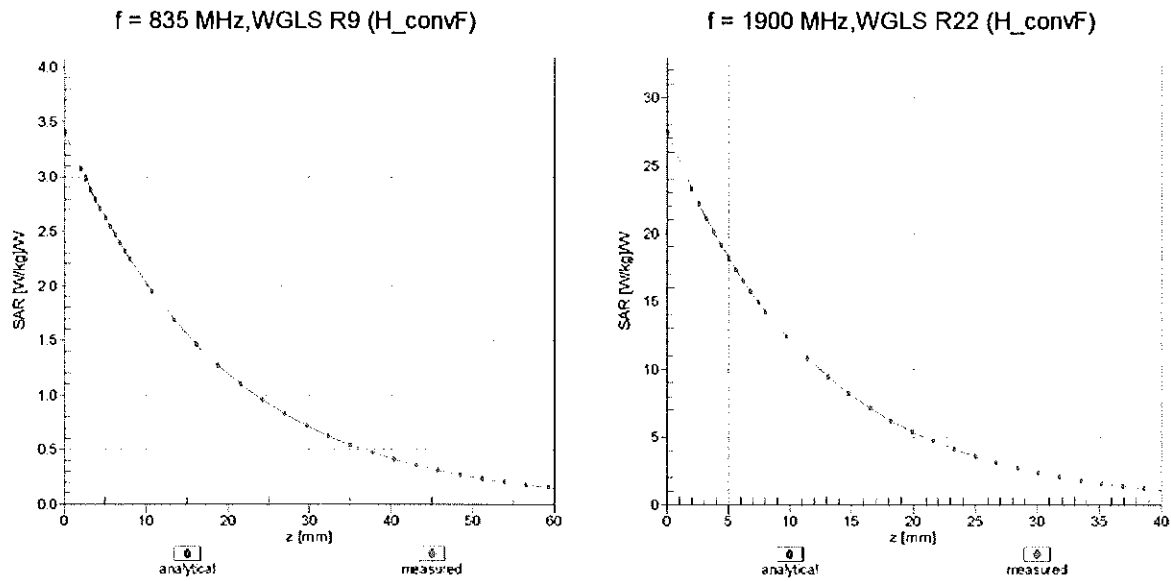
**Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)**

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



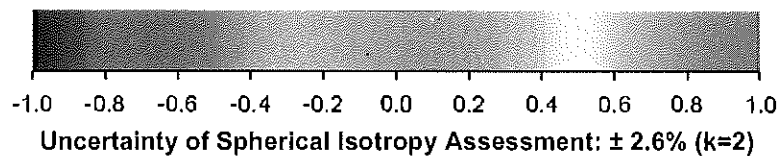
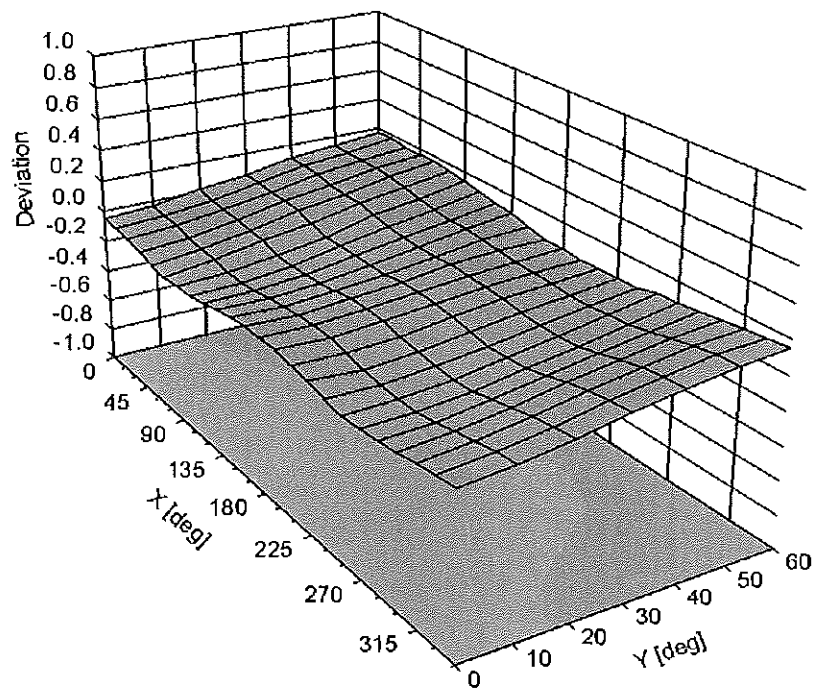
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3263

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	63.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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



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Swiss Calibration Service

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3288_Sep12**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3288**

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

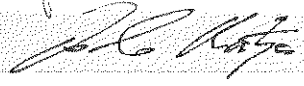
Calibration date: **September 20, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature 
Approved by:	Katja Pokovic	Technical Manager	
			Issued: September 20, 2012
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}; A, B, C** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3288

Manufactured: July 6, 2010
Calibrated: September 20, 2012

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.87	0.97	0.75	$\pm 10.1 \%$
DCP (mV) ^B	101.3	102.4	103.9	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
0	CW	0.00	X	0.00	0.00	1.00	168.6	$\pm 3.3 \%$
			Y	0.00	0.00	1.00	132.2	
			Z	0.00	0.00	1.00	156.8	

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:3288

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	6.67	6.67	6.67	0.80	1.14	± 12.0 %
835	41.5	0.90	6.41	6.41	6.41	0.76	1.18	± 12.0 %
1750	40.1	1.37	5.51	5.51	5.51	0.70	1.28	± 12.0 %
1900	40.0	1.40	5.28	5.28	5.28	0.80	1.22	± 12.0 %
2450	39.2	1.80	4.61	4.61	4.61	0.80	1.26	± 12.0 %
2600	39.0	1.96	4.45	4.45	4.45	0.80	1.31	± 12.0 %

^c Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Calibration Parameter Determined in Body Tissue Simulating Media

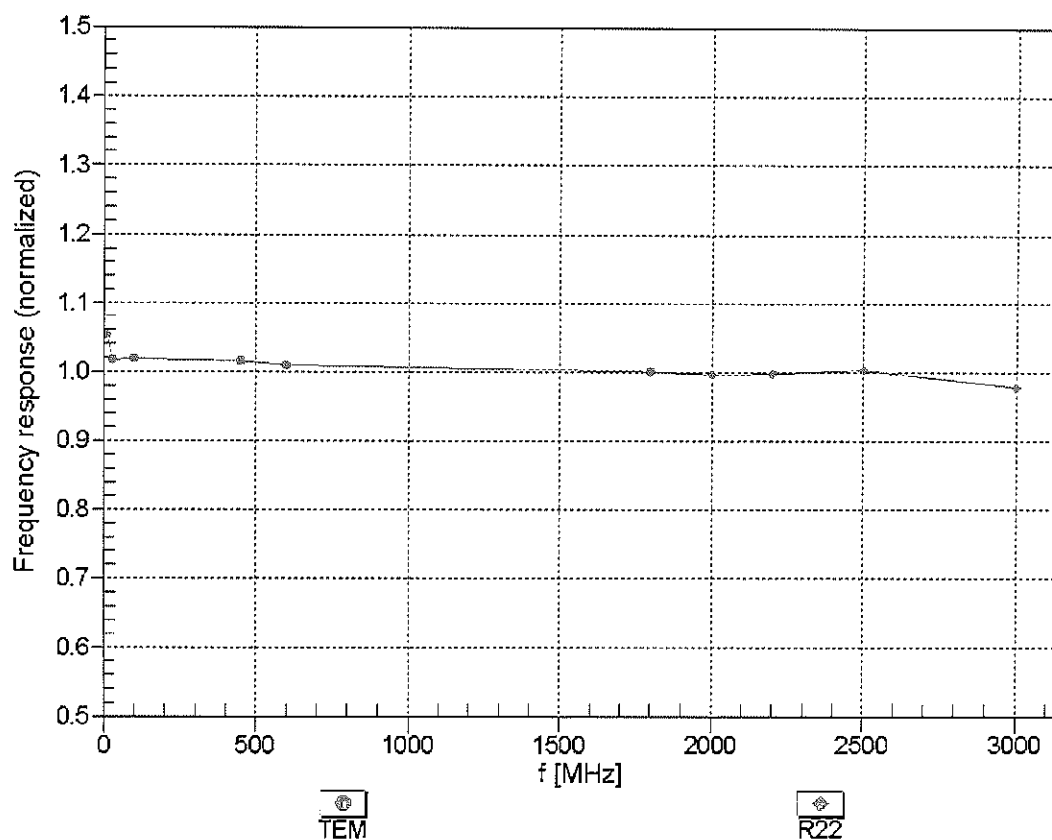
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.44	6.44	6.44	0.62	1.31	± 12.0 %
835	55.2	0.97	6.31	6.31	6.31	0.38	1.78	± 12.0 %
1750	53.4	1.49	5.18	5.18	5.18	0.64	1.43	± 12.0 %
1900	53.3	1.52	4.89	4.89	4.89	0.50	1.64	± 12.0 %
2450	52.7	1.95	4.35	4.35	4.35	0.74	1.23	± 12.0 %
2600	52.5	2.16	4.09	4.09	4.09	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.

Frequency Response of E-Field

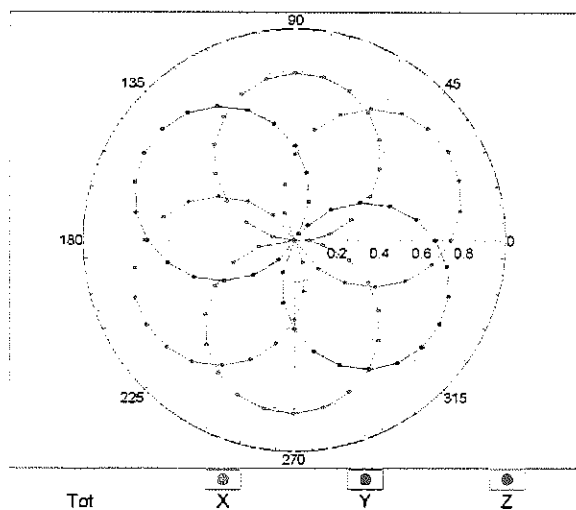
(TEM-Cell: ifi110 EXX, Waveguide: R22)



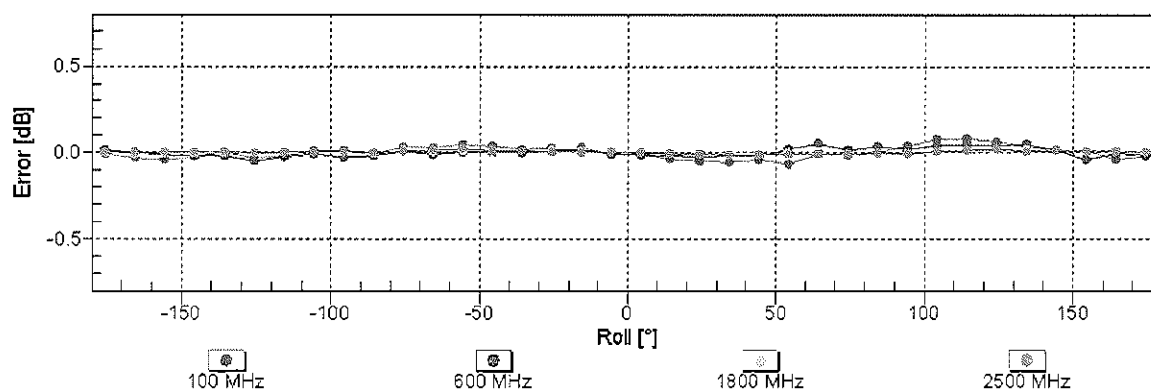
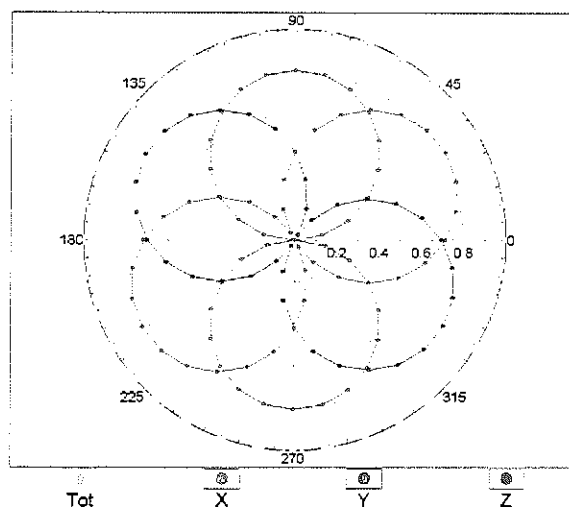
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz,TEM

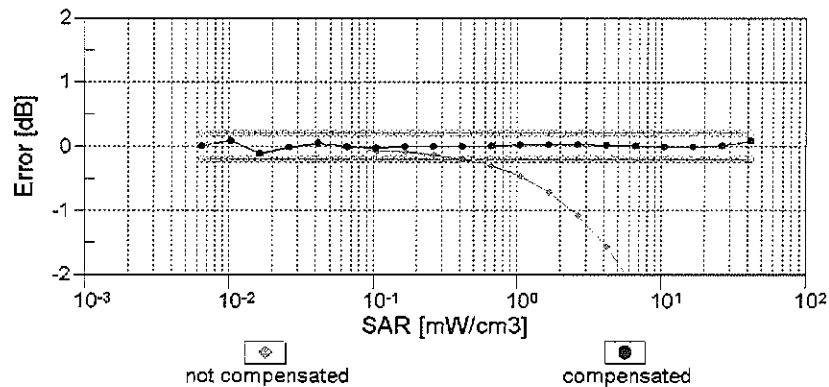
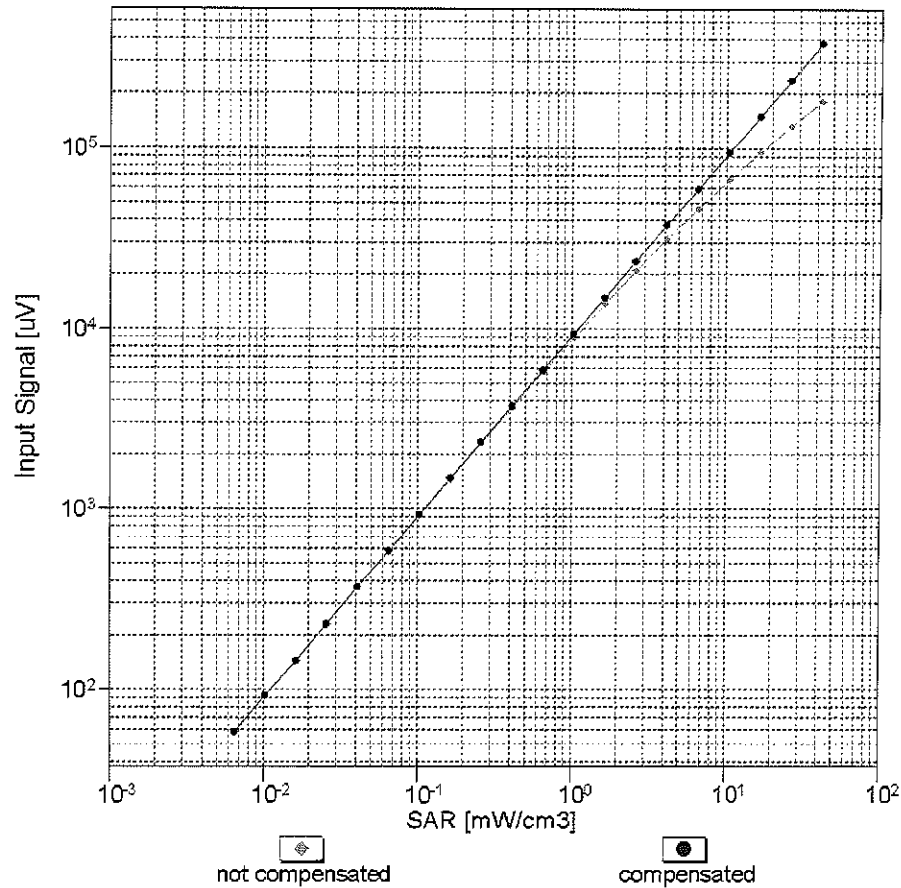


f=1800 MHz,R22



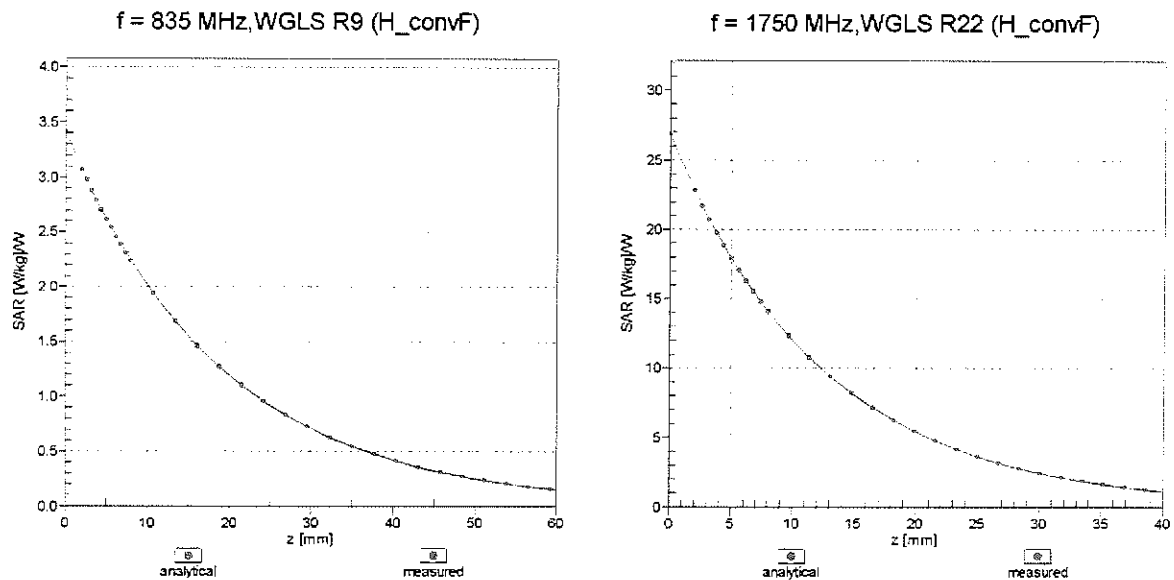
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f = 900 \text{ MHz}$)



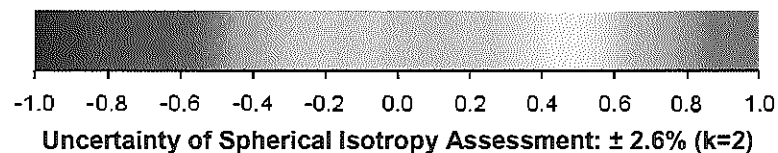
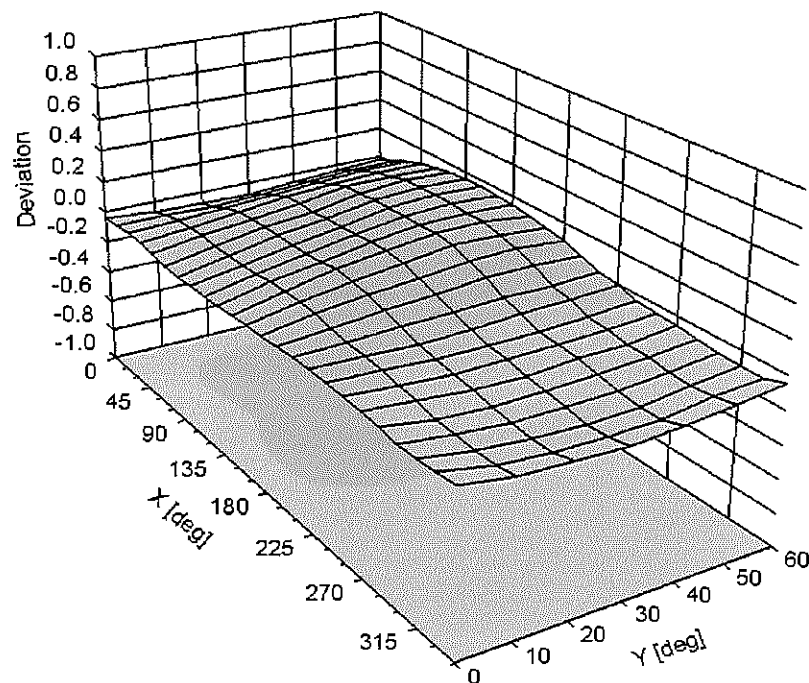
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	54.3
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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **EX3-3561_Jul12**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3561**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

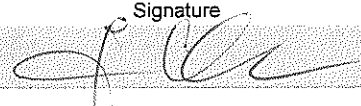
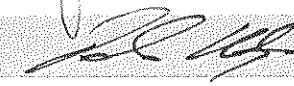
Calibration date: **July 26, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 
			Issued: July 26, 2012
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}**: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe EX3DV4

SN:3561

Manufactured: February 14, 2005
Calibrated: July 26, 2012

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3561

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$) ^A	0.43	0.48	0.43	± 10.1 %
DCP (mV) ^B	95.3	100.0	98.1	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
0	CW	0.00	X	0.00	0.00	1.00	147.3	±1.7 %
			Y	0.00	0.00	1.00	112.4	
			Z	0.00	0.00	1.00	109.9	

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 E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3561

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	8.41	8.41	8.41	0.65	0.69	± 12.0 %
835	41.5	0.90	7.98	7.98	7.98	0.22	1.34	± 12.0 %
1750	40.1	1.37	7.27	7.27	7.27	0.60	0.73	± 12.0 %
1900	40.0	1.40	6.95	6.95	6.95	0.47	0.81	± 12.0 %
2450	39.2	1.80	6.23	6.23	6.23	0.50	0.81	± 12.0 %
2600	39.0	1.96	6.12	6.12	6.12	0.54	0.79	± 12.0 %
4950	36.3	4.40	4.66	4.66	4.66	0.35	1.80	± 13.1 %
5200	36.0	4.66	4.45	4.45	4.45	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.16	4.16	4.16	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.18	4.18	4.18	0.43	1.80	± 13.1 %
5600	35.5	5.07	4.00	4.00	4.00	0.40	1.80	± 13.1 %
5800	35.3	5.27	3.92	3.92	3.92	0.45	1.80	± 13.1 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3561

Calibration Parameter Determined in Body Tissue Simulating Media

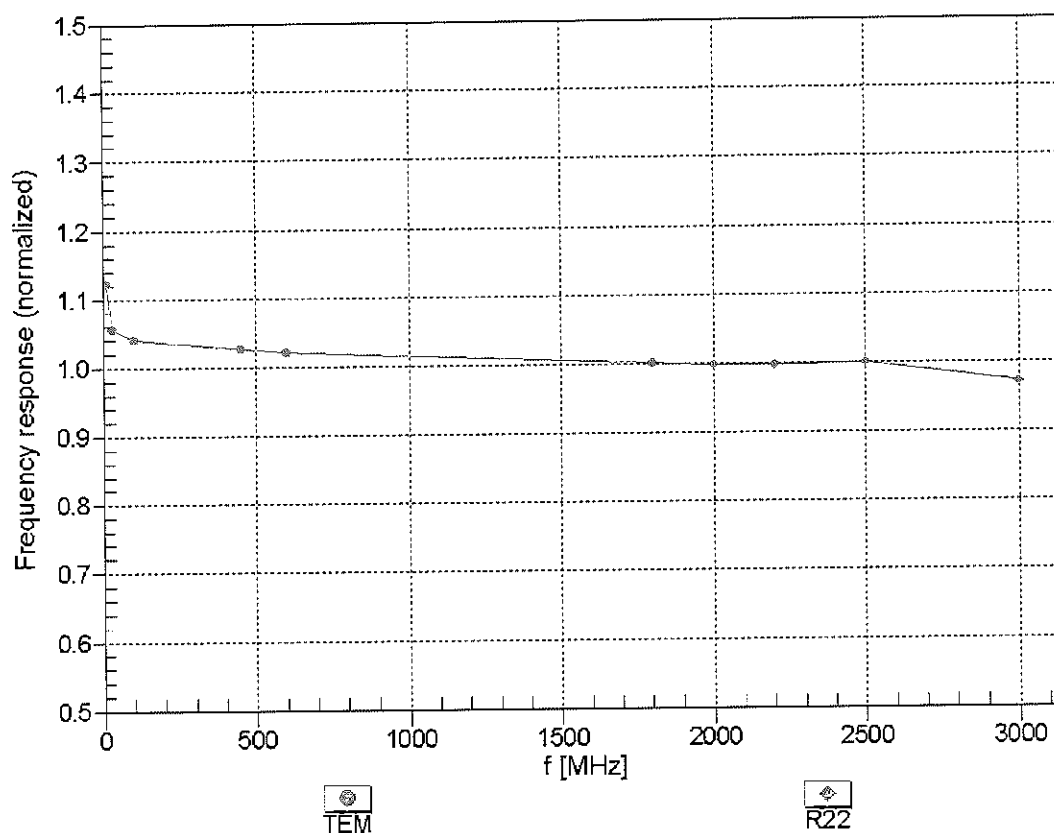
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	8.18	8.18	8.18	0.37	0.97	± 12.0 %
835	55.2	0.97	8.11	8.11	8.11	0.48	0.81	± 12.0 %
1750	53.4	1.49	6.78	6.78	6.78	0.35	0.96	± 12.0 %
1900	53.3	1.52	6.51	6.51	6.51	0.31	1.01	± 12.0 %
2450	52.7	1.95	6.22	6.22	6.22	0.80	0.60	± 12.0 %
2600	52.5	2.16	6.09	6.09	6.09	0.80	0.50	± 12.0 %
4950	49.4	5.01	3.91	3.91	3.91	0.45	1.90	± 13.1 %
5200	49.0	5.30	3.76	3.76	3.76	0.50	1.90	± 13.1 %
5300	48.9	5.42	3.54	3.54	3.54	0.52	1.90	± 13.1 %
5500	48.6	5.65	3.33	3.33	3.33	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.17	3.17	3.17	0.50	1.90	± 13.1 %
5800	48.2	6.00	3.42	3.42	3.42	0.55	1.90	± 13.1 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

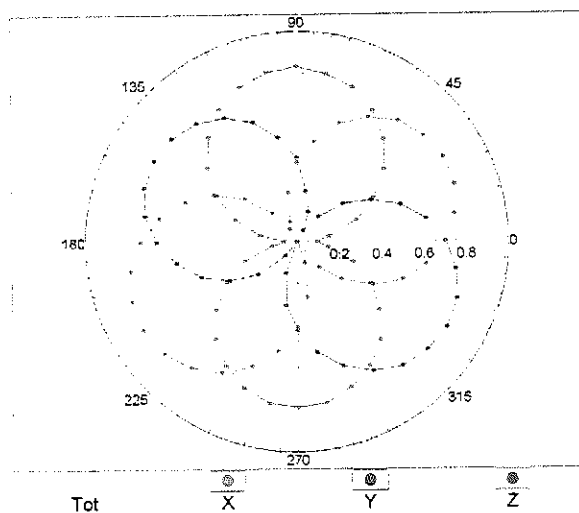
(TEM-Cell:ifi110 EXX, Waveguide: R22)



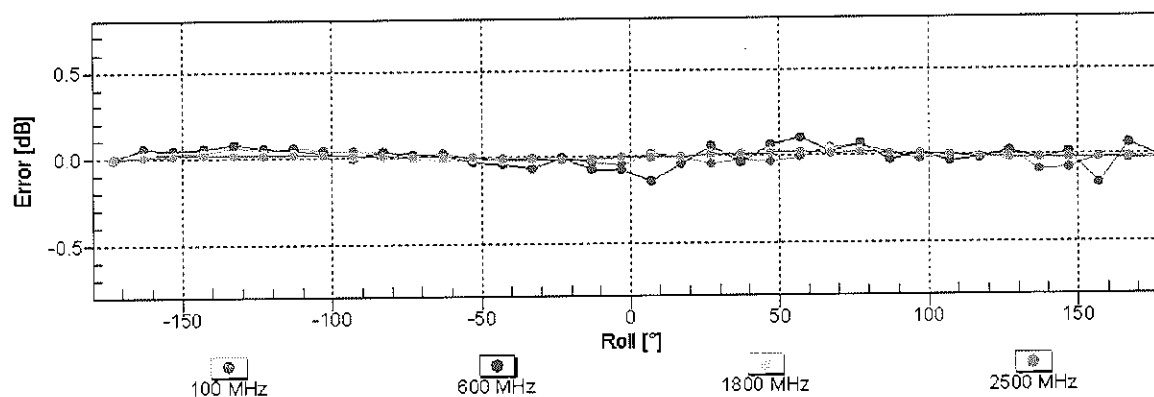
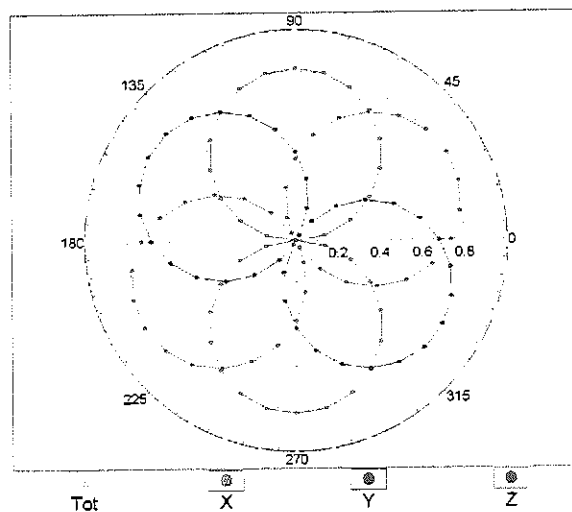
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz,TEM

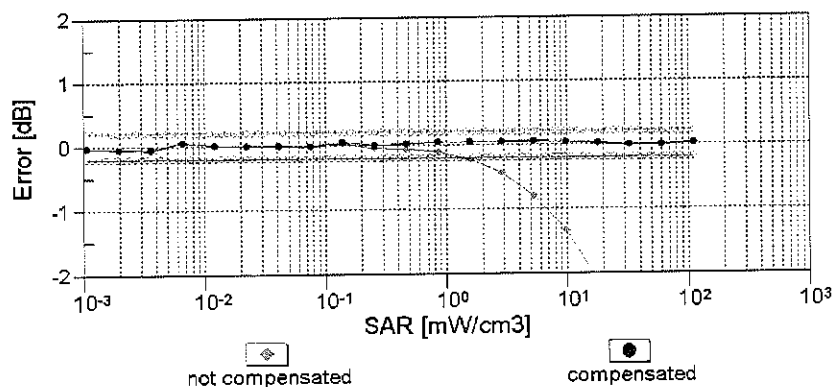
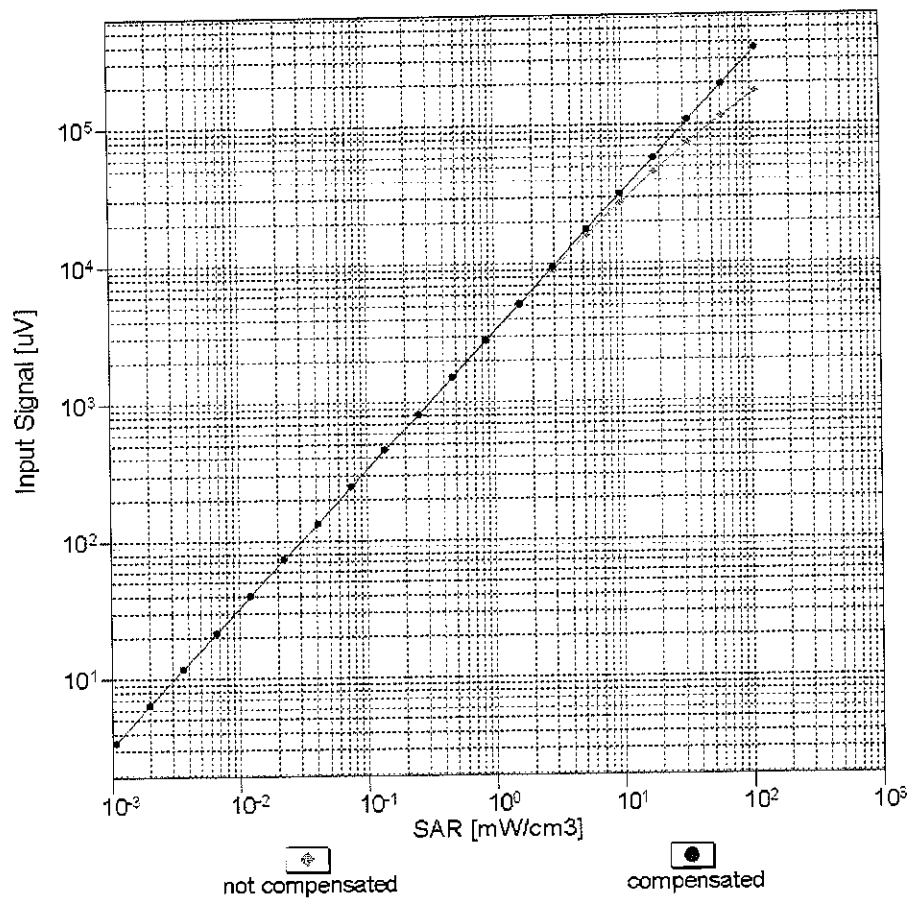


f=1800 MHz,R22



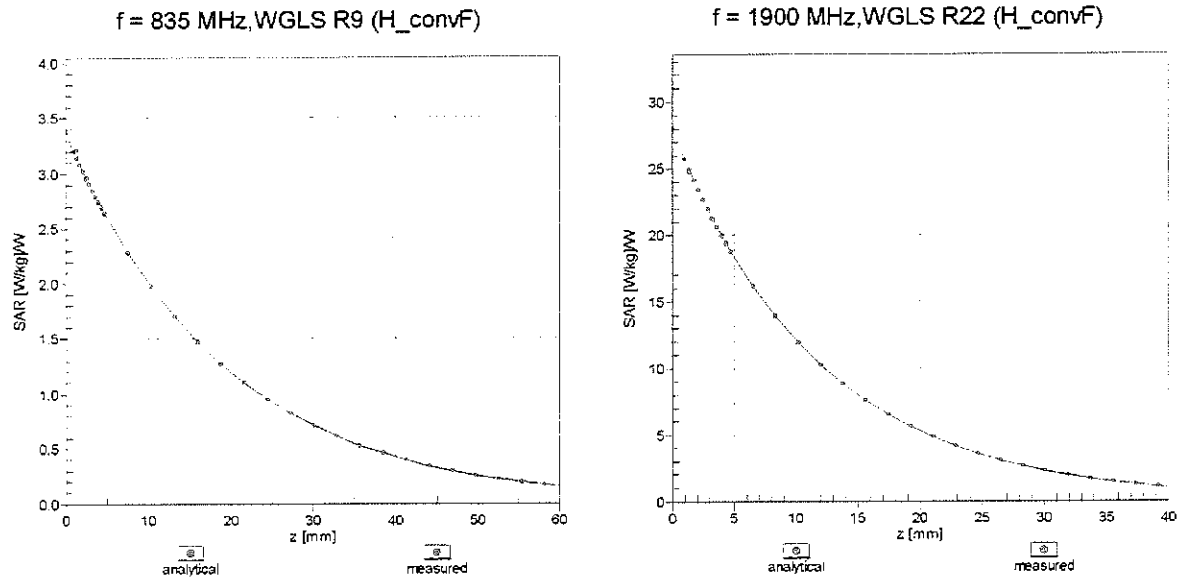
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



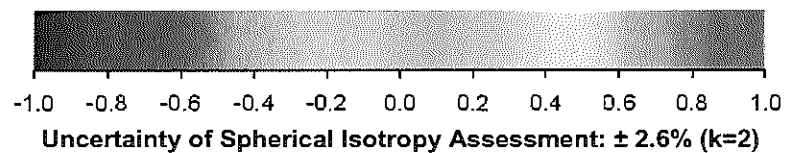
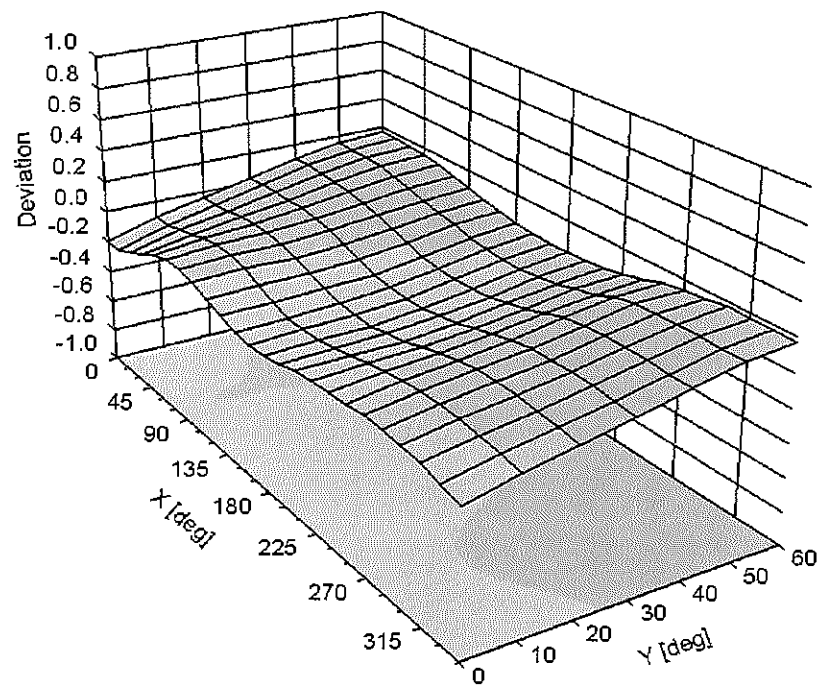
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3561

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	77.1
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

APPENDIX D: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue verification:

- 1) The network analyzer and probe system was configured and calibrated.
- 2) The probe was immersed in the tissue. The tissue was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
- 3) The complex admittance with respect to the probe aperture was measured
- 4) The complex relative permittivity ϵ can be calculated from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\epsilon_r\epsilon_0}{[\ln(b/a)]^2} \int_a^b \int_a^b \int_0^\pi \cos\phi' \frac{\exp[-j\omega r(\mu_0\epsilon_r'\epsilon_0)^{1/2}]}{r} d\phi' d\rho' d\rho$$

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 Next Page		See Next Page	
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:

H ₂ O	Water, 52 – 75%
C ₈ H ₁₈ O ₃	Diethylene glycol monobutyl ether (DGBE), 25 – 48% (CAS-No. 112-34-5, EC-No. 203-961-6, EC-index-No. 603-096-00-8)
	Relevant for safety; Refer to the respective Safety Data Sheet*.
NaCl	Sodium Chloride, <1.0%

Figure D-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 (HSL 2450)
Product No.	SL AAH 245 BA (Charge: 110718-3)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe (type DAK).

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

Ambient Condition 22°C ; 30% humidity
TSL Temperature 23°C
Test Date 20-Jul-11

Additional Information

TSL Density 0.988 g/cm³
TSL Heat-capacity 3.680 kJ/(kg*K)

Results

Measured			Target		Diff.to Target (%)		
f (MHz)	HP-ε'	HP-ε''	σ	ops. σ	Δ-ε	Δ-σ	
1900	40.5	11.75	1.24	40.0	1.40	1.3	-11.3
1925	40.4	11.84	1.27	40.0	1.40	1.1	-9.4
1950	40.3	11.93	1.29	40.0	1.40	0.8	-7.8
1975	40.2	12.01	1.32	40.0	1.40	0.6	-5.7
2000	40.1	12.10	1.35	40.0	1.40	0.3	-3.8
2025	40.0	12.19	1.37	40.0	1.42	0.2	-3.4
2050	40.0	12.29	1.40	39.9	1.44	0.1	-3.0
2075	39.9	12.39	1.43	39.9	1.47	0.0	-2.5
2100	39.8	12.48	1.46	39.8	1.49	-0.1	-2.0
2125	39.7	12.59	1.49	39.8	1.51	-0.3	-1.5
2150	39.5	12.69	1.52	39.7	1.53	-0.5	-1.0
2175	39.4	12.77	1.55	39.7	1.56	-0.6	-0.6
2200	39.3	12.86	1.57	39.6	1.58	-0.8	-0.3
2225	39.2	12.94	1.60	39.6	1.60	-1.0	0.1
2250	39.1	13.03	1.63	39.6	1.62	-1.1	0.5
2275	39.0	13.10	1.66	39.5	1.64	-1.3	0.9
2300	38.8	13.18	1.69	39.5	1.67	-1.4	1.2
2325	38.8	13.25	1.71	39.4	1.69	-1.6	1.4
2350	38.7	13.31	1.74	39.4	1.71	-1.7	1.7
2375	38.6	13.39	1.77	39.3	1.73	-1.9	2.1
2400	38.5	13.47	1.80	39.3	1.76	-2.0	2.5
2425	38.4	13.54	1.83	39.2	1.78	-2.1	2.8
2450	38.3	13.61	1.86	39.2	1.80	-2.3	3.1
2475	38.2	13.69	1.89	39.2	1.83	-2.5	3.2
2500	38.1	13.78	1.92	39.1	1.85	-2.7	3.3
2525	38.0	13.85	1.95	39.1	1.88	-2.8	3.4
2550	37.9	13.92	1.97	39.1	1.91	-3.0	3.4
2575	37.8	13.99	2.00	39.0	1.94	-3.2	3.5
2600	37.7	14.06	2.03	39.0	1.96	-3.5	3.6
2625	37.6	14.14	2.06	39.0	1.99	-3.6	3.7
2650	37.4	14.21	2.10	38.9	2.02	-3.8	3.8
2675	37.3	14.26	2.12	38.9	2.05	-4.0	3.8
2700	37.2	14.32	2.15	38.9	2.07	-4.2	3.7

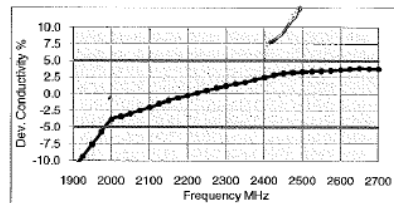
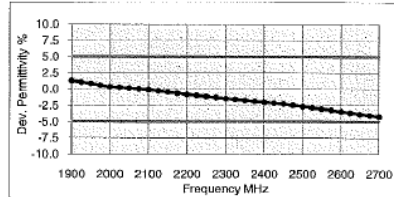


Figure D-2

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/cm³
TSL Heat-capacity 3.383 kJ/(kg*K)

Results

	Measured	Target	Diff.to Target (%)
f [MHz]	HP-ε' HP-ε'' sigma eps sigma Δ-eps Δ-sigma		
3400	38.7 14.96 2.83 38.0 2.81 1.8 0.7		
3500	38.6 14.91 2.90 37.9 2.91 1.7 -0.3		
3600	38.5 14.92 2.99 37.8 3.02 1.7 -0.9		
3700	38.3 14.92 3.07 37.7 3.12 1.7 -1.5		
3800	38.2 14.94 3.16 37.6 3.22 1.7 -1.9		
3900	38.1 14.95 3.24 37.5 3.32 1.7 -2.4		
4000	38.0 15.00 3.34 37.4 3.43 1.8 -2.5		
4100	37.9 15.04 3.43 37.2 3.53 1.8 -2.6		
4200	37.8 15.08 3.52 37.1 3.63 1.8 -2.9		
4300	37.7 15.14 3.62 37.0 3.73 1.8 -3.0		
4400	37.5 15.18 3.71 36.9 3.84 1.7 -3.1		
4500	37.4 15.20 3.81 36.8 3.94 1.6 -3.3		
4600	37.3 15.29 3.91 36.7 4.04 1.6 -3.2		
4700	37.1 15.34 4.01 36.6 4.14 1.5 -3.2		
4800	37.0 15.39 4.11 36.4 4.25 1.4 -3.2		
4850	36.9 15.43 4.16 36.4 4.30 1.3 -3.1		
4900	36.8 15.45 4.21 36.3 4.35 1.3 -3.1		
4950	36.7 15.47 4.26 36.3 4.40 1.2 -3.1		
5000	36.7 15.50 4.31 36.2 4.45 1.2 -3.1		
5050	36.6 15.55 4.37 36.2 4.50 1.1 -3.0		
5100	36.5 15.60 4.43 36.1 4.55 1.1 -2.8		
5150	36.4 15.62 4.48 36.0 4.60 1.0 -2.8		
5200	36.4 15.65 4.53 36.0 4.66 1.0 -2.8		
5250	36.3 15.67 4.58 35.9 4.71 1.0 -2.8		
5300	36.2 15.70 4.63 35.9 4.76 1.0 -2.7		
5350	36.1 15.70 4.67 35.8 4.81 0.9 -2.9		
5400	36.1 15.74 4.73 35.8 4.86 0.8 -2.7		
5450	36.0 15.75 4.77 35.7 4.91 0.9 -2.8		
5500	35.9 15.78 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 0.6 -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		

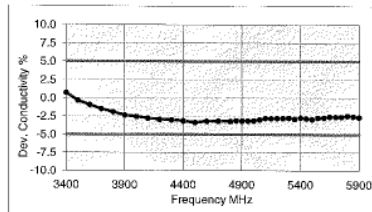
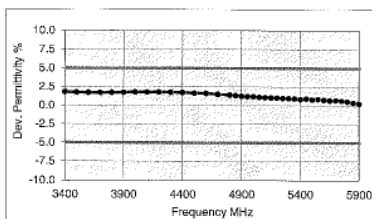


Figure D-4
5GHz Head Tissue Equivalent Matter

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APPENDIX E: SAR SYSTEM VALIDATION

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 IEEE 1528-2003 and FCC KDB 865664 D01 v01. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table E-I
SAR System Validation Summary

SAR SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
							(σ)	(ϵ_r)	SENSI- TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
D	835	10/17/2012	3288	ES3DV3	835	Head	0.899	42.07	PASS	PASS	PASS	GMSK	PASS	N/A
B	1900	10/19/2012	3209	ES3DV3	1900	Head	1.440	40.51	PASS	PASS	PASS	GMSK	PASS	N/A
D	2450	10/25/2012	3288	ES3DV3	2450	Head	1.882	39.68	PASS	PASS	PASS	OFDM	N/A	PASS
C	5200	1/5/2013	3561	EX3DV4	5200	Head	4.530	36.240	PASS	PASS	PASS	OFDM	N/A	PASS
C	5300	1/5/2013	3561	EX3DV4	5300	Head	4.612	36.000	PASS	PASS	PASS	OFDM	N/A	PASS
C	5500	1/5/2013	3561	EX3DV4	5500	Head	4.822	35.940	PASS	PASS	PASS	OFDM	N/A	PASS
C	5600	1/5/2013	3561	EX3DV4	5600	Head	4.939	35.740	PASS	PASS	PASS	OFDM	N/A	PASS
C	5800	1/5/2013	3561	EX3DV4	5800	Head	5.117	35.360	PASS	PASS	PASS	OFDM	N/A	PASS
A	835	10/20/2012	3258	ES3DV3	835	Body	0.958	55.70	PASS	PASS	PASS	GMSK	PASS	N/A
A	1900	1/2/2013	3022	ES3DV3	1900	Body	1.516	51.09	PASS	PASS	PASS	GMSK	PASS	N/A
B	2450	10/31/2012	3209	ES3DV3	2450	Body	2.044	51.82	PASS	PASS	PASS	OFDM	N/A	PASS
E	2450	11/1/2012	3263	ES3DV3	2450	Body	2.032	50.78	PASS	PASS	PASS	OFDM	N/A	PASS
C	5200	1/2/2013	3561	EX3DV4	5200	Body	5.344	48.480	PASS	PASS	PASS	OFDM	N/A	PASS
C	5300	1/2/2013	3561	EX3DV4	5300	Body	5.498	48.160	PASS	PASS	PASS	OFDM	N/A	PASS
C	5500	1/2/2013	3561	EX3DV4	5500	Body	5.770	47.710	PASS	PASS	PASS	OFDM	N/A	PASS
C	5600	1/2/2013	3561	EX3DV4	5600	Body	5.955	47.470	PASS	PASS	PASS	OFDM	N/A	PASS
C	5800	1/2/2013	3561	EX3DV4	5800	Body	6.260	46.930	PASS	PASS	PASS	OFDM	N/A	PASS

FCC ID: A3LGTN5100		SAR EVALUATION REPORT		Reviewed by: Quality Manager
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