



SAR EVALUATION REPORT

Applicant Name:

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Date of Testing:

04/02/14-05/21/14

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

OY1404030686.A3L

FCC ID:

A3LSMT2558

APPLICANT:

SAMSUNG ELECTRONICS, CO. LTD.

DUT Type:

Portable Tablet

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

SM-T2558

Equipment Class	Band & Mode	Tx Frequency	SAR	
			1 gm Head (W/kg)	1 gm Body (W/kg)
PCB	GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	< 0.1	0.74
PCB	UMTS 850	826.40 - 846.60 MHz	0.12	0.60
PCB	GSM/GPRS/EDGE 1900	1850.20 - 1909.80	0.11	1.09
PCB	UMTS 1900	1852.4 - 1907.6 MHz	< 0.1	1.09
DTS	Bluetooth LE	2402 - 2480 MHz		N/A
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.30	1.05
DTS	5.8 GHz WLAN	5745 - 5825 MHz	<0.1	< 0.1
NII	5.2 GHz WLAN	5180 - 5240 MHz	<0.1	0.11
NII	5.3 GHz WLAN	5260 - 5320 MHz	<0.1	< 0.1
NII	5.5 GHz WLAN	5500 - 5700 MHz	<0.1	< 0.1
DSS	Bluetooth	2402 - 2480 MHz		<0.1
Simultaneous SAR per KDB 690783 D01v01r02:			0.42	1.47

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

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


Randy Ortanez
President



FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 1 of 48	

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

1	DEVICE UNDER TEST	3
2	INTRODUCTION	9
3	DOSIMETRIC ASSESSMENT	10
4	DEFINITION OF REFERENCE POINTS	11
5	TEST CONFIGURATION POSITIONS FOR HANDSETS	12
6	RF EXPOSURE LIMITS	14
7	FCC MEASUREMENT PROCEDURES.....	15
8	RF CONDUCTED POWERS.....	18
9	SYSTEM VERIFICATION.....	25
10	SAR DATA SUMMARY	28
11	FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS.....	33
12	SAR MEASUREMENT VARIABILITY	42
13	EQUIPMENT LIST	43
14	MEASUREMENT UNCERTAINTIES	44
15	CONCLUSION.....	46
16	REFERENCES	47
APPENDIX A: SAR TEST PLOTS		
APPENDIX B: SAR DIPOLE VERIFICATION PLOTS		
APPENDIX C: PROBE AND DIPOLE CALIBRATION CERTIFICATES		
APPENDIX D: SAR TISSUE SPECIFICATIONS		
APPENDIX E: SAR SYSTEM VALIDATION		
APPENDIX F: SAR TEST SETUP PHOTOGRAPHS		

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 2 of 48	

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
NFC	Data	13.56 MHz
ANT+	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

This device uses a sensor for SAR compliance. The sensor is activated when used in close proximity to the user's body. The sensor triggers power reduction for voice/data modes and is only applicable for tablet operations.

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.

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 3 of 48

Maximum Power:

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slot	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots
GSM/GPRS/EDGE 850	Maximum	33.0	33.0	31.0	29.5	27.0	27.5	26.5	25.5	23.5
	Nominal	32.5	32.5	30.5	29.0	26.5	27.0	26.0	25.0	23.0
GSM/GPRS/EDGE 1900	Maximum	30.0	30.0	28.0	26.5	24.5	27.0	25.5	23.5	23.0
	Nominal	29.5	29.5	27.5	26.0	24.0	26.5	25.0	23.0	22.5

Mode / Band		Modulated Average (dBm)		
		3GPP RMC Rel 99	3GPP HSDPA Rel 5	3GPP HSUPA Rel 6
UMTS Band 5 (850 MHz)	Maximum	23.5	22.5	22.0
	Nominal	23.0	22.0	21.5
UMTS Band 2 (1900 MHz)	Maximum	23.5	23.5	22.5
	Nominal	23.0	23.0	22.0

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	15.0
	Nominal	14.5
IEEE 802.11g (2.4 GHz)	Maximum	13.5
	Nominal	13.0
IEEE 802.11n (2.4 GHz)	Maximum	10.5
	Nominal	10.0
IEEE 802.11a (5 GHz)	Maximum	12.5
	Nominal	12.0
IEEE 802.11n (5 GHz, 20 MHz)	Maximum	12.5
	Nominal	12.0
IEEE 802.11n (5 GHz, 40 MHz)	Maximum	12.0
	Nominal	11.5
Bluetooth	Maximum	10.0
	Nominal	9.5
Bluetooth LE	Maximum	3.5
	Nominal	3.0

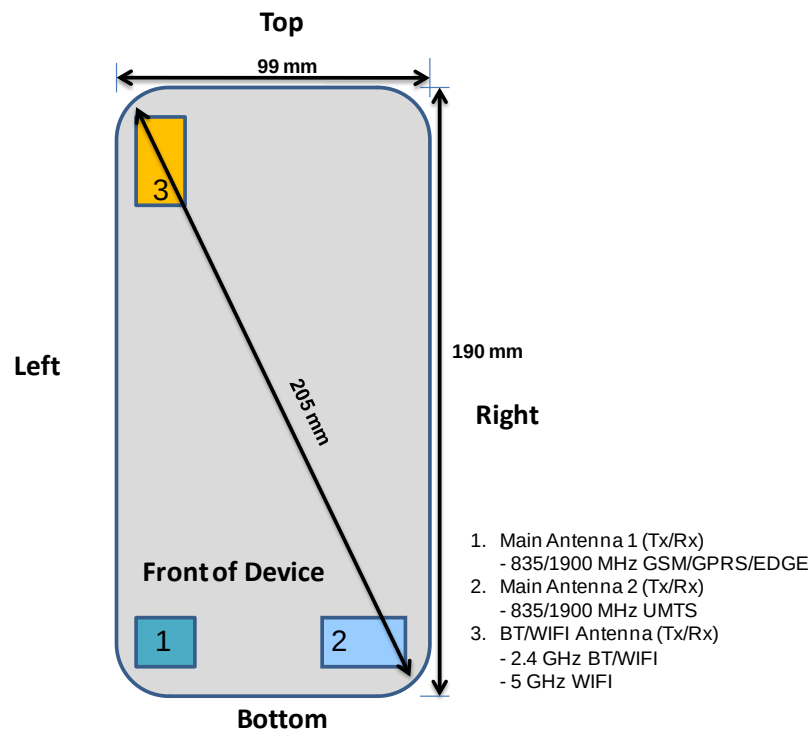
FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 4 of 48	

Reduced Power (Representing Body at 0 mm):

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)					Burst Average 8-PSK (dBm)			
		1 TX Slot	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots	
GSM/GPRS/EDGE 850	Maximum	24.7	24.7	21.0	19.0	17.5	18.5	17.0	16.0	14.5	
	Nominal	24.2	24.2	20.5	18.5	17.0	18.0	16.5	15.5	14.0	
GSM/GPRS/EDGE 1900	Maximum	21.5	20.0	20.0	20.0	19.5	20.0	20.0	20.0	19.5	
	Nominal	21.0	19.5	19.5	19.5	19.0	19.5	19.5	19.5	19.0	

Mode / Band		Modulated Average (dBm)		
		3GPP RMC Rel 99	3GPP HSDPA Rel 5	3GPP HSUPA Rel 6
UMTS Band 5 (850 MHz)	Maximum	12.6	11.6	11.1
	Nominal	12.1	11.1	10.6
UMTS Band 2 (1900 MHz)	Maximum	12.8	11.8	11.3
	Nominal	12.3	11.3	10.8

1.4 DUT Antenna Locations



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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 5 of 48	

Figure 1-1
DUT Antenna Locations

Table 1-1
Body Sides for SAR Testing

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

Note: Per FCC KDB 616217 D04v01r01, Particular DUT edges were not required to be evaluated for SAR based on the SAR exclusion threshold in KDB 447498 D01v05r01.

1.5 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into a specialized battery. The SAR tests were performed with the specialized battery (model: B700BC).

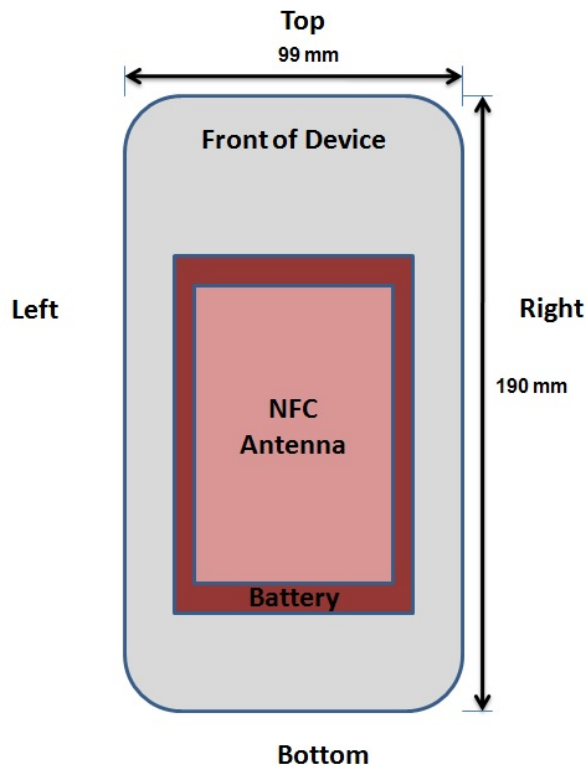


Figure 1-2
NFC Antenna Locations

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 6 of 48	

1.6 Simultaneous Transmission Capabilities

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

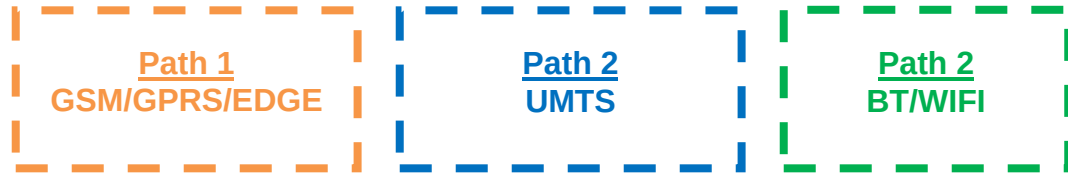


Figure 1-3
Simultaneous Transmission Paths

Table 1-2
Simultaneous Transmission Scenarios

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

Notes:

- 2.4 GHz WLAN, 2.4 GHz Bluetooth, and 5 GHz WLAN share the same antenna path and cannot transmit simultaneously.
- GSM/GPRS and UMTS cannot transmit simultaneously.
- WIFI Direct is not expected to be used in a held-to-ear exposure condition. Therefore, there are no simultaneous transmission scenarios involving WIFI direct beyond that listed in the above table.
- 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 for body operations, additional SAR testing for tablet voice use is not required. Therefore, voice standalone and simultaneous combinations are not evaluated for body configurations. Corresponding data modes are used for summation with Bluetooth when applicable.

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 7 of 48

1.7 SAR Test Exclusions Applied

(A) WIFI/BT

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

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

Based on the maximum conducted power of Bluetooth LE (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth LE SAR was not required; $[(2/5) * \sqrt{2.440}] = 0.62 < 3.0$. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

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

(B) Licensed Transmitter(s)

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.

1.8 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (2G/3G)
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05 (General SAR Guidance)
- FCC KDB Publication 616217 D04v01 (Tablet SAR Consideration)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)
- October 2013 TCB Workshop Notes (GPRS/EDGE)

1.9 Device Serial Numbers

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

	Head Serial Number	Maximum Body Serial Number	Reduced Body Serial Number
GSM/GPRS/EDGE 850	20402	20402	20404
UMTS 850	20401	20403	20405
GSM/GPRS/EDGE 1900	20402	20402	120501
UMTS 1900	20403	20403	20405
2.4 GHz WLAN	20402	20402	-
Bluetooth	-	20401	-
5 GHz WLAN	20401	20401	-

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 8 of 48

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

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

2.1 SAR Definition

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

Equation 2-1
SAR Mathematical Equation

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

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

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

where:

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

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 9 of 48

3 DOSIMETRIC ASSESSMENT

3.1 Measurement Procedure

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

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

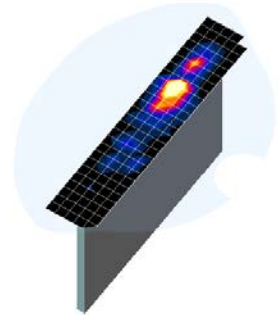


Figure 3-1
Sample SAR Area Scan

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	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 22

*Also compliant to IEEE 1528-2013 Table 6

FCC ID: A3LSMT2558		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			Page 10 of 48

4

DEFINITION OF REFERENCE POINTS

4.1 EAR REFERENCE POINT

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

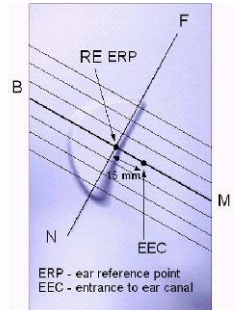


Figure 4-1
Close-Up Side view
of ERP

4.2 HANDSET REFERENCE POINTS

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the acoustic output located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (See Figure 4-3). The acoustic output was 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

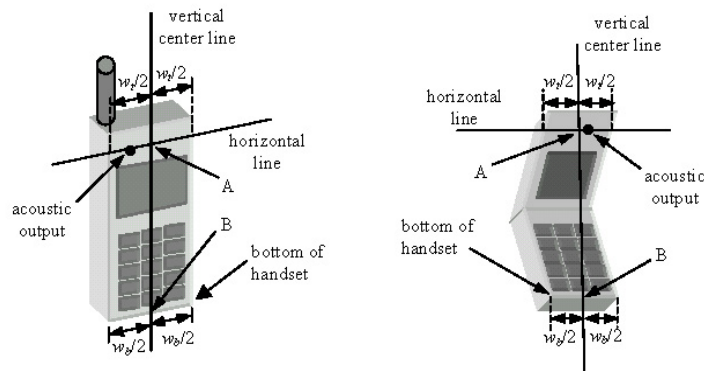


Figure 4-3
Handset Vertical Center & Horizontal Line Reference Points

FCC ID: A3LSMT2558	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT	 SAMSUNG	Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 11 of 48

5

TEST CONFIGURATION POSITIONS FOR HANDSETS

5.1 Device Holder

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

5.2 Positioning for Cheek

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

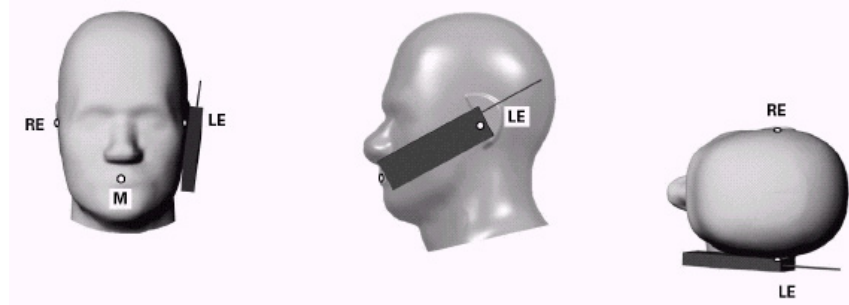


Figure 5-1 Front, Side and Top View of Cheek Position

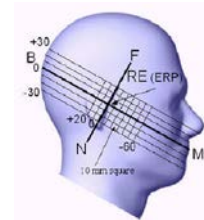
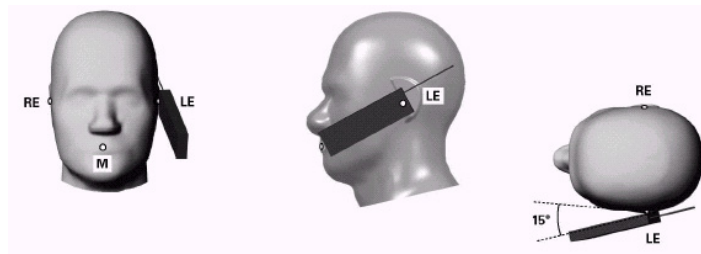
2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the pinna.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the reference plane.
4. The phone was then rotated around the vertical centerline until the phone (horizontal line) was symmetrical 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. In this situation, the tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 5-2).

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 12 of 48



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)
Peak Spatial Average SAR Head	1.6	8.0
Whole Body SAR	0.08	0.4
Peak Spatial Average SAR Hands, Feet, Ankle, Wrists, etc.	4.0	20

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 14 of 48

7 FCC MEASUREMENT PROCEDURES

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

7.1 Measured and Reported SAR

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

7.2 Procedures Used to Establish RF Signal for SAR

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

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

7.3 SAR Measurement Conditions for UMTS

7.3.1 Output Power Verification

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

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

7.3.2 Head SAR Measurements for Handsets

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 15 of 48

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 DPCH. The default test configuration is to measure SAR in UMTS without HSDPA, with an established radio link between the DUT and a communication test set with 12.2 kbps RMC mode configured in Test Loop Mode 1; and tested with HSDPA with FRC and a 12.2 kbps RMC using the highest SAR configuration in UMTS. SAR is selectively confirmed for other physical channel configurations according to output power, exposure conditions and device operating capabilities. Maximum output power is verified according to 3GPP TS 23.121 (Release 5) and SAR must be measured according to these maximum output conditions.

Sub-Test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (Note 1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (Note 4)	15/15 (Note 4)	64	12/15 (Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5
Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$. Note 2: For the HS-DPCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and $\Delta_{NACK} = 8$ ($A_{hs} = 30/15$) with $\beta_{hs} = 30/15 * \beta_c$, and $\Delta_{CQI} = 7$ ($A_{hs} = 24/15$) with $\beta_{hs} = 24/15 * \beta_c$. Note 3: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPCH, DPCH and HS-DPCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.							

Figure 7-1
Table C.10.1.4 of TS 23.121-1

7.3.5 SAR Measurement Conditions for HSUPA Data Devices

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 16 of 48	

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	$\beta_{hs}^{(1)}$	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM ⁽²⁾ (dB)	MPR (dB)	AG ⁽⁴⁾ Index	E-TFCI
1	11/15 ⁽³⁾	15/15 ⁽³⁾	64	11/15 ⁽³⁾	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	$\beta_{ed1}: 47/15$ $\beta_{ed2}: 47/15$	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 $\Delta_{CQI} = 8 \Leftrightarrow A_{18} = \beta_{18}/\beta_c = 30/15 \Leftrightarrow \beta_{18} = 30/15 * \beta_c$.

Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{18}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ 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.

7.4 SAR Testing with 802.11 Transmitters

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

7.4.1 General Device Setup

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

7.4.2 Frequency Channel Configurations [24]

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

For 5 GHz, the highest average RF output power channel across the default test channels at the lowest data rate was selected for SAR evaluation in 802.11a. When the adjacent channels are higher in power 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 higher than 0.25 dB or more than the 802.11a mode.

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 17 of 48

8 RF CONDUCTED POWERS

8.1 GSM Conducted Powers

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

		Maximum Burst-Averaged Output Power								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	32.89	32.83	29.85	28.04	25.94	27.15	26.13	25.25	23.50
	190	32.55	32.71	29.53	27.72	25.69	26.72	25.80	24.81	23.25
	251	32.49	32.40	29.32	27.56	25.57	26.55	25.50	24.62	23.01
GSM 1900	512	29.78	29.63	26.82	24.79	22.79	26.14	24.80	22.44	21.79
	661	29.80	29.61	26.83	24.78	22.74	25.92	24.64	22.23	21.69
	810	29.72	29.67	26.84	24.81	22.87	25.83	24.43	22.05	21.91
GSM 850	Targets:	32.5	32.5	30.5	29.0	26.5	27.0	26.0	25.0	23.0
GSM 1900		29.5	29.5	27.5	26.0	24.0	26.5	25.0	23.0	22.5
		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	23.86	23.80	23.83	23.78	22.93	18.12	20.11	20.99	20.49
	190	23.52	23.68	23.51	23.46	22.68	17.69	19.78	20.55	20.24
	251	23.46	23.37	23.30	23.30	22.56	17.52	19.48	20.36	20.00
GSM 1900	512	20.75	20.60	20.80	20.53	19.78	17.11	18.78	18.18	18.78
	661	20.77	20.58	20.81	20.52	19.73	16.89	18.62	17.97	18.68
	810	20.69	20.64	20.82	20.55	19.86	16.80	18.41	17.79	18.90
GSM 850	Frame Avg.Targets:	23.47	23.47	24.48	24.74	23.49	17.97	19.98	20.74	19.99
GSM 1900		20.47	20.47	21.48	21.74	20.99	17.47	18.98	18.74	19.49

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 18 of 48	

Table 8-2
Reduced GSM/GPRS/EDGE Average RF Conducted Powers
(Representing Body at 0 mm)

		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	23.39	23.37	20.56	18.84	16.91	18.33	16.37	15.91	14.25
	190	23.48	23.39	20.68	18.88	17.02	18.27	16.97	15.80	13.96
	251	23.17	23.11	20.40	18.57	16.66	18.26	16.61	15.53	14.23
GSM 1900	512	20.37	19.73	19.72	19.64	19.44	19.80	19.93	19.56	19.43
	661	20.59	19.78	19.63	19.56	19.47	19.62	19.74	19.78	19.45
	810	20.54	19.72	19.65	19.50	19.50	19.94	19.66	19.61	19.50
GSM 850	Targets:	24.2	24.2	20.5	18.5	17.0	18.0	16.5	15.5	14.0
GSM 1900		21.0	19.5	19.5	19.5	19.0	19.5	19.5	19.5	19.0
		Calculated Maximum Frame-Averaged Output Power								
Band	Channel	Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
		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	14.36	14.34	14.54	14.58	13.90	9.30	10.35	11.65	11.24
	190	14.45	14.36	14.66	14.62	14.01	9.24	10.95	11.54	10.95
	251	14.14	14.08	14.38	14.31	13.65	9.23	10.59	11.27	11.22
GSM 1900	512	11.34	10.70	13.70	15.38	16.43	10.77	13.91	15.30	16.42
	661	11.56	10.75	13.61	15.30	16.46	10.59	13.72	15.52	16.44
	810	11.51	10.69	13.63	15.24	16.49	10.91	13.64	15.35	16.49
GSM 850	Frame Avg.Targets:	15.17	15.17	14.48	14.24	13.99	8.97	10.48	11.24	10.99
GSM 1900		11.97	10.47	13.48	15.24	15.99	10.47	13.48	15.24	15.99

Notes:

- 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.
- The source-based frame-averaged output power was evaluated for all GPRS/EDGE slot configurations. The configuration with the highest target frame averaged output power was evaluated for body SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
- 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.
- EDGE (8-PSK) output powers were measured with MCS7 on the base station simulator. MCS7 coding scheme was used to measure the output powers for EDGE since investigation has shown that choosing MCS7 coding scheme will ensure 8-PSK modulation. It has been shown that MCS levels that produce 8PSK modulation do not have an impact on output power.

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

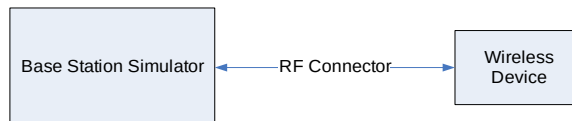


Figure 8-1
Power Measurement Setup

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 19 of 48

8.2 UMTS Conducted Powers

Table 8-3
Maximum UMTS Average RF Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	22.60	22.45	22.33	22.87	23.18	23.33	-
99		12.2 kbps AMR	22.55	22.50	22.30	22.92	23.00	23.46	-
6	HSDPA	Subtest 1	21.34	21.23	21.13	21.59	21.72	21.85	0
6		Subtest 2	21.30	21.27	21.12	21.50	21.71	21.84	0
6		Subtest 3	20.72	20.67	20.54	21.10	21.25	21.35	0.5
6		Subtest 4	20.82	20.72	20.62	21.00	21.16	21.33	0.5
6	HSUPA	Subtest 1	20.07	20.00	20.08	20.52	20.50	20.54	0
6		Subtest 2	19.56	19.53	19.32	19.01	19.29	20.21	2
6		Subtest 3	19.88	19.40	19.84	20.43	19.64	20.36	1
6		Subtest 4	19.97	19.82	19.76	20.22	19.33	20.20	2
6		Subtest 5	20.92	20.31	20.42	20.62	20.93	21.67	0

Table 8-4
Reduced UMTS Average RF Conducted Powers
(Representing Body at 0 mm)

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	11.64	12.18	11.74	12.35	11.86	11.46	-
99		12.2 kbps AMR	11.59	12.13	11.67	12.28	11.85	11.44	-
6	HSDPA	Subtest 1	10.24	10.61	10.35	11.09	10.75	10.36	0
6		Subtest 2	10.29	10.66	10.41	11.07	10.65	10.23	0
6		Subtest 3	9.69	10.03	9.75	10.48	10.12	9.71	0.5
6		Subtest 4	9.78	10.10	9.84	10.48	10.11	9.72	0.5
6	HSUPA	Subtest 1	10.24	10.65	10.09	11.05	10.44	10.26	0
6		Subtest 2	8.53	8.59	8.64	8.36	8.58	8.64	2
6		Subtest 3	8.87	9.46	9.21	8.95	9.01	9.08	1
6		Subtest 4	8.49	8.57	8.75	8.63	8.88	8.79	2
6		Subtest 5	10.15	10.45	10.23	11.01	10.78	10.54	0

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

This device does not support DC-HSDPA.

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



Figure 8-2
Power Measurement Setup

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 20 of 48

8.3 WLAN/Bluetooth Conducted Powers

Table 8-5
IEEE 802.11b Average RF Power

Mode	Freq [MHz]	Channel	802.11b Conducted Power [dBm]			
			Data Rate [Mbps]			
			1	2	5.5	11
802.11b	2412	1*	14.65	14.74	14.88	14.81
802.11b	2437	6*	14.58	14.74	14.75	14.74
802.11b	2462	11*	14.90	14.85	14.88	14.84

Table 8-6
IEEE 802.11g Average RF Power

Mode	Freq [MHz]	Channel	802.11g Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11g	2412	1	12.98	13.02	13.40	12.96	13.04	12.90	13.01	12.93
802.11g	2437	6	13.09	13.07	13.34	13.12	13.15	13.02	13.15	12.96
802.11g	2462	11	13.25	13.22	13.39	13.23	13.25	13.10	13.34	13.22

Table 8-7
IEEE 802.11n Average RF Power

Mode	Freq [MHz]	Channel	802.11n (2.4GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	19.5	26	39	52	58.5	65
802.11n	2412	1	10.08	10.18	10.17	10.01	10.07	10.11	10.01	10.20
802.11n	2437	6	10.19	10.43	10.36	10.25	10.31	10.26	10.28	10.37
802.11n	2462	11	9.43	9.59	9.61	9.71	9.70	9.54	9.62	9.63

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 21 of 48

Table 8-8
IEEE 802.11a Average RF Power

Mode	Freq [MHz]	Channel	802.11a Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11a	5180	36*	12.49	12.20	12.26	12.27	12.15	12.25	12.25	12.47
802.11a	5200	40	12.42	12.17	12.16	12.20	12.03	12.17	12.12	12.39
802.11a	5220	44	12.39	12.15	12.15	12.13	12.11	12.14	12.17	12.35
802.11a	5240	48*	12.46	12.23	12.20	12.24	12.14	12.21	12.24	12.44
802.11a	5260	52*	12.47	12.28	12.19	12.27	12.17	12.33	12.15	12.11
802.11a	5280	56	12.45	12.27	12.16	12.24	12.12	12.33	12.14	12.03
802.11a	5300	60	12.21	11.97	11.99	12.05	11.91	12.11	11.97	11.89
802.11a	5320	64*	12.49	12.31	12.19	12.35	12.12	12.33	12.16	12.18
802.11a	5500	100	11.85	11.59	11.61	11.40	11.51	11.51	11.49	11.41
802.11a	5520	104*	11.87	11.56	11.66	11.39	11.54	11.55	11.53	11.44
802.11a	5540	108	12.03	11.83	11.77	11.58	11.61	11.69	11.67	11.58
802.11a	5560	112	12.15	11.83	11.91	11.73	11.89	11.82	11.83	11.72
802.11a	5580	116*	11.86	11.59	11.60	11.46	11.55	11.49	11.50	11.42
802.11a	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5660	132	12.07	11.75	11.78	11.55	11.72	11.79	11.69	11.60
802.11a	5680	136*	12.48	12.26	12.25	12.03	12.19	12.16	12.14	12.04
802.11a	5700	140	12.47	12.19	12.18	11.95	12.07	12.03	12.09	12.09
802.11a	5745	149*	12.01	12.03	12.06	12.02	12.01	12.01	11.93	11.88
802.11a	5765	153	12.00	12.09	12.02	11.95	11.96	11.96	11.88	11.88
802.11a	5785	157*	11.91	11.92	11.99	11.99	11.97	11.96	11.86	11.73
802.11a	5805	161	11.81	11.80	11.86	11.85	11.80	11.80	11.68	11.64
802.11a	5825	165*	12.46	12.33	12.48	12.38	12.44	12.34	12.37	12.29

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

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			Page 22 of 48

Table 8-9
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	19.5	26	39	52	58.5	65
802.11n	5180	36	12.38	12.35	12.44	12.35	12.45	12.43	12.39	12.38
802.11n	5200	40	12.42	12.33	12.44	12.44	12.48	12.48	12.37	12.48
802.11n	5220	44	12.35	12.32	12.37	12.29	12.46	12.36	12.31	12.34
802.11n	5240	48	12.21	12.17	12.28	12.22	12.30	12.26	12.29	12.17
802.11n	5260	52	12.21	12.48	12.43	12.38	12.43	12.38	12.41	12.42
802.11n	5280	56	12.45	12.34	12.33	12.41	12.36	12.40	12.47	12.49
802.11n	5300	60	11.98	12.20	12.25	12.19	12.13	12.08	12.19	12.16
802.11n	5320	64	12.46	12.38	12.44	12.49	12.47	12.35	12.33	12.44
802.11n	5500	100	11.74	11.69	11.80	11.71	11.78	11.66	11.70	11.70
802.11n	5520	104	11.65	11.63	11.69	11.62	11.71	11.59	11.56	11.71
802.11n	5540	108	12.03	11.96	12.10	12.05	12.05	11.97	11.90	11.95
802.11n	5560	112	12.07	12.05	12.14	12.07	12.15	12.00	12.01	12.02
802.11n	5580	116	11.89	11.82	11.95	11.91	11.95	11.71	11.86	11.87
802.11n	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5660	132	12.15	12.08	12.21	12.11	12.25	12.02	12.10	12.08
802.11n	5680	136	11.50	11.43	11.57	11.43	11.59	11.41	11.50	11.46
802.11n	5700	140	12.41	12.32	12.39	12.36	12.46	12.27	12.38	12.31
802.11n	5745	149	11.96	11.96	11.98	11.95	11.98	11.86	11.96	12.01
802.11n	5765	153	11.97	12.04	12.05	11.88	12.05	11.89	11.96	12.00
802.11n	5785	157	11.89	11.89	11.88	11.86	11.95	11.85	11.92	11.85
802.11n	5805	161	11.85	11.85	11.83	11.85	11.83	11.73	11.88	11.82
802.11n	5825	165	11.60	11.65	11.60	11.59	11.61	11.47	11.59	11.70

Table 8-10
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	27	40.5	54	81	108	121.5	135
802.11n	5190	38	11.26	11.29	11.24	11.30	11.20	11.31	11.34	11.21
802.11n	5230	46	11.12	11.13	11.11	11.22	11.08	11.15	11.24	11.08
802.11n	5270	54	10.81	10.78	10.84	10.74	10.77	10.86	10.73	10.75
802.11n	5310	62	10.51	10.45	10.47	10.38	10.40	10.43	10.42	10.47
802.11n	5510	102	11.35	11.44	11.36	11.43	11.48	11.36	11.47	11.39
802.11n	5550	110	10.61	10.70	10.63	10.75	10.72	10.71	10.79	10.84
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	11.15	11.20	11.21	11.26	11.29	11.14	11.31	11.31
802.11n	5755	151	10.61	10.72	10.81	10.57	10.55	10.67	10.66	10.68
802.11n	5795	159	10.77	10.94	10.92	10.73	10.62	10.90	10.89	10.81



Figure 8-3
Power Measurement Setup

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 23 of 48	

Table 8-11
Bluetooth RF Conducted Powers

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
			[dBm]	[mW]
2402	1.0	0	8.43	6.963
2441	1.0	39	9.59	9.106
2480	1.0	78	7.91	6.181
2402	2.0	0	6.91	4.910
2441	2.0	39	8.21	6.621
2480	2.0	78	6.37	4.335
2402	3.0	0	6.97	4.973
2441	3.0	39	8.27	6.721
2480	3.0	78	6.43	4.397

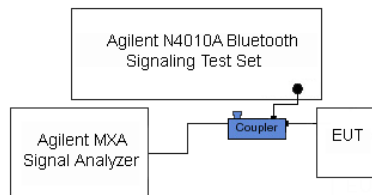


Figure 8-4
Power Measurement Setup

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

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 24 of 48	

9 SYSTEM VERIFICATION

9.1 Tissue Verification

Table 9-1
Measured Head 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
4/21/2014	835H	23.8	820	0.886	40.076	0.899	41.578	-1.45%	-3.61%
			835	0.900	39.901	0.900	41.500	0.00%	-3.85%
			850	0.913	39.670	0.916	41.500	-0.33%	-4.41%
4/24/2014	835H	23.5	820	0.906	42.576	0.899	41.578	0.78%	2.40%
			835	0.919	42.384	0.900	41.500	2.11%	2.13%
			850	0.933	42.213	0.916	41.500	1.86%	1.72%
4/22/2014	1900H	22.9	1850	1.365	39.091	1.400	40.000	-2.50%	-2.27%
			1880	1.395	38.966	1.400	40.000	-0.36%	-2.59%
			1910	1.425	38.848	1.400	40.000	1.79%	-2.88%
4/28/2014	1900H	22.4	1850	1.379	40.146	1.400	40.000	-1.50%	0.37%
			1880	1.414	40.039	1.400	40.000	1.00%	0.10%
			1910	1.443	39.922	1.400	40.000	3.07%	-0.20%
4/4/2014	2450H	22.6	2401	1.743	38.650	1.756	39.287	-0.74%	-1.62%
			2450	1.797	38.447	1.800	39.200	-0.17%	-1.92%
			2499	1.850	38.274	1.853	39.138	-0.16%	-2.21%
04/09/2014	5200H-5800H	23.3	5180	4.514	37.632	4.635	36.009	-2.61%	4.51%
			5200	4.526	37.524	4.655	35.986	-2.77%	4.27%
			5300	4.626	37.422	4.758	35.871	-2.77%	4.32%
			5320	4.645	37.406	4.778	35.849	-2.78%	4.34%
			5600	4.932	37.033	5.065	35.529	-2.63%	4.23%
			5680	5.018	36.976	5.147	35.437	-2.51%	4.34%
			5800	5.141	36.799	5.270	35.300	-2.45%	4.25%
			5825	5.154	36.784	5.296	35.271	-2.68%	4.29%

FCC ID: A3LSMT2558		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			Page 25 of 48

Table 9-2
Measured Body 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
4/21/2014	835B	22.0	820	0.997	54.298	0.969	55.258	2.89%	-1.74%
			835	1.012	54.122	0.970	55.200	4.33%	-1.95%
			850	1.026	53.952	0.988	55.154	3.85%	-2.18%
4/24/2014	835B	22.7	820	0.991	54.213	0.969	55.258	2.27%	-1.89%
			835	1.006	54.072	0.970	55.200	3.71%	-2.04%
			850	1.019	53.893	0.988	55.154	3.14%	-2.29%
4/28/2014	1900B	23.1	1850	1.488	51.619	1.520	53.300	-2.11%	-3.15%
			1880	1.522	51.517	1.520	53.300	0.13%	-3.35%
			1910	1.557	51.378	1.520	53.300	2.43%	-3.61%
5/14/2014	1900B	24.5	1850	1.483	52.804	1.520	53.300	-2.43%	-0.93%
			1880	1.517	52.708	1.520	53.300	-0.20%	-1.11%
			1910	1.551	52.643	1.520	53.300	2.04%	-1.23%
4/2/2014	2450B	23.1	2401	1.969	52.151	1.903	52.765	3.47%	-1.16%
			2450	2.038	51.977	1.950	52.700	4.51%	-1.37%
			2499	2.103	51.789	2.019	52.638	4.16%	-1.61%
5/21/2014	2450B	22.2	2401	1.965	51.772	1.903	52.765	3.26%	-1.88%
			2450	2.030	51.586	1.950	52.700	4.10%	-2.11%
			2499	2.100	51.396	2.019	52.638	4.01%	-2.36%
04/09/2014	5200B-5800B	23.7	5180	5.421	46.996	5.276	49.041	2.75%	-4.17%
			5200	5.462	46.941	5.299	49.014	3.08%	-4.23%
			5300	5.586	46.756	5.416	48.879	3.14%	-4.34%
			5320	5.606	46.678	5.439	48.851	3.07%	-4.45%
			5600	5.987	46.154	5.766	48.471	3.83%	-4.78%
			5680	6.094	46.010	5.860	48.363	3.99%	-4.87%
			5800	6.257	45.808	6.000	48.200	4.28%	-4.96%
			5825	6.285	45.807	6.029	48.166	4.25%	-4.90%

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 26 of 48	

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. Full system validation status and result summary can be found in Appendix E.

Table 9-3
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR _{1g} (W/kg)	1 W Target SAR _{1g} (W/kg)	1 W Normalized SAR _{1g} (W/kg)	Deviation _{1g} (%)
E	835	HEAD	04/21/2014	23.8	22.5	0.100	4d132	3914	0.985	9.200	9.850	7.07%
E	835	HEAD	04/24/2014	24.4	23.5	0.100	4d119	3914	0.982	9.220	9.820	6.51%
K	1900	HEAD	04/22/2014	24.5	22.9	0.100	5d149	3333	4.080	40.400	40.800	0.99%
G	1900	HEAD	04/28/2014	23.9	22.4	0.100	5d149	3258	3.760	40.400	37.600	-6.93%
K	2450	HEAD	04/04/2014	24.5	22.6	0.040	719	3333	2.130	53.200	53.250	0.09%
E	5200	HEAD	04/09/2014	24.5	23.4	0.100	1057	3914	7.140	78.000	71.400	-8.46%
E	5300	HEAD	04/09/2014	24.4	23.4	0.100	1057	3914	7.900	83.000	79.000	-4.82%
E	5600	HEAD	04/09/2014	24.5	23.3	0.100	1057	3914	7.890	83.500	78.900	-5.51%
E	5800	HEAD	04/09/2014	24.5	23.5	0.100	1057	3914	8.120	79.300	81.200	2.40%
D	835	BODY	04/21/2014	23.3	22.0	0.100	4d132	3022	0.998	9.310	9.980	7.20%
D	835	BODY	04/24/2014	24.3	22.7	0.100	4d132	3022	0.940	9.310	9.400	0.97%
H	1900	BODY	04/28/2014	23.4	23.1	0.100	5d149	3589	3.970	40.500	39.700	-1.98%
D	1900	BODY	05/14/2014	24.0	24.5	0.100	5d149	3022	4.070	40.500	40.700	0.49%
G	2450	BODY	04/02/2014	24.4	23.4	0.040	719	3258	2.130	51.700	53.250	3.00%
K	2450	BODY	05/21/2014	24.2	22.2	0.100	719	3333	5.440	51.700	54.400	5.22%
A	5200	BODY	04/09/2014	23.5	23.7	0.100	1007	3920	7.040	72.600	70.400	-3.03%
A	5300	BODY	04/09/2014	23.5	23.7	0.100	1007	3920	7.410	74.700	74.100	-0.80%
A	5600	BODY	04/09/2014	23.4	23.6	0.100	1007	3920	8.050	77.300	80.500	4.14%
A	5800	BODY	04/09/2014	23.4	23.6	0.100	1007	3920	7.320	72.900	73.200	0.41%

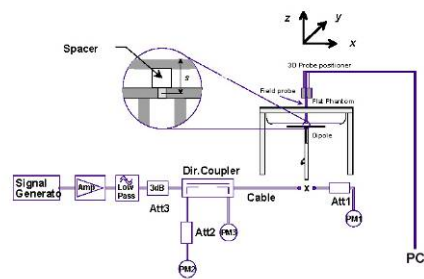


Figure 9-1
System Verification Setup Diagram



Figure 9-2
System Verification Setup Photo

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 27 of 48

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	33.0	32.55	0.17	Right	Cheek	20402	1:8.3	0.021	1.109	0.023	A1
836.60	190	GSM 850	GSM	33.0	32.55	-0.02	Right	Tilt	20402	1:8.3	0.016	1.109	0.018	
836.60	190	GSM 850	GSM	33.0	32.55	-0.07	Left	Cheek	20402	1:8.3	0.021	1.109	0.023	
836.60	190	GSM 850	GSM	33.0	32.55	-0.04	Left	Tilt	20402	1:8.3	0.018	1.109	0.020	
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	23.5	22.45	0.03	Right	Cheek	20401	1:1	0.090	1.274	0.115	A2
836.60	4183	UMTS 850	RMC	23.5	22.45	0.06	Right	Tilt	20401	1:1	0.057	1.274	0.073	
836.60	4183	UMTS 850	RMC	23.5	22.45	-0.10	Left	Cheek	20401	1:1	0.088	1.274	0.112	
836.60	4183	UMTS 850	RMC	23.5	22.45	-0.02	Left	Tilt	20401	1:1	0.056	1.274	0.071	
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	30.0	29.80	-0.06	Right	Cheek	20402	1:8.3	0.071	1.047	0.074	
1880.00	661	GSM 1900	GSM	30.0	29.80	0.03	Right	Tilt	20402	1:8.3	0.052	1.047	0.054	
1880.00	661	GSM 1900	GSM	30.0	29.80	-0.05	Left	Cheek	20402	1:8.3	0.107	1.047	0.112	A3
1880.00	661	GSM 1900	GSM	30.0	29.80	0.11	Left	Tilt	20402	1:8.3	0.041	1.047	0.043	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram						

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 28 of 48

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	23.5	23.18	0.07	Right	Cheek	20403	1:1	0.053	1.076	0.057	
1880.00	9400	UMTS 1900	RMC	23.5	23.18	-0.19	Right	Tilt	20403	1:1	0.053	1.076	0.057	
1880.00	9400	UMTS 1900	RMC	23.5	23.18	0.08	Left	Cheek	20403	1:1	0.054	1.076	0.058	
1880.00	9400	UMTS 1900	RMC	23.5	23.18	0.10	Left	Tilt	20403	1:1	0.066	1.076	0.071	A4
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	15.0	14.90	0.13	Right	Cheek	20402	1	1:1	0.296	1.023	0.303	A5
2462	11	IEEE 802.11b	DSSS	15.0	14.90	0.10	Right	Tilt	20402	1	1:1	0.196	1.023	0.201	
2462	11	IEEE 802.11b	DSSS	15.0	14.90	0.12	Left	Cheek	20402	1	1:1	0.115	1.023	0.118	
2462	11	IEEE 802.11b	DSSS	15.0	14.90	0.05	Left	Tilt	20402	1	1:1	0.087	1.023	0.089	
5825	165	IEEE 802.11a	OFDM	12.5	12.46	0.00	Right	Cheek	20401	6	1:1	0.000	1.009	0.000	
5825	165	IEEE 802.11a	OFDM	12.5	12.46	0.00	Right	Tilt	20401	6	1:1	0.000	1.009	0.000	
5825	165	IEEE 802.11a	OFDM	12.5	12.46	0.10	Left	Cheek	20401	6	1:1	0.000	1.009	0.000	
5825	165	IEEE 802.11a	OFDM	12.5	12.46	0.16	Left	Tilt	20401	6	1:1	0.000	1.009	0.000	A6
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) (W/kg)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
5180	36	IEEE 802.11a	OFDM	12.5	12.49	0.00	Right	Cheek	20401	6	1:1	0.000	1.002	0.000	
5180	36	IEEE 802.11a	OFDM	12.5	12.49	0.00	Right	Tilt	20401	6	1:1	0.000	1.002	0.000	
5180	36	IEEE 802.11a	OFDM	12.5	12.49	0.00	Left	Cheek	20401	6	1:1	0.000	1.002	0.000	
5180	36	IEEE 802.11a	OFDM	12.5	12.49	0.00	Left	Tilt	20401	6	1:1	0.000	1.002	0.000	A7
5320	64	IEEE 802.11a	OFDM	12.5	12.49	0.00	Right	Cheek	20401	6	1:1	0.000	1.002	0.000	
5320	64	IEEE 802.11a	OFDM	12.5	12.49	0.00	Right	Tilt	20401	6	1:1	0.000	1.002	0.000	
5320	64	IEEE 802.11a	OFDM	12.5	12.49	0.05	Left	Cheek	20401	6	1:1	0.000	1.002	0.000	
5320	64	IEEE 802.11a	OFDM	12.5	12.49	0.10	Left	Tilt	20401	6	1:1	0.000	1.002	0.000	
5680	136	IEEE 802.11a	OFDM	12.5	12.48	0.00	Right	Cheek	20401	6	1:1	0.000	1.005	0.000	
5680	136	IEEE 802.11a	OFDM	12.5	12.48	0.10	Right	Tilt	20401	6	1:1	0.000	1.005	0.000	
5680	136	IEEE 802.11a	OFDM	12.5	12.48	0.10	Left	Cheek	20401	6	1:1	0.000	1.005	0.000	
5680	136	IEEE 802.11a	OFDM	12.5	12.48	0.10	Left	Tilt	20401	6	1:1	0.000	1.005	0.000	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram							

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 29 of 48

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	29.5	27.72	-0.02	15 mm	20402	3	1:2.76	back	0.115	1.507	0.173	
836.60	190	GSM 850	GPRS	29.5	27.72	0.03	10 mm	20402	3	1:2.76	bottom	0.092	1.507	0.139	
836.60	190	GSM 850	GPRS	29.5	27.72	-0.17	15 mm	20402	3	1:2.76	right	0.066	1.507	0.099	
836.60	190	GSM 850	GPRS	29.5	27.72	0.08	15 mm	20402	3	1:2.76	left	0.493	1.507	0.743	A8
836.60	190	GSM 850	GPRS	24.7	23.39	-0.02	0 mm	20404	1	1:8.3	back	0.417	1.352	0.564	
836.60	190	GSM 850	GPRS	24.7	23.39	0.01	0 mm	20404	1	1:8.3	bottom	0.240	1.352	0.324	
836.60	190	GSM 850	GPRS	24.7	23.39	0.03	0 mm	20404	1	1:8.3	right	0.011	1.352	0.015	
836.60	190	GSM 850	GPRS	24.7	23.39	0.07	0 mm	20404	1	1:8.3	left	0.076	1.352	0.103	
836.60	4183	UMTS 850	RMC	23.5	22.45	-0.03	15 mm	20403	N/A	1:1	back	0.323	1.274	0.412	
836.60	4183	UMTS 850	RMC	23.5	22.45	0.00	10 mm	20403	N/A	1:1	bottom	0.467	1.274	0.595	A9
836.60	4183	UMTS 850	RMC	23.5	22.45	-0.01	15 mm	20403	N/A	1:1	right	0.066	1.274	0.084	
826.40	4132	UMTS 850	RMC	23.5	22.45	0.07	15 mm	20403	N/A	1:1	left	0.040	1.274	0.051	
836.60	4183	UMTS 850	RMC	12.6	12.18	0.05	0 mm	20405	N/A	1:1	back	0.308	1.102	0.339	
836.60	4183	UMTS 850	RMC	12.6	12.18	0.04	0 mm	20405	N/A	1:1	bottom	0.244	1.102	0.269	
836.60	4183	UMTS 850	RMC	12.6	12.18	0.12	0 mm	20405	N/A	1:1	right	0.149	1.102	0.164	
826.40	4132	UMTS 850	RMC	12.6	12.18	-0.10	0 mm	20405	N/A	1:1	left	0.008	1.102	0.009	
1880.00	661	GSM 1900	GPRS	26.5	24.78	0.00	15 mm	20402	3	1:2.76	back	0.203	1.486	0.302	
1880.00	661	GSM 1900	GPRS	26.5	24.78	-0.05	10 mm	20402	3	1:2.76	bottom	0.220	1.486	0.327	
1880.00	661	GSM 1900	GPRS	26.5	24.78	0.09	15 mm	20402	3	1:2.76	right	0.045	1.486	0.067	
1850.20	512	GSM 1900	GPRS	26.5	24.79	-0.21	15 mm	20402	3	1:2.76	left	0.567	1.483	0.841	
1880.00	661	GSM 1900	GPRS	26.5	24.78	-0.01	15 mm	20402	3	1:2.76	left	0.596	1.486	0.886	
1909.80	810	GSM 1900	GPRS	26.5	24.81	0.02	15 mm	20402	3	1:2.76	left	0.649	1.476	0.958	
1850.20	512	GSM 1900	GPRS	19.5	19.44	-0.13	0 mm	120501	4	1:2.076	back	0.973	1.014	0.987	
1880.00	661	GSM 1900	GPRS	19.5	19.47	-0.12	0 mm	120501	4	1:2.076	back	1.040	1.007	1.047	
1909.80	810	GSM 1900	GPRS	19.5	19.50	-0.04	0 mm	120501	4	1:2.076	back	1.080	1.000	1.080	
1880.00	661	GSM 1900	GPRS	19.5	19.47	-0.16	0 mm	120501	4	1:2.076	bottom	0.322	1.007	0.324	
1880.00	661	GSM 1900	GPRS	19.5	19.47	0.08	0 mm	120501	4	1:2.076	right	0.013	1.007	0.013	
1880.00	661	GSM 1900	GPRS	19.5	19.47	0.01	0 mm	120501	4	1:2.076	left	0.250	1.007	0.252	
1909.80	810	GSM 1900	GPRS	19.5	19.50	-0.01	0 mm	120501	4	1:2.076	back	1.090	1.000	1.090	A10
1880.00	9400	UMTS 1900	RMC	23.5	23.18	-0.05	15 mm	20403	N/A	1:1	back	0.387	1.076	0.416	
1880.00	9400	UMTS 1900	RMC	23.5	23.18	0.08	10 mm	20403	N/A	1:1	bottom	0.693	1.076	0.746	
1880.00	9400	UMTS 1900	RMC	23.5	23.18	0.00	15 mm	20403	N/A	1:1	right	0.103	1.076	0.111	
1880.00	9400	UMTS 1900	RMC	23.5	23.18	0.21	15 mm	20403	N/A	1:1	left	0.044	1.076	0.047	
1852.40	9262	UMTS 1900	RMC	12.8	12.35	0.04	0 mm	20405	N/A	1:1	back	0.984	1.109	1.091	A11
1880.00	9400	UMTS 1900	RMC	12.8	11.86	-0.03	0 mm	20405	N/A	1:1	back	0.593	1.242	0.737	
1907.60	9538	UMTS 1900	RMC	12.8	11.46	0.02	0 mm	20405	N/A	1:1	back	0.457	1.361	0.622	
1852.40	9262	UMTS 1900	RMC	12.8	12.35	0.00	0 mm	20405	N/A	1:1	bottom	0.445	1.109	0.494	
1852.40	9262	UMTS 1900	RMC	12.8	12.35	0.03	0 mm	20405	N/A	1:1	right	0.098	1.109	0.109	
1852.40	9262	UMTS 1900	RMC	12.8	12.35	0.05	0 mm	20405	N/A	1:1	left	0.013	1.109	0.100	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

Note: Blue entry represents variability measurement.

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 30 of 48

**Table 10-8
DTS Body SAR**

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2412	1	IEEE 802.11b	DSSS	15.0	14.65	0.10	0 mm	20402	1	back	1:1	0.874	1.084	0.947	
2437	6	IEEE 802.11b	DSSS	15.0	14.58	0.13	0 mm	20402	1	back	1:1	0.955	1.102	1.052	A12
2462	11	IEEE 802.11b	DSSS	15.0	14.90	0.06	0 mm	20402	1	back	1:1	0.816	1.023	0.835	
2462	11	IEEE 802.11b	DSSS	15.0	14.90	0.02	0 mm	20402	1	top	1:1	0.305	1.023	0.312	
2462	11	IEEE 802.11b	DSSS	15.0	14.90	0.06	0 mm	20402	1	left	1:1	0.455	1.023	0.465	
2437	6	IEEE 802.11b	DSSS	15.0	14.58	0.00	0 mm	20402	1	back	1:1	0.866	1.102	0.954	
5825	165	IEEE 802.11a	OFDM	12.5	12.46	0.04	0 mm	20401	6	back	1:1	0.003	1.009	0.003	
5825	165	IEEE 802.11a	OFDM	12.5	12.46	0.10	0 mm	20401	6	top	1:1	0.006	1.009	0.006	A14
5825	165	IEEE 802.11a	OFDM	12.5	12.46	0.07	0 mm	20401	6	left	1:1	0.004	1.009	0.004	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

Note: Blue entry represents variability measurement.

**Table 10-9
NII Body SAR**

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
5180	36	IEEE 802.11a	OFDM	12.5	12.49	0.04	0 mm	20401	6	back	1:1	0.105	1.002	0.105	A15
5180	36	IEEE 802.11a	OFDM	12.5	12.49	0.19	0 mm	20401	6	top	1:1	0.013	1.002	0.013	
5180	36	IEEE 802.11a	OFDM	12.5	12.49	0.09	0 mm	20401	6	left	1:1	0.019	1.002	0.019	
5320	64	IEEE 802.11a	OFDM	12.5	12.49	0.03	0 mm	20401	6	back	1:1	0.058	1.002	0.058	
5320	64	IEEE 802.11a	OFDM	12.5	12.49	0.06	0 mm	20401	6	top	1:1	0.012	1.002	0.012	
5320	64	IEEE 802.11a	OFDM	12.5	12.49	0.03	0 mm	20401	6	left	1:1	0.013	1.002	0.013	
5680	136	IEEE 802.11a	OFDM	12.5	12.48	0.17	0 mm	20401	6	back	1:1	0.004	1.005	0.004	
5680	136	IEEE 802.11a	OFDM	12.5	12.48	0.03	0 mm	20401	6	top	1:1	0.008	1.005	0.008	
5680	136	IEEE 802.11a	OFDM	12.5	12.48	-0.02	0 mm	20401	6	left	1:1	0.008	1.005	0.008	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

**Table 10-10
Bluetooth Body SAR**

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2441	39	Bluetooth	FHSS	10.0	9.59	0.10	0 mm	20401	1	back	1:1	0.063	1.099	0.069	A13
2441	39	Bluetooth	FHSS	10.0	9.59	0.08	0 mm	20401	1	top	1:1	0.018	1.099	0.020	
2441	39	Bluetooth	FHSS	10.0	9.59	0.10	0 mm	20401	1	left	1:1	0.023	1.099	0.025	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

FCC ID: A3LSMT2558		SAR EVALUATION REPORT					Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet				Page 31 of 48	

10.3 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, FCC KDB 616217 D04, and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements. A specialized battery with NFC operations was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. 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. Bottom, right, and left edge SAR tests were required for the main antennas. Top and left edge SAR tests were required for the WLAN/BT 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. All head SAR tests were performed at maximum power levels for all modes.

GSM Test Notes:

1. Justification for reduced test configurations per KDB Publication 941225 D03v01 and October 2013 TCB Workshop Notes: The source-based frame-averaged output power was evaluated for all GPRS/EDGE slot configurations. The configuration with the highest target frame averaged output power was evaluated for body SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
2. Per FCC KDB Publication 447498 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel was used.

UMTS Notes:

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

WLAN/Bluetooth Notes:

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 32 of 48

11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

11.1 Introduction

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

11.2 Simultaneous Transmission Procedures

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

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

Table 11-1
Estimated SAR

Mode	Configuration	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
		[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth LE	Back Side, Right Edge, Left Edge, and Top Edge Touching*	2440	3.50	5	0.083
Bluetooth LE	Left Edge	2440	3.50	15	0.028

Notes:

- (*) – Per FCC KDB Publication 447498, when the test separation distance is < 5 mm, a distance of 5 mm is applied to determine estimated SAR.
- Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission.
- Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

FCC ID: A3LSMT2558		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			Page 33 of 48

11.3 Head SAR Simultaneous Transmission Analysis

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

Simult Tx	Configuration	GSM 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.023	0.303	0.326	Head SAR	Right Cheek	0.115	0.303	0.418
	Right Tilt	0.018	0.201	0.219		Right Tilt	0.073	0.201	0.274
	Left Cheek	0.023	0.118	0.141		Left Cheek	0.112	0.118	0.230
	Left Tilt	0.020	0.089	0.109		Left Tilt	0.071	0.089	0.160
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	0.074	0.303	0.377	Head SAR	Right Cheek	0.057	0.303	0.360
	Right Tilt	0.054	0.201	0.255		Right Tilt	0.057	0.201	0.258
	Left Cheek	0.112	0.118	0.230		Left Cheek	0.058	0.118	0.176
	Left Tilt	0.043	0.089	0.132		Left Tilt	0.071	0.089	0.160

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

Simult Tx	Configuration	GSM 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.023	0.000	0.023	Head SAR	Right Cheek	0.115	0.000	0.115
	Right Tilt	0.018	0.000	0.018		Right Tilt	0.073	0.000	0.073
	Left Cheek	0.023	0.000	0.023		Left Cheek	0.112	0.000	0.112
	Left Tilt	0.020	0.000	0.020		Left Tilt	0.071	0.000	0.071
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	0.074	0.000	0.074	Head SAR	Right Cheek	0.057	0.000	0.057
	Right Tilt	0.054	0.000	0.054		Right Tilt	0.057	0.000	0.057
	Left Cheek	0.112	0.000	0.112		Left Cheek	0.058	0.000	0.058
	Left Tilt	0.043	0.000	0.043		Left Tilt	0.071	0.000	0.071

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 34 of 48

11.4 Body 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)	SPLSR	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.564	1.052	See Note 1	0.01	Body SAR	Back	0.339	1.052	1.391	N/A
	Top	0.400	0.312	0.712	N/A		Top	0.400	0.312	0.712	N/A
	Bottom	0.324	0.400	0.724	N/A		Bottom	0.269	0.400	0.669	N/A
	Right	0.015	0.400	0.415	N/A		Right	0.164	0.400	0.564	N/A
	Left	0.103	0.465	0.568	N/A		Left	0.009	0.465	0.474	N/A
Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.090	1.052	See Note 1	0.02	Body SAR	Back	1.091	1.052	See Note 1	0.02
	Top	0.400	0.312	0.712	N/A		Top	0.400	0.312	0.712	N/A
	Bottom	0.324	0.400	0.724	N/A		Bottom	0.494	0.400	0.894	N/A
	Right	0.013	0.400	0.413	N/A		Right	0.109	0.400	0.509	N/A
	Left	0.252	0.465	0.717	N/A		Left	0.100	0.465	0.565	N/A

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

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.564	0.105	0.669	N/A	Body SAR	Back	0.339	0.105	0.444	N/A
	Top	0.400	0.013	0.413	N/A		Top	0.400	0.013	0.413	N/A
	Bottom	0.324	0.400	0.724	N/A		Bottom	0.269	0.400	0.669	N/A
	Right	0.015	0.400	0.415	N/A		Right	0.164	0.400	0.564	N/A
	Left	0.103	0.019	0.122	N/A		Left	0.009	0.019	0.028	N/A
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)	SPLSR
Body SAR	Back	1.090	0.105	1.195	N/A	Body SAR	Back	1.091	0.105	1.196	N/A
	Top	0.400	0.013	0.413	N/A		Top	0.400	0.013	0.413	N/A
	Bottom	0.324	0.400	0.724	N/A		Bottom	0.494	0.400	0.894	N/A
	Right	0.013	0.400	0.413	N/A		Right	0.109	0.400	0.509	N/A
	Left	0.252	0.019	0.271	N/A		Left	0.100	0.019	0.119	N/A

The worst case 5 GHz WIFI reported SAR for each body configuration was considered for simultaneous SAR exclusion via summation of standalone SAR, regardless of whether the WIFI channel has WIFI Direct capability, for simplicity to determine compliance. Please note that the actual simultaneous transmission SAR will not exceed the summed levels indicated.

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)	SPLSR	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.564	0.083	0.647	N/A	Body SAR	Back	0.339	0.083	0.422	N/A
	Top	0.400	0.083	0.483	N/A		Top	0.400	0.083	0.483	N/A
	Bottom	0.324	0.400	0.724	N/A		Bottom	0.269	0.400	0.669	N/A
	Right	0.015	0.400	0.415	N/A		Right	0.164	0.400	0.564	N/A
	Left	0.103	0.083	0.186	N/A		Left	0.009	0.083	0.092	N/A
Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.090	0.083	1.173	N/A	Body SAR	Back	1.091	0.083	1.174	N/A
	Top	0.400	0.083	0.483	N/A		Top	0.400	0.083	0.483	N/A
	Bottom	0.324	0.400	0.724	N/A		Bottom	0.494	0.400	0.894	N/A
	Right	0.013	0.400	0.413	N/A		Right	0.109	0.400	0.509	N/A
	Left	0.252	0.083	0.335	N/A		Left	0.100	0.083	0.183	N/A

Note: Estimated Bluetooth LE SAR result for back, top, and left edges was used in the above table to determine simultaneous transmission SAR test exclusion since it was more conservative than Bluetooth reported SAR.

FCC ID: A3LSMT2558		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			Page 35 of 48

Table 11-7
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Back at 15 mm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GSM 850	0.173	< 1.052	< 1.225	N/A
Back Side	UMTS 850	0.412	< 1.052	< 1.464	N/A
Back Side	GSM 1900	0.302	< 1.052	< 1.354	N/A
Back Side	UMTS 1900	0.416	< 1.052	< 1.468	N/A

Table 11-8
Simultaneous Transmission Scenario with 5 GHz WLAN (Back at 15 mm)

Configuration	Mode	2G/3G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GSM 850	0.173	< 0.105	< 0.278	N/A
Back Side	UMTS 850	0.412	< 0.105	< 0.517	N/A
Back Side	GSM 1900	0.302	< 0.105	< 0.407	N/A
Back Side	UMTS 1900	0.416	< 0.105	< 0.521	N/A

The worst case 5 GHz WIFI reported SAR for each body configuration was considered for simultaneous SAR exclusion via summation of standalone SAR, regardless of whether the WIFI channel has WIFI Direct capability, for simplicity to determine compliance. Please note that the actual simultaneous transmission SAR will not exceed the summed levels indicated.

Table 11-9
Simultaneous Transmission Scenario with Bluetooth (Back at 15 mm)

Configuration	Mode	2G/3G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GSM 850	0.173	<0.069	<0.242	N/A
Back Side	UMTS 850	0.412	<0.069	<0.481	N/A
Back Side	GSM 1900	0.302	<0.069	<0.371	N/A
Back Side	UMTS 1900	0.416	<0.069	< 0.485	N/A

Table 11-10
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Bottom at 10 mm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Bottom Edge	GSM 850	0.139	0.400	0.539	N/A
Bottom Edge	UMTS 850	0.595	0.400	0.995	N/A
Bottom Edge	GSM 1900	0.327	0.400	0.727	N/A
Bottom Edge	UMTS 1900	0.746	0.400	1.146	N/A

Table 11-11
Simultaneous Transmission Scenario with 5 GHz WLAN (Bottom at 10 mm)

Configuration	Mode	2G/3G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Bottom Edge	GSM 850	0.139	0.400	0.539	N/A
Bottom Edge	UMTS 850	0.595	0.400	0.995	N/A
Bottom Edge	GSM 1900	0.327	0.400	0.727	N/A
Bottom Edge	UMTS 1900	0.746	0.400	1.146	N/A

The worst case 5 GHz WIFI reported SAR for each body configuration was considered for simultaneous SAR exclusion via summation of standalone SAR, regardless of whether the WIFI channel has WIFI Direct capability, for simplicity to determine compliance. Please note that the actual simultaneous transmission SAR will not exceed the summed levels indicated.

FCC ID: A3LSMT2558	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 36 of 48	

Table 11-12
Simultaneous Transmission Scenario with Bluetooth (Bottom at 10 mm)

Configuration	Mode	2G/3G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Bottom Edge	GSM 850	0.139	0.400	0.539	N/A
Bottom Edge	UMTS 850	0.595	0.400	0.995	N/A
Bottom Edge	GSM 1900	0.327	0.400	0.727	N/A
Bottom Edge	UMTS 1900	0.746	0.400	1.146	N/A

Table 11-13
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Right at 15 mm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Right Edge	GSM 850	0.099	0.400	0.499	N/A
Right Edge	UMTS 850	0.084	0.400	0.484	N/A
Right Edge	GSM 1900	0.067	0.400	0.467	N/A
Right Edge	UMTS 1900	0.111	0.400	0.511	N/A

Table 11-14
Simultaneous Transmission Scenario with 5 GHz WLAN (Right at 15 mm)

Configuration	Mode	2G/3G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Right Edge	GSM 850	0.099	0.400	0.499	N/A
Right Edge	UMTS 850	0.084	0.400	0.484	N/A
Right Edge	GSM 1900	0.067	0.400	0.467	N/A
Right Edge	UMTS 1900	0.111	0.400	0.511	N/A

Table 11-15
Simultaneous Transmission Scenario with Bluetooth (Right at 15 mm)

Configuration	Mode	2G/3G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Right Edge	GSM 850	0.099	0.400	0.499	N/A
Right Edge	UMTS 850	0.084	0.400	0.484	N/A
Right Edge	GSM 1900	0.067	0.400	0.467	N/A
Right Edge	UMTS 1900	0.111	0.400	0.511	N/A

Table 11-16
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Left at 15 mm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Left Edge	GSM 850	0.743	<0.465	<1.208	N/A
Left Edge	UMTS 850	0.051	<0.465	<0.516	N/A
Left Edge	GSM 1900	0.958	<0.465	<1.423	N/A
Left Edge	UMTS 1900	0.047	<0.465	<0.512	N/A

Table 11-17
Simultaneous Transmission Scenario with 5 GHz WLAN (Left at 15 mm)

Configuration	Mode	2G/3G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Left Edge	GSM 850	0.743	<0.019	<0.762	N/A
Left Edge	UMTS 850	0.051	<0.019	<0.07	N/A
Left Edge	GSM 1900	0.958	<0.019	<0.977	N/A
Left Edge	UMTS 1900	0.047	<0.019	<0.066	N/A

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 37 of 48

The worst case 5 GHz WIFI reported SAR for each body configuration was considered for simultaneous SAR exclusion via summation of standalone SAR, regardless of whether the WIFI channel has WIFI Hotspot capability, for simplicity to determine compliance. Please note that the actual simultaneous transmission SAR will not exceed the summed levels indicated.

Table 11-18
Simultaneous Transmission Scenario with Bluetooth (Left at 15 mm)

Configuration	Mode	2G/3G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Left Edge	GSM 850	0.743	0.028	0.771	N/A
Left Edge	UMTS 850	0.051	0.028	0.079	N/A
Left Edge	GSM 1900	0.958	0.028	0.986	N/A
Left Edge	UMTS 1900	0.047	0.028	0.075	N/A

Note: Estimated Bluetooth LE SAR result for left edge was used in the above table to determine simultaneous transmission SAR test exclusion since it was more conservative than Bluetooth reported SAR.

Notes:

1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was not higher than 0.04 per FCC KDB 447498 D01v05. See Section 11.5 for detailed SPLS ratio analysis.
2. For configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion when the test separation distance was >50mm.
3. For SAR summations not at 0 mm, WLAN/Bluetooth SAR values for 0.0 cm were used since the 0.0 cm test distance was more conservative. "<" denotes that the 0.0 cm SAR values were used for summation purposes.
4. The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Direct capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

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.

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

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 38 of 48

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

Table 11-19
Peak SAR Locations for Body Back Side at 0 mm GPRS 850 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
2.4 GHz WLAN	29.00	86.00
GPRS 850	12.00	-71.50

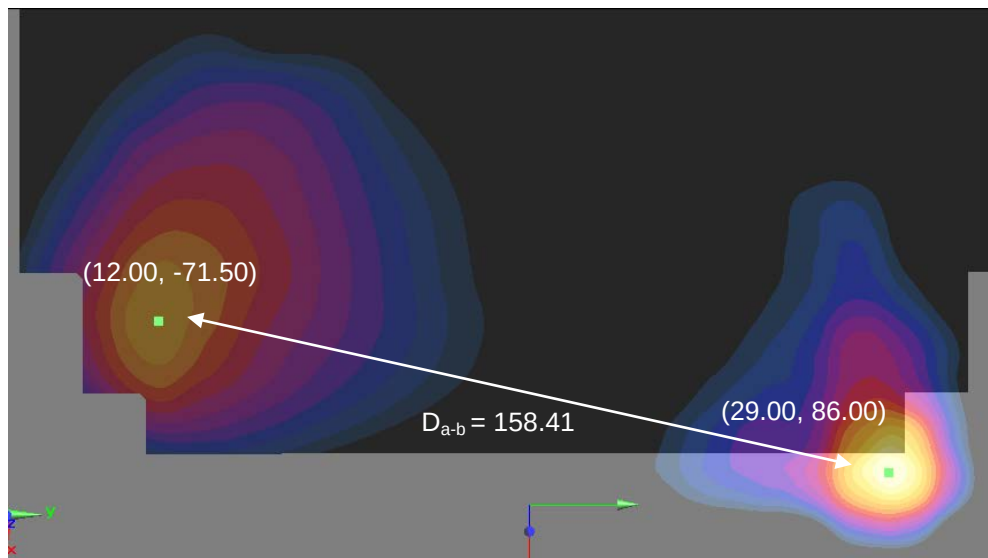


Figure 11-1
Peak SAR Locations for Body Back Side at 0 mm GPRS 850 and 2.4 GHz WLAN Antenna

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}	$(a+b)^{1.5}/D_{a-b}$
2.4 GHz WLAN	GPRS 850	1.052	0.564	1.616	158.41	0.01

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 antenna operating at limited output power with 2.4 GHz WIFI.

Table 11-21

Peak SAR Locations for Body Back Side at 0 mm GPRS 1900 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
2.4 GHz WLAN	29.00	86.00
GPRS 1900	7.00	-87.00

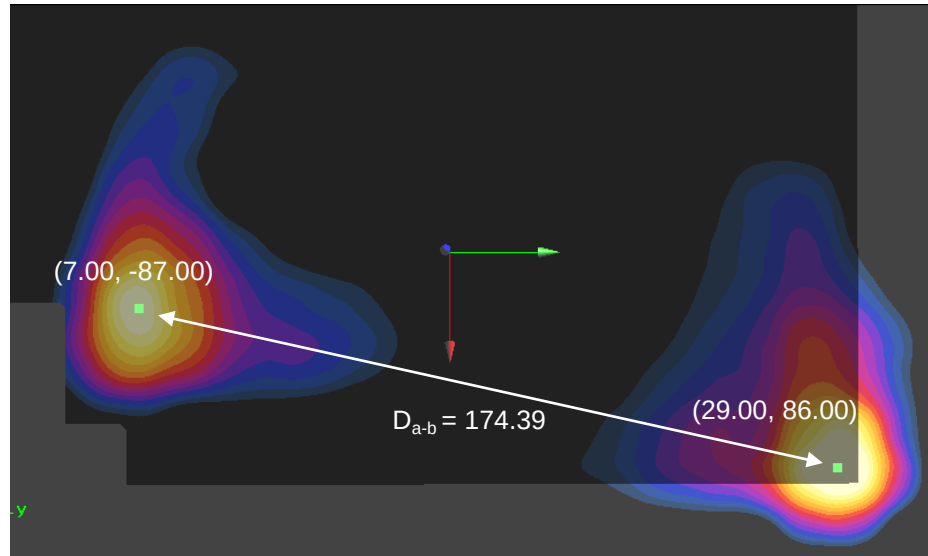


Figure 11-2

Peak SAR Locations for Body Back Side at 0 mm GPRS 1900 and 2.4 GHz WLAN Antenna

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}	$(a+b)^{1.5}/D_{a-b}$
2.4 GHz WLAN	GPRS 1900	1.052	1.09	2.142	174.39	0.02

FCC ID: A3LSMT2558		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			Page 40 of 48

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

Table 11-23
Peak SAR Locations for Body Back Side at 0 mm UMTS 1900 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
2.4 GHz WLAN	29.00	86.00
GPRS 1900	-50.00	-78.00

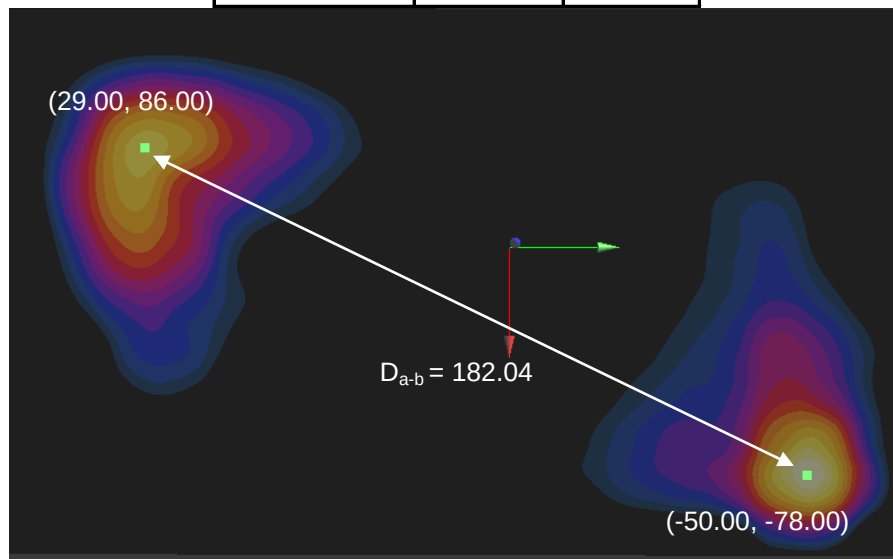


Figure 11-3
Peak SAR Locations for Body Back Side at 0 mm UMTS 1900 and 2.4 GHz WLAN Antenna

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

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
2.4 GHz WLAN	UMTS 1900	1.052	1.091	2.143	182.04	0.02

11.6 Simultaneous Transmission Conclusion

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			Page 41 of 48

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													
Band	FREQUENCY		Mode	Service	# of Time Slots	Data Rate (Mbps)	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	3rd Repeated SAR (1g)
	MHz	Ch.							(W/kg)	(W/kg)		(W/kg)	(W/kg)
1900	1909.80	810	GSM 1900	GPRS	4	N/A	back	0 mm	1.080	1.090	1.01	N/A	N/A
2450	2437.00	6	IEEE 802.11b	DSSS	N/A	1	back	0 mm	0.955	0.866	1.10	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 extended measurement uncertainty analysis per IEEE 1528-2003 was not required.

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 42 of 48

13 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/15/2014	Annual	4/15/2015	MY45470194
Agilent	8753E	(30kHz-6GHz) Network Analyzer	7/23/2013	Annual	7/23/2014	US37390350
Agilent	E4438C	ESG Vector Signal Generator	3/31/2014	Annual	3/31/2015	MY42082659
Agilent	E4438C	ESG Vector Signal Generator	4/1/2014	Annual	4/1/2015	MY47270002
Agilent	E4438C	ESG Vector Signal Generator	4/15/2014	Annual	4/15/2015	MY45090700
Agilent	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Agilent	N5182A	MXG Vector Signal Generator	4/15/2014	Annual	4/15/2015	MY47420800
Agilent	N5182A	MXG Vector Signal Generator	4/15/2014	Annual	4/15/2015	MY47420651
Agilent	8753ES	S-Parameter Network Analyzer	10/29/2013	Annual	10/29/2014	US39170122
Agilent	E5515C	Wireless Communications Test Set	10/18/2012	Biennial	10/18/2014	GB43193563
Agilent	E5515C	Wireless Communications Test Set	3/18/2014	Annual	3/18/2015	GB46110872
Agilent	E5515C	Wireless Communications Test Set	3/19/2014	Annual	3/19/2015	GB45360985
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Anritsu	ML2495A	Power Meter	10/31/2013	Annual	10/31/2014	1039008
Anritsu	ML2469A	Power Meter	3/14/2014	Annual	3/14/2015	1306009
Anritsu	MA2481A	Power Sensor	10/30/2013	Annual	10/30/2014	5605
Anritsu	MA2411B	Pulse Power Sensor	11/14/2013	Annual	11/14/2014	1126066
Anritsu	MA2411B	Pulse Power Sensor	2/3/2014	Annual	2/3/2015	1339018
Anritsu	MA2411B	Pulse Power Sensor	3/25/2014	Annual	3/25/2015	1207470
Anritsu	MT8820C	Radio Communication Analyzer	6/28/2013	Annual	6/28/2014	6201240328
Anritsu	MT8820C	Radio Communication Analyzer	12/12/2013	Annual	12/12/2014	6200901190
Anritsu	MA24106A	USB Power Sensor	12/18/2013	Annual	12/18/2014	1344555
Anritsu	MA24106A	USB Power Sensor	12/18/2013	Annual	12/18/2014	1344556
Anritsu	MA24106A	USB Power Sensor	12/18/2013	Annual	12/18/2014	1344545
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
Control Company	36934-158	Wall-Mounted Thermometer	4/29/2014	Biennial	4/29/2016	122014488
Fisher Scientific	15-077-960	Digital Thermometer	11/6/2012	Biennial	11/6/2014	122640025
Fisher Scientific	15-077-960	Digital Thermometer	12/4/2013	Biennial	12/4/2015	130764551
Fisher Scientific	S407993	Long Stem Thermometer	11/4/2013	Biennial	11/4/2015	130671801
Fisher Scientific	S407993	Long Stem Thermometer	11/4/2013	Biennial	11/4/2015	130671821
Gigatronix	80701A	(0.05-18GHz) Power Sensor	10/30/2013	Annual	10/30/2014	1833460
Gigatronix	8651A	Universal Power Meter	10/30/2013	Annual	10/30/2014	8650319
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-53W2	Attenuator (3dB)	CBT	N/A	CBT	120
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
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	9/23/2013	Annual	9/23/2014	109892
Rohde & Schwarz	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	SME06	Signal Generator	10/30/2013	Annual	10/30/2014	832026
Rohde & Schwarz	NRVS	Single Channel Power Meter	10/31/2013	Annual	10/31/2014	835360/0079
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/18/2014	Biennial	3/18/2016	N/A
SPEAG	D1900V2	1900 MHz SAR Dipole	7/22/2013	Annual	7/22/2014	5d149
SPEAG	D2450V2	2450 MHz SAR Dipole	8/23/2013	Annual	8/23/2014	719
SPEAG	D5GHZV2	5 GHz SAR Dipole	9/23/2013	Annual	9/23/2014	1007
SPEAG	D5GHZV2	5 GHz SAR Dipole	1/27/2014	Annual	1/27/2015	1057
SPEAG	D835V2	835 MHz SAR Dipole	1/22/2014	Annual	1/22/2015	4d132
SPEAG	D835V2	835 MHz SAR Dipole	4/7/2014	Annual	4/7/2015	4d119
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/21/2013	Annual	8/21/2014	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/19/2013	Annual	11/19/2014	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/19/2013	Annual	11/19/2014	1408
SPEAG	DAE4	Dasy Data Acquisition Electronics	12/12/2013	Annual	12/12/2014	649
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/22/2014	Annual	1/22/2015	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/26/2014	Annual	2/26/2015	665
SPEAG	DAK-3.5	Dielectric Assessment Kit	11/13/2013	Annual	11/13/2014	1091
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/18/2013	Annual	8/18/2014	1008
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/18/2013	Annual	8/18/2014	1009
SPEAG	ES3DV2	SAR Probe	8/22/2013	Annual	8/22/2014	3022
SPEAG	EX3DV4	SAR Probe	10/23/2013	Annual	10/23/2014	3914
SPEAG	ES3DV3	SAR Probe	11/22/2013	Annual	11/22/2014	3333
SPEAG	EX3DV4	SAR Probe	12/18/2013	Annual	12/18/2014	3920
SPEAG	EX3DV4	SAR Probe	1/29/2014	Annual	1/29/2015	3589
SPEAG	ES3DV3	SAR Probe	2/25/2014	Annual	2/25/2015	3258

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. Each equipment item was used solely within its respective calibration period.

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 43 of 48

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
								299	

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			Page 44 of 48

Applicable for frequencies up to 6 GHz.

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

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

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 45 of 48	

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]

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	Page 46 of 48	

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FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 47 of 48

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FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1404030686.A3L	Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet		Page 48 of 48

APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20402

Communication System: UID 0, GSM; Frequency: 836.6 MHz; Duty Cycle: 1:8.3

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 0.92 \text{ S/m}$; $\epsilon_r = 42.366$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 04-24-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3914; ConvF(9.34, 9.34, 9.34); Calibrated: 10/23/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/19/2013

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

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

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

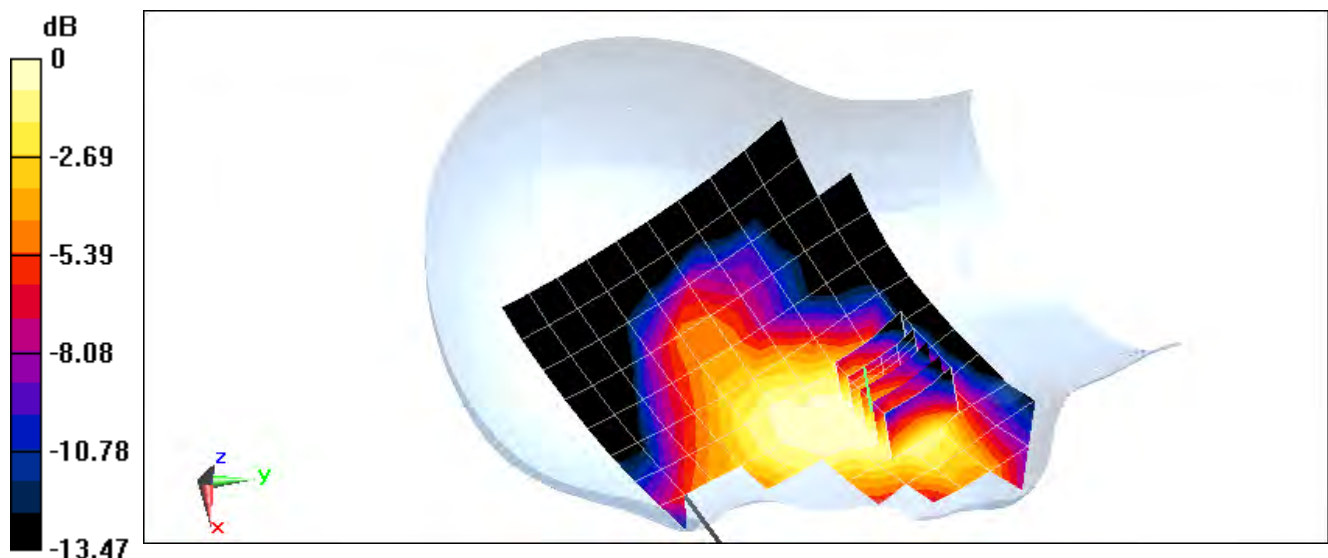
Area Scan (11x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 4.796 V/m; Power Drift = 0.17 dB

Peak SAR (extrapolated) = 0.0250 W/kg

SAR(1 g) = 0.021 W/kg



0 dB = 0.0224 W/kg = -16.50 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20401

Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 0.901 \text{ S/m}$; $\epsilon_r = 39.876$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 04-21-2014; Ambient Temp: 23.8°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3914; ConvF(9.34, 9.34, 9.34); Calibrated: 10/23/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/19/2013

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

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

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

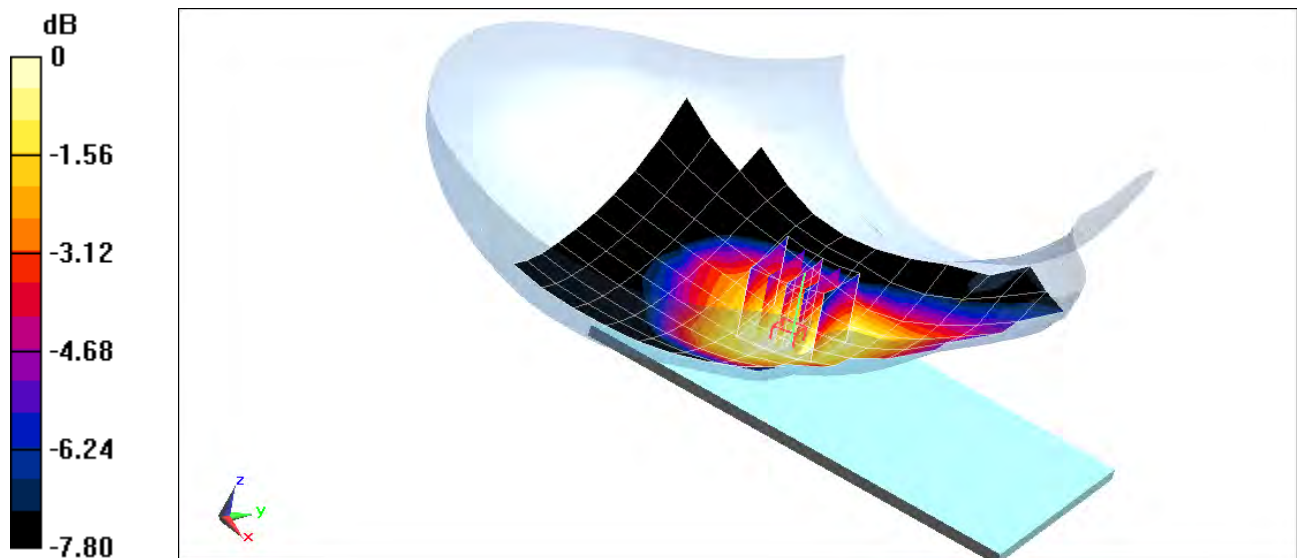
Area Scan (11x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 10.220 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.111 W/kg

SAR(1 g) = 0.090 W/kg



0 dB = 0.0940 W/kg = -10.27 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20402

Communication System: UID 0, GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium: 1900 Head Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.395 \text{ S/m}$; $\epsilon_r = 38.966$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 04-22-2014; Ambient Temp: 24.5°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3333; ConvF(5.05, 5.05, 5.05); Calibrated: 11/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 11/19/2013

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797

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

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

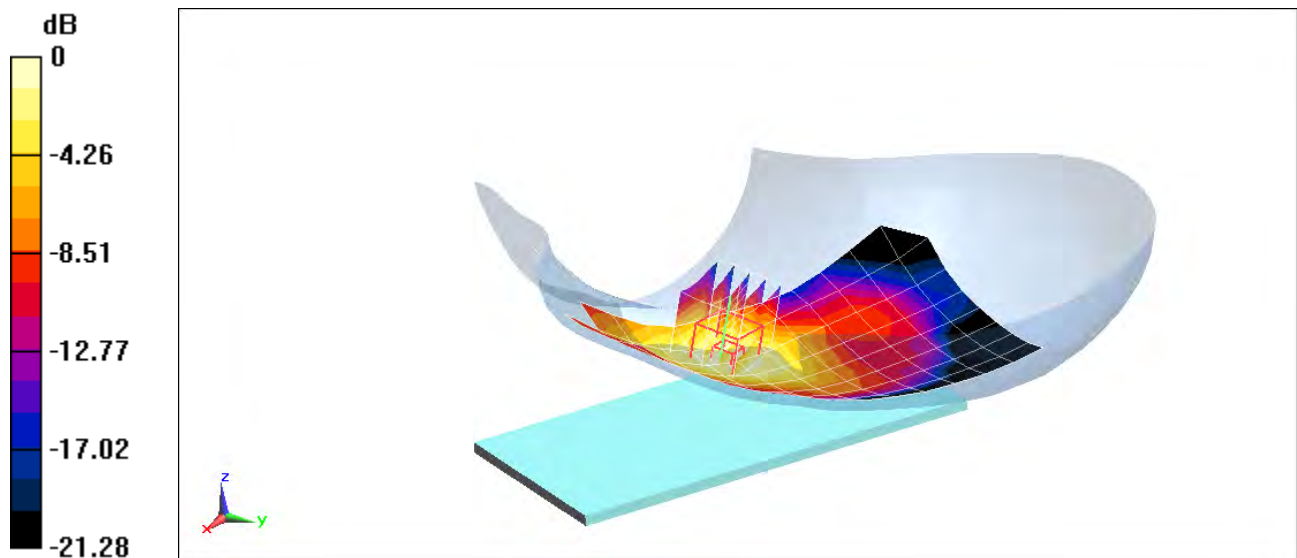
Area Scan (9x17x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 9.051 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.153 W/kg

SAR(1 g) = 0.107 W/kg



0 dB = 0.114 W/kg = -9.43 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20403

Communication System: UID 0, UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Head Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.414 \text{ S/m}$; $\epsilon_r = 40.039$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 04-28-2014; Ambient Temp: 23.9°C; Tissue Temp: 22.4°C

Probe: ES3DV3 - SN3258; ConvF(5.04, 5.04, 5.04); Calibrated: 2/25/2014;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: SAM Front; Type: SAM; Serial: 1686

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

Mode: UMTS 1900, Left Head, Tilt, Mid.ch

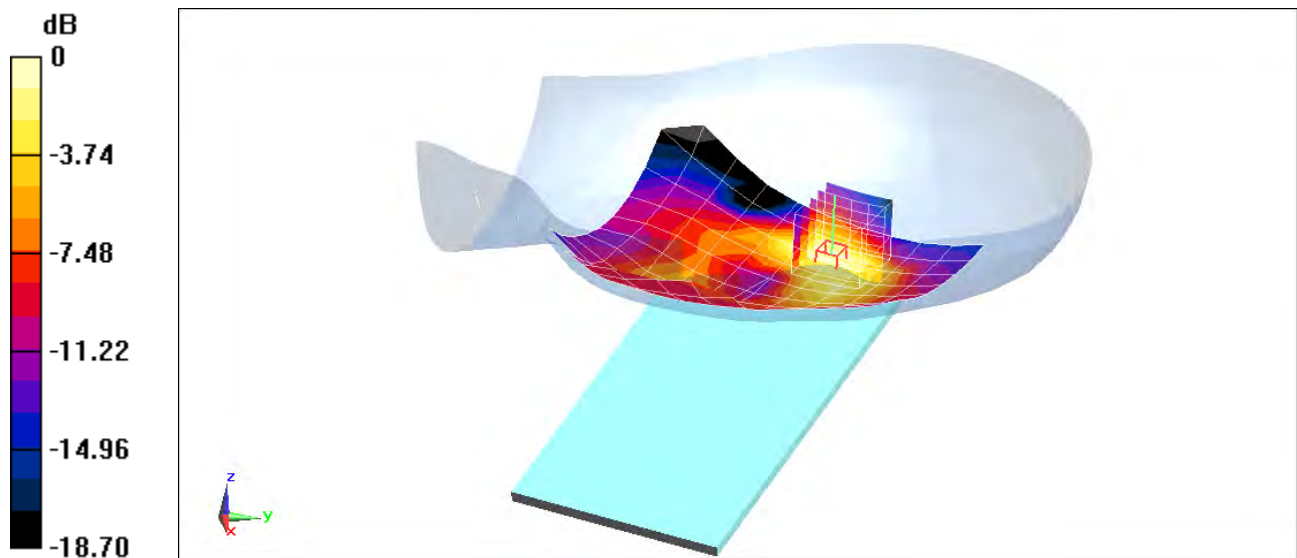
Area Scan (11x17x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 7.151 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 0.107 W/kg

SAR(1 g) = 0.066 W/kg



0 dB = 0.0676 W/kg = -11.70 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20402

Communication System: UID 0, IEEE 802.11b; Frequency: 2462 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used (interpolated):

$f = 2462 \text{ MHz}$; $\sigma = 1.81 \text{ S/m}$; $\epsilon_r = 38.405$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 04-04-2014; Ambient Temp: 24.5°C; Tissue Temp: 22.6°C

Probe: ES3DV3 - SN3333; ConvF(4.42, 4.42, 4.42); Calibrated: 11/22/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 11/19/2013

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797

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

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

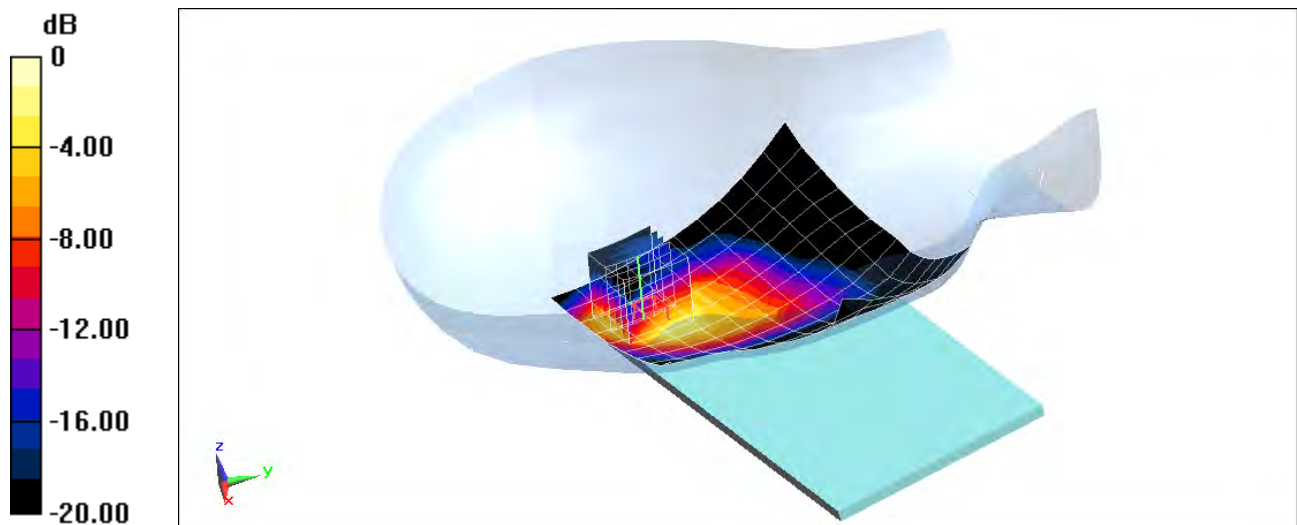
Area Scan (11x21x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 13.559 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 0.544 W/kg

SAR(1 g) = 0.296 W/kg



0 dB = 0.357 W/kg = -4.47 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20401

Communication System: UID 0, IEEE 802.11a; Frequency: 5825 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5825 \text{ MHz}$; $\sigma = 5.154 \text{ S/m}$; $\epsilon_r = 36.784$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 04-09-2014; Ambient Temp: 24.5°C; Tissue Temp: 23.5°C

Calibrated: 10/23/2013, ConvF(4.52, 4.52, 4.52); Calibrated: 10/23/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/19/2013

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

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

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

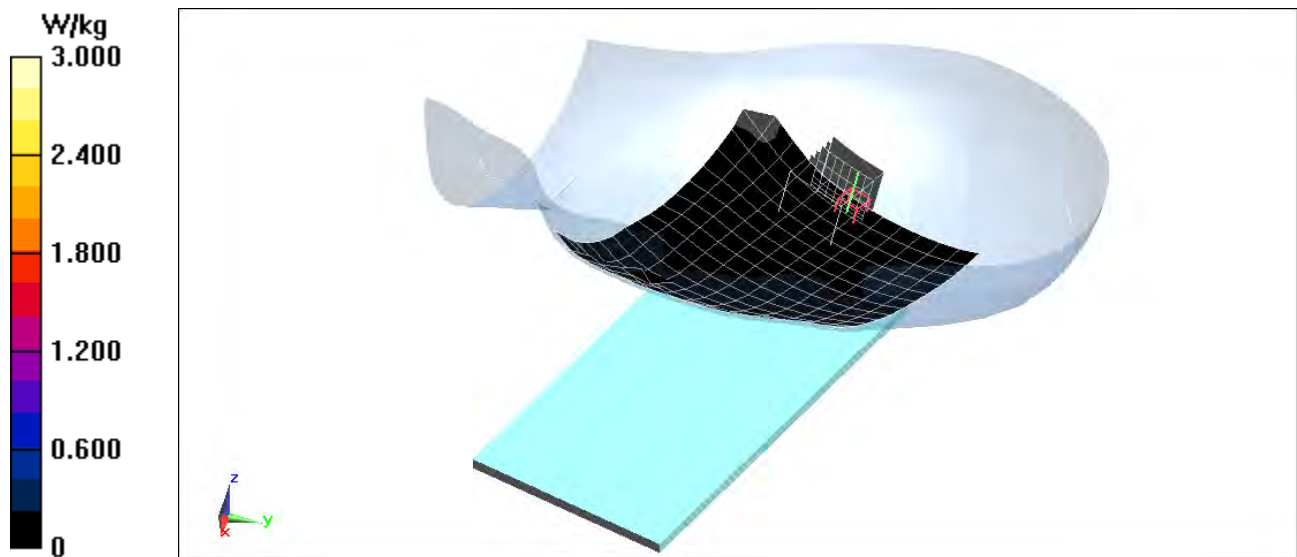
Area Scan (13x22x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Zoom Scan (8x9x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Reference Value = 0 V/m; Power Drift = 0.16 dB

Peak SAR (extrapolated) = 0.00420 W/kg

SAR(1 g) = 0.00 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20401

Communication System: UID 0, IEEE 802.11a; Frequency: 5180 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5180 \text{ MHz}$; $\sigma = 4.514 \text{ S/m}$; $\epsilon_r = 37.632$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 04-09-2014; Ambient Temp: 24.5°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3914; ConvF(4.99, 4.99, 4.99); Calibrated: 10/23/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/19/2013

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

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

Mode: IEEE 802.11a, 5.2 GHz, Left Head, Tilt, Ch 36, 6 Mbps

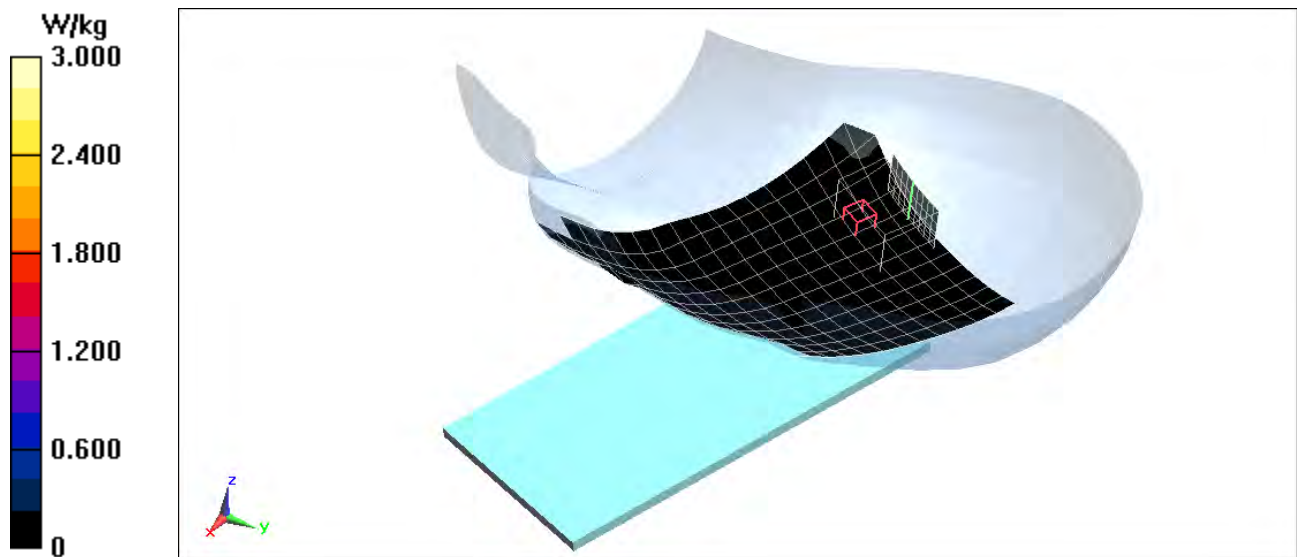
Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (10x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 0 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.00700 W/kg

SAR(1 g) = 0.00 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20402

Communication System: UID 0, GSM GPRS; 3 Tx slots; Frequency: 836.6 MHz; Duty Cycle: 1:2.76

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 1.007 \text{ S/m}$; $\epsilon_r = 54.053$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.5 cm

Test Date: 04-24-2014; Ambient Temp: 24.3°C; Tissue Temp: 22.7°C

Probe: ES3DV2 - SN3022; ConvF(5.91, 5.91, 5.91); Calibrated: 8/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687

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

Mode: GPRS 850, Body SAR, Left Edge, Mid.ch, 3 Tx Slots

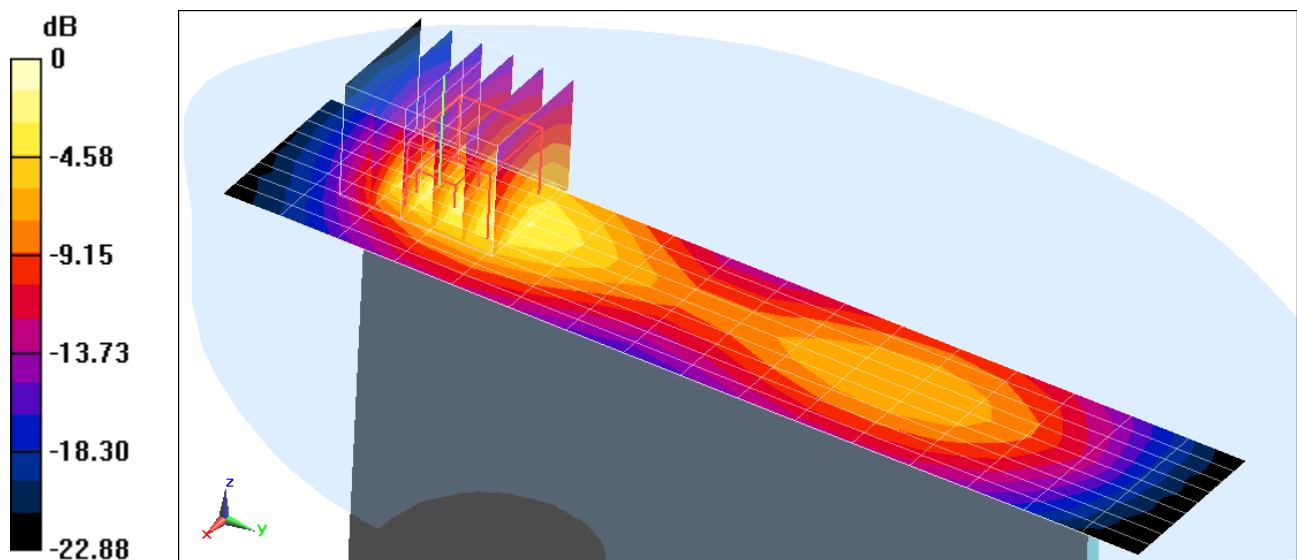
Area Scan (10x17x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 21.786 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 1.38 W/kg

SAR(1 g) = 0.493 W/kg



0 dB = 0.646 W/kg = -1.90 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20403

Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 1.013 \text{ S/m}$; $\epsilon_r = 54.104$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-21-2014; Ambient Temp: 23.3°C; Tissue Temp: 22.0°C

Probe: ES3DV2 - SN3022; ConvF(5.91, 5.91, 5.91); Calibrated: 8/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687

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

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

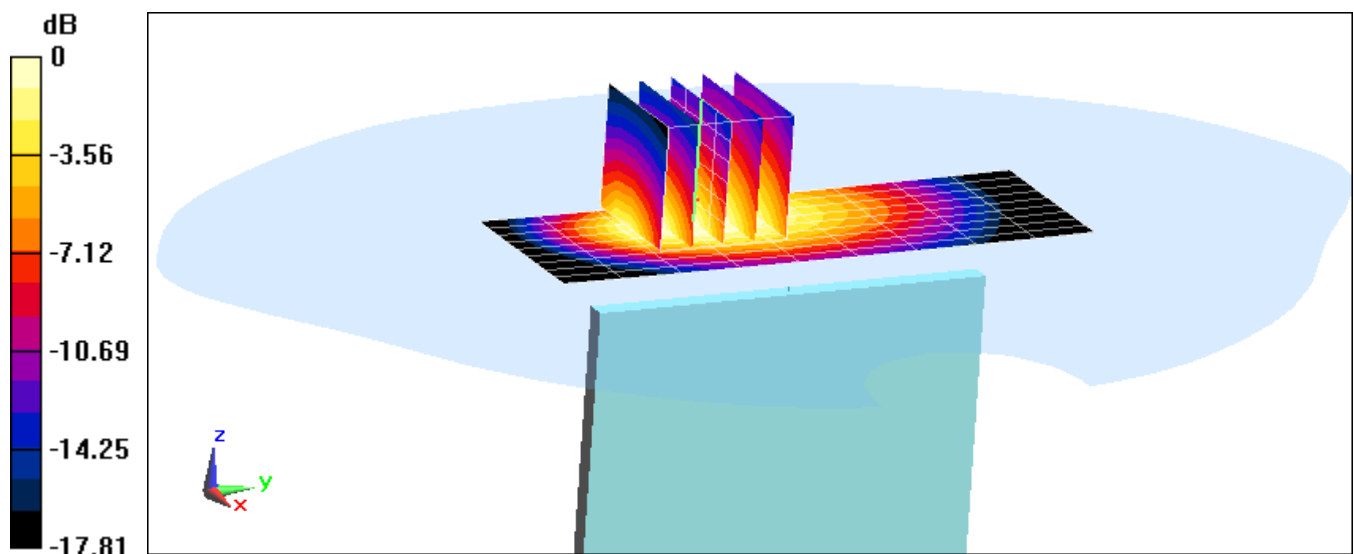
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 13.263 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.766 W/kg

SAR(1 g) = 0.467 W/kg



0 dB = 0.364 W/kg = -4.39 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 120501

Communication System: UID 0, GSM GPRS; 4 Tx slots; Frequency: 1909.8 MHz; Duty Cycle: 1:2.076

Medium: 1900 Body Medium parameters used:

$f = 1910 \text{ MHz}$; $\sigma = 1.551 \text{ S/m}$; $\epsilon_r = 52.643$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 05-14-2014; Ambient Temp: 24.0°C; Tissue Temp: 24.5°C

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

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

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

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

Mode: GPRS 1900, Body SAR, Back side, High.ch, 4 Tx Slots

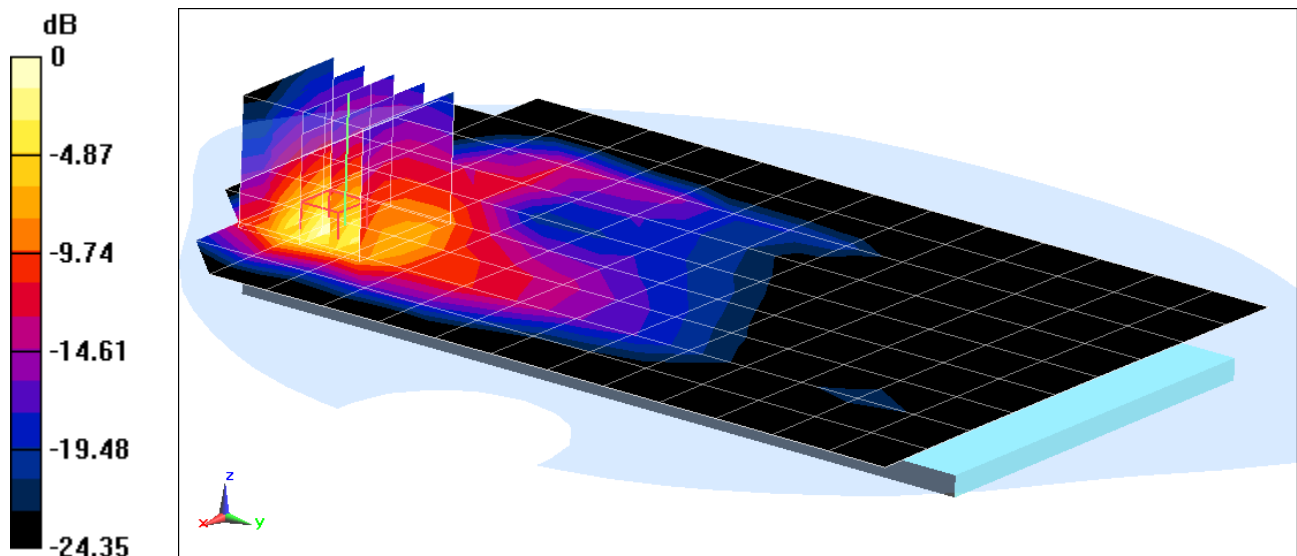
Area Scan (10x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 27.360 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 2.68 W/kg

SAR(1 g) = 1.09 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20405

Communication System: UID 0, UMTS; Frequency: 1852.4 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1852.4 \text{ MHz}$; $\sigma = 1.491 \text{ S/m}$; $\epsilon_r = 51.611$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 04-28-2014; Ambient Temp: 23.4°C; Tissue Temp: 23.1°C

Probe: EX3DV4 - SN3589; ConvF(6.54, 6.54, 6.54); Calibrated: 1/29/2014;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/22/2014

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

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

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

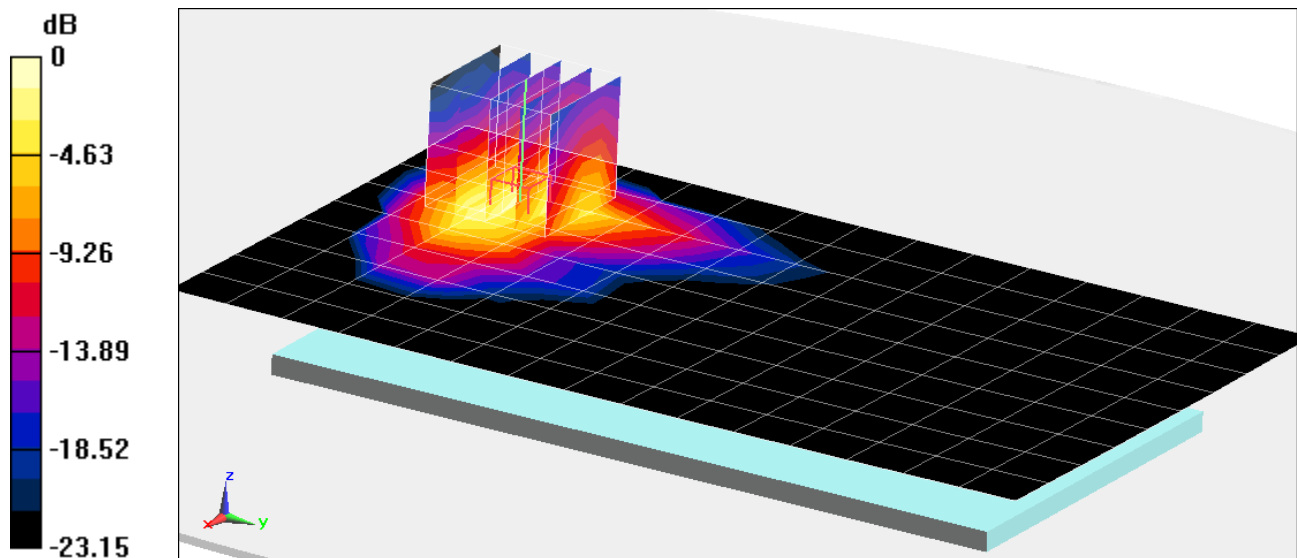
Area Scan (10x16x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 23.635 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 2.25 W/kg

SAR(1 g) = 0.984 W/kg



0 dB = 1.12 W/kg = 0.49 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20402

Communication System: UID 0, IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 2.02 \text{ S/m}$; $\epsilon_r = 52.023$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 04-02-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.4°C

Probe: ES3DV3 - SN3258; ConvF(4.14, 4.14, 4.14); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

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

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

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

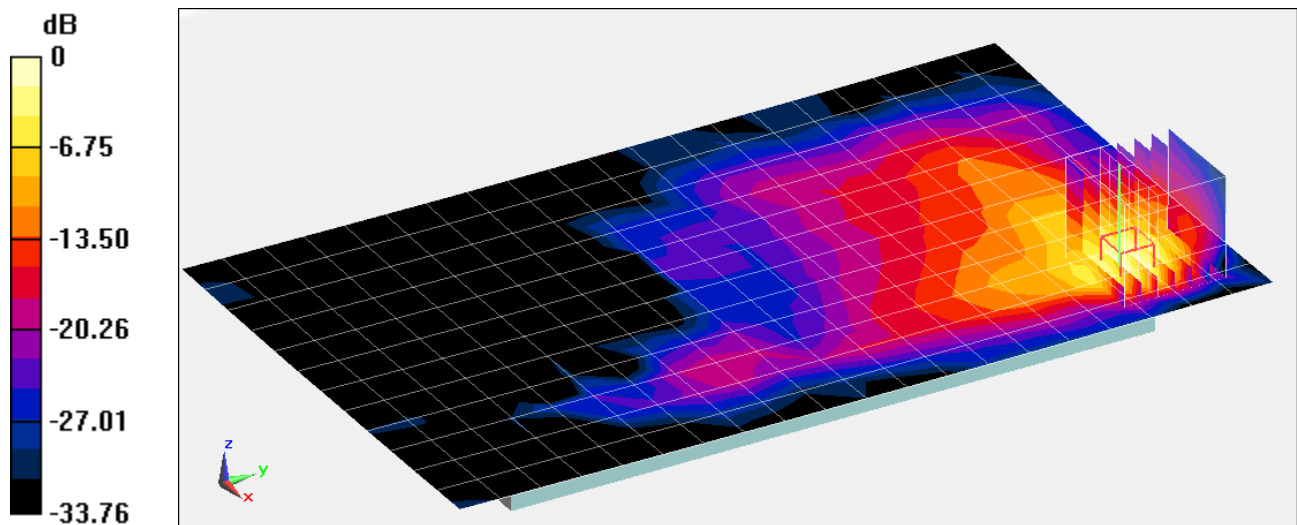
Area Scan (13x21x1): Measurement grid: dx=12mm, dy=12mm

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

Reference Value = 21.073 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 3.34 W/kg

SAR(1 g) = 0.955 W/kg



0 dB = 1.28 W/kg = 1.07 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20401

Communication System: UID 0, Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2441 \text{ MHz}$; $\sigma = 2.018 \text{ S/m}$; $\epsilon_r = 51.62$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 05-21-2014; Ambient Temp: 24.2°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3333; ConvF(4.22, 4.22, 4.22); Calibrated: 11/22/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 11/19/2013

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229

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

Mode: Bluetooth, Body SAR, Ch 39, 1 Mbps, Back Side

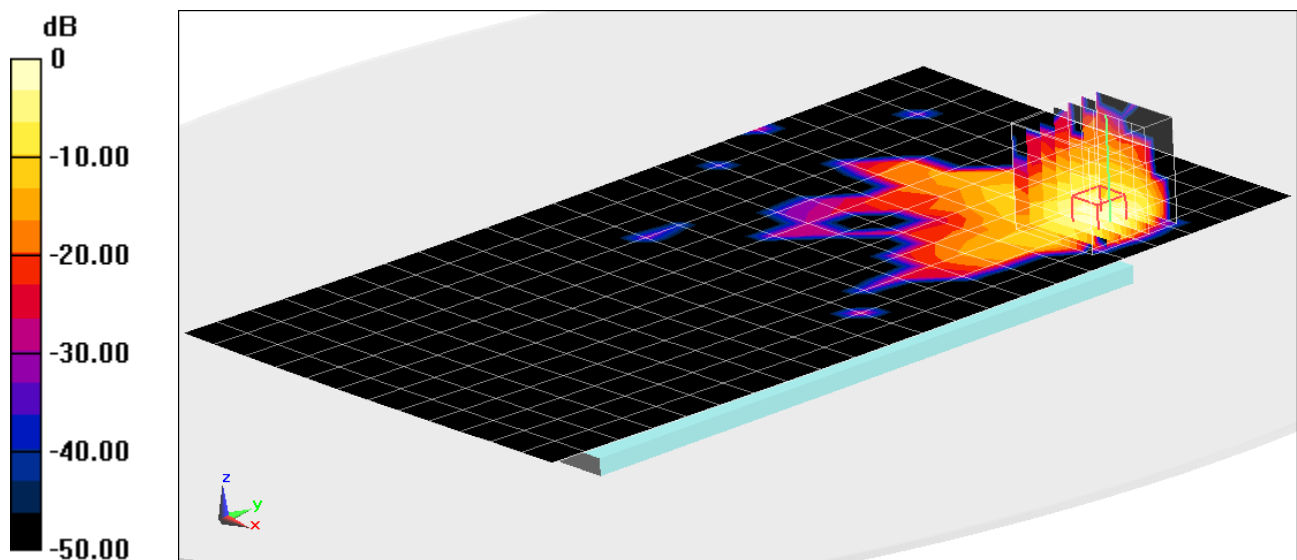
Area Scan (13x23x1): Measurement grid: dx=12mm, dy=12mm

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

Reference Value = 5.596 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 0.224 W/kg

SAR(1 g) = 0.063 W/kg



0 dB = 0.0945 W/kg = -10.25 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20401

Communication System: UID 0, IEEE 802.11a; Frequency: 5825 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5825 \text{ MHz}$; $\sigma = 6.285 \text{ S/m}$; $\epsilon_r = 45.807$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 04-09-2014; Ambient Temp: 23.4°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3920; ConvF(4, 4, 4); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

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

Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 165, 6 Mbps, Top Edge

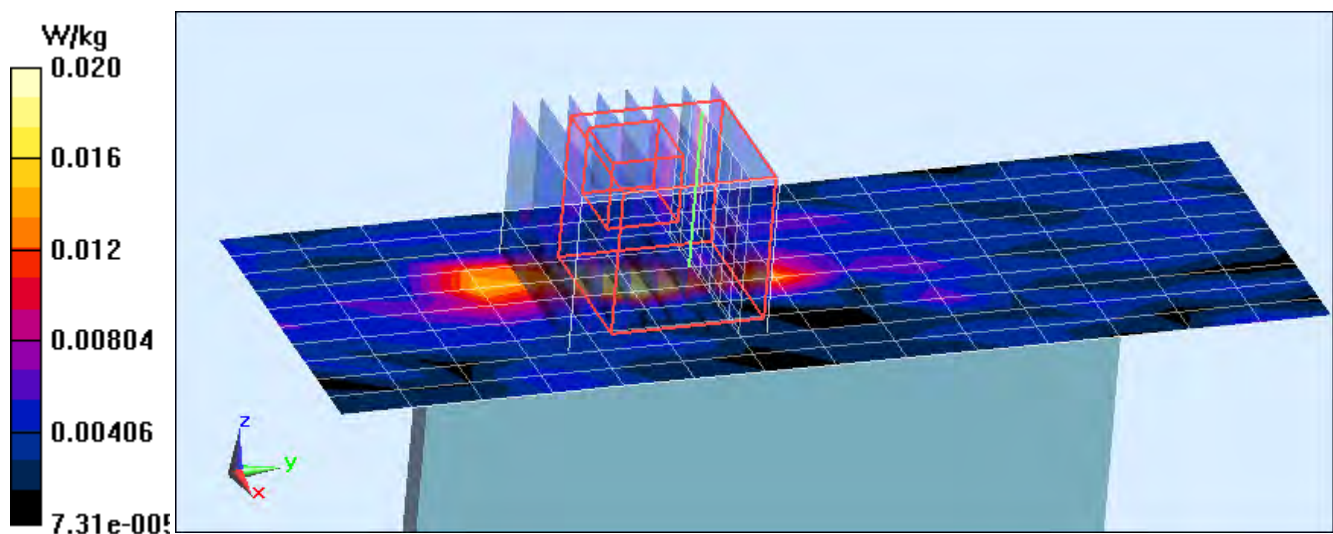
Area Scan (11x15x1): Measurement grid: dx=5mm, dy=10mm

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

Reference Value = 1.101 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 0.0180 W/kg

SAR(1 g) = 0.00573 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT2558; Type: Portable Tablet; Serial: 20401

Communication System: UID 0, IEEE 802.11a; Frequency: 5180 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5180 \text{ MHz}$; $\sigma = 5.421 \text{ S/m}$; $\epsilon_r = 46.996$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 04-09-2014; Ambient Temp: 23.5°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN3920; ConvF(4.23, 4.23, 4.23); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

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

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

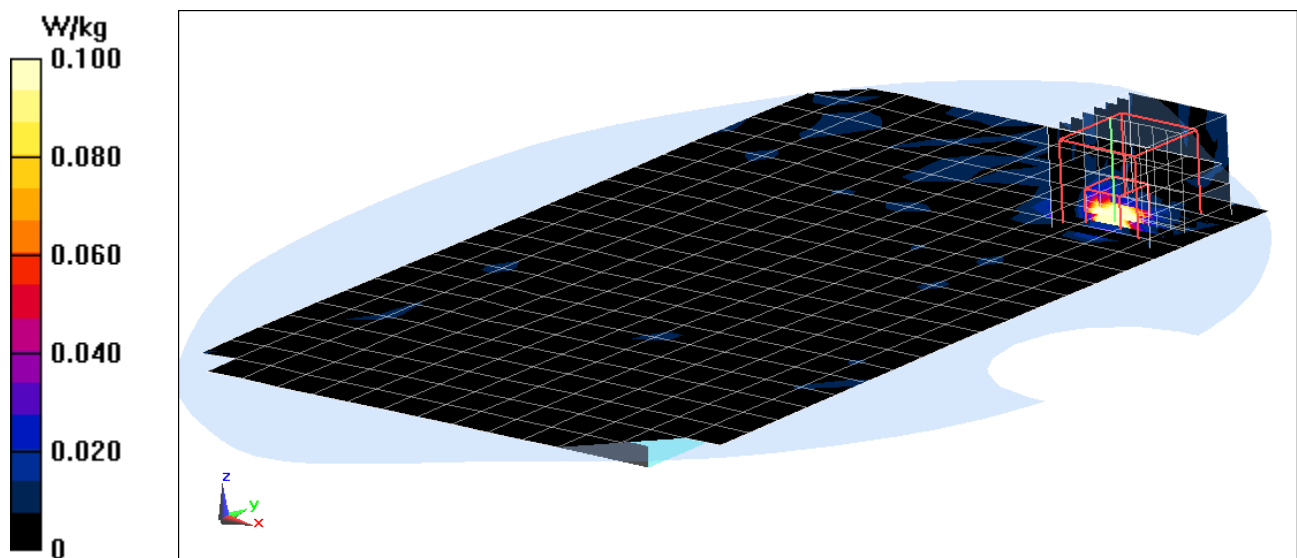
Area Scan (15x24x1): Measurement grid: dx=10mm, dy=10mm

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

Reference Value = 2.965 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.670 W/kg

SAR(1 g) = 0.105 W/kg



APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Head Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.9 \text{ S/m}$; $\epsilon_r = 39.901$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.5 cm

Test Date: 04-21-2014; Ambient Temp: 23.8°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3914; ConvF(9.34, 9.34, 9.34); Calibrated: 10/23/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/19/2013

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

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

835 MHz System Verification

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

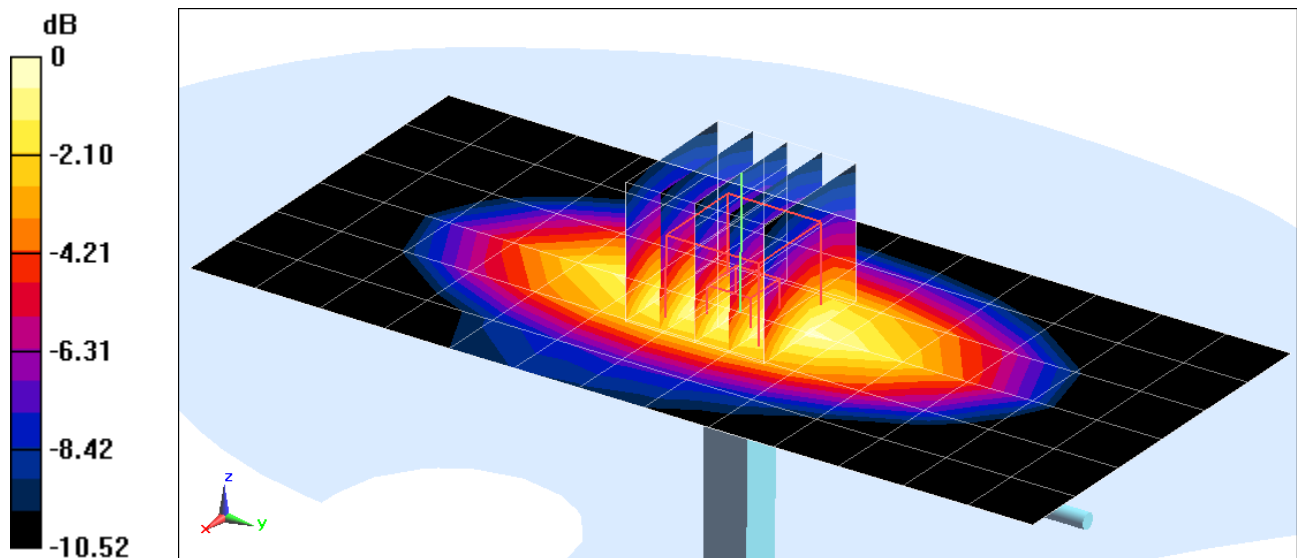
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.47 W/kg

SAR(1 g) = 0.985 W/kg

Deviation = 7.07%



PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Head Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.919 \text{ S/m}$; $\epsilon_r = 42.384$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.5 cm

Test Date: 04-24-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3914; ConvF(9.34, 9.34, 9.34); Calibrated: 10/23/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/19/2013

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

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

835 MHz System Verification

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

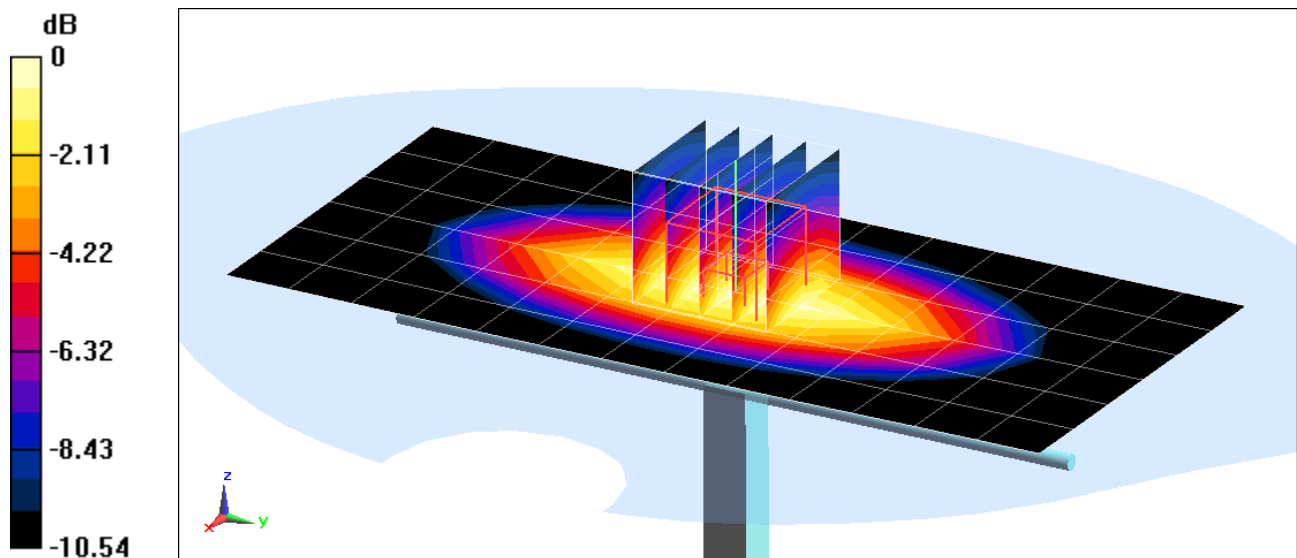
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.47 W/kg

SAR(1 g) = 0.982 W/kg

Deviation = 6.51%



PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.415 \text{ S/m}$; $\epsilon_r = 38.887$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-22-2014; Ambient Temp: 24.5°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3333; ConvF(5.05, 5.05, 5.05); Calibrated: 11/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 11/19/2013

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797

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

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm

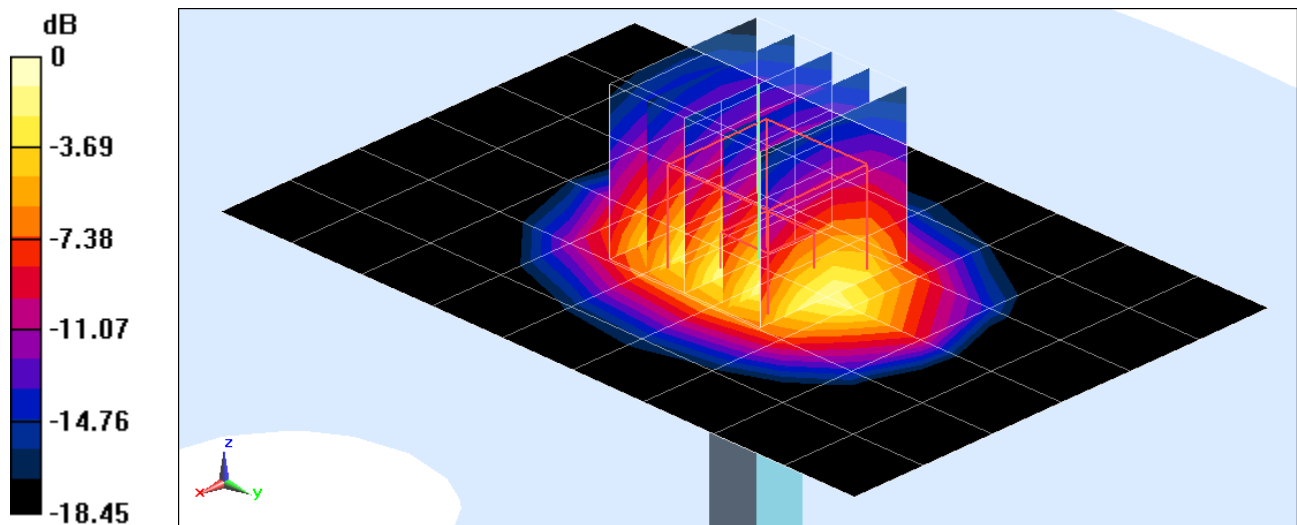
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.68 W/kg

SAR(1 g) = 4.08 W/kg

Deviation = 0.99%



0 dB = 4.52 W/kg = 6.55 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.433 \text{ S/m}$; $\epsilon_r = 39.961$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-28-2014; Ambient Temp: 23.9°C; Tissue Temp: 22.4°C

Probe: ES3DV3 - SN3258; ConvF(5.04, 5.04, 5.04); Calibrated: 2/25/2014;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: SAM Front; Type: SAM; Serial: 1686

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

1900 MHz System Verification

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

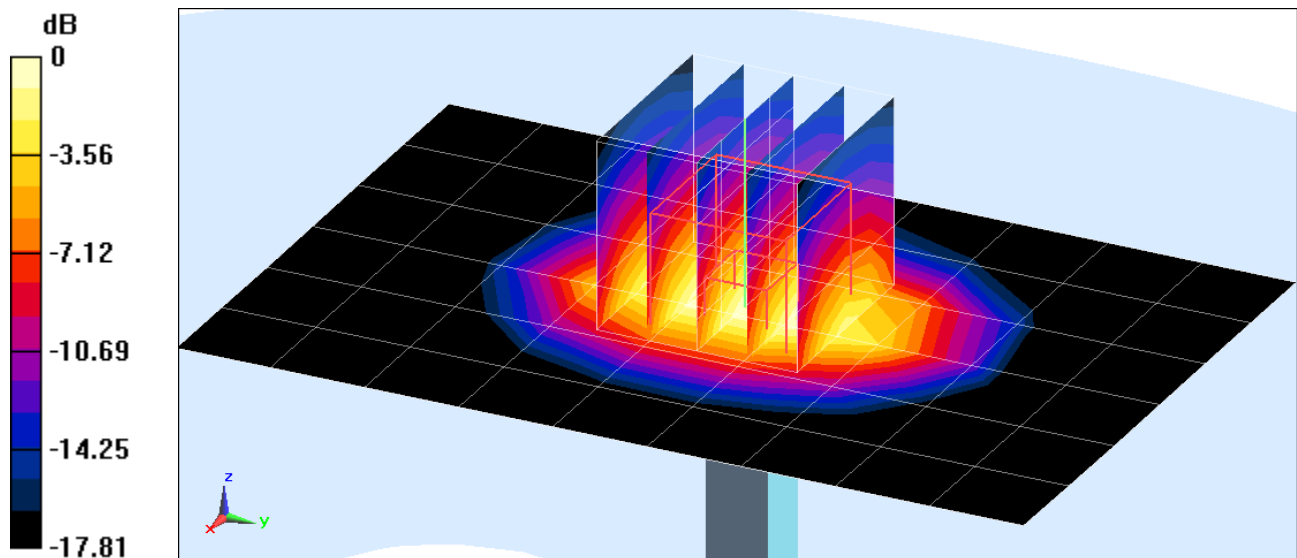
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.03 W/kg

SAR(1 g) = 3.76 W/kg

Deviation = -6.93%



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

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.797 \text{ S/m}$; $\epsilon_r = 38.447$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-04-2014; Ambient Temp: 24.5°C; Tissue Temp: 22.6°C

Probe: ES3DV3 - SN3333; ConvF(4.42, 4.42, 4.42); Calibrated: 11/22/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 11/19/2013

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797

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

2450 MHz System Verification

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm

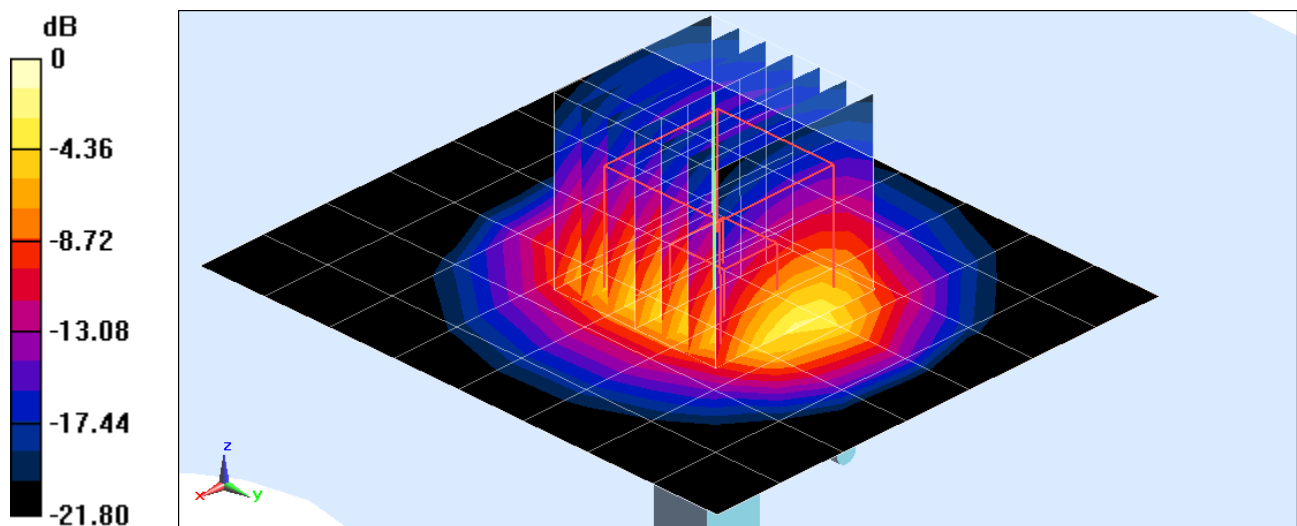
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Input Power = 16.0 dBm (40 mW)

Peak SAR (extrapolated) = 4.38 W/kg

SAR(1 g) = 2.13 W/kg

Deviation = 0.09%



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

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5200 \text{ MHz}$; $\sigma = 4.526 \text{ S/m}$; $\epsilon_r = 37.524$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-09-2014; Ambient Temp: 24.5°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3914; ConvF(4.99, 4.99, 4.99); Calibrated: 10/23/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/19/2013

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

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

5200 MHz System Verification

Area Scan (7x8x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

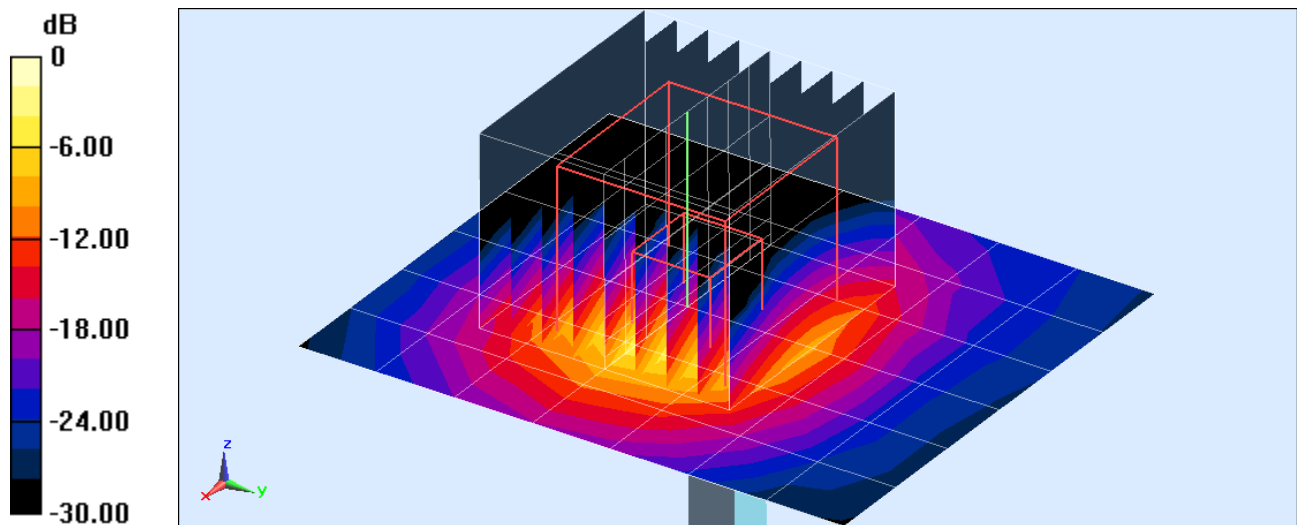
Zoom Scan (9x9x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 29.9 W/kg

SAR(1 g) = 7.14 W/kg

Deviation = -8.46%



0 dB = 17.1 W/kg = 12.33 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 4.626 \text{ S/m}$; $\epsilon_r = 37.422$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-09-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3914; ConvF(4.82, 4.82, 4.82); Calibrated: 10/23/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/19/2013

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

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

5300 MHz System Verification

Area Scan (7x8x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

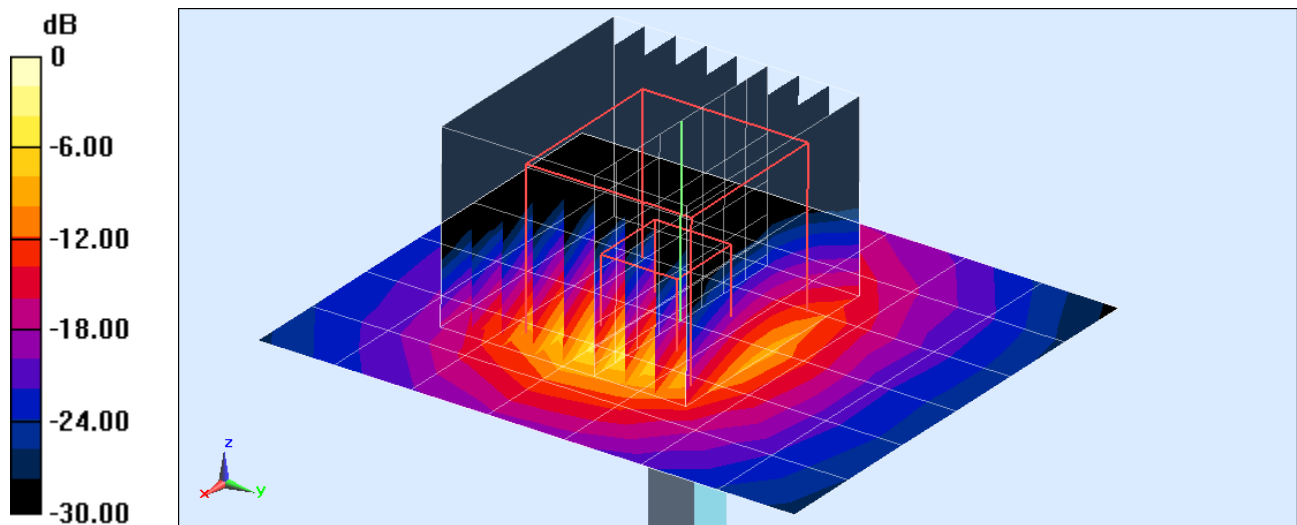
Zoom Scan (9x9x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 34.2 W/kg

SAR(1 g) = 7.9 W/kg

Deviation = -4.82%



0 dB = 19.7 W/kg = 12.94 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 4.932 \text{ S/m}$; $\epsilon_r = 37.033$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-09-2014; Ambient Temp: 24.5°C; Tissue Temp: 23.3°C

Probe: EX3DV4 - SN3914; ConvF(4.37, 4.37, 4.37); Calibrated: 10/23/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/19/2013

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

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

5600 MHz System Verification

Area Scan (7x8x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

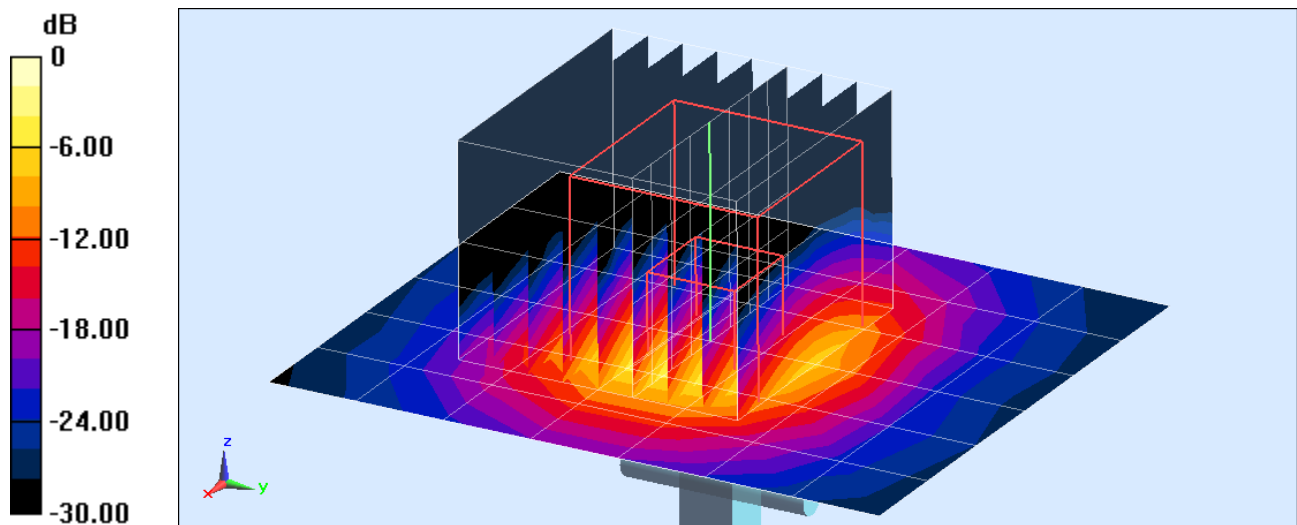
Zoom Scan (9x9x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 35.1 W/kg

SAR(1 g) = 7.89 W/kg

Deviation = -5.51%



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

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 5.141 \text{ S/m}$; $\epsilon_r = 36.799$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-09-2014; Ambient Temp: 24.5°C; Tissue Temp: 23.5°C

Probe: EX3DV4 - SN3914; ConvF(4.52, 4.52, 4.52); Calibrated: 10/23/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/19/2013

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

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

5800 MHz System Verification

Area Scan (7x8x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

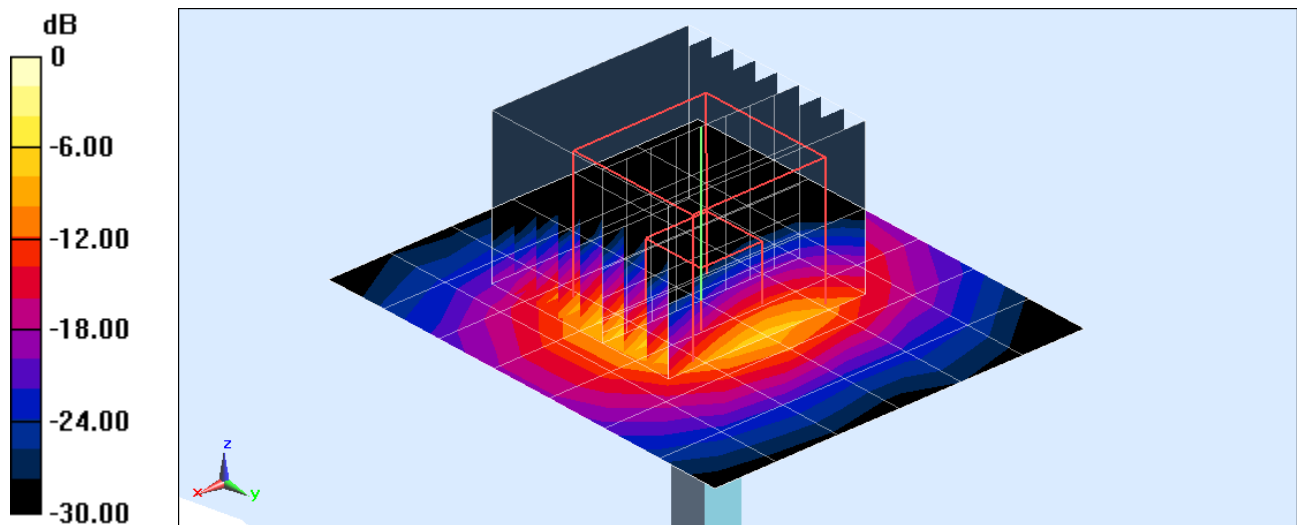
Zoom Scan (9x9x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 37.4 W/kg

SAR(1 g) = 8.12 W/kg

Deviation = 2.40%



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

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 1.012 \text{ S/m}$; $\epsilon_r = 54.122$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.5 cm

Test Date: 04-21-2014; Ambient Temp: 23.3°C; Tissue Temp: 22.0°C

Probe: ES3DV2 - SN3022; ConvF(5.91, 5.91, 5.91); Calibrated: 8/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687

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

835 MHz System Verification

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

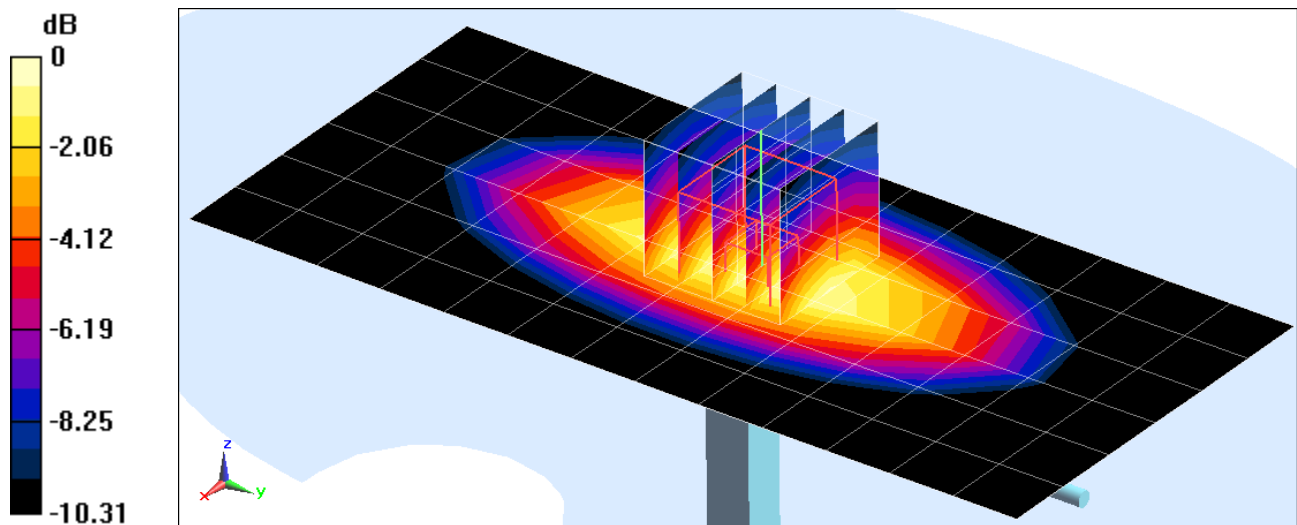
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.44 W/kg

SAR(1 g) = 0.998 W/kg

Deviation = 7.20%



0 dB = 1.08 W/kg = 0.33 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.545 \text{ S/m}$; $\epsilon_r = 51.424$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-28-2014; Ambient Temp: 23.4°C; Tissue Temp: 23.1°C

Probe: EX3DV4 - SN3589; ConvF(6.54, 6.54, 6.54); Calibrated: 1/29/2014;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/22/2014

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

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

1900 MHz System Verification

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

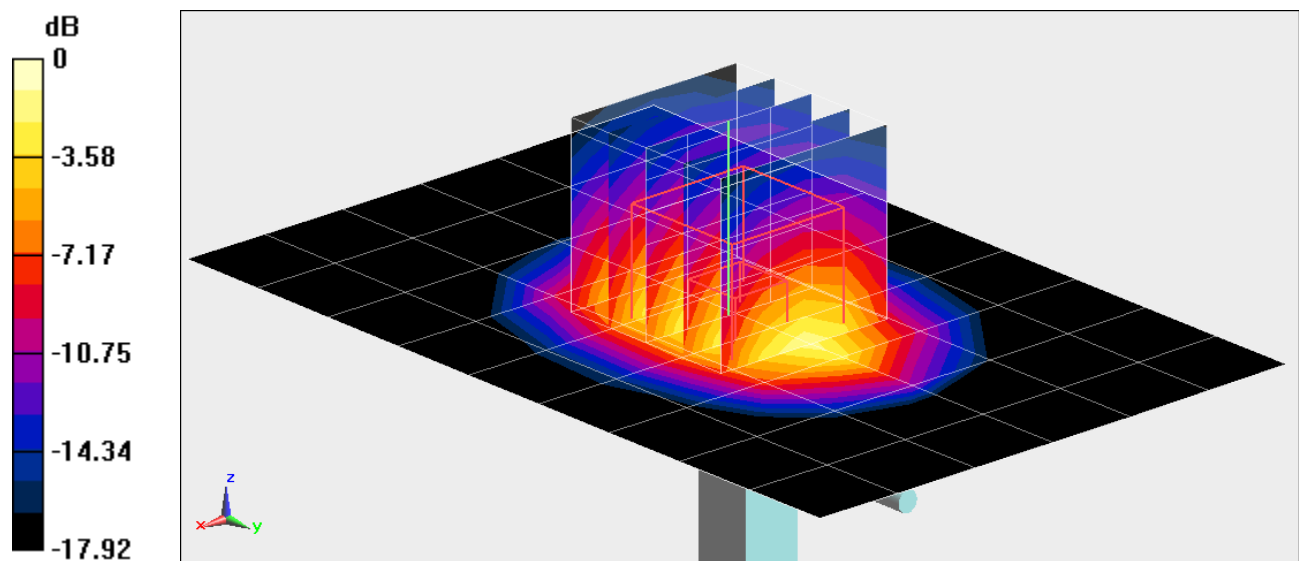
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.35 W/kg

SAR(1 g) = 3.97 W/kg

Deviation = -1.98%



0 dB = 4.44 W/kg = 6.47 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.54 \text{ S/m}$; $\epsilon_r = 52.665$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 05-14-2014; Ambient Temp: 24.0°C; Tissue Temp: 24.5°C

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

Sensor-Surface: 4mm (Mechanical Surface Detection)

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

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

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

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm

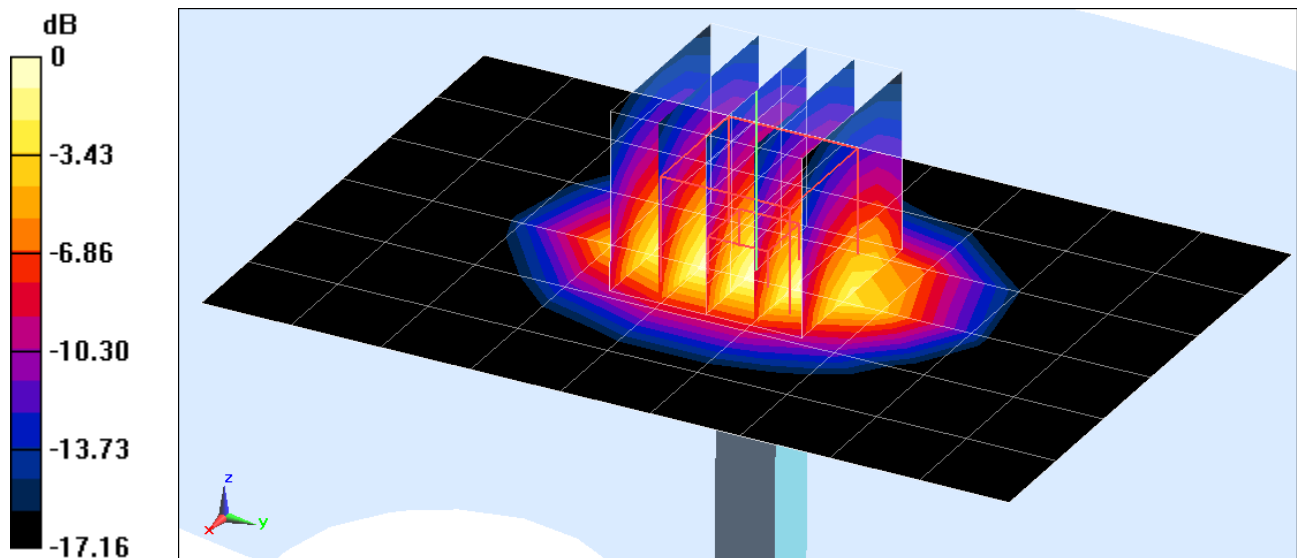
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.30 W/kg

SAR(1 g) = 4.07 W/kg

Deviation = 0.49%



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

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 2.038 \text{ S/m}$; $\epsilon_r = 51.977$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-02-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.4°C

Probe: ES3DV3 - SN3258; ConvF(4.14, 4.14, 4.14); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

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

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

2450 MHz System Verification

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

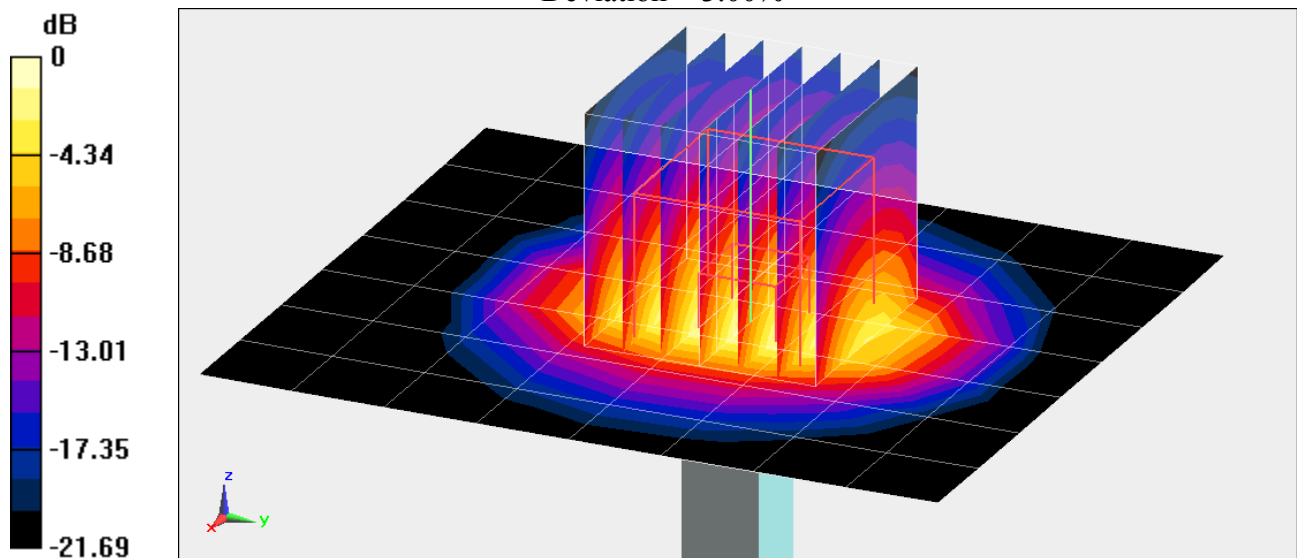
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power = 16.0 dBm (100 mW)

Peak SAR (extrapolated) = 4.46 W/kg

SAR(1 g) = 2.13 W/kg

Deviation = 3.00%



0 dB = 2.78 W/kg = 4.44 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 2.03 \text{ S/m}$; $\epsilon_r = 51.586$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 05-21-2014; Ambient Temp: 24.2°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3333; ConvF(4.22, 4.22, 4.22); Calibrated: 11/22/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 11/19/2013

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229

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

2450 MHz System Verification

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

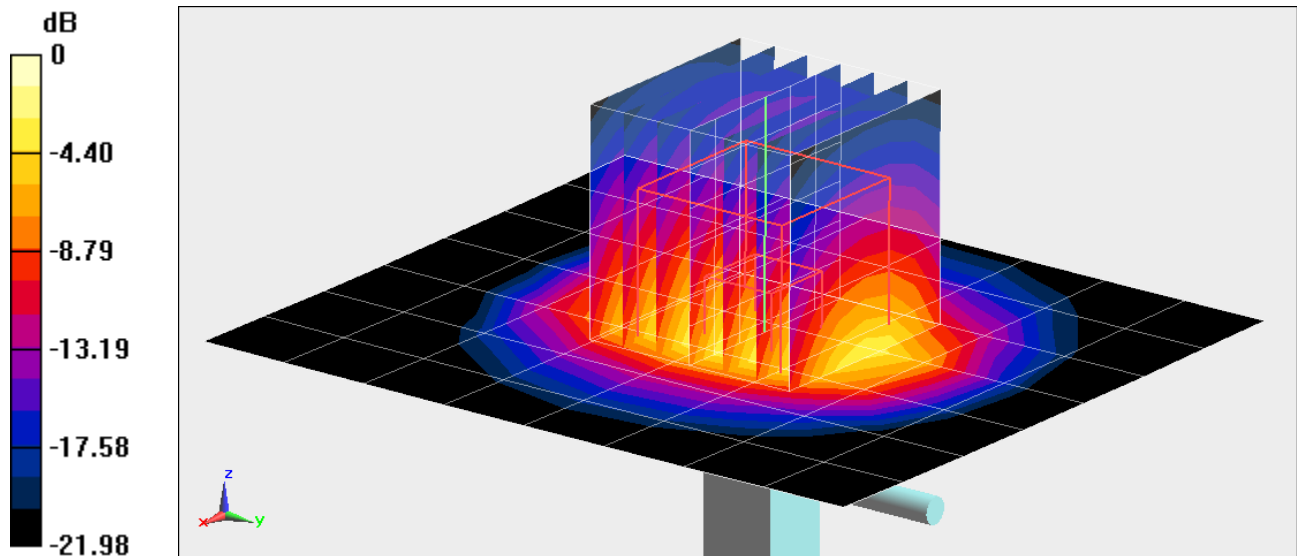
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 11.8 W/kg

SAR(1 g) = 5.44 W/kg

Deviation = 5.22%



0 dB = 7.09 W/kg = 8.51 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5200 \text{ MHz}$; $\sigma = 5.462 \text{ S/m}$; $\epsilon_r = 46.941$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-09-2014; Ambient Temp: 23.5°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN3920; ConvF(4.23, 4.23, 4.23); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

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

5200 MHz System Verification

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

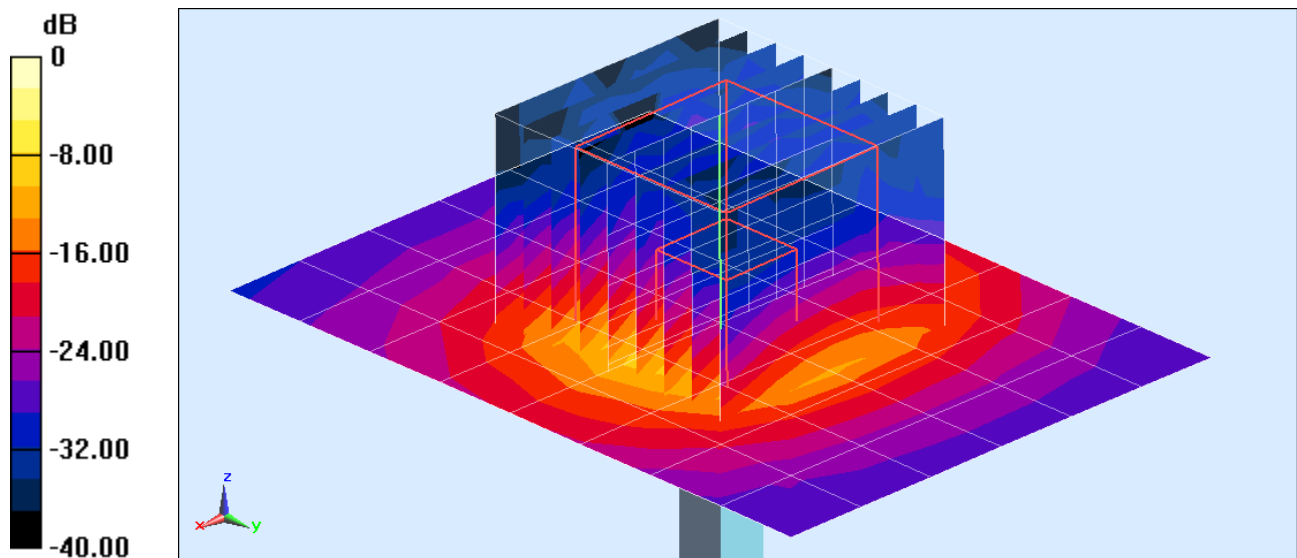
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 29.7 W/kg

SAR(1 g) = 7.04 W/kg

Deviation = -3.03%



0 dB = 18.0 W/kg = 12.55 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 5.586 \text{ S/m}$; $\epsilon_r = 46.756$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-09-2014; Ambient Temp: 23.5°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN3920; ConvF(4.11, 4.11, 4.11); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

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

5300 MHz System Verification

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

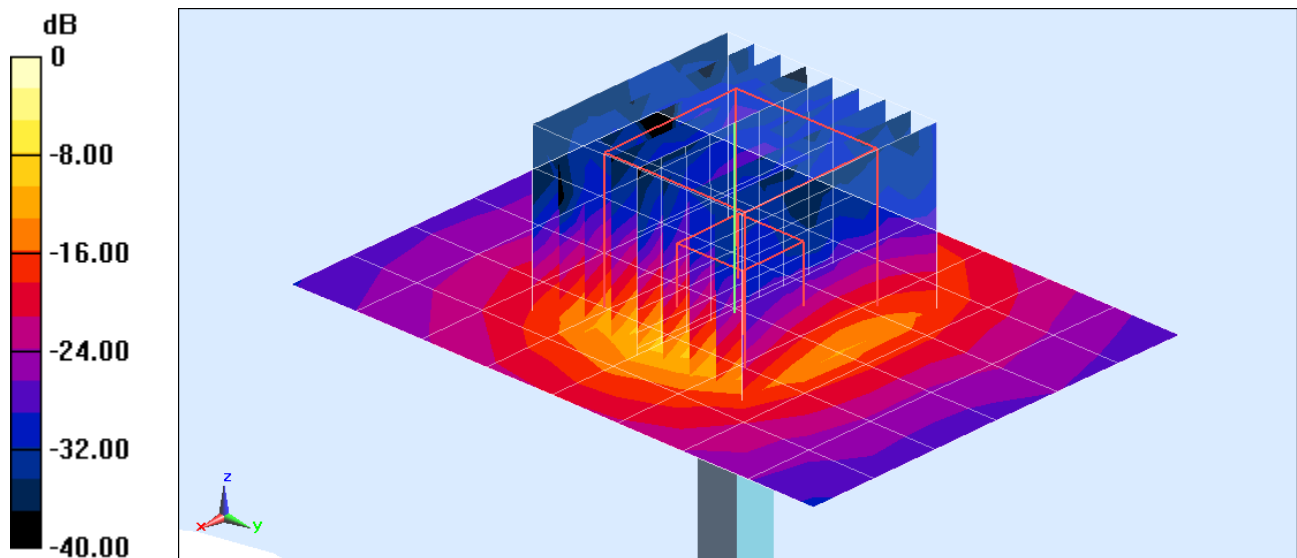
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 31.4 W/kg

SAR(1 g) = 7.41 W/kg

Deviation = -0.80%



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

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.987 \text{ S/m}$; $\epsilon_r = 46.154$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-09-2014; Ambient Temp: 23.4°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3920; ConvF(3.62, 3.62, 3.62); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

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

5600 MHz System Verification

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

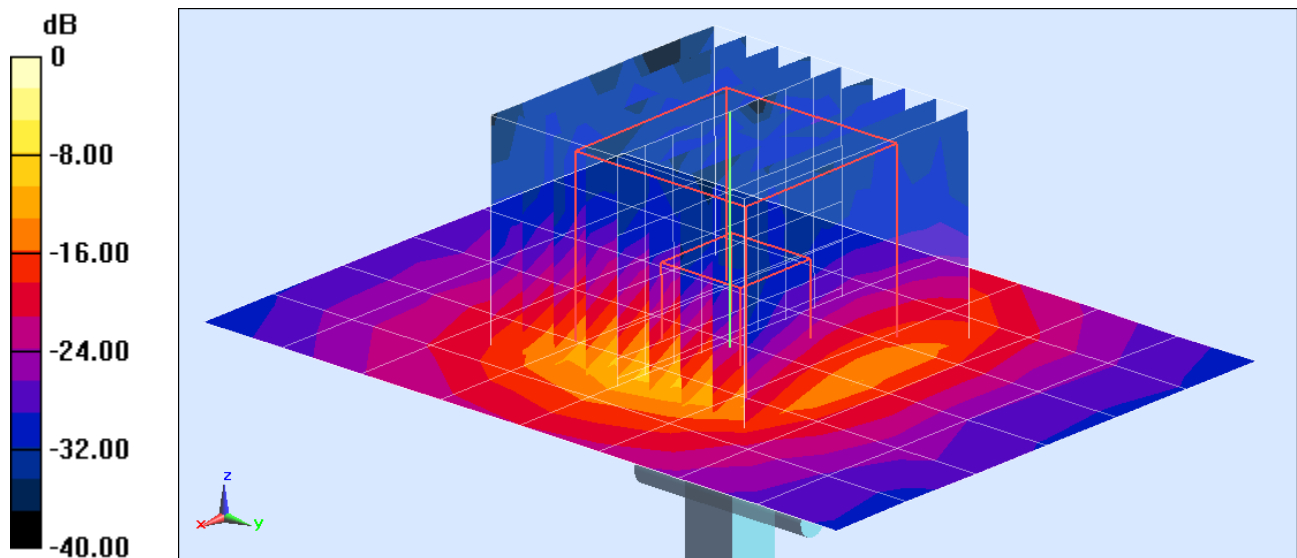
Zoom Scan (9x9x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 37.1 W/kg

SAR(1 g) = 8.05 W/kg

Deviation = 4.14%



PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 6.257 \text{ S/m}$; $\epsilon_r = 45.808$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-09-2014; Ambient Temp: 23.4°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3920; ConvF(4, 4, 4); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

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

5800 MHz System Verification

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

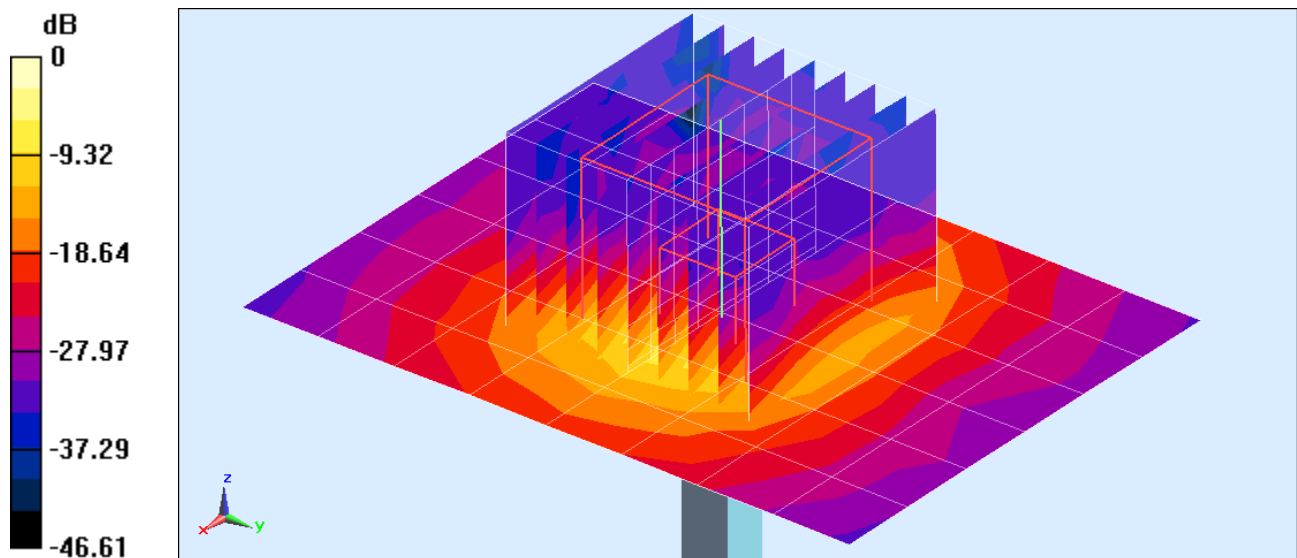
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 34.6 W/kg

SAR(1 g) = 7.32 W/kg

Deviation = 0.41%



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

APPENDIX C: PROBE CALIBRATION



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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3022_Aug13**

CALIBRATION CERTIFICATE

Object **ES3DV2 - SN:3022**

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

Calibration date: **August 22, 2013**

UTC
9/13/13

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: August 23, 2013			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the 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}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV2

SN:3022

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

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.00	1.04	0.99	± 10.1 %
DCP (mV) ^B	100.7	97.4	99.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	178.6	±3.0 %
		Y	0.0	0.0	1.0		141.9	
		Z	0.0	0.0	1.0		134.7	

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

^A The uncertainties of NormX,Y,Z do not affect the 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: ES3DV2 - SN:3022

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.21	6.21	6.21	0.19	2.37	± 12.0 %
835	41.5	0.90	6.09	6.09	6.09	0.30	1.70	± 12.0 %
1750	40.1	1.37	5.19	5.19	5.19	0.65	1.23	± 12.0 %
1900	40.0	1.40	5.03	5.03	5.03	0.51	1.43	± 12.0 %
2450	39.2	1.80	4.36	4.36	4.36	0.51	1.51	± 12.0 %
2600	39.0	1.96	4.16	4.16	4.16	0.74	1.29	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

Calibration Parameter Determined in Body Tissue Simulating Media

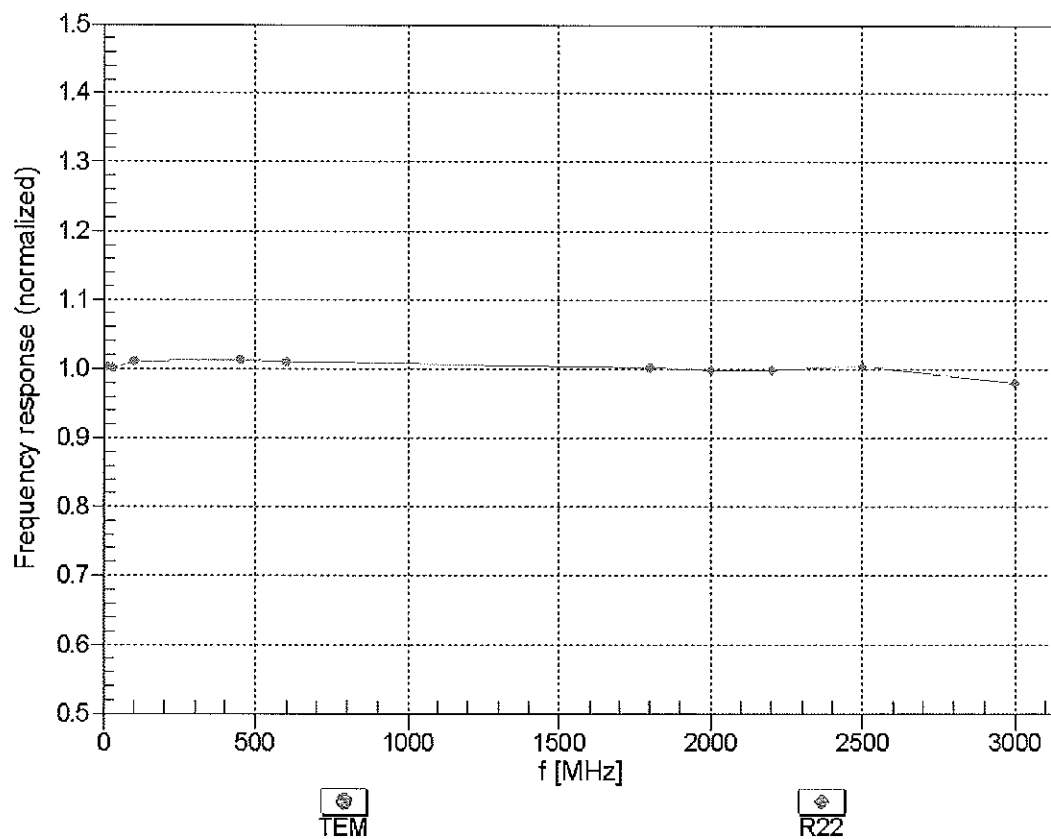
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	5.92	5.92	5.92	0.24	1.99	± 12.0 %
835	55.2	0.97	5.91	5.91	5.91	0.29	1.85	± 12.0 %
1750	53.4	1.49	4.75	4.75	4.75	0.52	1.52	± 12.0 %
1900	53.3	1.52	4.49	4.49	4.49	0.49	1.56	± 12.0 %
2450	52.7	1.95	4.01	4.01	4.01	0.70	1.02	± 12.0 %
2600	52.5	2.16	3.85	3.85	3.85	0.58	0.90	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

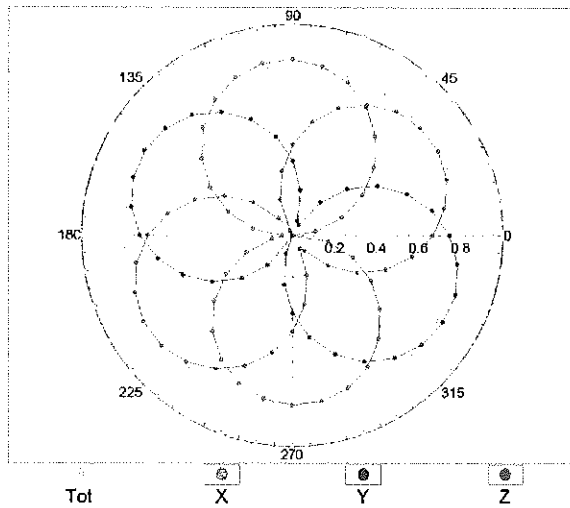
(TEM-Cell:ifi110 EXX, Waveguide: R22)



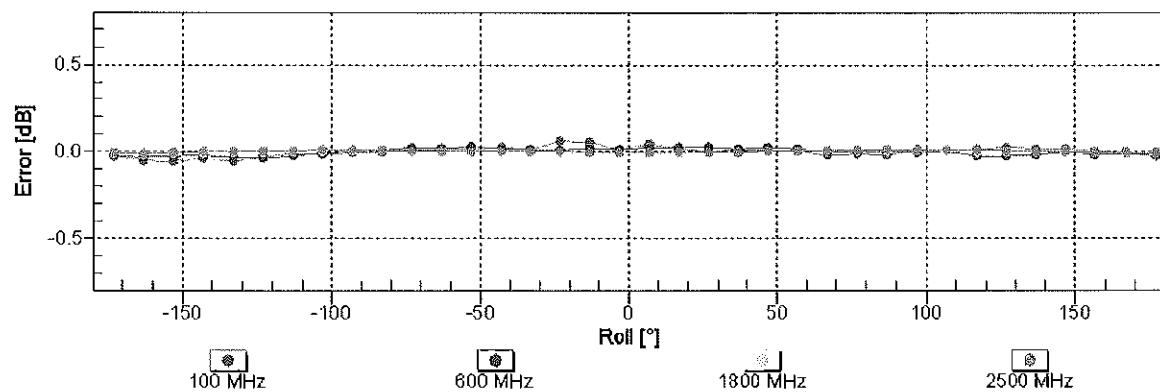
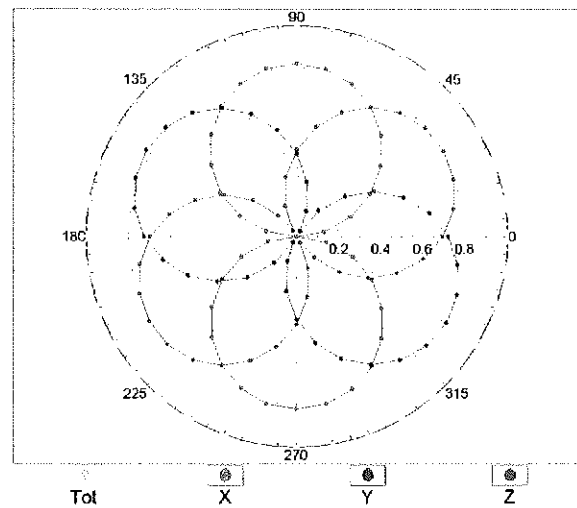
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$

f=600 MHz,TEM

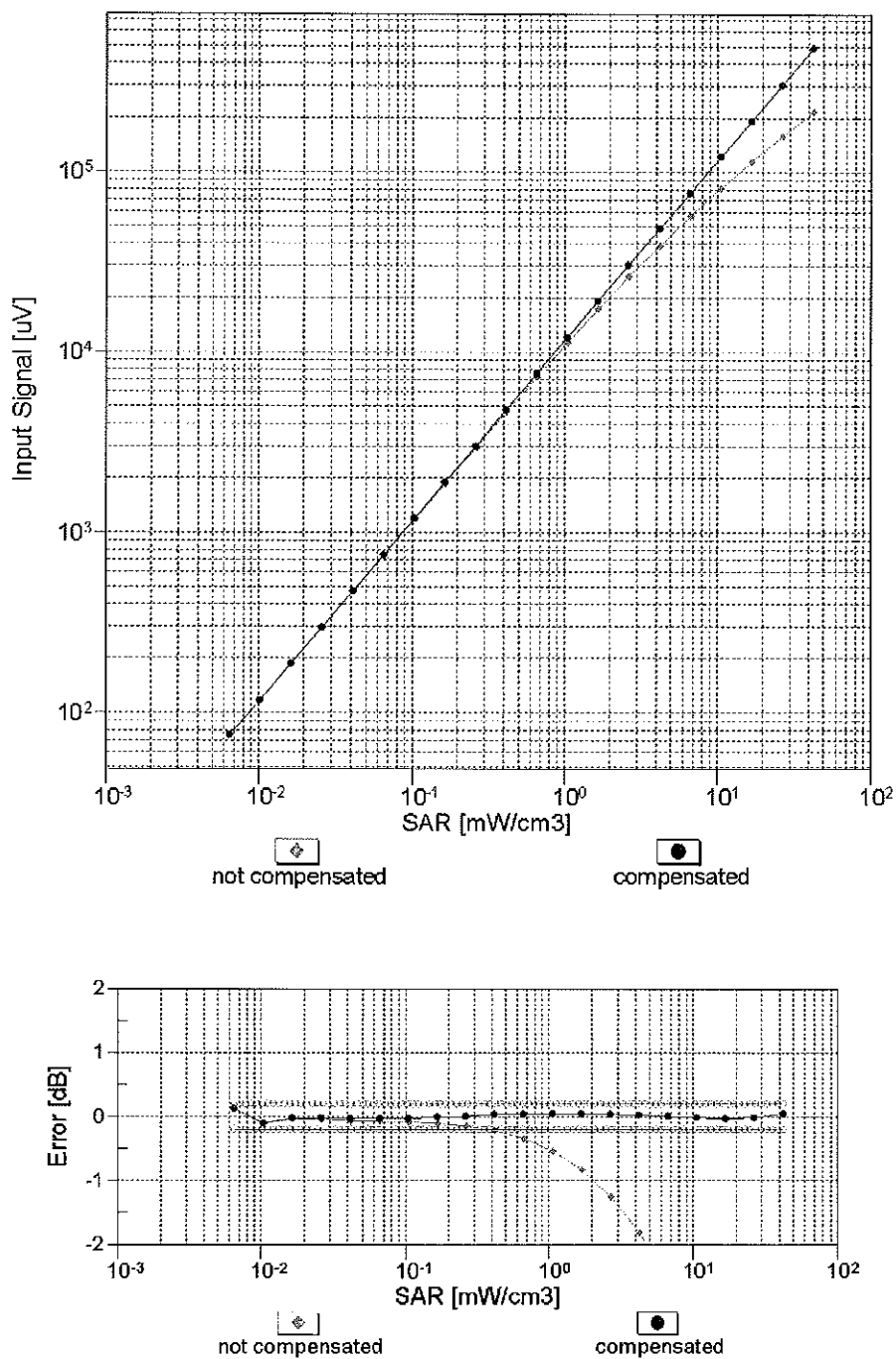


f=1800 MHz,R22



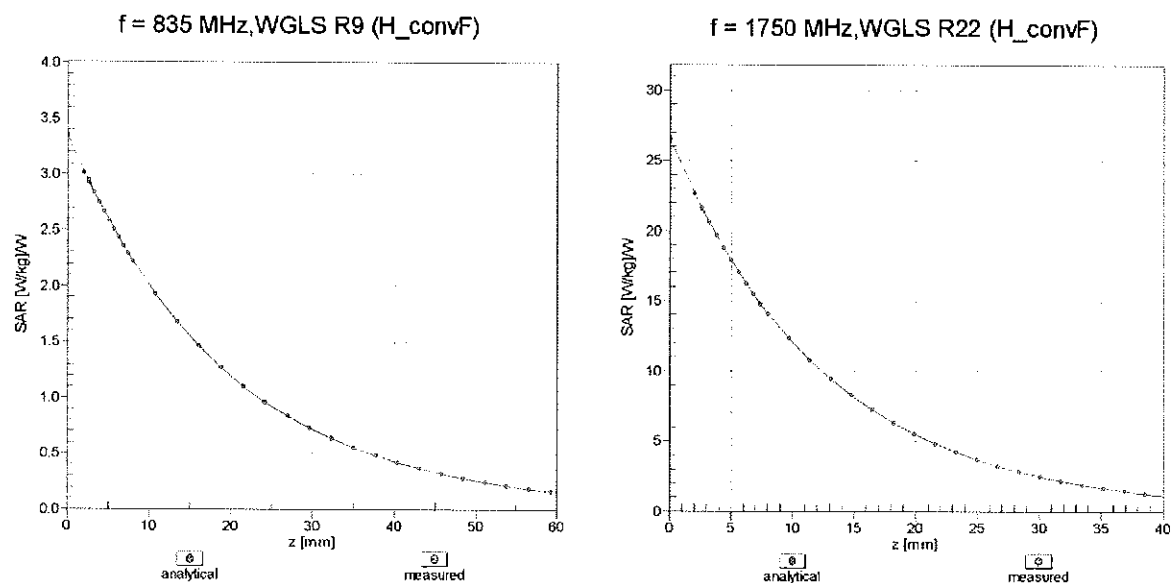
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



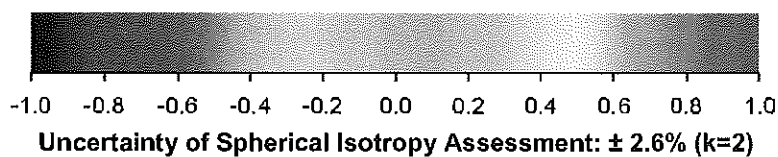
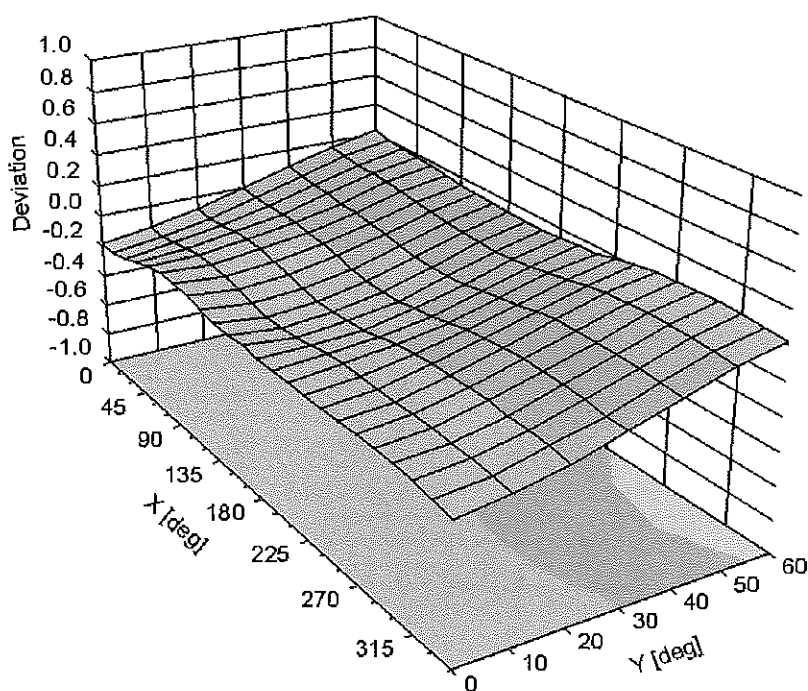
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

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 (°)	-83.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **EX3-3914_Oct13**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3914**

Calibration procedure(s) **QA CAL-01 v3, QA CAL-14 v4, QA CAL-23 v5, QA CAL-25 v6**
 Calibration procedure for dosimetric E-field probes

Calibration date: **October 23, 2013**

VCC
 11/20/2013

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: October 25, 2013

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

PCT # 81072



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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, D	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}; A, B, C, D** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe EX3DV4

SN:3914

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

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

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

Basic Calibration Parameters

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

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	158.3	$\pm 3.0 \%$
		Y	0.0	0.0	1.0		154.6	
		Z	0.0	0.0	1.0		170.8	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	0.71	53.3	6.1	10.00	48.4	$\pm 2.5 \%$
		Y	2.43	67.0	13.8		39.9	
		Z	4.18	68.7	13.8		45.7	
10011-CAA	UMTS-FDD (WCDMA)	X	3.05	64.4	16.5	2.91	122.4	$\pm 0.5 \%$
		Y	3.31	66.5	18.2		123.5	
		Z	3.34	66.3	17.8		136.6	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.49	64.8	16.1	1.87	120.6	$\pm 0.5 \%$
		Y	2.94	68.6	18.7		123.6	
		Z	2.63	65.9	17.0		135.4	
10021-DAA	GSM-FDD (TDMA, GMSK)	X	1.52	61.5	10.9	9.39	83.6	$\pm 1.2 \%$
		Y	2.22	67.4	15.0		116.0	
		Z	2.47	66.8	14.7		95.9	
10023-DAA	GPRS-FDD (TDMA, GMSK, TN 0)	X	1.73	63.3	11.9	9.57	81.5	$\pm 1.7 \%$
		Y	2.11	66.2	14.2		111.8	
		Z	2.76	69.0	16.0		93.6	
10024-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	1.34	62.1	9.4	6.56	121.0	$\pm 1.2 \%$
		Y	4.24	78.6	17.9		130.0	
		Z	2.91	70.7	14.9		141.4	
10027-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	1.25	63.5	9.7	4.80	143.5	$\pm 1.4 \%$
		Y	1.59	66.9	12.2		149.7	
		Z	2.98	71.5	14.0		123.3	
10028-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	0.51	58.3	7.4	3.55	113.4	$\pm 1.2 \%$
		Y	25.43	100.0	22.6		121.3	
		Z	38.67	97.5	20.6		133.3	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	0.28	58.6	5.3	1.16	134.7	$\pm 0.9 \%$
		Y	65.75	99.6	18.6		141.3	
		Z	0.20	55.6	4.1		112.1	
10039-CAA	CDMA2000 (1xRTT, RC1)	X	4.33	64.6	17.4	4.57	113.8	$\pm 0.7 \%$
		Y	4.55	66.0	18.6		120.8	
		Z	4.85	66.2	18.4		135.9	
10062-CAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	9.83	67.6	20.7	8.68	109.0	$\pm 2.5 \%$
		Y	10.06	68.4	21.5		118.2	
		Z	10.66	69.2	21.7		134.0	

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

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

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

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	9.70	9.70	9.70	0.34	1.01	± 12.0 %
835	41.5	0.90	9.34	9.34	9.34	0.67	0.67	± 12.0 %
1750	40.1	1.37	7.99	7.99	7.99	0.79	0.56	± 12.0 %
1900	40.0	1.40	7.69	7.69	7.69	0.80	0.58	± 12.0 %
2450	39.2	1.80	6.95	6.95	6.95	0.41	0.77	± 12.0 %
2600	39.0	1.96	6.79	6.79	6.79	0.40	0.82	± 12.0 %
5200	36.0	4.66	4.99	4.99	4.99	0.30	1.80	± 13.1 %
5300	35.9	4.76	4.82	4.82	4.82	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.55	4.55	4.55	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.37	4.37	4.37	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.52	4.52	4.52	0.35	1.80	± 13.1 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	9.39	9.39	9.39	0.63	0.74	± 12.0 %
835	55.2	0.97	9.31	9.31	9.31	0.56	0.76	± 12.0 %
1750	53.4	1.49	7.89	7.89	7.89	0.32	1.03	± 12.0 %
1900	53.3	1.52	7.51	7.51	7.51	0.51	0.76	± 12.0 %
2450	52.7	1.95	7.02	7.02	7.02	0.80	0.50	± 12.0 %
2600	52.5	2.16	6.81	6.81	6.81	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.52	4.52	4.52	0.35	1.90	± 13.1 %
5300	48.9	5.42	4.32	4.32	4.32	0.35	1.90	± 13.1 %
5500	48.6	5.65	4.07	4.07	4.07	0.35	1.90	± 13.1 %
5600	48.5	5.77	3.97	3.97	3.97	0.35	1.90	± 13.1 %
5800	48.2	6.00	4.14	4.14	4.14	0.40	1.90	± 13.1 %

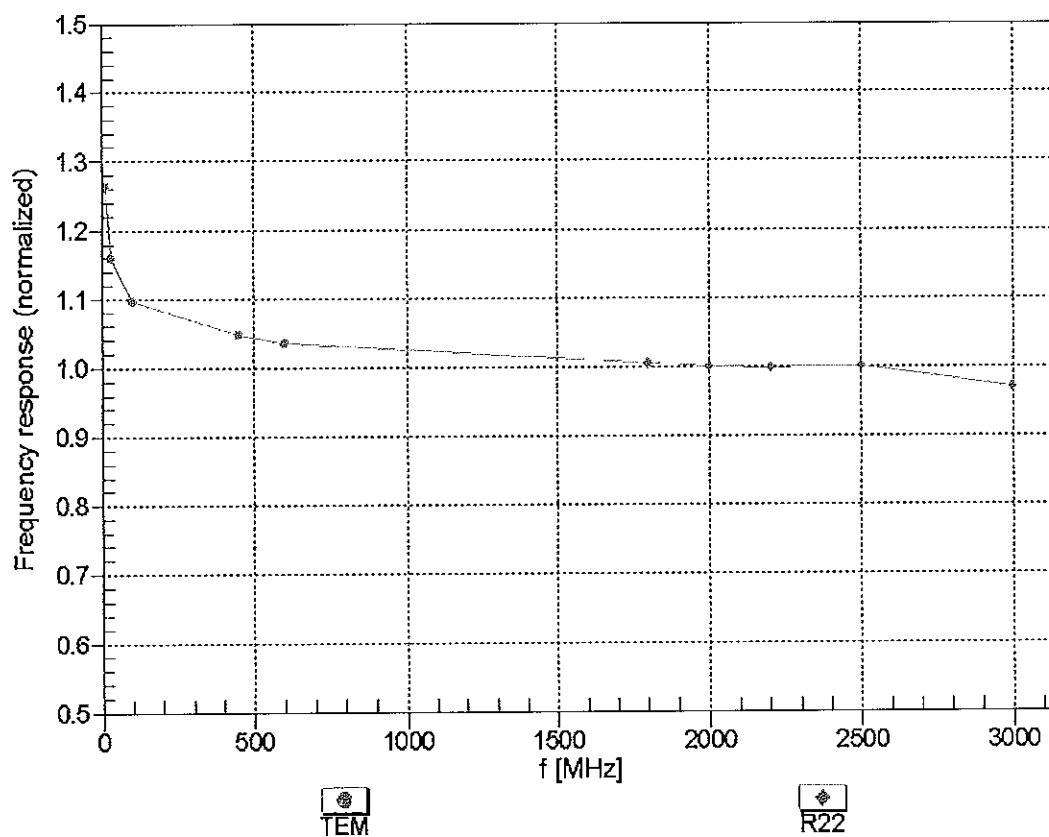
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

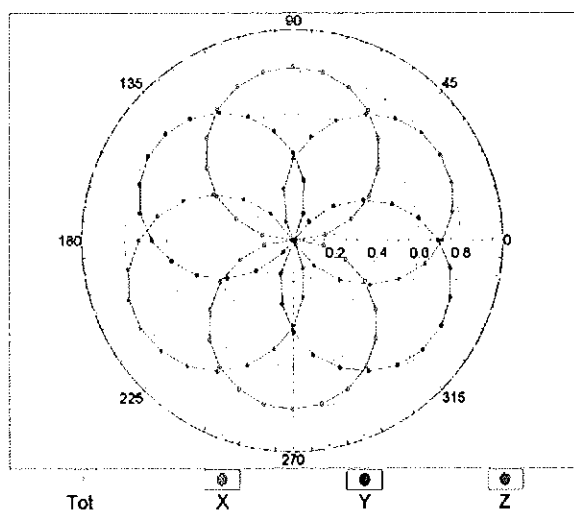
(TEM-Cell: ifi110 EXX, Waveguide: R22)



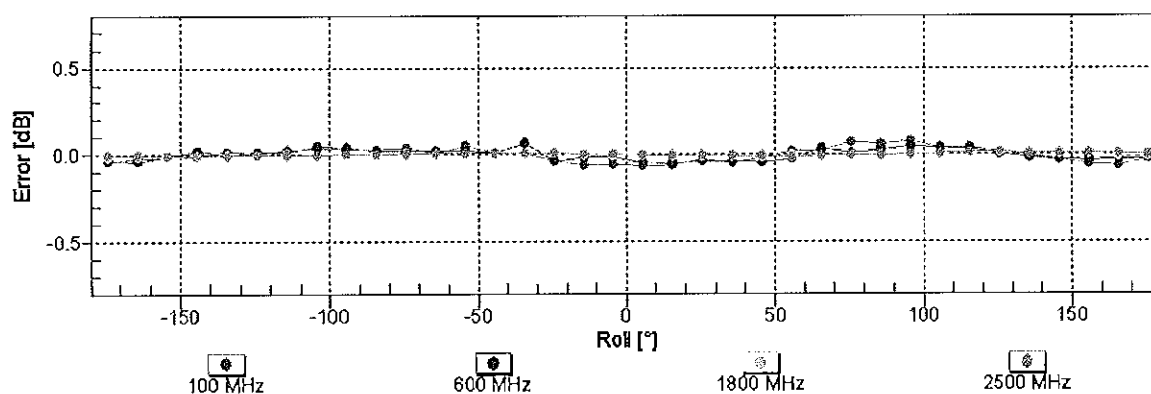
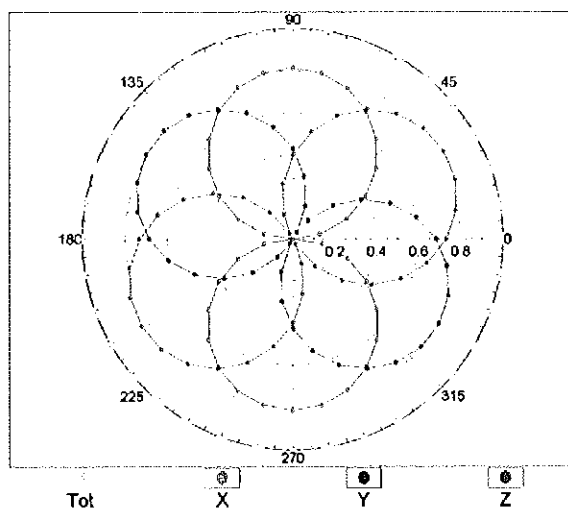
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz,TEM

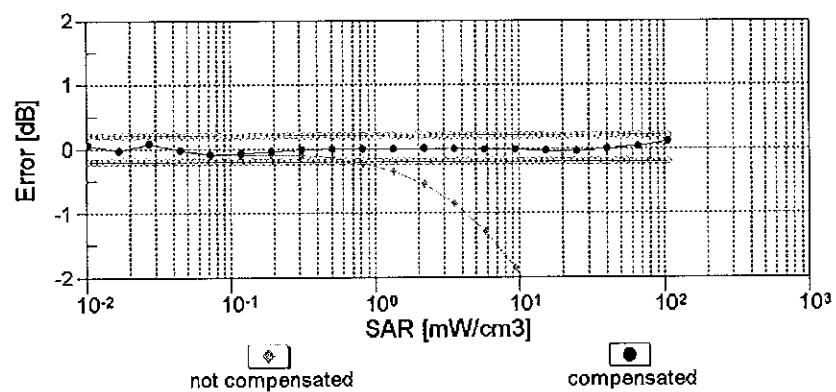
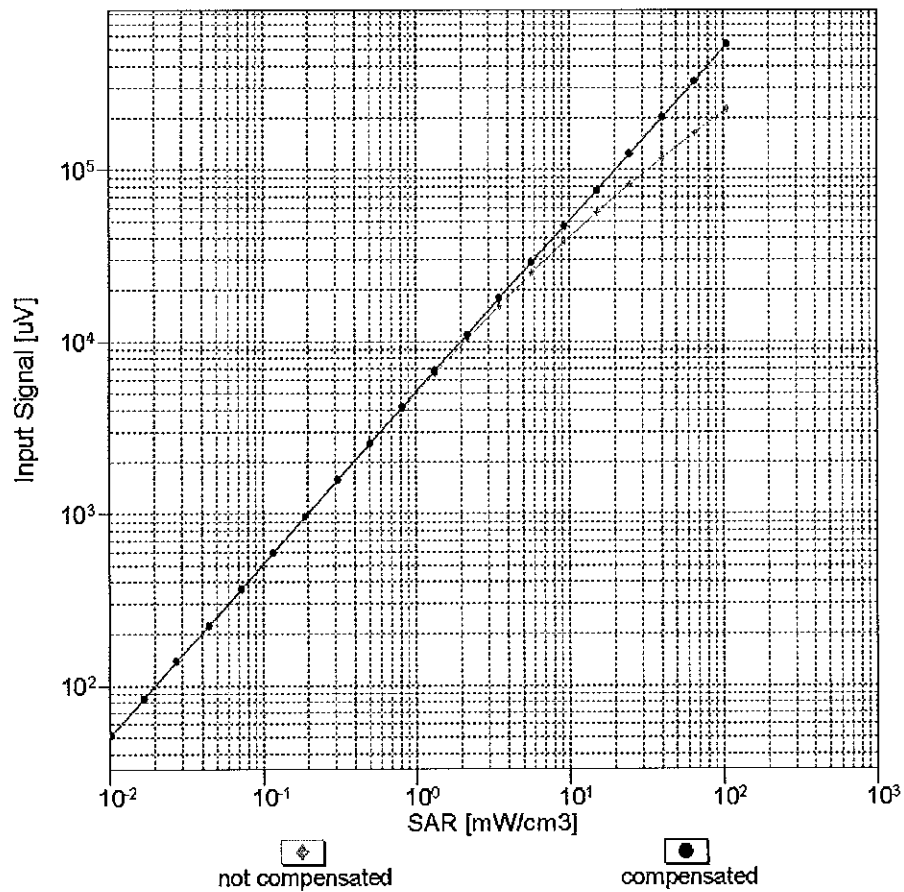


f=1800 MHz,R22



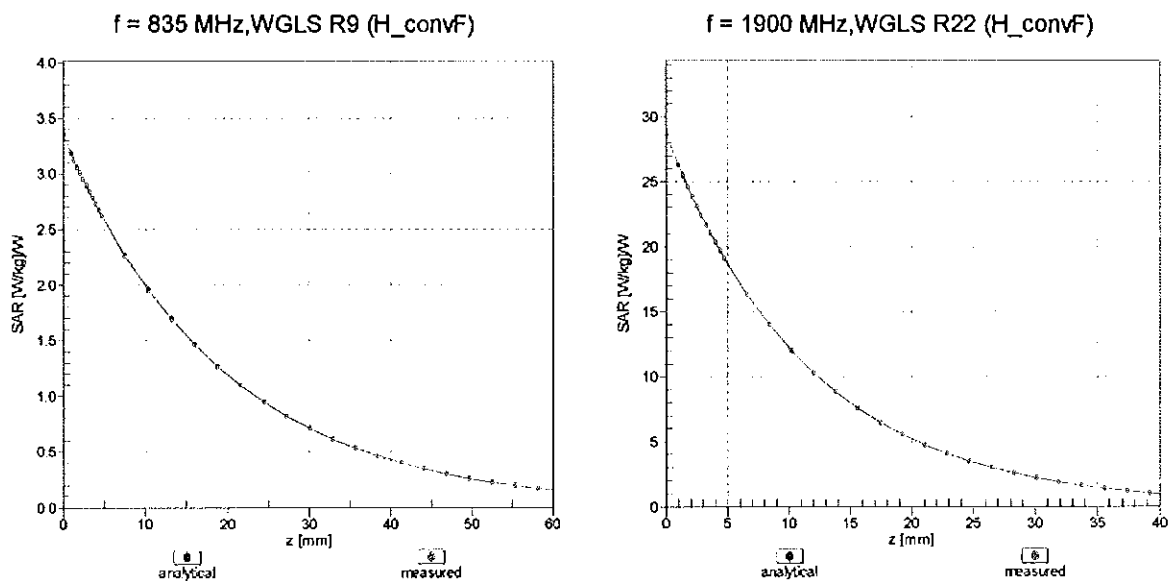
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



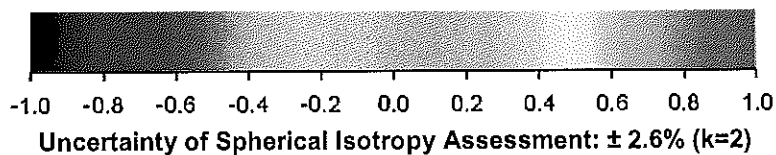
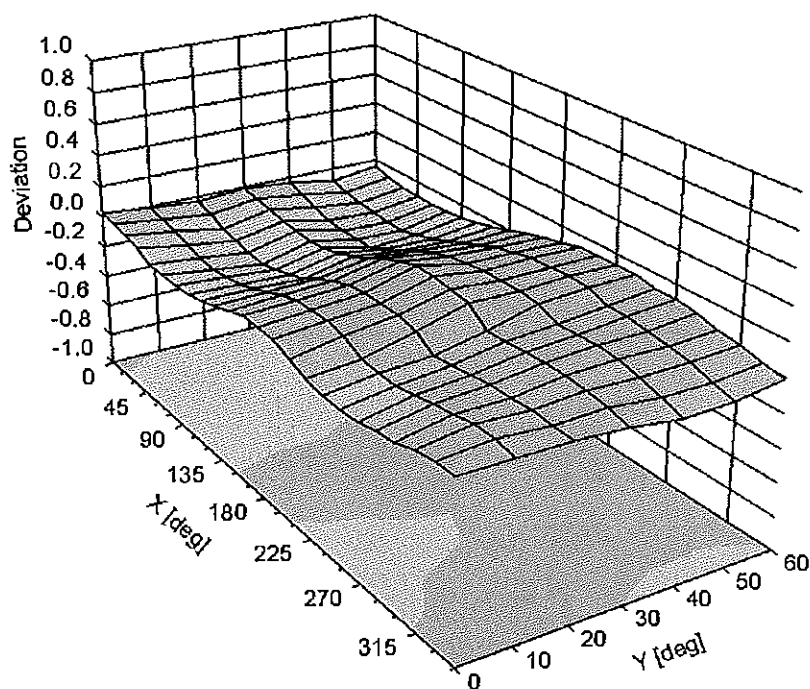
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-24.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm



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

Client **PC Test**

Certificate No: **ES3-3333_Nov13**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3333**

Calibration procedure(s) **QA CAL-01 v5, QA CAL-23 v5, QA CAL-25 v5
 Calibration procedure for dosimetric E-field probes**

Calibration date: **November 22, 2013**

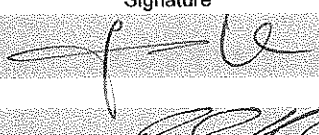
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

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

Calibration Equipment used (M&TE critical for calibration)

*KOK
11/14*

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

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

Issued: November 25, 2013

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



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Accreditation No.: **SCS 108**

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 Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below **ConvF**).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of **ConvF**.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV3

SN:3333

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

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

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

Basic Calibration Parameters

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

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	140.9	$\pm 2.2 \%$
		Y	0.0	0.0	1.0		132.0	
		Z	0.0	0.0	1.0		170.3	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.56	6.56	6.56	0.44	1.54	± 12.0 %
850	41.5	0.92	6.30	6.30	6.30	0.46	1.48	± 12.0 %
1750	40.1	1.37	5.23	5.23	5.23	0.77	1.17	± 12.0 %
1900	40.0	1.40	5.05	5.05	5.05	0.80	1.19	± 12.0 %
2450	39.2	1.80	4.42	4.42	4.42	0.74	1.31	± 12.0 %
2600	39.0	1.96	4.28	4.28	4.28	0.80	1.30	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.11	6.11	6.11	0.33	1.90	± 12.0 %
850	55.2	0.99	6.07	6.07	6.07	0.80	1.19	± 12.0 %
1750	53.4	1.49	4.95	4.95	4.95	0.80	1.26	± 12.0 %
1900	53.3	1.52	4.71	4.71	4.71	0.49	1.54	± 12.0 %
2450	52.7	1.95	4.22	4.22	4.22	0.80	0.95	± 12.0 %
2600	52.5	2.16	4.16	4.16	4.16	0.80	1.07	± 12.0 %

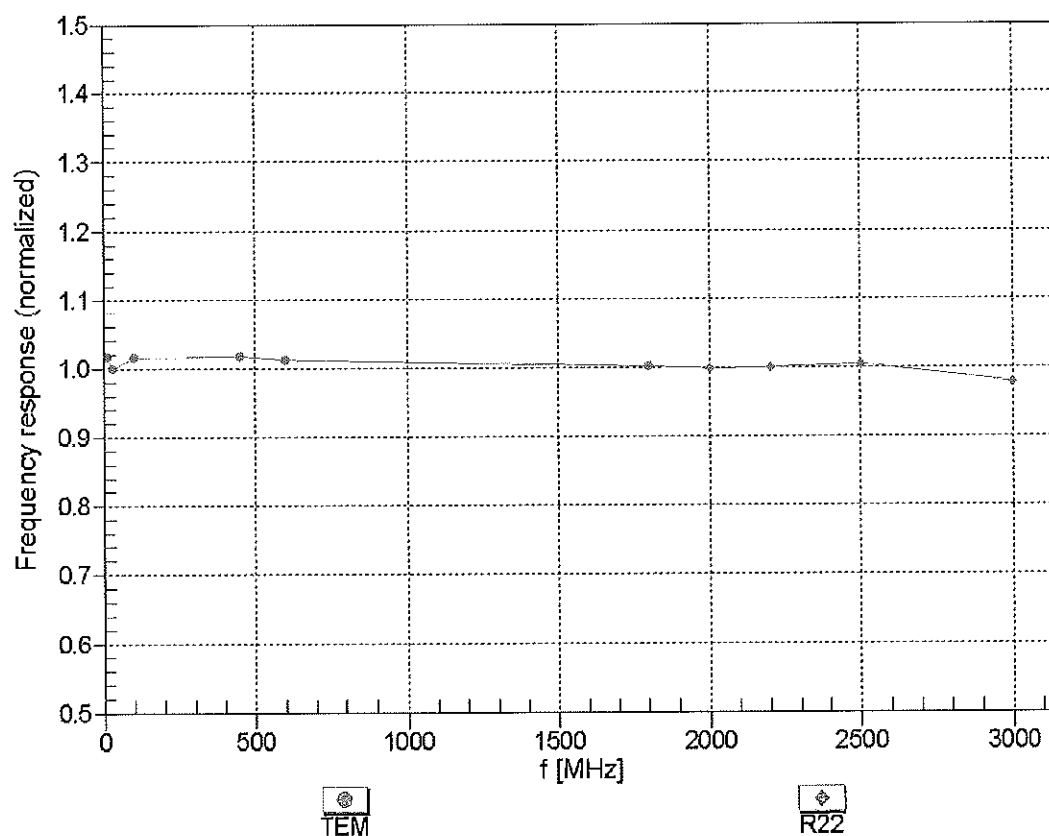
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

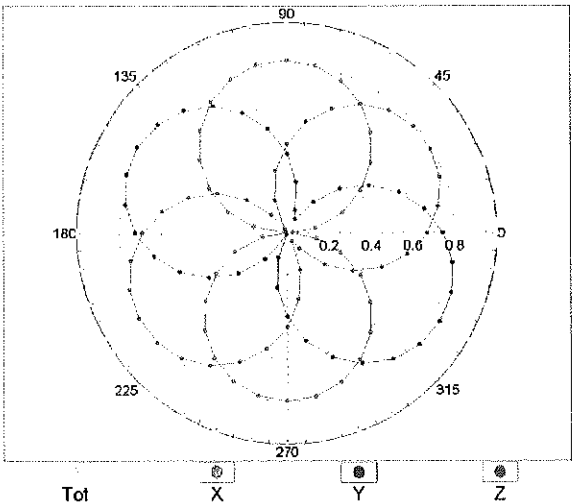
(TEM-Cell:ifi110 EXX, Waveguide: R22)



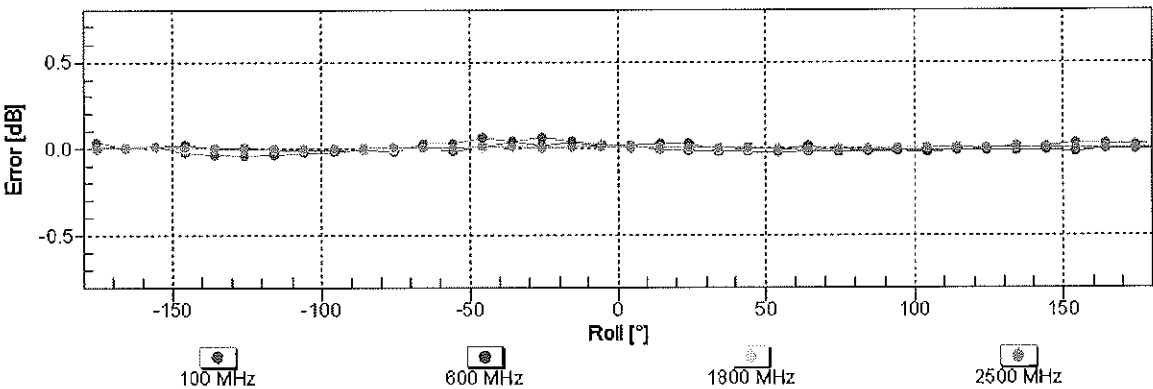
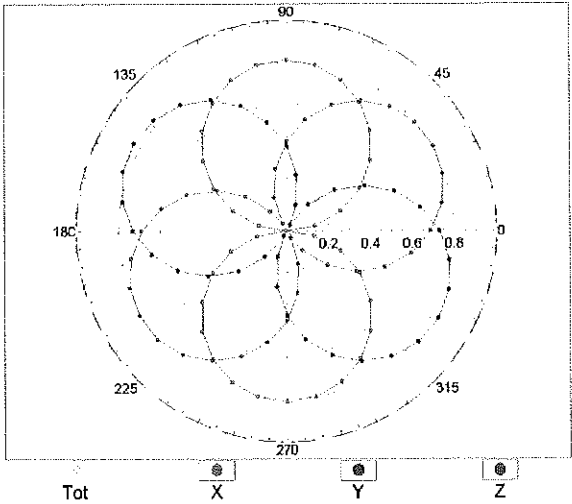
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$

f=600 MHz,TEM

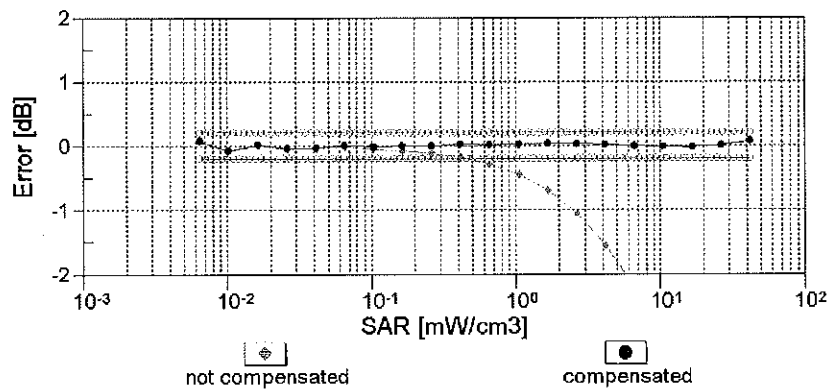
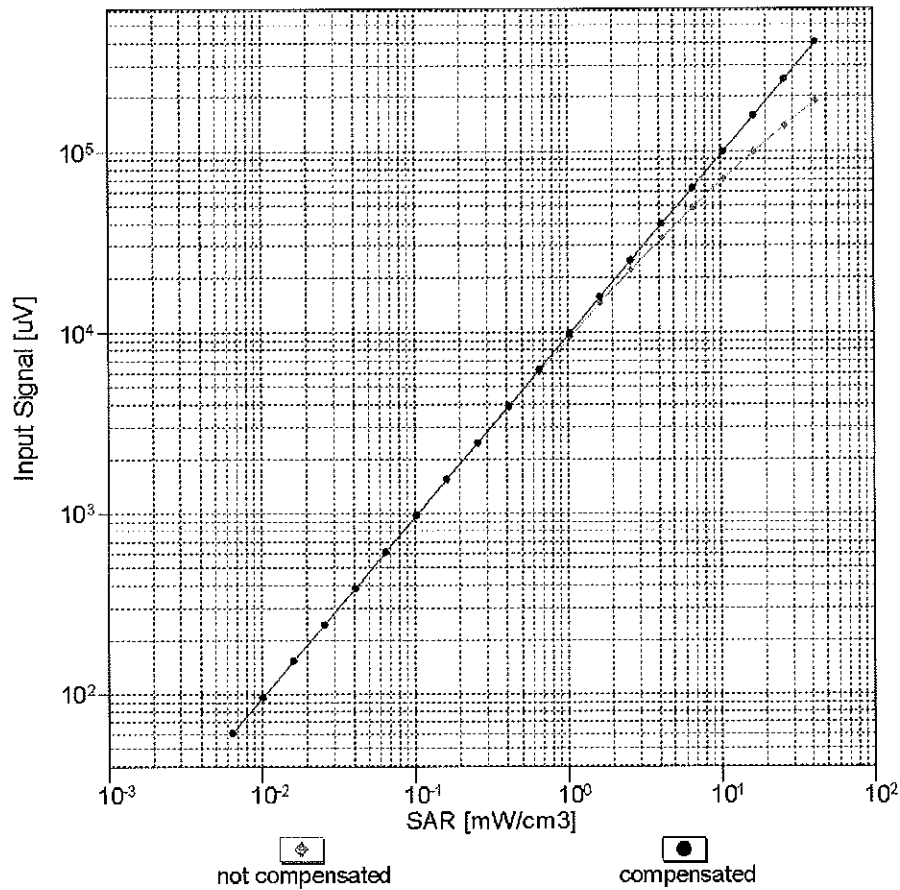


f=1800 MHz,R22



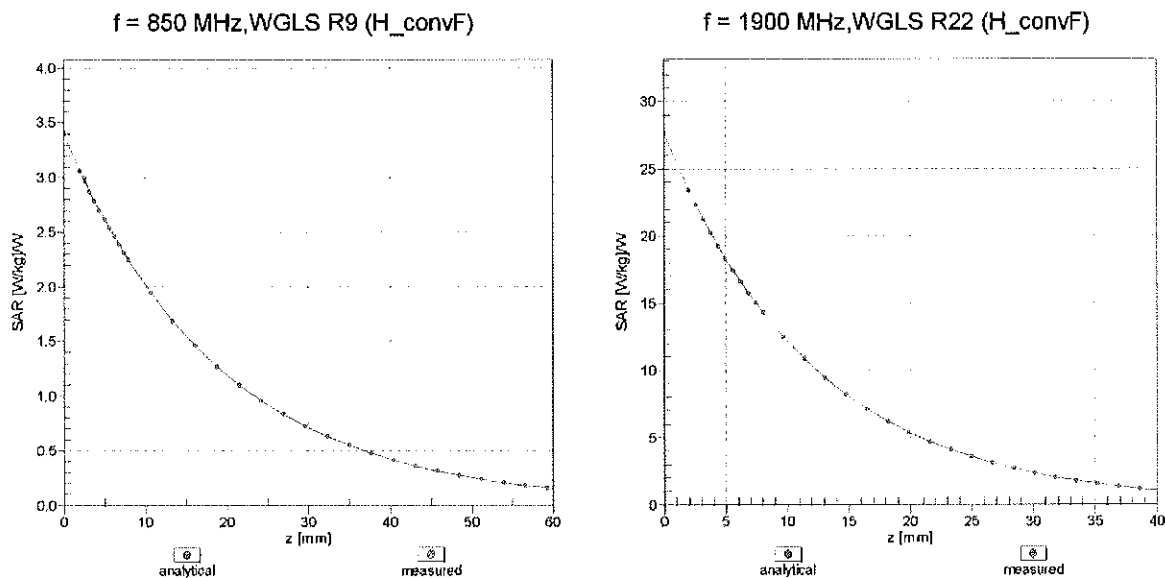
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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



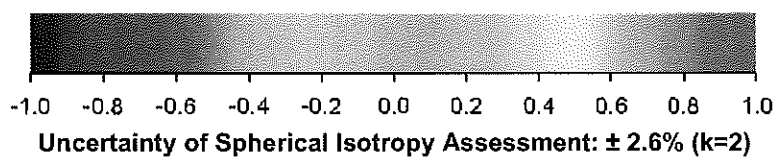
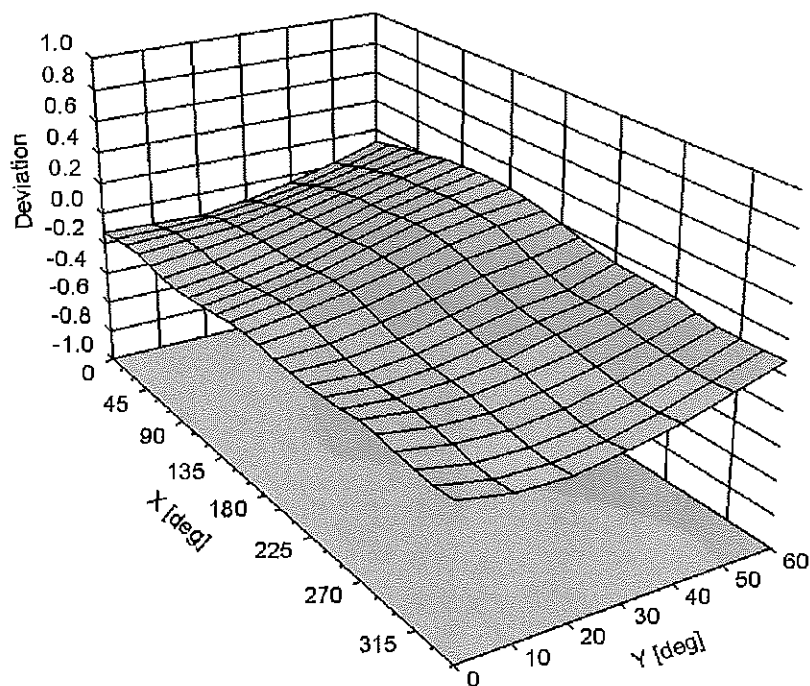
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-35.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **EX3-3920_Dec13**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3920**

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

Calibration date: **December 18, 2013**

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

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: December 19, 2013			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}; A, B, C, D** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe EX3DV4

SN:3920

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

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.34	0.50	0.49	$\pm 10.1 \%$
DCP (mV) ^B	102.9	99.5	98.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	182.5	$\pm 2.7 \%$
		Y	0.0	0.0	1.0		164.9	
		Z	0.0	0.0	1.0		153.0	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	0.76	53.8	6.5	10.00	44.1	$\pm 2.2 \%$
		Y	2.33	62.8	11.4		43.7	
		Z	1.15	55.6	7.5		53.0	
10011-CAA	UMTS-FDD (WCDMA)	X	3.36	66.5	17.5	2.91	142.4	$\pm 0.5 \%$
		Y	3.15	65.0	16.7		131.4	
		Z	3.26	66.0	17.7		121.6	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.69	66.4	16.9	1.87	138.1	$\pm 0.5 \%$
		Y	2.56	65.1	16.2		130.7	
		Z	2.72	66.6	17.2		121.4	
10021-DAA	GSM-FDD (TDMA, GMSK)	X	2.06	63.4	11.7	9.39	99.7	$\pm 1.9 \%$
		Y	2.43	66.1	14.1		94.7	
		Z	2.90	69.9	16.1		121.8	
10023-DAA	GPRS-FDD (TDMA, GMSK, TN 0)	X	1.94	62.4	11.3	9.57	95.1	$\pm 1.9 \%$
		Y	2.31	64.8	13.1		90.1	
		Z	2.98	70.4	16.4		117.0	
10024-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	2.19	67.1	12.2	6.56	140.1	$\pm 1.4 \%$
		Y	2.35	67.0	12.9		134.0	
		Z	3.45	73.5	16.1		131.4	
10027-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	1.18	61.7	8.5	4.80	121.6	$\pm 1.2 \%$
		Y	1.57	63.4	10.0		116.0	
		Z	1.57	65.5	11.9		109.2	
10028-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	3.80	74.5	13.3	3.55	130.3	$\pm 0.9 \%$
		Y	1.00	60.5	8.0		123.9	
		Z	1.58	66.1	11.1		119.0	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	0.18	55.2	3.4	1.16	111.6	$\pm 0.7 \%$
		Y	0.34	57.4	4.4		143.6	
		Z	0.40	59.2	5.7		136.6	
10039-CAA	CDMA2000 (1xRTT, RC1)	X	4.49	65.9	18.1	4.57	131.8	$\pm 0.9 \%$
		Y	4.57	65.1	17.5		123.0	
		Z	4.66	65.9	18.3		118.6	
10062-CAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.09	68.6	21.3	8.68	126.5	$\pm 2.5 \%$
		Y	10.31	68.5	21.1		121.9	
		Z	10.12	68.3	21.3		115.8	

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

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

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

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	10.05	10.05	10.05	0.27	1.13	± 12.0 %
835	41.5	0.90	9.69	9.69	9.69	0.50	0.76	± 12.0 %
1750	40.1	1.37	7.91	7.91	7.91	0.72	0.62	± 12.0 %
1900	40.0	1.40	7.70	7.70	7.70	0.77	0.61	± 12.0 %
2450	39.2	1.80	6.98	6.98	6.98	0.37	0.86	± 12.0 %
2600	39.0	1.96	6.74	6.74	6.74	0.34	0.97	± 12.0 %
5200	36.0	4.66	4.87	4.87	4.87	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.66	4.66	4.66	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.54	4.54	4.54	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.37	4.37	4.37	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.11	4.11	4.11	0.50	1.80	± 13.1 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	9.54	9.54	9.54	0.32	1.07	± 12.0 %
835	55.2	0.97	9.47	9.47	9.47	0.45	0.85	± 12.0 %
1750	53.4	1.49	7.77	7.77	7.77	0.59	0.74	± 12.0 %
1900	53.3	1.52	7.50	7.50	7.50	0.37	0.91	± 12.0 %
2450	52.7	1.95	7.18	7.18	7.18	0.80	0.56	± 12.0 %
2600	52.5	2.16	6.91	6.91	6.91	0.80	0.57	± 12.0 %
5200	49.0	5.30	4.23	4.23	4.23	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.11	4.11	4.11	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.80	3.80	3.80	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.62	3.62	3.62	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.00	4.00	4.00	0.50	1.90	± 13.1 %

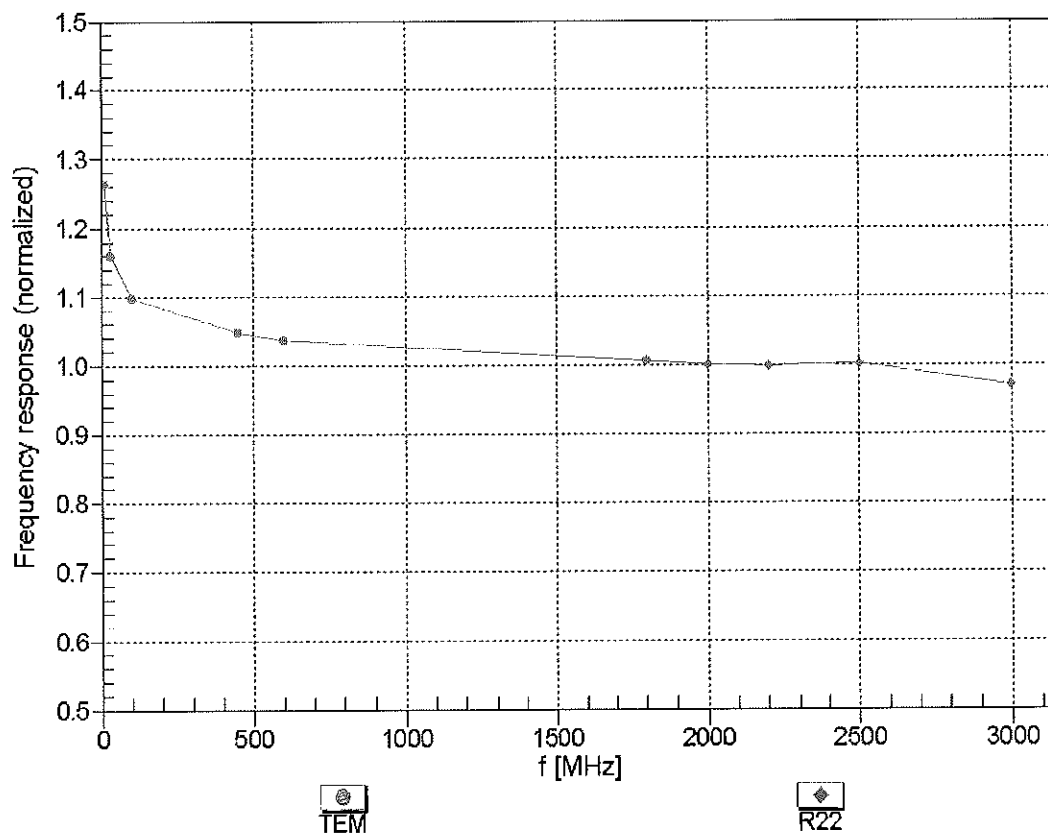
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

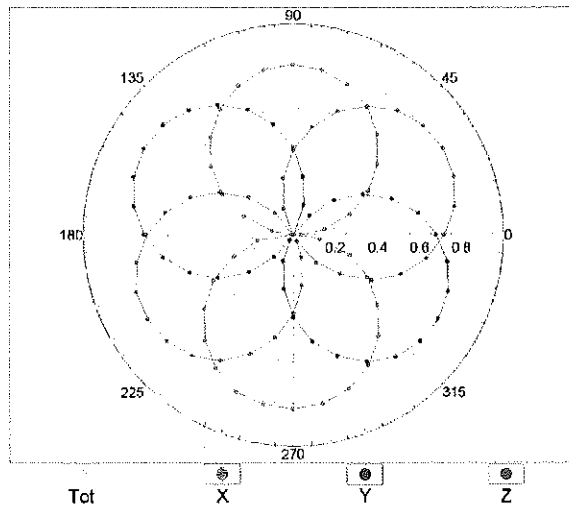
(TEM-Cell:ifi110 EXX, Waveguide: R22)



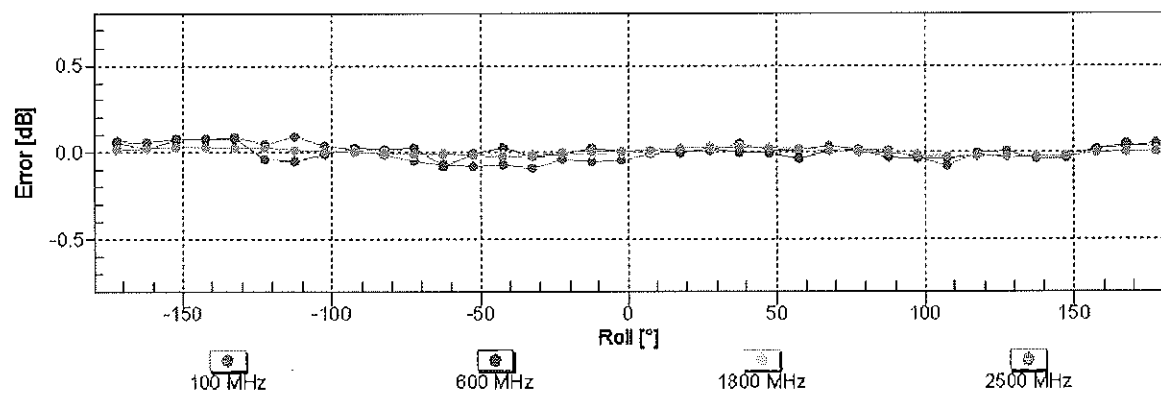
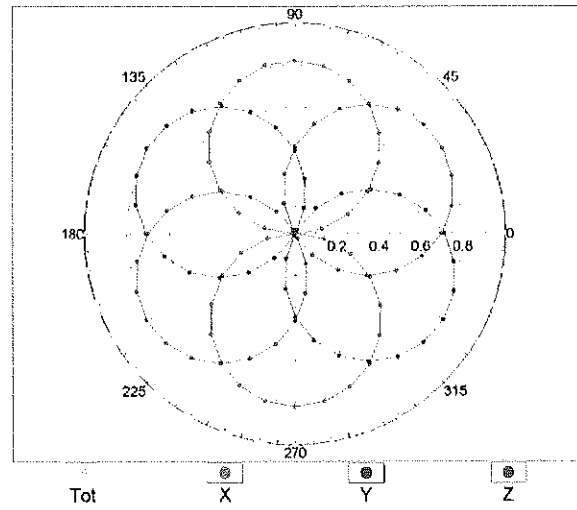
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\theta = 0^\circ$

$f=600$ MHz, TEM

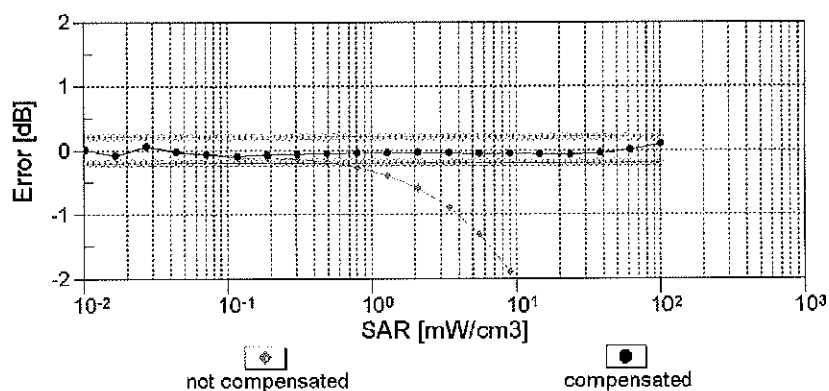
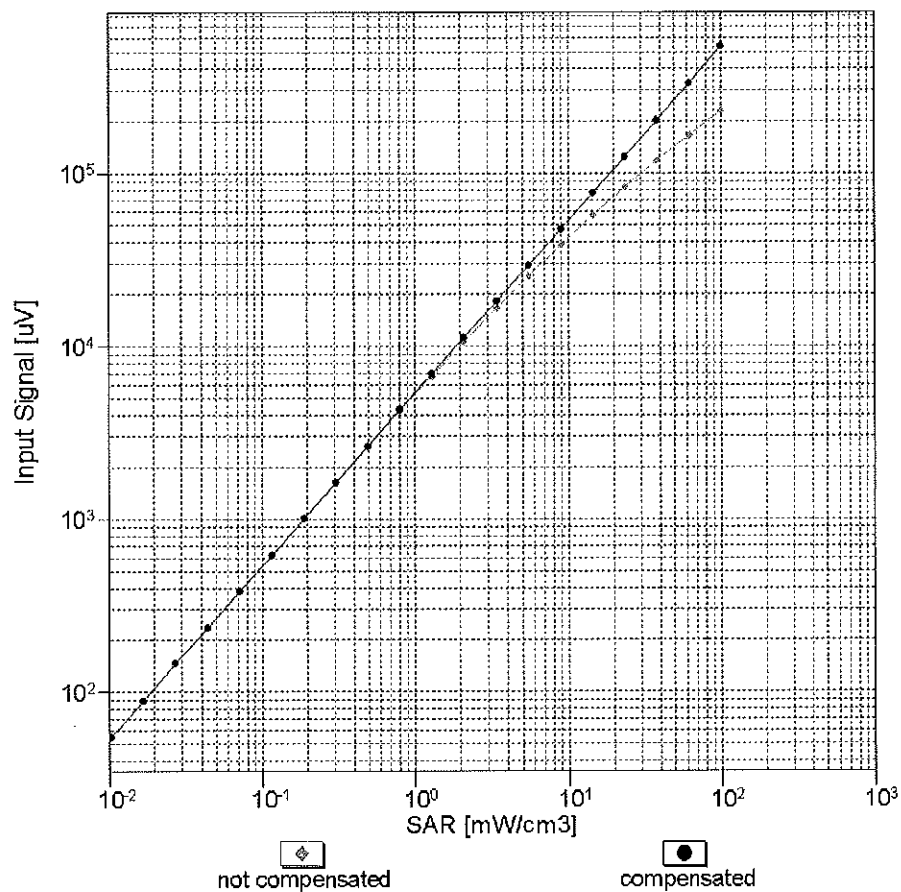


$f=1800$ MHz, R22



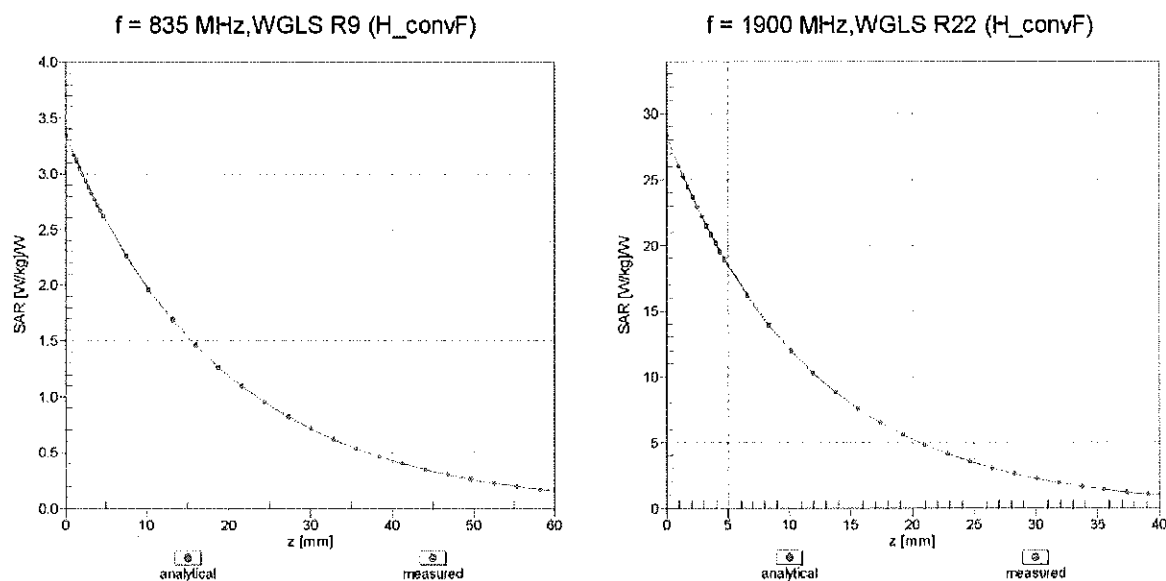
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



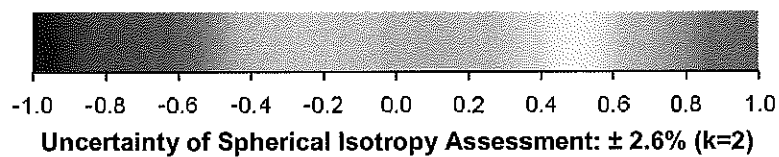
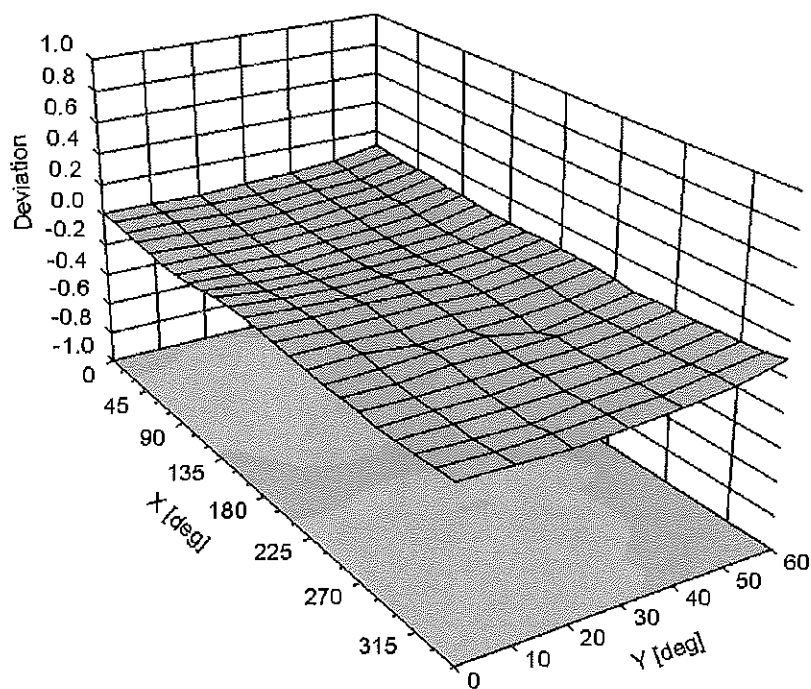
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-22.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm



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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **EX3-3589_Jan14**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3589**

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

Calibration date: **January 29, 2014**

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

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

Issued: January 30, 2014

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, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe EX3DV4

SN:3589

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

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$) ^A	0.46	0.40	0.40	± 10.1 %
DCP (mV) ^B	101.2	100.8	98.0	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	150.4	±3.8 %
		Y	0.0	0.0	1.0		142.3	
		Z	0.0	0.0	1.0		171.7	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	6.00	69.5	14.2	10.00	42.1	±0.9 %
		Y	7.03	71.8	15.0		40.3	
		Z	3.33	64.6	12.1		44.6	
10011-CAA	UMTS-FDD (WCDMA)	X	3.26	66.2	17.8	2.91	117.6	±0.9 %
		Y	3.38	66.8	18.2		113.0	
		Z	2.79	62.4	14.7		133.2	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.77	66.8	17.4	1.87	117.4	±0.7 %
		Y	3.22	69.6	18.8		113.5	
		Z	2.22	62.0	13.8		135.2	
10021-DAA	GSM-FDD (TDMA, GMSK)	X	3.61	69.7	16.6	9.39	91.2	±1.7 %
		Y	5.48	77.1	19.6		125.1	
		Z	2.18	62.5	12.6		75.3	
10023-DAA	GPRS-FDD (TDMA, GMSK, TN 0)	X	3.01	66.4	14.9	9.57	86.1	±2.7 %
		Y	7.02	82.0	22.0		120.5	
		Z	2.13	62.9	12.7		71.4	
10024-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	18.01	91.8	22.6	6.56	132.3	±1.7 %
		Y	8.55	83.0	19.9		134.3	
		Z	4.04	72.4	15.7		139.6	
10027-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	4.70	74.7	15.9	4.80	107.5	±1.7 %
		Y	4.94	76.1	16.4		107.8	
		Z	2.97	68.7	12.8		127.1	
10028-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	67.89	99.9	21.4	3.55	114.7	±2.7 %
		Y	48.02	99.7	21.9		116.6	
		Z	1.36	61.4	7.8		134.4	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	97.41	97.0	17.7	1.16	129.2	±3.0 %
		Y	71.47	99.8	19.3		130.9	
		Z	0.29	53.5	0.9		109.2	
10039-CAA	CDMA2000 (1xRTT, RC1)	X	4.62	65.4	18.0	4.57	113.0	±1.7 %
		Y	4.74	66.1	18.4		111.5	
		Z	4.22	63.3	15.9		133.6	
10062-CAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.10	67.8	20.8	8.68	108.0	±2.7 %
		Y	10.07	68.1	21.1		108.1	
		Z	10.03	67.6	20.2		130.3	

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

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

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

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Uct. (k=2)
750	41.9	0.89	8.86	8.86	8.86	0.80	0.62	± 12.0 %
835	41.5	0.90	8.49	8.49	8.49	0.45	0.82	± 12.0 %
1750	40.1	1.37	7.31	7.31	7.31	0.80	0.60	± 12.0 %
1900	40.0	1.40	7.05	7.05	7.05	0.52	0.73	± 12.0 %
2450	39.2	1.80	6.45	6.45	6.45	0.29	1.08	± 12.0 %
2600	39.0	1.96	6.24	6.24	6.24	0.76	0.62	± 12.0 %
5200	36.0	4.66	4.78	4.78	4.78	0.30	1.80	± 13.1 %
5300	35.9	4.76	4.58	4.58	4.58	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.44	4.44	4.44	0.31	1.80	± 13.1 %
5600	35.5	5.07	4.20	4.20	4.20	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.39	4.39	4.39	0.32	1.80	± 13.1 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

Calibration Parameter Determined in Body Tissue Simulating Media

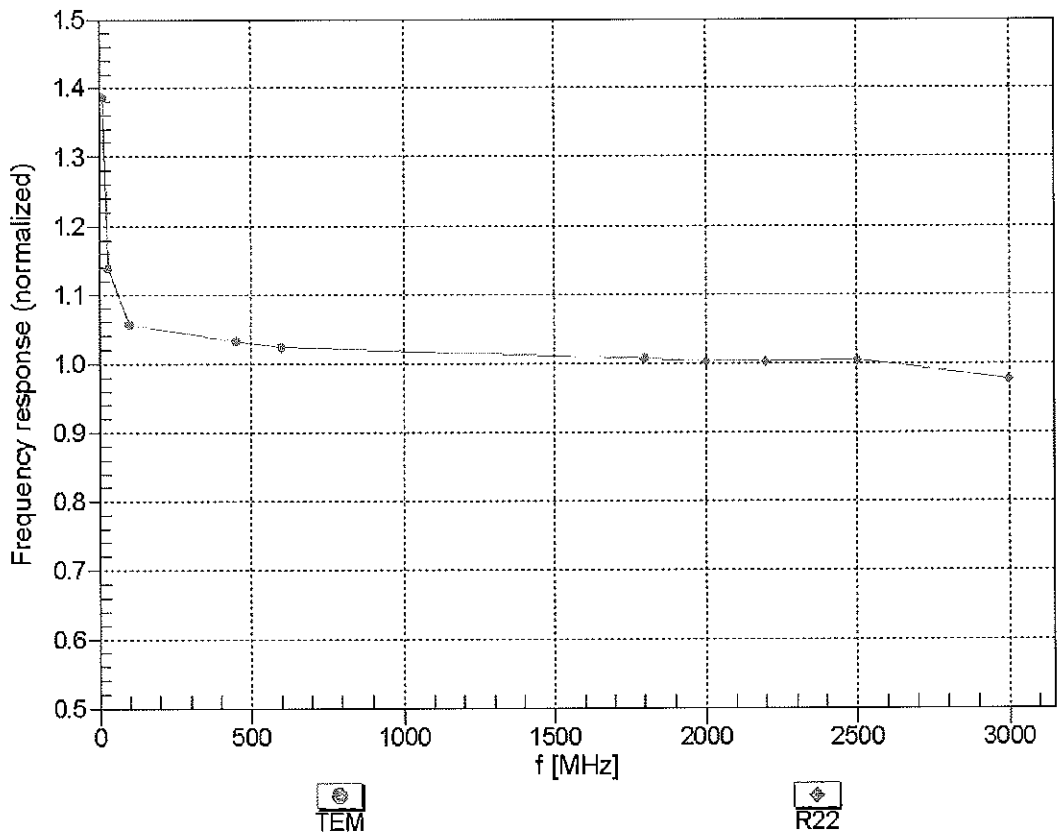
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	8.34	8.34	8.34	0.66	0.72	± 12.0 %
835	55.2	0.97	8.29	8.29	8.29	0.31	1.11	± 12.0 %
1750	53.4	1.49	6.68	6.68	6.68	0.80	0.61	± 12.0 %
1900	53.3	1.52	6.54	6.54	6.54	0.72	0.64	± 12.0 %
2450	52.7	1.95	6.26	6.26	6.26	0.80	0.57	± 12.0 %
2600	52.5	2.16	6.08	6.08	6.08	0.68	0.50	± 12.0 %
5200	49.0	5.30	4.19	4.19	4.19	0.38	1.90	± 13.1 %
5300	48.9	5.42	3.98	3.98	3.98	0.38	1.90	± 13.1 %
5500	48.6	5.65	3.76	3.76	3.76	0.42	1.90	± 13.1 %
5600	48.5	5.77	3.81	3.81	3.81	0.30	1.90	± 13.1 %
5800	48.2	6.00	3.97	3.97	3.97	0.43	1.90	± 13.1 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

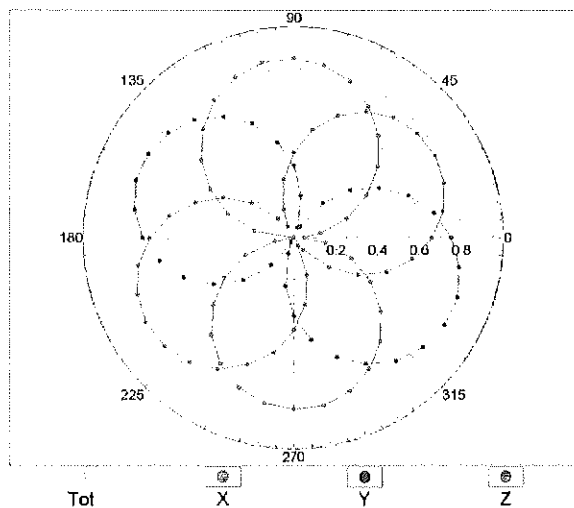
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



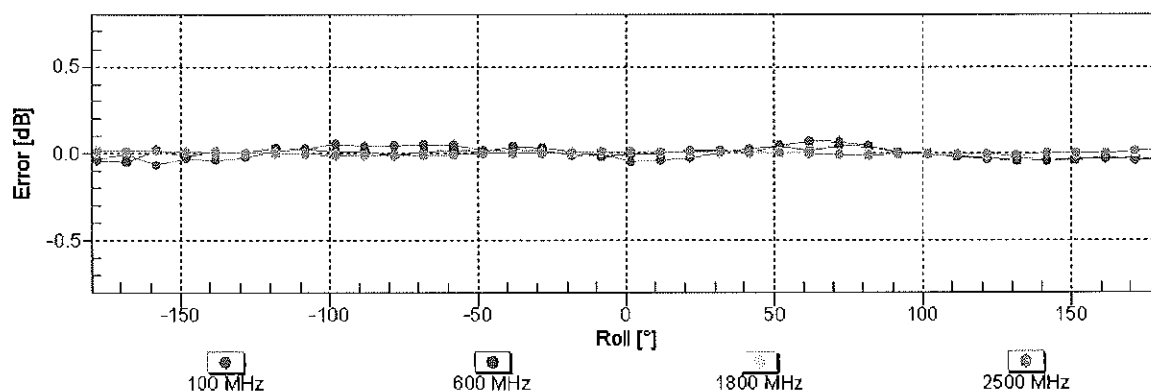
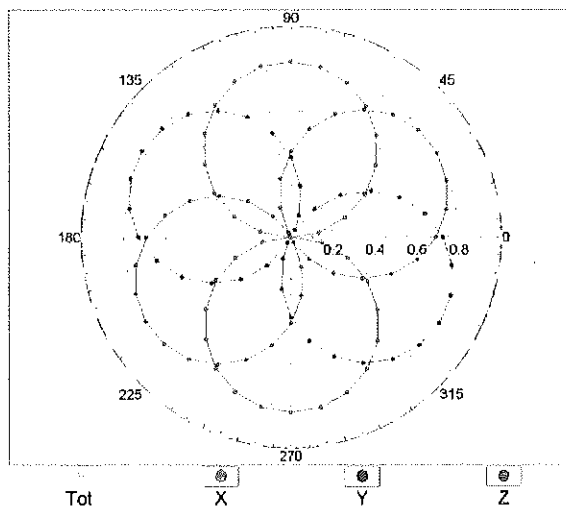
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$

f=600 MHz,TEM



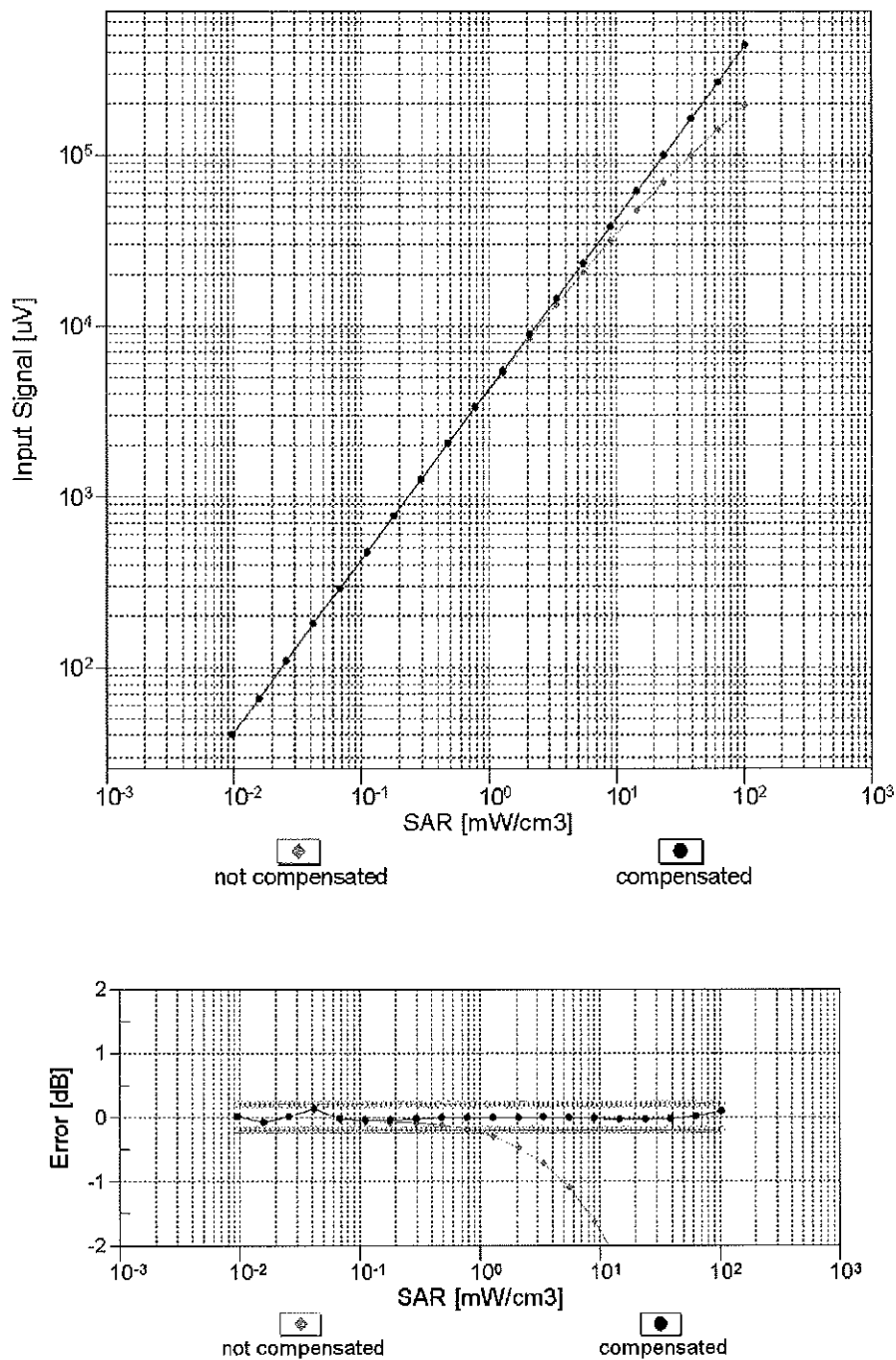
f=1800 MHz,R22



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

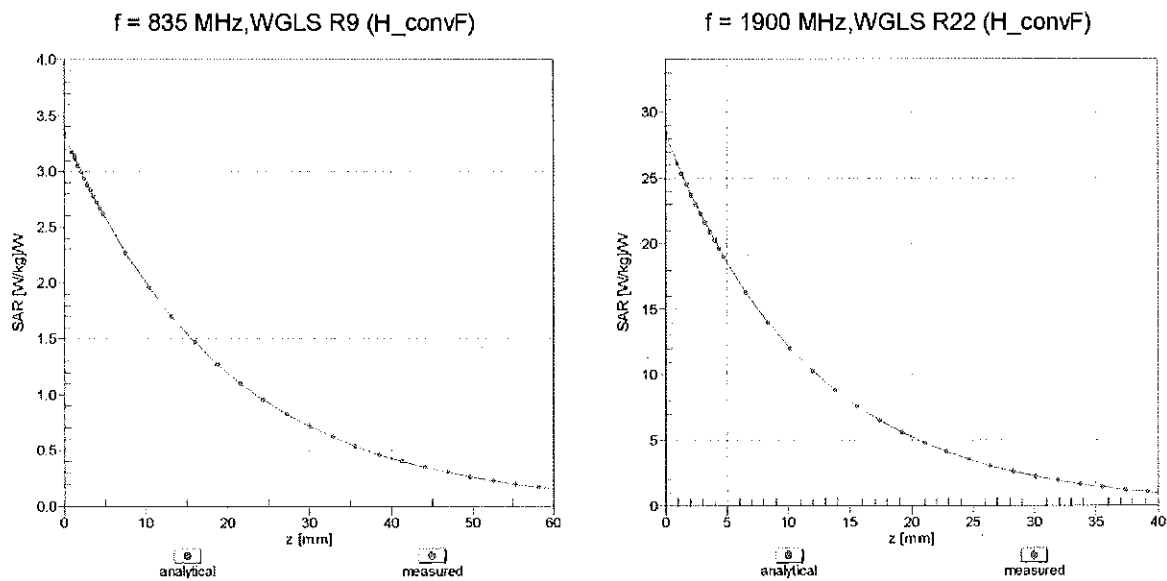
Dynamic Range f(SAR_{head})

(TEM cell , f = 900 MHz)

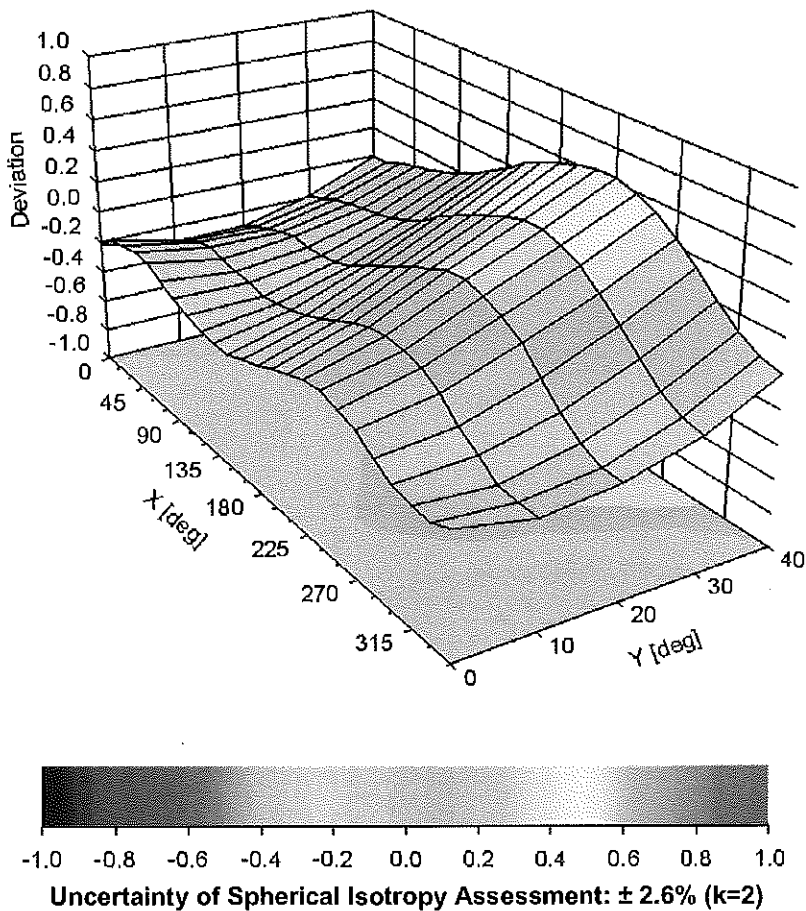


Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ, ϑ), f = 900 MHz



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-38.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm



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: **ES3-3258_Feb14**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3258**

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

CCV
 3/6/14

Calibration date: **February 25, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

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

Calibrated by:	Name Israe El-Naouq	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	
			Issued: February 27, 2014
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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, D	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV3

SN:3258

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

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

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

Basic Calibration Parameters

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

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	222.4	$\pm 3.8 \%$
		Y	0.0	0.0	1.0		202.2	
		Z	0.0	0.0	1.0		207.1	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	5.09	65.6	14.1	10.00	44.8	$\pm 1.9 \%$
		Y	1.68	57.4	9.3		40.7	
		Z	4.01	62.4	13.0		51.1	
10011- CAB	UMTS-FDD (WCDMA)	X	3.34	67.5	18.9	2.91	131.2	$\pm 0.5 \%$
		Y	3.43	67.9	18.7		137.1	
		Z	3.42	67.8	19.0		146.0	
10012- CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.40	70.9	19.8	1.87	134.2	$\pm 0.7 \%$
		Y	3.19	70.2	19.2		137.9	
		Z	3.46	70.8	19.6		149.6	
10021- DAB	GSM-FDD (TDMA, GMSK)	X	30.24	99.7	28.7	9.39	131.2	$\pm 1.4 \%$
		Y	12.91	88.5	23.9		147.5	
		Z	30.37	99.5	28.9		128.0	
10023- DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	29.88	100.0	29.0	9.57	123.0	$\pm 1.9 \%$
		Y	16.02	92.5	25.4		140.7	
		Z	30.01	100.0	29.4		125.8	
10024- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	44.57	99.7	25.9	6.56	119.6	$\pm 1.7 \%$
		Y	28.97	95.3	23.2		127.6	
		Z	43.72	99.8	26.3		120.1	
10027- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	53.52	99.7	24.4	4.80	129.4	$\pm 2.2 \%$
		Y	54.55	99.9	22.9		143.3	
		Z	51.63	99.7	24.8		127.5	
10028- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	58.93	99.8	23.4	3.55	133.4	$\pm 2.2 \%$
		Y	77.54	99.7	21.3		125.3	
		Z	56.64	99.8	23.8		130.8	
10032- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	47.03	99.5	21.3	1.16	136.3	$\pm 1.7 \%$
		Y	95.86	95.2	17.1		138.2	
		Z	39.68	100.0	22.2		132.3	
10039- CAB	CDMA2000 (1xRTT, RC1)	X	4.84	66.8	19.1	4.57	131.3	$\pm 0.9 \%$
		Y	4.75	67.0	18.9		135.2	
		Z	4.86	66.7	19.0		127.2	

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

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

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

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.53	6.53	6.53	0.40	1.60	± 12.0 %
835	41.5	0.90	6.27	6.27	6.27	0.80	1.17	± 12.0 %
1750	40.1	1.37	5.19	5.19	5.19	0.80	1.10	± 12.0 %
1900	40.0	1.40	5.04	5.04	5.04	0.68	1.27	± 12.0 %
2450	39.2	1.80	4.52	4.52	4.52	0.78	1.23	± 12.0 %
2600	39.0	1.96	4.34	4.34	4.34	0.76	1.33	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

Calibration Parameter Determined in Body Tissue Simulating Media

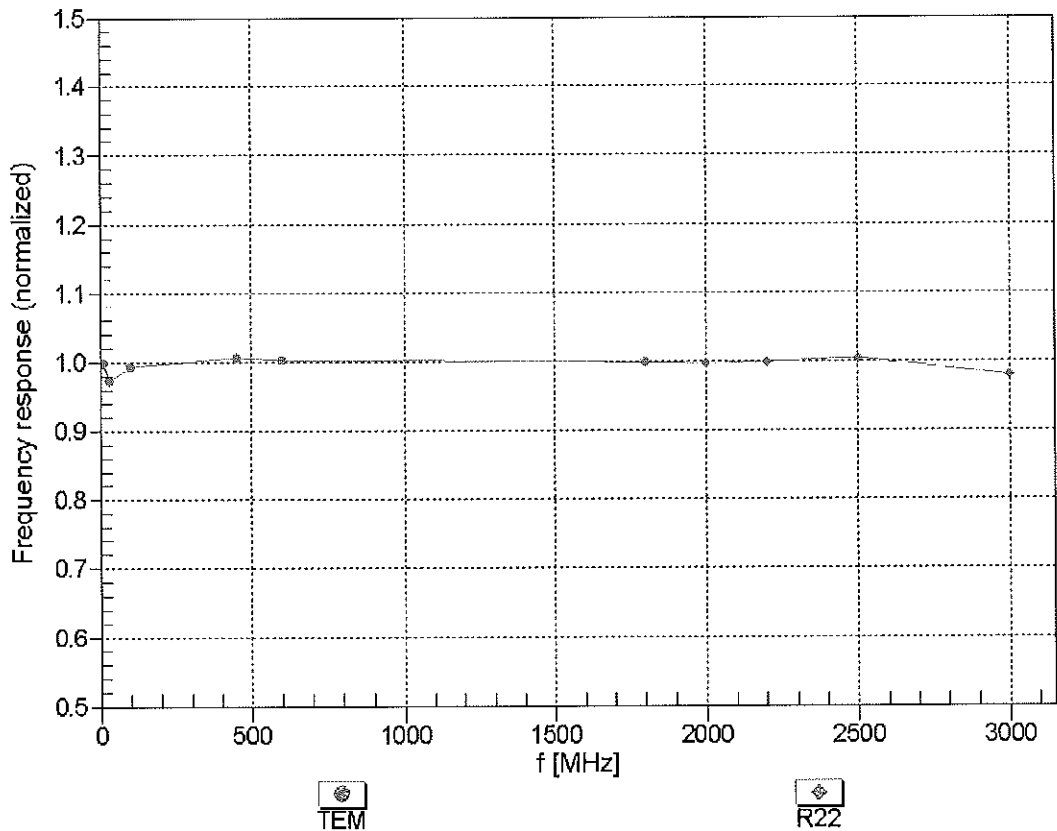
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.15	6.15	6.15	0.61	1.32	± 12.0 %
835	55.2	0.97	6.11	6.11	6.11	0.80	1.15	± 12.0 %
1750	53.4	1.49	4.83	4.83	4.83	0.47	1.74	± 12.0 %
1900	53.3	1.52	4.61	4.61	4.61	0.55	1.59	± 12.0 %
2450	52.7	1.95	4.14	4.14	4.14	0.80	1.11	± 12.0 %
2600	52.5	2.16	3.91	3.91	3.91	0.80	1.00	± 12.0 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

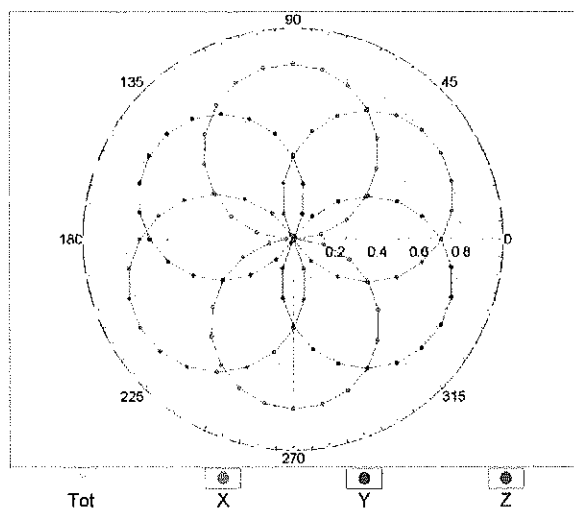
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



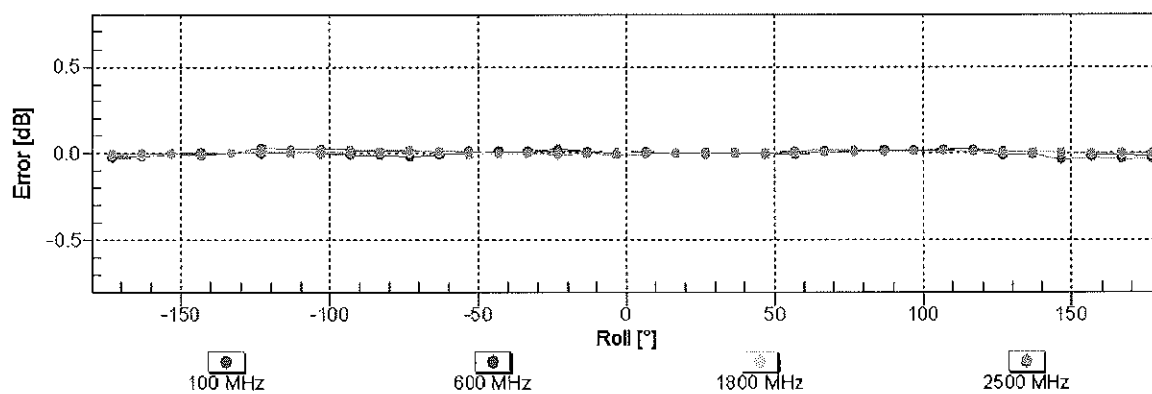
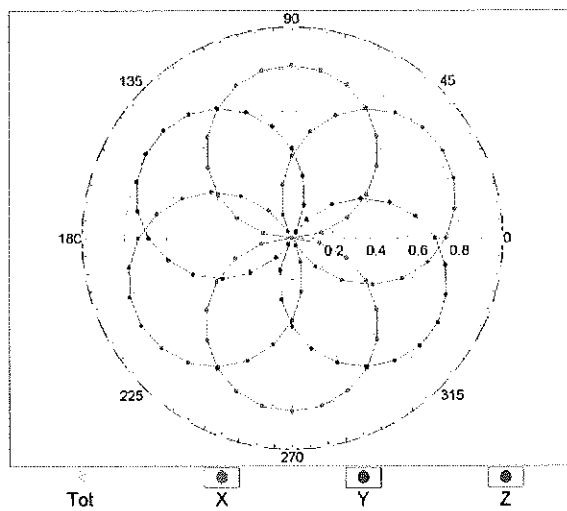
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz,TEM



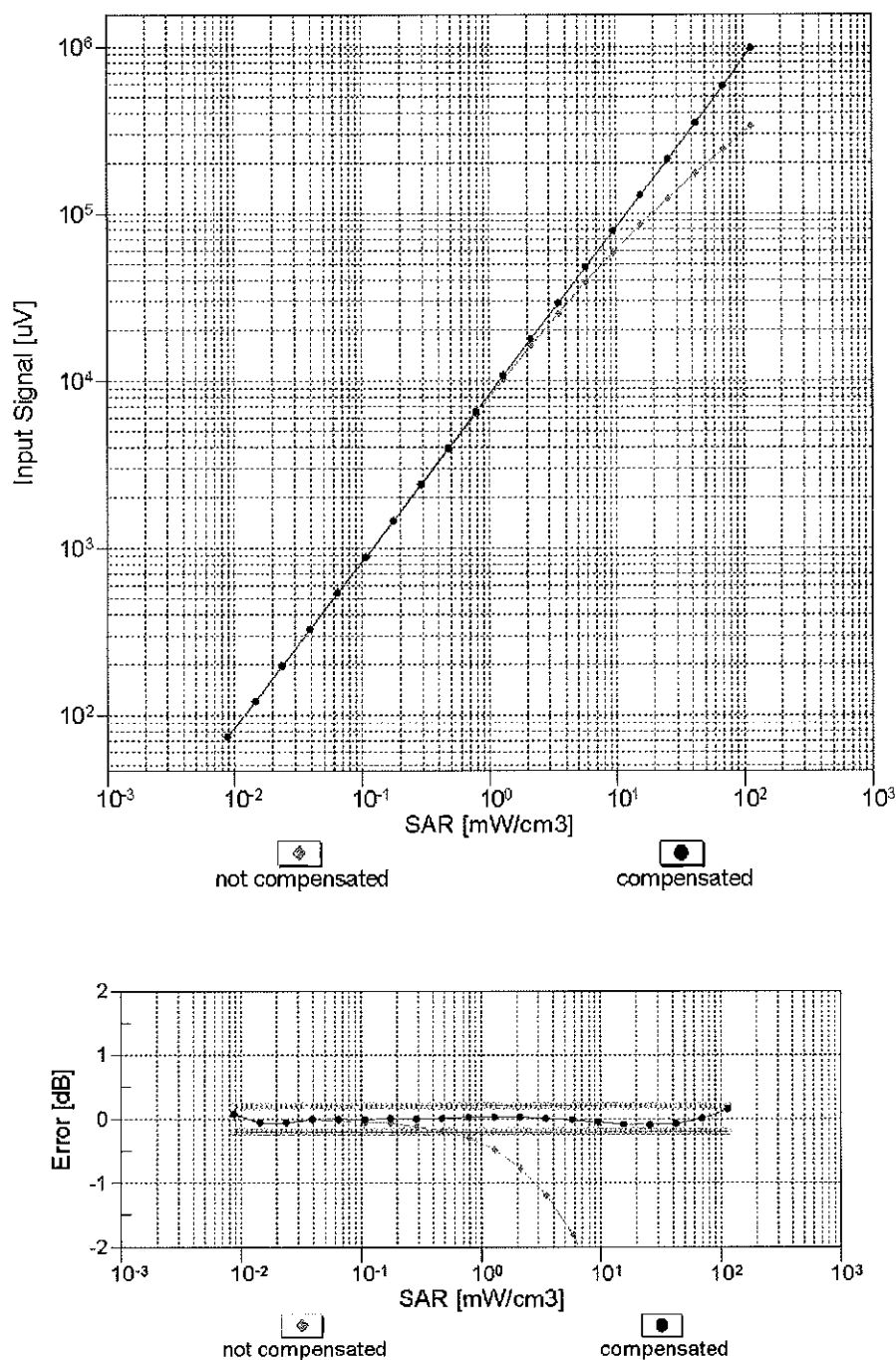
f=1800 MHz,R22



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

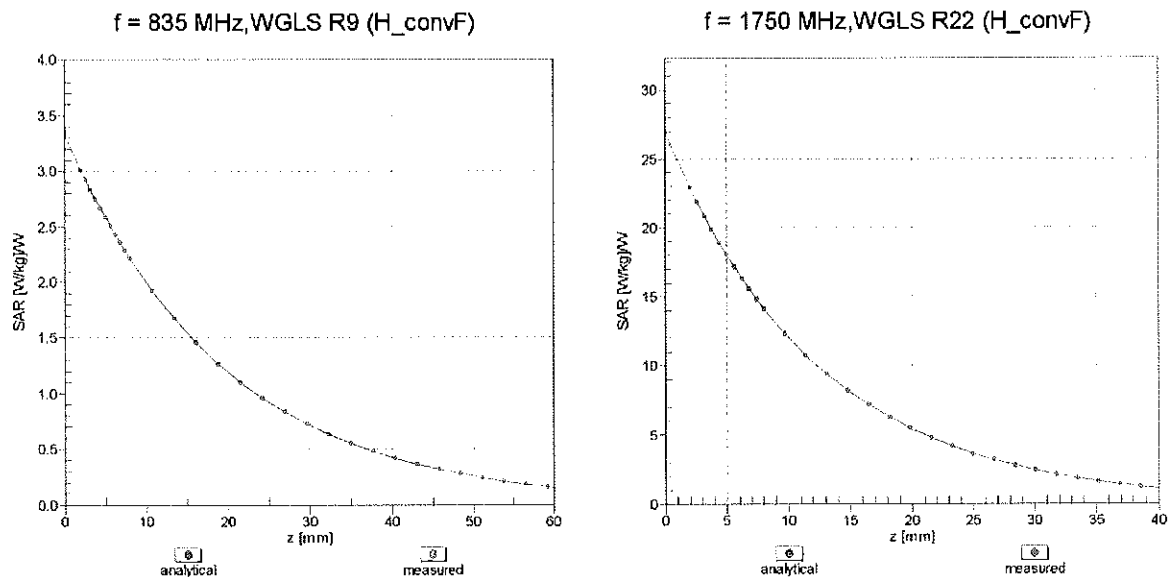
Dynamic Range f(SAR_{head})

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



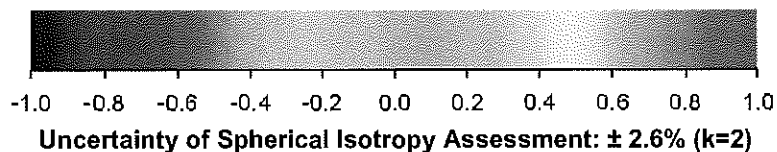
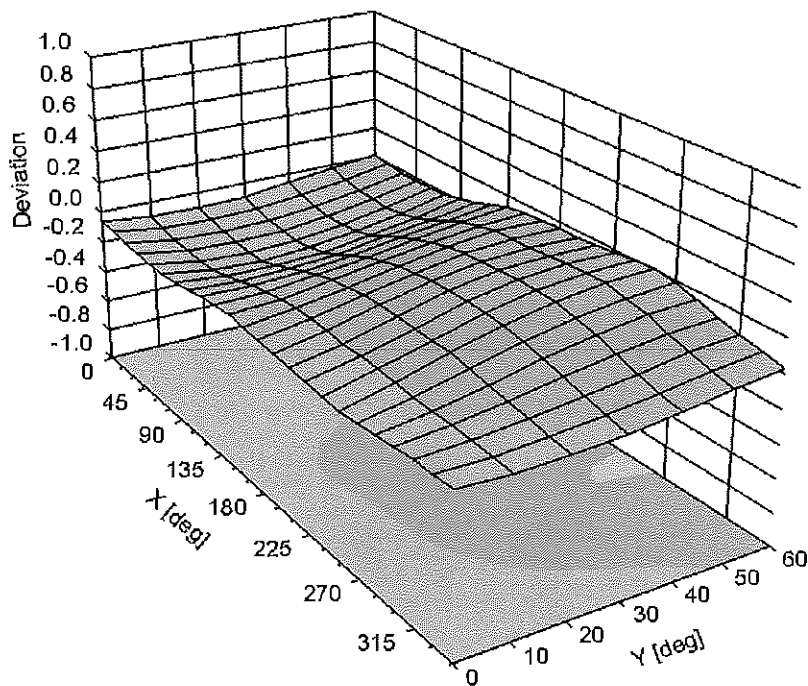
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

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 (°)	-123.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



Accredited by the Swiss Accreditation Service (SAS)
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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d149_Jul13**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d149**

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

Calibration date: **July 22, 2013**

✓
 KOK
 8/19/13

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: July 22, 2013

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



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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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 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	38.9 $\pm$ 6 %	1.36 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	9.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.4 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.3 W/kg $\pm$ 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	53.4 $\pm$ 6 %	1.49 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	10.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.5 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.36 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.9 \Omega + 6.0 j\Omega$
Return Loss	- 23.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.5 \Omega + 6.4 j\Omega$
Return Loss	- 23.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.196 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 1900 MHz

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.36 \text{ S/m}$; $\epsilon_r = 38.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

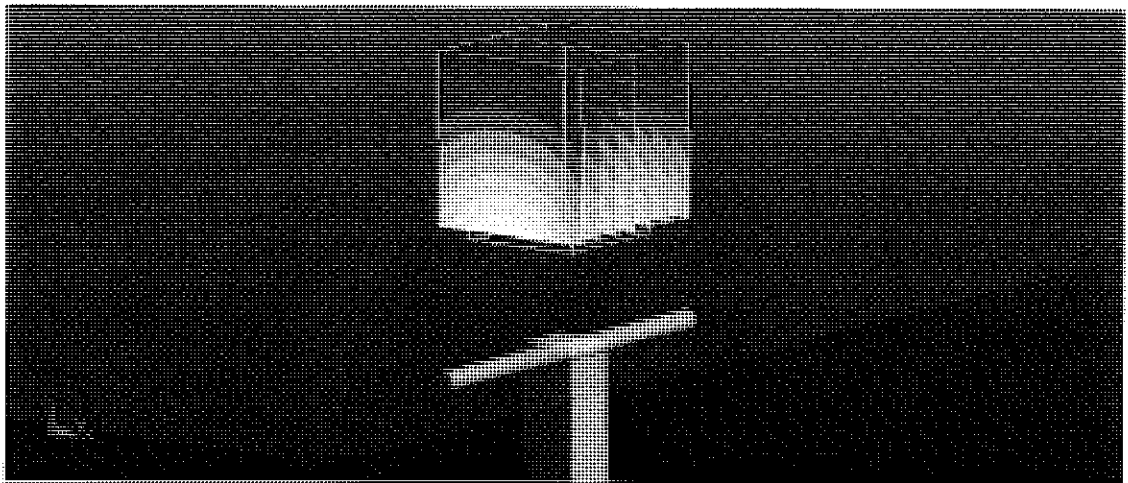
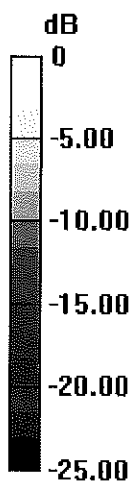
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 96.173 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 18.0 W/kg

SAR(1 g) = 9.99 W/kg; SAR(10 g) = 5.28 W/kg

Maximum value of SAR (measured) = 12.4 W/kg



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

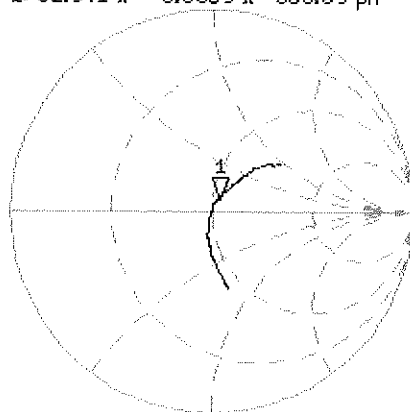
Impedance Measurement Plot for Head TSL

22 Jul 2013 11:59:34
 CH1 S11 1 U FS 1: 52.941 Ω 6.0059 Ω 503.09 μ H 1 900.000 000 MHz

*
 Del
 CA

Avg
 16

H1d

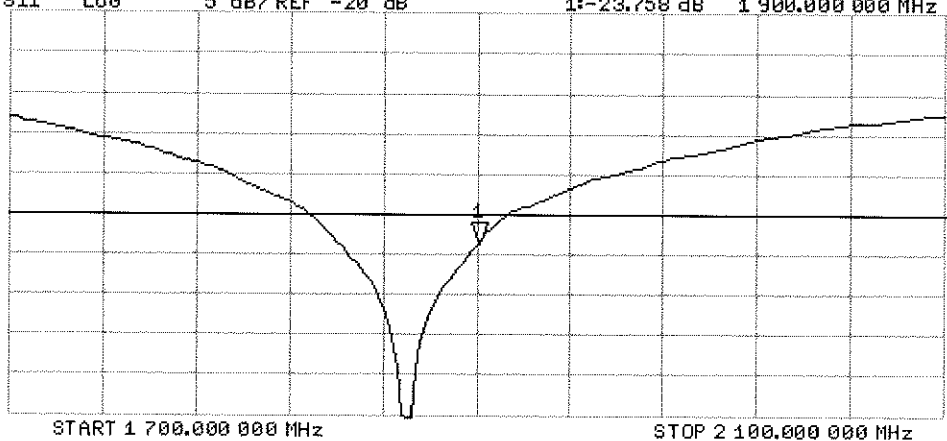


CH2 S11 LOG 5 dB/REF -20 dB 1:-23.758 dB 1 900.000 000 MHz

CA

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.49$ S/m; $\epsilon_r = 53.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

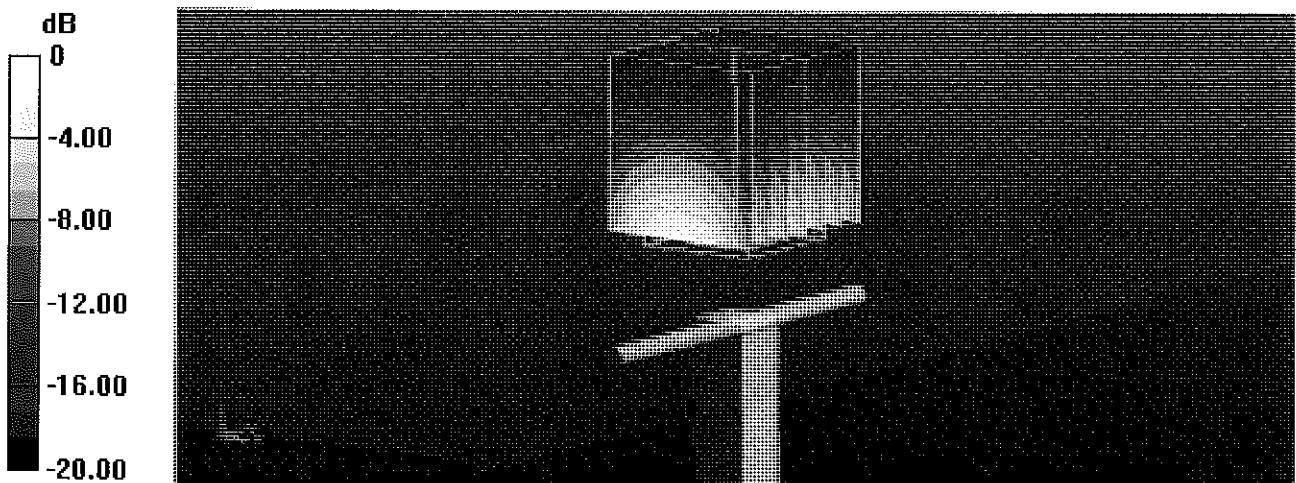
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.173 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 10 W/kg; SAR(10 g) = 5.36 W/kg

Maximum value of SAR (measured) = 12.6 W/kg

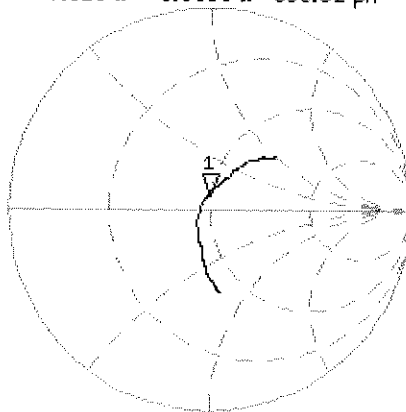


0 dB = 12.6 W/kg = 11.00 dBW/kg

Impedance Measurement Plot for Body TSL

22 Jul 2013 11:32:14
[CH1] S11 1 U FS 1: 48.525 Δ 6.3906 Δ 535.32 pH 1 900.000 000 MHz

*
De1
CA



Avg
16

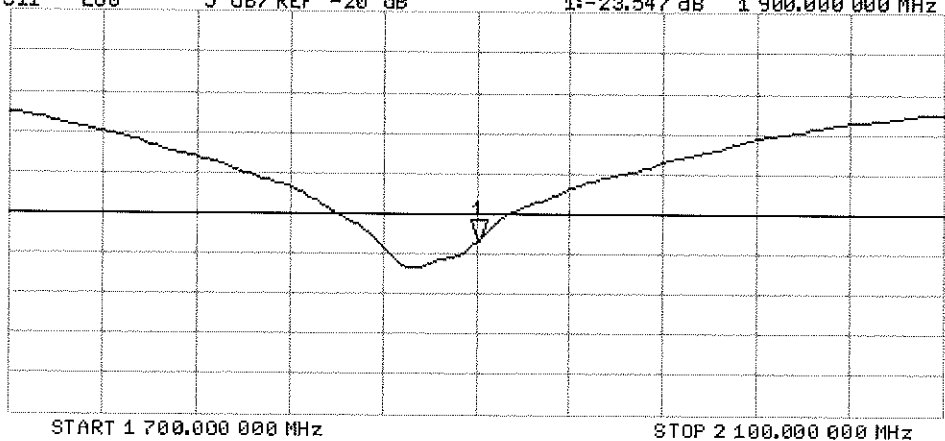
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -23.547 dB 1 900.000 000 MHz

CA

Avg
16

H1d





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Accreditation No.: **SCS 108**

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Client **PC Test**

Certificate No: **D2450V2-719_Aug13**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 719**

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

Calibration date: **August 23, 2013**

✓cc
9/13/13

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Jeton Kastrati** Name: **Jeton Kastrati** Function: **Laboratory Technician** Signature:

Approved by: **Katja Pokovic** Name: **Katja Pokovic** Function: **Technical Manager** Signature:

Issued: August 23, 2013

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Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.8 $\pm$ 6 %	1.80 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.2 W/kg $\pm$ 17.0 % (k=2)

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

Body TSL parameters

The following parameters and calculations were applied.

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

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$54.6 \Omega + 3.5 j\Omega$
Return Loss	- 25.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$51.1 \Omega + 5.4 j\Omega$
Return Loss	- 25.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 22.08.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.8$ S/m; $\epsilon_r = 37.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

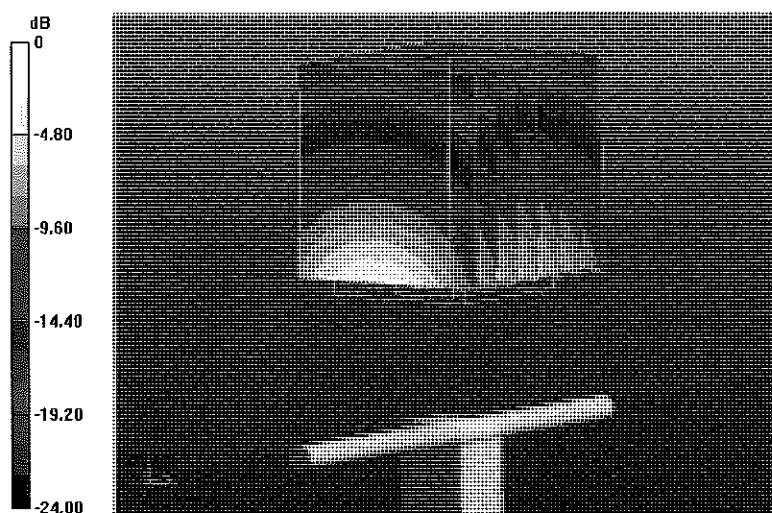
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.7 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 27.9 W/kg

SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.23 W/kg

Maximum value of SAR (measured) = 17.0 W/kg

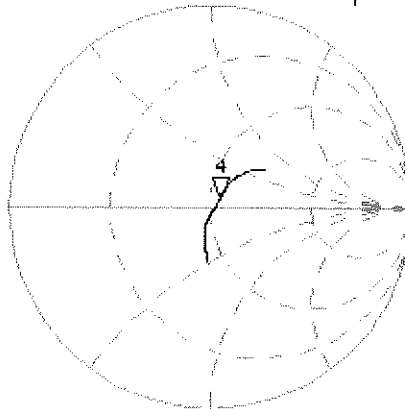


0 dB = 17.0 W/kg = 12.30 dBW/kg

Impedance Measurement Plot for Head TSL

22 Aug 2013 11:00:15
 [CH1] S11 1 U FS 4: 54.639 Ω 3.5215 Ω 228.76 pH 2 450.000 000 MHz

*
 De1
 CA



Avg
 16

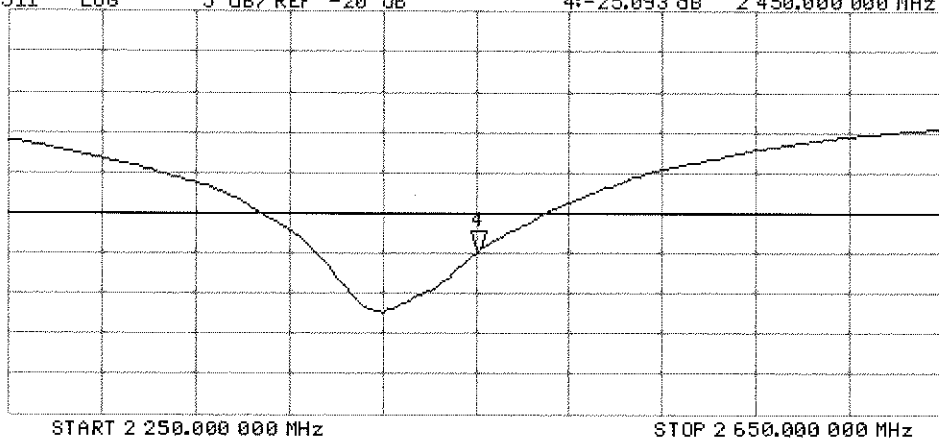
H1d

CH2 S11 LOG 5 dB/REF -20 dB 4: -25.093 dB 2 450.000 000 MHz

CA

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 23.08.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.03$ S/m; $\epsilon_r = 50.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

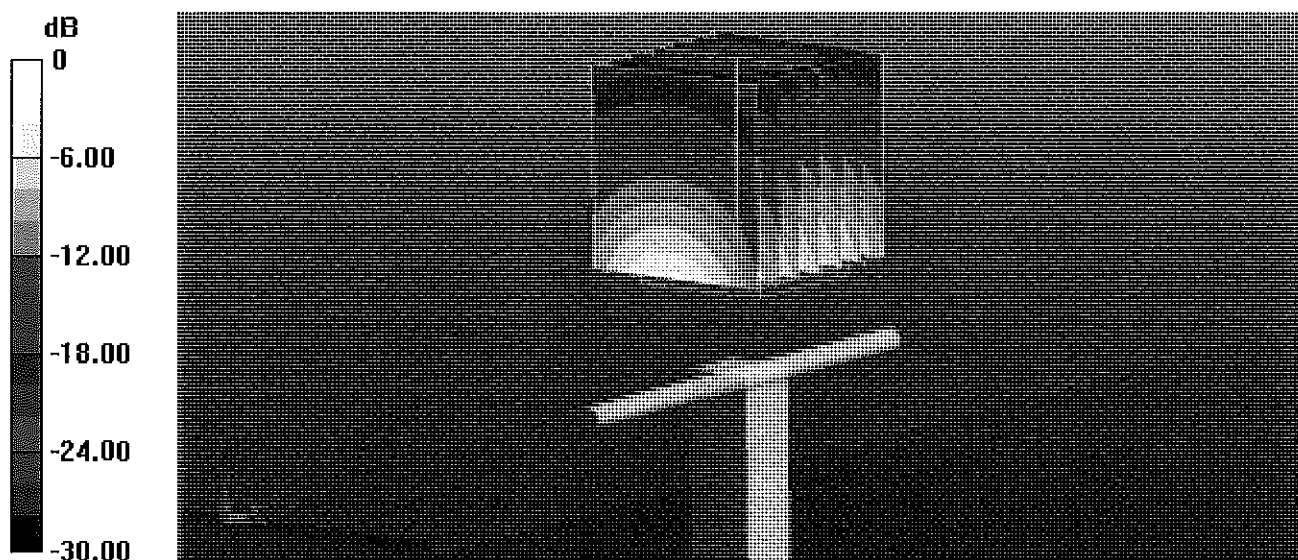
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.688 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 27.9 W/kg

SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.14 W/kg

Maximum value of SAR (measured) = 17.2 W/kg

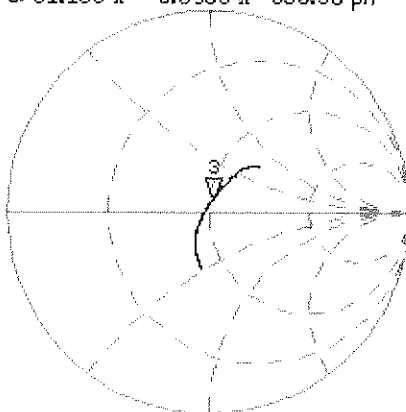


0 dB = 17.2 W/kg = 12.36 dBW/kg

Impedance Measurement Plot for Body TSL

23 Aug 2013 09:00:38
 CH1 S11 1 U FS 3: 51.135 Ω 5.3965 Ω 350.56 μ H 2 450.000 000 MHz

 Del
 CA



Avg
 16

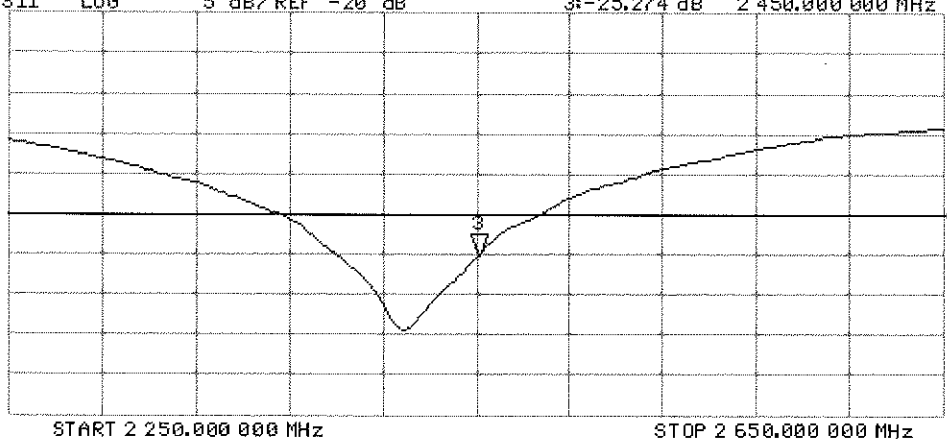
H1d

CH2 S11 LOG 5 dB/REF -20 dB 3:-25.274 dB 2 450.000 000 MHz

CA

Avg
 16

H1d





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Client **PC Test**

Certificate No: **D5GHzV2-1007_Sep13/2**

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

Object **D5GHzV2 - SN: 1007**

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

CC✓
10/15/13

Calibration date: **September 23, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Leif Klysner** Function: **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** Technical Manager

Issued: October 4, 2013

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz $\pm$ 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	35.8 $\pm$ 6 %	4.48 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.77 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.5 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.2 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 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	80.2 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.9 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.9 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.28 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	72.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.8 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.0 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.75 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.5 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.31 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	72.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.02 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.1 W/kg ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

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

Antenna Parameters with Head TSL at 5300 MHz

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

Antenna Parameters with Head TSL at 5500 MHz

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

Antenna Parameters with Head TSL at 5600 MHz

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

Antenna Parameters with Head TSL at 5800 MHz

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

Antenna Parameters with Body TSL at 5200 MHz

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

Antenna Parameters with Body TSL at 5300 MHz

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

Antenna Parameters with Body TSL at 5500 MHz

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

Antenna Parameters with Body TSL at 5600 MHz

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

Antenna Parameters with Body TSL at 5800 MHz

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 28, 2003

DASY5 Validation Report for Head TSL

Date: 23.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.48$ S/m; $\epsilon_r = 35.8$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.62$ S/m; $\epsilon_r = 35.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.76$ S/m; $\epsilon_r = 35.4$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.86$ S/m; $\epsilon_r = 35.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.07$ S/m; $\epsilon_r = 35$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.505 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 28.1 W/kg

SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.23 W/kg

Maximum value of SAR (measured) = 18.1 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.817 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 29.7 W/kg

SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.3 W/kg

Maximum value of SAR (measured) = 18.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.029 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 32.0 W/kg

SAR(1 g) = 8.17 W/kg; SAR(10 g) = 2.32 W/kg

Maximum value of SAR (measured) = 19.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.403 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 31.3 W/kg

SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.28 W/kg

Maximum value of SAR (measured) = 19.3 W/kg

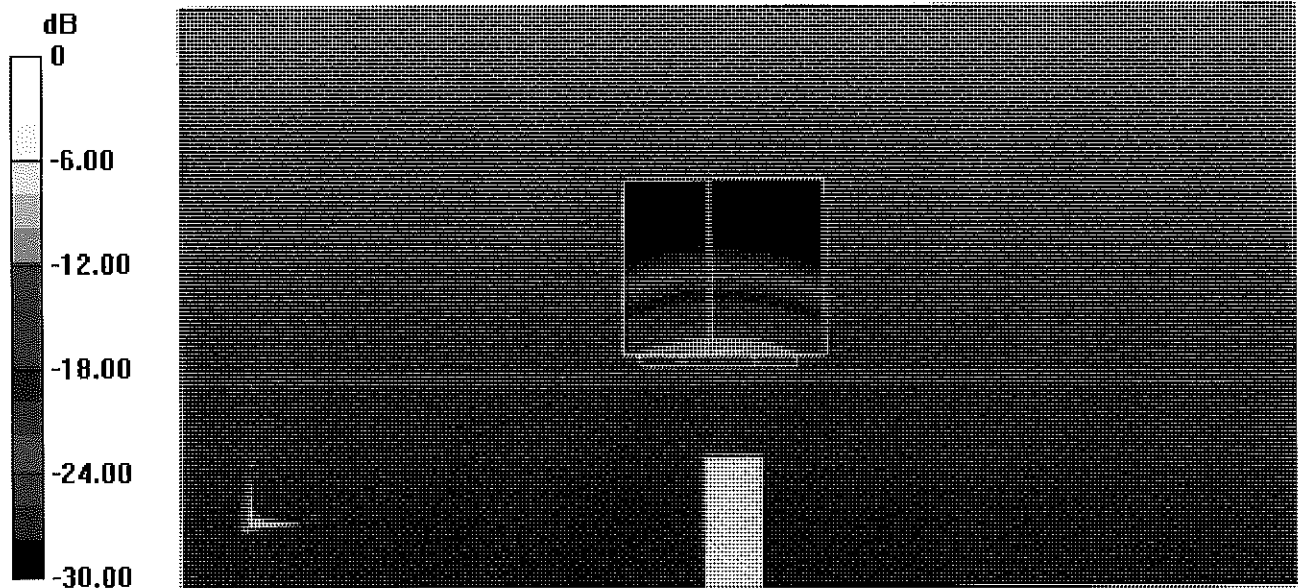
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 60.987 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 31.9 W/kg

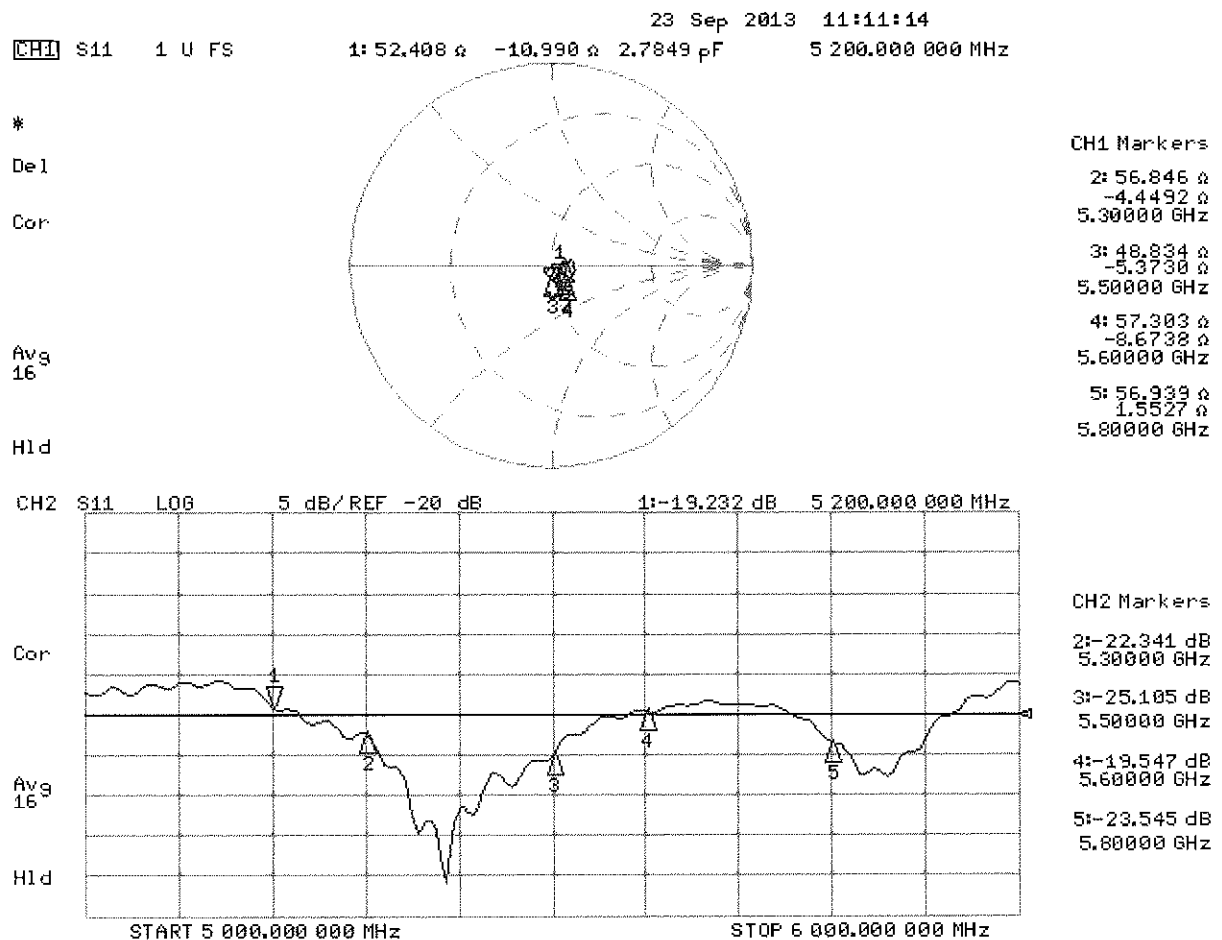
SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.2 W/kg

Maximum value of SAR (measured) = 19.0 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 20.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.36$ S/m; $\epsilon_r = 48.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 5.56$ S/m; $\epsilon_r = 48.1$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.75$ S/m; $\epsilon_r = 47.8$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.88$ S/m; $\epsilon_r = 47.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.17$ S/m; $\epsilon_r = 47.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.606 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 28.6 W/kg

SAR(1 g) = 7.28 W/kg; SAR(10 g) = 2.03 W/kg

Maximum value of SAR (measured) = 17.2 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.305 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 30.3 W/kg

SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.09 W/kg

Maximum value of SAR (measured) = 17.8 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.471 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 32.4 W/kg

SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.11 W/kg

Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.333 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 33.8 W/kg

SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.16 W/kg

Maximum value of SAR (measured) = 19.1 W/kg

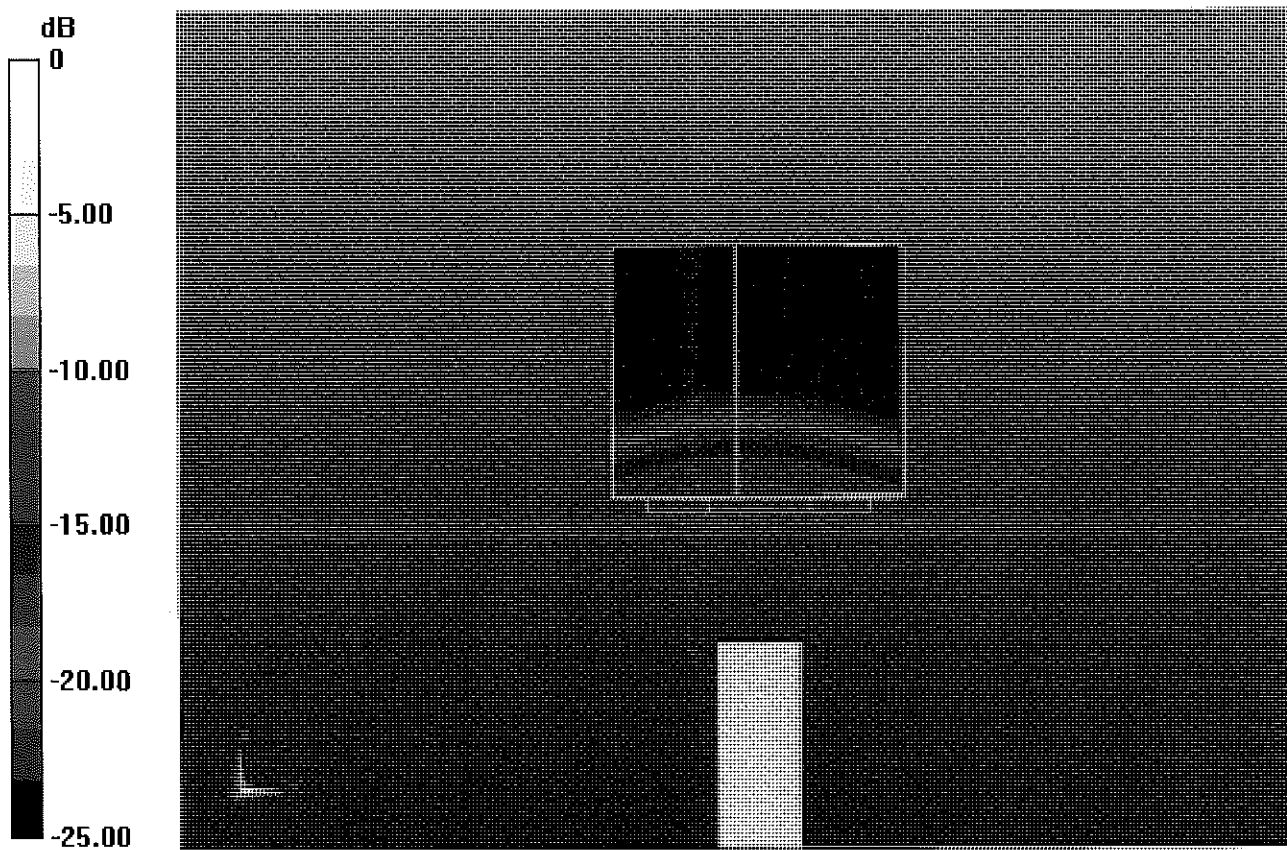
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 55.389 V/m; Power Drift = 0.00 dB

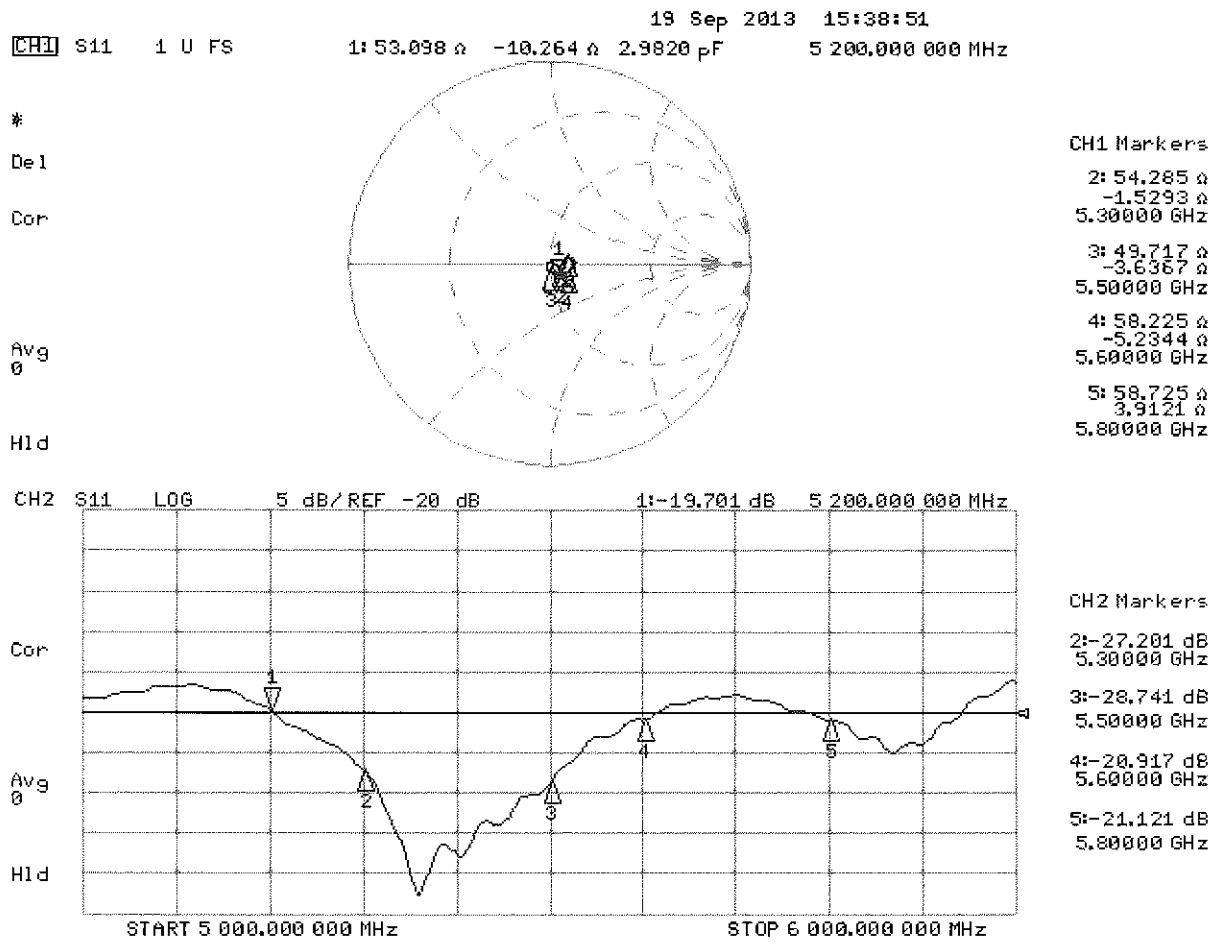
Peak SAR (extrapolated) = 34.1 W/kg

SAR(1 g) = 7.31 W/kg; SAR(10 g) = 2.02 W/kg

Maximum value of SAR (measured) = 18.3 W/kg



Impedance Measurement Plot for Body TSL





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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D5GHzV2-1057_Jan14**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1057**

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

Calibration date: **January 27, 2014**

CC
2/5/14 ✓

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ 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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	30-Dec-13 (No. EX3-3503_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Approved by: **Katja Pokovic** **Technical Manager**

Signature

Israe El-Naouq

Katja Pokovic

Issued: January 27, 2014

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



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

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz $\pm$ 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	35.0 $\pm$ 6 %	4.45 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.85 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.0 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.3 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.0 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.50 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.0 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.00 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.6 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5200 MHz

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

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

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5300 MHz

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

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

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.96 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	79.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.0 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 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	80.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5800 MHz

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

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

Appendix

Antenna Parameters with Head TSL at 5200 MHz

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

Antenna Parameters with Head TSL at 5300 MHz

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

Antenna Parameters with Head TSL at 5500 MHz

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

Antenna Parameters with Head TSL at 5600 MHz

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

Antenna Parameters with Head TSL at 5800 MHz

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

Antenna Parameters with Body TSL at 5200 MHz

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

Antenna Parameters with Body TSL at 5300 MHz

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

Antenna Parameters with Body TSL at 5500 MHz

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

Antenna Parameters with Body TSL at 5600 MHz

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

Antenna Parameters with Body TSL at 5800 MHz

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.186 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 27, 2006

DASY5 Validation Report for Head TSL

Date: 27.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.45$ S/m; $\epsilon_r = 35$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.54$ S/m; $\epsilon_r = 34.9$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.74$ S/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.86$ S/m; $\epsilon_r = 34.5$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.07$ S/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.497 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 28.2 W/kg

SAR(1 g) = 7.85 W/kg; SAR(10 g) = 2.25 W/kg

Maximum value of SAR (measured) = 18.6 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.444 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 31.2 W/kg

SAR(1 g) = 8.36 W/kg; SAR(10 g) = 2.4 W/kg

Maximum value of SAR (measured) = 20.1 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.807 V/m; Power Drift = 0.07 dB

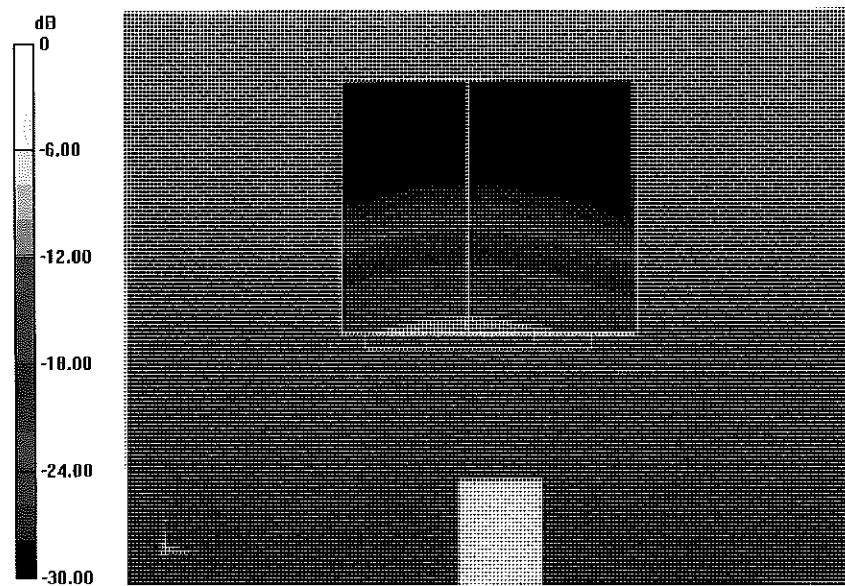
Peak SAR (extrapolated) = 33.0 W/kg

SAR(1 g) = 8.5 W/kg; SAR(10 g) = 2.42 W/kg

Maximum value of SAR (measured) = 20.8 W/kg

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

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

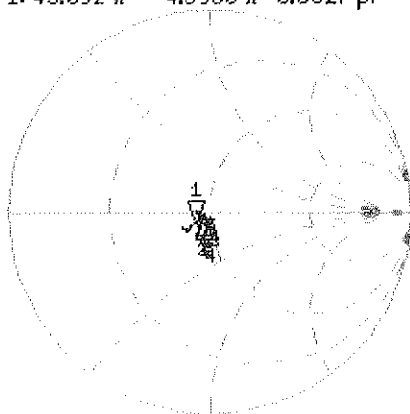


0 dB = 19.9 W/kg = 12.99 dBW/kg

Impedance Measurement Plot for Head TSL

27 Jan 2014 17:12:04
 CH1 S11 1 U FS 1: 43.092 Ω -4.5938 Ω 6.6627 pF 5 200.000 000 MHz

*
 Del
 Cor
 Avg
 16
 H1d

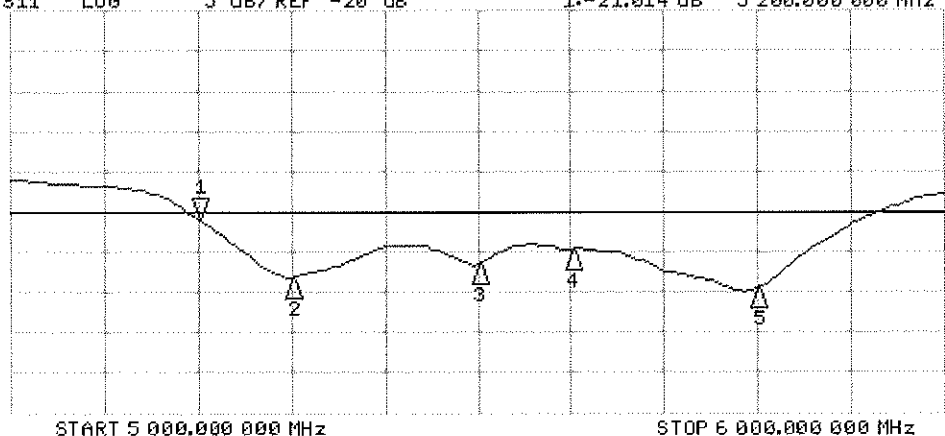


CH1 Markers

2: 46.475 Ω
 -1.3496 Ω
 5.30000 GHz
 3: 46.150 Ω
 -2.5078 Ω
 5.50000 GHz
 4: 48.900 Ω
 -5.6932 Ω
 5.60000 GHz
 5: 48.734 Ω
 -3.0762 Ω
 5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -21.014 dB 5 200.000 000 MHz

Del
 Cor
 Avg
 16
 H1d



CH2 Markers

2: -28.145 dB
 5.30000 GHz
 3: -26.415 dB
 5.50000 GHz
 4: -24.640 dB
 5.60000 GHz
 5: -29.464 dB
 5.80000 GHz

DASY5 Validation Report for Body TSL

Date: 24.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.44$ S/m; $\epsilon_r = 47.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 5.57$ S/m; $\epsilon_r = 47.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.84$ S/m; $\epsilon_r = 46.8$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.98$ S/m; $\epsilon_r = 46.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.23$ S/m; $\epsilon_r = 46.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.809 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 30.1 W/kg

SAR(1 g) = 7.58 W/kg; SAR(10 g) = 2.12 W/kg

Maximum value of SAR (measured) = 18.2 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.585 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 32.2 W/kg

SAR(1 g) = 7.79 W/kg; SAR(10 g) = 2.17 W/kg

Maximum value of SAR (measured) = 19.1 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.364 V/m; Power Drift = -0.01 dB

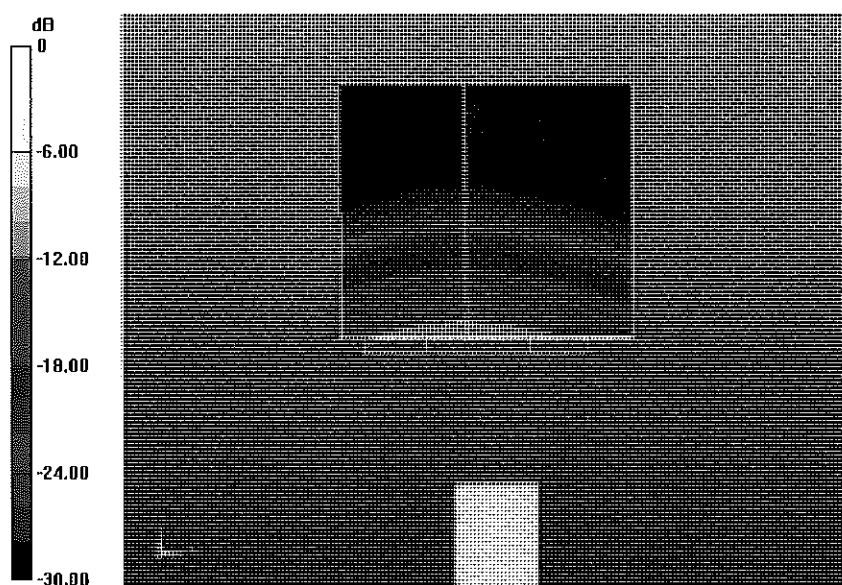
Peak SAR (extrapolated) = 34.4 W/kg

SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (measured) = 19.4 W/kg

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

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

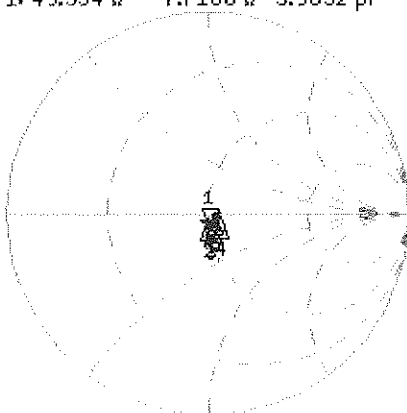


0 dB = 18.8 W/kg = 12.74 dBW/kg

Impedance Measurement Plot for Body TSL

24 Jan 2014 15:50:22
CH1 S11 1 U FS 1: 49.354 Ω -7.7188 Ω 3.9652 pF 5 200.000 000 MHz

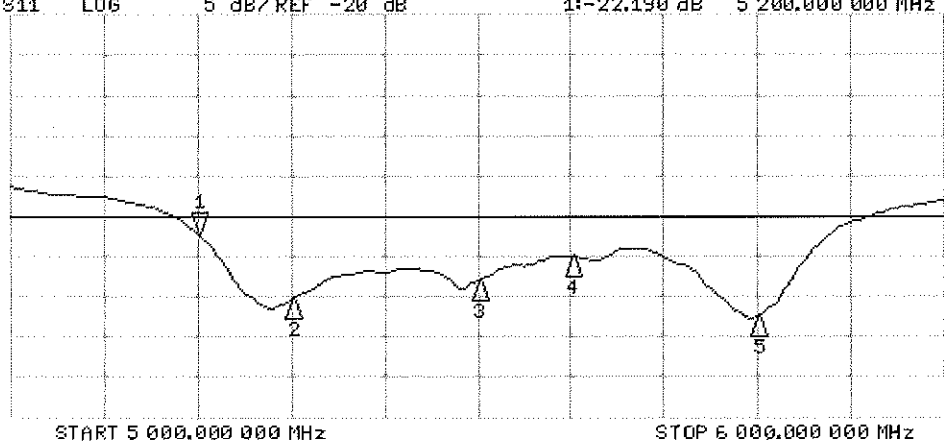
*
 Del
 Cor
 Avg
 16
 H1d



CH1 Markers
 2: 49.559 Ω
 -3.0176 Ω
 5.30000 GHz
 3: 50.793 Ω
 -3.9160 Ω
 5.50000 GHz
 4: 55.393 Ω
 -2.5176 Ω
 5.60000 GHz
 5: 52.320 Ω
 -716.80 m Ω
 5.80000 GHz

CH2 S11 L06 5 dB/REF -20 dB 1:-22.190 dB 5 200.000 000 MHz

Cor
 Avg
 16
 H1d



CH2 Markers
 2:-30.277 dB
 5.30000 GHz
 3:-28.039 dB
 5.50000 GHz
 4:-24.960 dB
 5.60000 GHz
 5:-32.401 dB
 5.80000 GHz



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Client **PC Test**

Certificate No: **D835V2-4d132_Jan14**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d132**

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

Calibration date: **January 22, 2014**

CC
21/14 ✓

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ 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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Jeton Kastrati** Function: **Laboratory Technician** Signature:

Approved by: **Katja Pokovic** Technical Manager Signature:

Issued: January 22, 2014

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

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

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.6 $\pm$ 6 %	0.93 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	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.20 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.02 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.6 $\pm$ 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	2.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.31 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.56 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.08 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.9 Ω - 1.4 j Ω
Return Loss	- 32.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.0 Ω - 2.9 j Ω
Return Loss	- 27.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.389 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 22, 2011

DASY5 Validation Report for Head TSL

Date: 22.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.93$ S/m; $\epsilon_r = 40.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

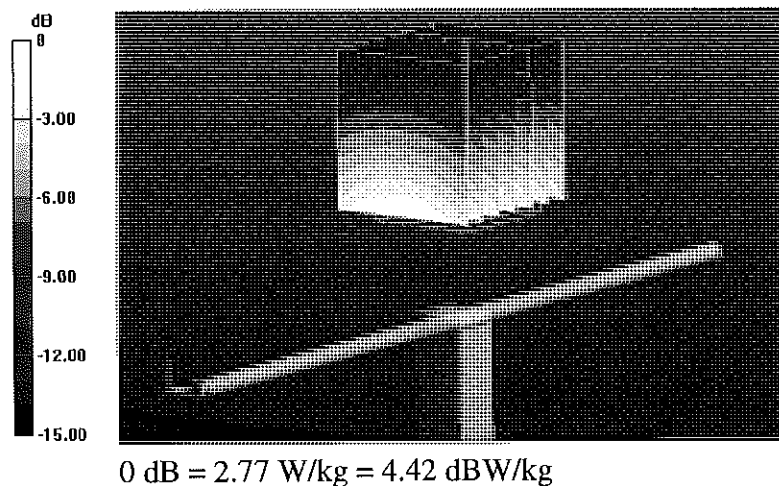
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.681 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.56 W/kg

SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.54 W/kg

Maximum value of SAR (measured) = 2.77 W/kg



Impedance Measurement Plot for Head TSL

22 Jan 2014 12:03:00
 CH1 S11 1 U FS 1: 51.861 $\angle$ -1.3574 $\angle$ 140.42 pF 835.000 000 MHz

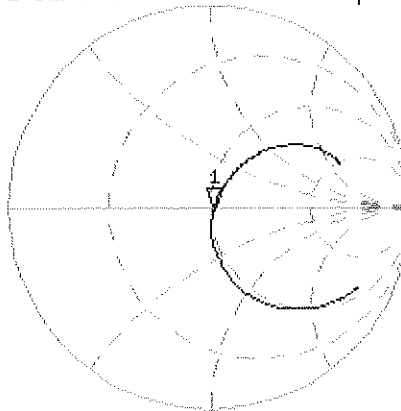
*

De1

CA

Avg
16

H1d

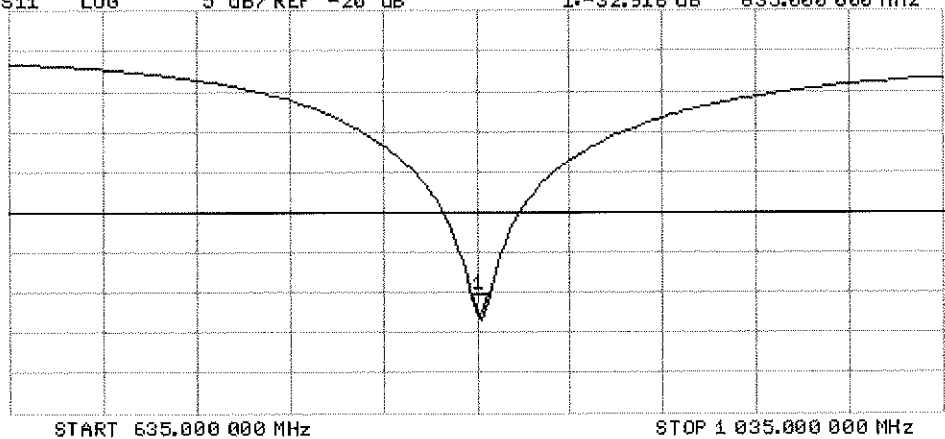


CH2 S11 LOG 5 dB/REF -20 dB 1: -32.916 dB 835.000 000 MHz

CA

Avg
16

H1d



DASY5 Validation Report for Body TSL

Date: 20.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.007 \text{ S/m}$; $\epsilon_r = 53.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

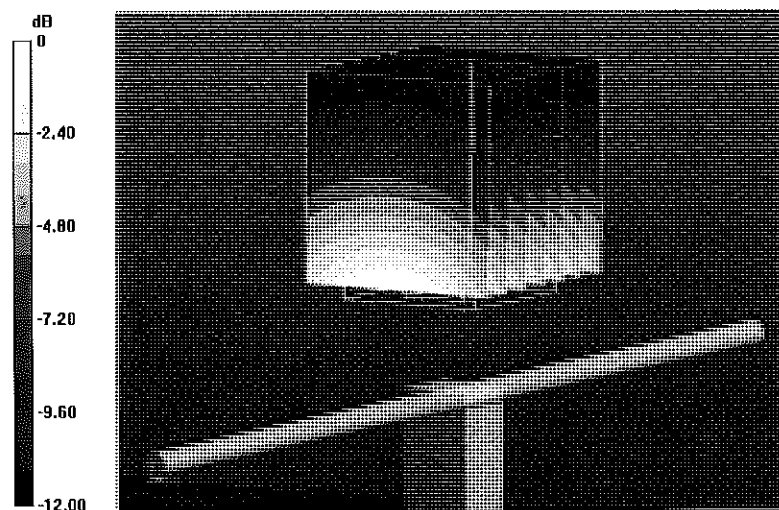
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 54.687 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.57 W/kg

SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.56 W/kg

Maximum value of SAR (measured) = 2.79 W/kg

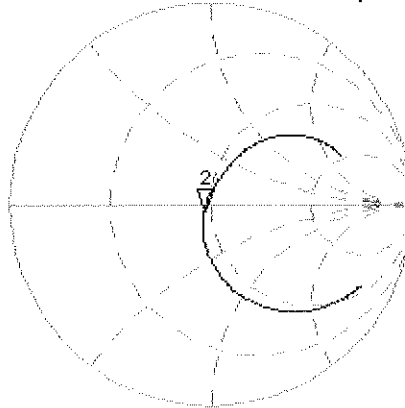


0 dB = 2.79 W/kg = 4.46 dBW/kg

Impedance Measurement Plot for Body TSL

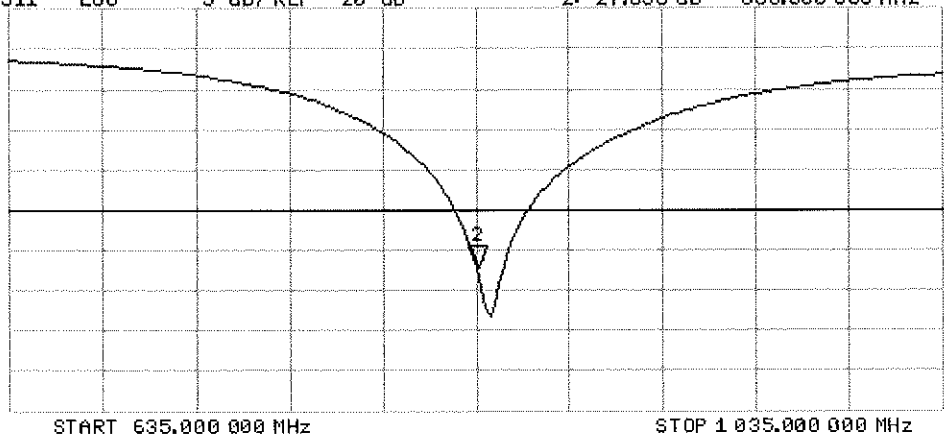
20 Jan 2014 10:35:09
 CH1 S11 1 U FS 2: 46.990 Ω -2.8711 Ω 66.388 pF 835.000 000 MHz

*
 De1
 CA
 Avg
 16
 H1d



CH2 S11 LOG 5 dB/REF -20 dB 21-27.356 dB 835.000 000 MHz

CA
 Avg
 16
 H1d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d119_Apr14**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d119**

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

CCV
4/25/14

Calibration date: **April 07, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: April 9, 2014

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Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 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	41.6 $\pm$ 6 %	0.94 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

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

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

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.6 $\pm$ 6 %	1.02 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	2.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.34 W/kg $\pm$ 17.0 % (k=2)

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

Appendix

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

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

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 29, 2010

DASY5 Validation Report for Head TSL

Date: 07.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.94$ S/m; $\epsilon_r = 41.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

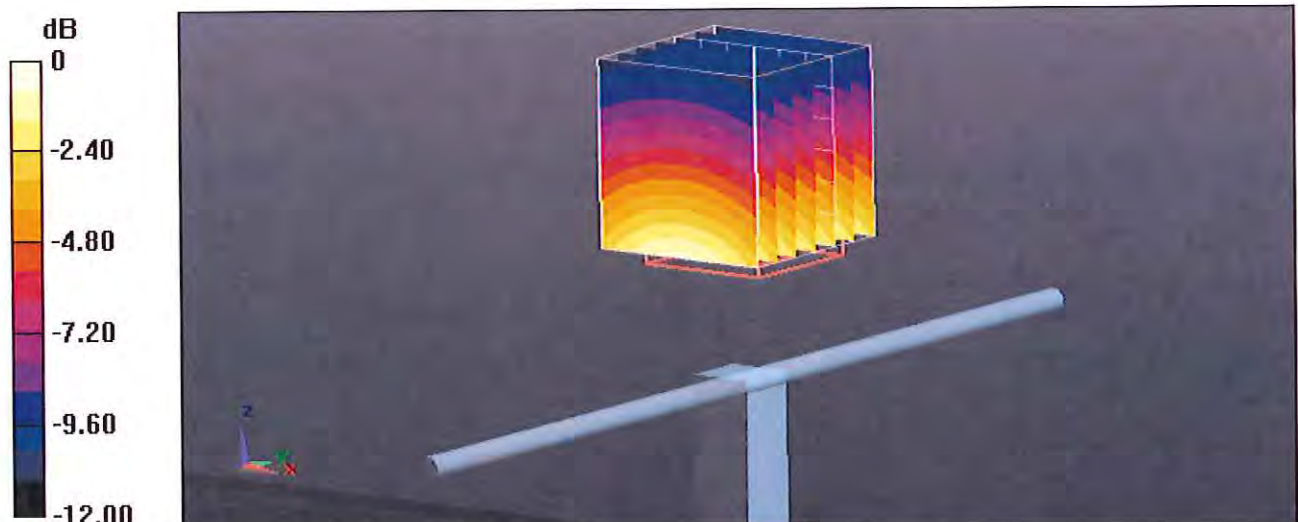
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.289 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.59 W/kg

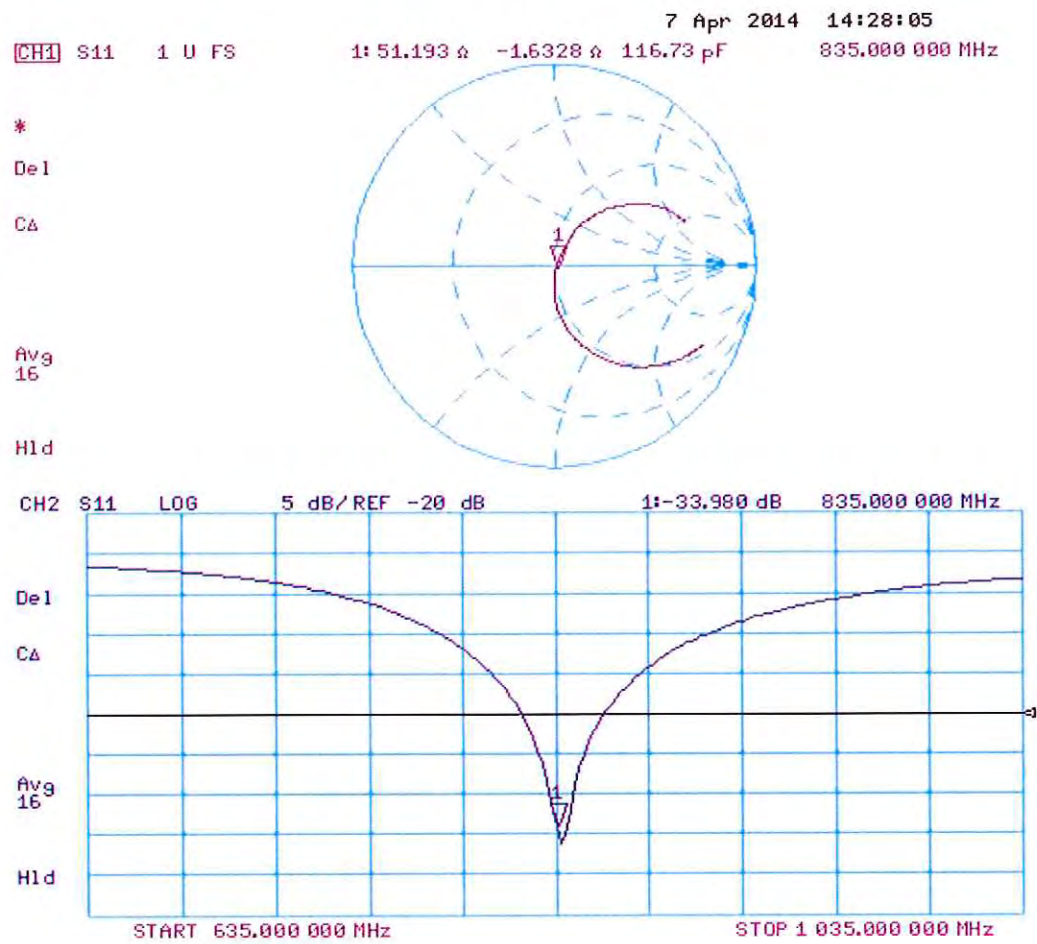
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.53 W/kg

Maximum value of SAR (measured) = 2.80 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 1.02$ S/m; $\epsilon_r = 53.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

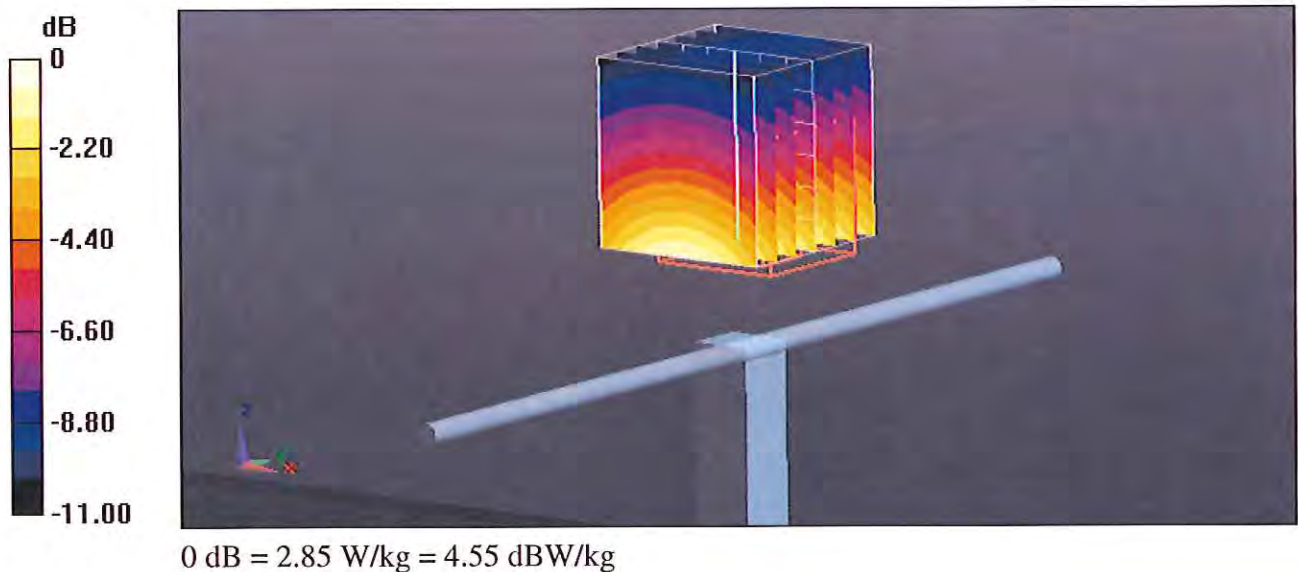
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.594 V/m; Power Drift = -0.01 dB

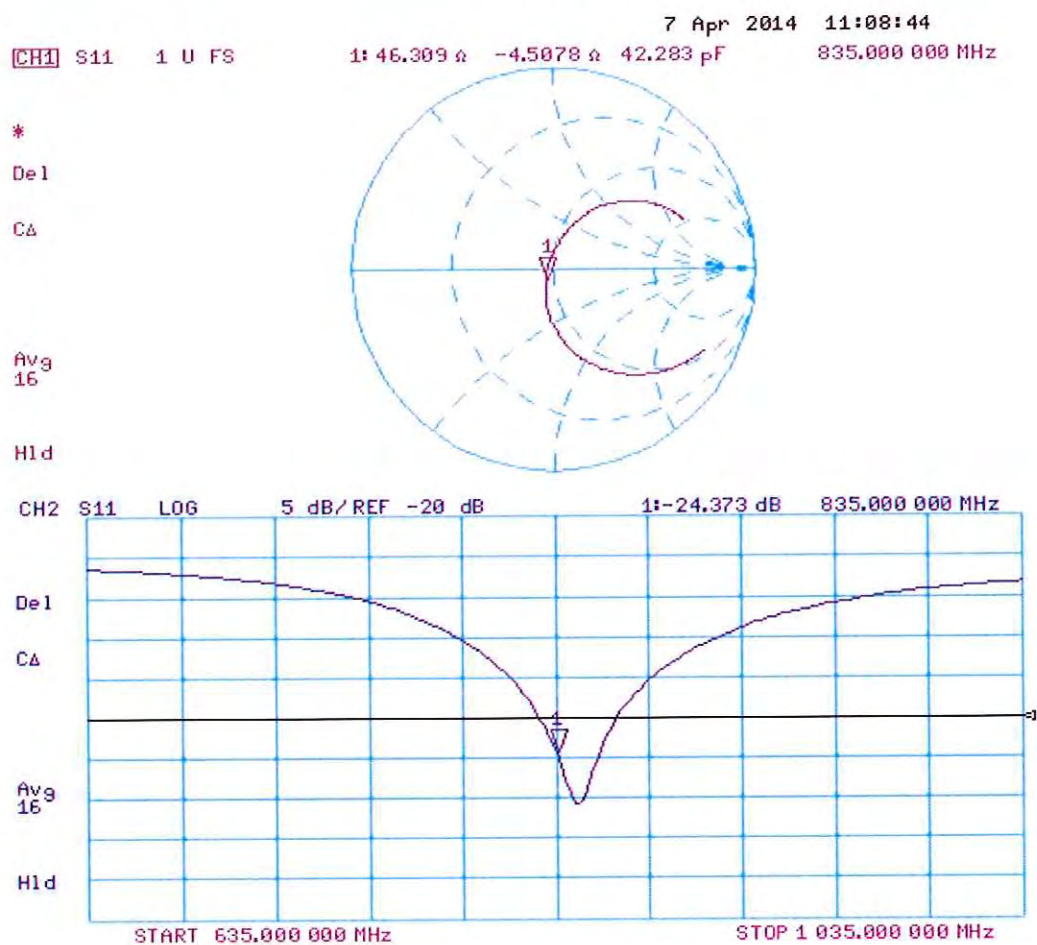
Peak SAR (extrapolated) = 3.61 W/kg

SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.85 W/kg



Impedance Measurement Plot for Body TSL



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 Page 2		See Page 3	
DGBE			44.92	29.44		26.7		
HEC	1	1						
NaCl	1.45	0.94	0.18	0.39		0.1		
Sucrose	57	44.9						
Polysorbate (Tween) 80								20
Water	40.45	53.06	54.9	70.17		73.2		80

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			APPENDIX D: Page 1 of 3

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 (HSL2450V2)
Product No.	SL AAH 245 BA (Charge: 130212-2)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within $\pm 2.5\%$ towards the target values of Methanol.

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	23°C
Test Date	13-Feb-13
Operator	DI

Additional Information

TSL Density	0.988 g/cm ³
TSL Heat-capacity	3.680 kJ/(kg*K)

f (MHz)	Measured			Target		Diff. to Target [%]	
	HP-e*	HP-a*	sigma	eps	sigma	Δ-eps	Δ-sigma
1900	40.4	11.94	1.26	40.0	1.40	1.0	-9.9
1925	40.3	12.02	1.29	40.0	1.40	0.7	-8.0
1950	40.2	12.11	1.31	40.0	1.40	0.5	-6.2
1975	40.1	12.20	1.34	40.0	1.40	0.2	-4.2
2000	40.0	12.29	1.37	40.0	1.40	-0.1	-2.3
2025	39.9	12.39	1.40	40.0	1.42	-0.2	-1.9
2050	39.8	12.49	1.42	39.9	1.44	-0.4	-1.4
2075	39.6	12.57	1.45	39.9	1.47	-0.6	-1.1
2100	39.5	12.65	1.48	39.8	1.49	-0.7	-0.7
2125	39.4	12.74	1.51	39.8	1.51	-0.9	-0.4
2150	39.3	12.82	1.53	39.7	1.53	-1.0	0.0
2175	39.2	12.89	1.56	39.7	1.56	-1.2	0.3
2200	39.1	12.97	1.59	39.6	1.58	-1.3	0.6
2225	39.0	13.04	1.61	39.6	1.60	-1.5	0.9
2250	38.9	13.11	1.64	39.6	1.62	-1.7	1.2
2275	38.8	13.20	1.67	39.5	1.64	-1.8	1.6
2300	38.7	13.28	1.70	39.5	1.67	-2.0	2.0
2325	38.6	13.35	1.73	39.4	1.69	-2.1	2.3
2350	38.5	13.42	1.75	39.4	1.71	-2.3	2.6
2375	38.4	13.50	1.78	39.3	1.73	-2.4	2.9
2400	38.3	13.58	1.81	39.3	1.75	-2.6	3.3
2425	38.2	13.65	1.84	39.2	1.78	-2.7	3.6
2450	38.1	13.73	1.87	39.2	1.80	-2.9	4.0
2475	38.0	13.79	1.90	39.2	1.83	-3.1	3.9
2500	37.9	13.85	1.93	39.1	1.85	-3.3	3.9
2525	37.8	13.94	1.96	39.1	1.88	-3.4	4.0
2550	37.7	14.02	1.99	39.1	1.91	-3.6	4.2
2575	37.6	14.09	2.02	39.0	1.94	-3.8	4.3
2600	37.5	14.17	2.05	39.0	1.96	-4.0	4.4
2625	37.4	14.23	2.08	39.0	1.99	-4.2	4.4
2650	37.3	14.29	2.11	38.9	2.02	-4.3	4.4
2675	37.1	14.36	2.14	38.9	2.05	-4.5	4.5
2700	37.0	14.43	2.17	38.9	2.07	-4.8	4.6

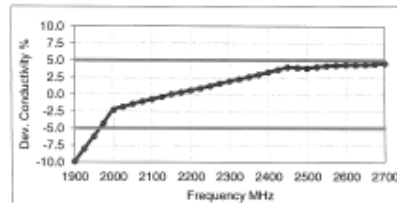
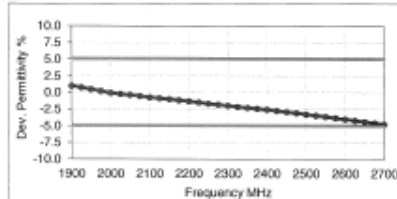


Figure D-2

2.4 GHz Head Tissue Equivalent Matter

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	APPENDIX D: Page 2 of 3		

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 AC (Charge: 130903-1)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within $\pm 2.5\%$ towards the target values of Methanol.

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	4-Sep-13
Operator	IEN

Additional Information

TSL Density	0.985 g/cm ³
TSL Heat-capacity	3.383 kJ/(kg°K)

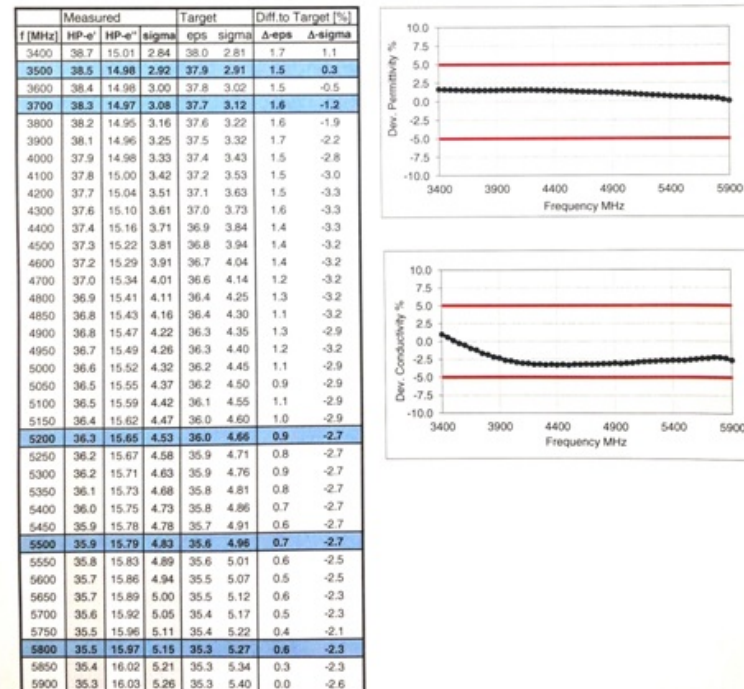


Figure D-4
5GHz Head Tissue Equivalent Matter

FCC ID: A3LSMT2558		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			APPENDIX D: Page 3 of 3

APPENDIX E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01 v01 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table E-I
SAR System Validation Summary

SAR SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
							(σ)	(ϵ_r)	SENSI- TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
E	835	12/31/2013	3914	EX3DV4	835	Head	0.909	40.02	PASS	PASS	PASS	GMSK	PASS	N/A
K	1900	1/15/2014	3333	ES3DV3	1900	Head	1.400	39.37	PASS	PASS	PASS	GMSK	PASS	N/A
G	1900	3/7/2014	3258	ES3DV3	1900	Head	1.448	40.49	PASS	PASS	PASS	GMSK	PASS	N/A
K	2450	1/17/2014	3333	ES3DV3	2450	Head	1.885	37.27	PASS	PASS	PASS	OFDM	N/A	PASS
E	5200	12/3/2013	3914	EX3DV4	5200	Head	4.482	34.70	PASS	PASS	PASS	OFDM	N/A	PASS
E	5300	12/3/2013	3914	EX3DV4	5300	Head	4.604	34.60	PASS	PASS	PASS	OFDM	N/A	PASS
E	5600	12/3/2013	3914	EX3DV4	5600	Head	4.907	34.13	PASS	PASS	PASS	OFDM	N/A	PASS
E	5800	12/3/2013	3914	EX3DV4	5800	Head	5.133	33.89	PASS	PASS	PASS	OFDM	N/A	PASS
D	835	10/8/2013	3022	ES3DV2	835	Body	1.012	53.65	PASS	PASS	PASS	GMSK	PASS	N/A
H	1900	3/17/2014	3589	EX3DV4	1900	Body	1.577	52.62	PASS	PASS	PASS	GMSK	PASS	N/A
D	1900	9/10/2013	3022	ES3DV2	1900	Body	1.516	52.49	PASS	PASS	PASS	GMSK	PASS	N/A
G	2450	3/5/2014	3258	ES3DV3	2450	Body	2.044	51.30	PASS	PASS	PASS	OFDM	N/A	PASS
K	2450	1/23/2014	3333	ES3DV3	2450	Body	1.944	50.34	PASS	PASS	PASS	OFDM	N/A	PASS
A	5200	1/13/2014	3920	EX3DV4	5200	Body	5.344	47.27	PASS	PASS	PASS	OFDM	N/A	PASS
A	5300	1/13/2014	3920	EX3DV4	5300	Body	5.500	46.91	PASS	PASS	PASS	OFDM	N/A	PASS
A	5600	1/13/2014	3920	EX3DV4	5600	Body	5.991	46.16	PASS	PASS	PASS	OFDM	N/A	PASS
A	5800	1/23/2014	3920	EX3DV4	5800	Body	6.282	46.05	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.

FCC ID: A3LSMT2558	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	APPENDIX E: Page 1 of 1

APPENDIX G: SENSOR TRIGGERING DATA SUMMARY

FCC ID: A3LSMT2558	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			APPENDIX G: Page 1 of 6

A3LSMT2558 Sensor Triggering Data Summary

Per FCC KDB Publication 616217 D04v01, this device was tested by the manufacturer to determine the proximity sensor triggering distances for the back side, bottom, right, and left edges of the device. The measured output power within ± 5 mm of the triggering points (or until touching the phantom) is included for back side and each applicable edge.

To ensure all production units are compliant it is necessary to test SAR at a distance 1 mm less than the smallest distance from the device and SAR phantom (determined from these triggering tests according to the KDB 616217 D04v01) with the device at maximum output power without power reduction. These SAR Tests are included in addition to the SAR tests for the device touching the SAR phantom, with reduced power.

The operational description contains information explaining how this device remains compliant in the event of a sensor malfunction.

FCC ID: A3LSMT2558	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet	APPENDIX G: Page 2 of 6

Back Side

Moving device toward the phantom:

KDB 616217 6.2.6 Measured Power [dBm]											
Distance[mm]	21	20	19	18	17	16	15	14	13	12	11
GSM850	32.86	32.72	32.76	32.66	32.8	24.35	24.35	24.33	24.63	24.5	24.48
GSM1900	29.86	29.62	29.86	29.71	29.92	19.9	19.71	19.77	19.93	19.81	19.74
GPRS 850 1Tx	32.86	32.94	32.95	32.88	32.65	24.46	24.47	24.35	24.34	24.59	24.43
GPRS 850 2Tx	30.78	30.61	30.61	30.61	30.87	20.82	20.61	20.81	20.79	20.75	20.79
GPRS 850 3Tx	29.33	29.27	29.16	29.27	29.29	18.62	18.94	18.65	18.64	18.91	18.78
GPRS 850 4Tx	26.84	26.75	26.89	26.9	26.85	17.26	17.43	17.22	17.33	17.21	17.11
GPRS 1900 1Tx	29.73	29.84	29.86	29.89	29.61	19.75	19.84	19.78	19.84	19.82	19.79
GPRS 1900 2Tx	27.77	27.85	27.66	27.67	27.61	19.89	19.65	19.86	19.92	19.73	19.9
GPRS 1900 3Tx	26.13	26.27	26.2	26.34	26.13	19.8	19.7	19.83	19.79	19.74	19.67
GPRS 1900 4Tx	24.15	24.1	24.36	24.15	24.42	19.13	19.38	19.37	19.13	19.35	19.14
WCDMA 850	23.12	23.12	23.45	23.32	23.43	12.25	12.39	12.32	12.3	12.37	12.31
WCDMA 1900	23.42	23.2	23.14	23.27	23.1	12.56	12.67	12.57	12.5	12.4	12.5
EDGE850 1Tx	27.1	27.18	27.12	27.25	27.23	18.34	18.32	18.36	18.31	18.22	18.26
EDGE850 2Tx	26.45	26.36	26.23	26.38	26.34	16.62	16.95	16.68	16.7	16.68	16.72
EDGE850 3Tx	25.42	25.39	25.38	25.21	25.16	15.88	15.9	15.75	15.71	15.73	15.85
EDGE850 4Tx	23.44	23.33	23.37	23.17	23.29	14.19	14.19	14.1	14.23	14.25	14.41
EDGE1900 1Tx	26.89	26.85	26.87	26.62	26.61	19.81	19.68	19.95	19.82	19.63	19.71
EDGE1900 2Tx	25.39	25.32	25.23	25.34	25.44	19.86	19.8	19.9	19.66	19.74	19.93
EDGE1900 3Tx	23.23	23.3	23.2	23.24	23.45	19.69	19.77	19.82	19.93	19.86	19.61
EDGE1900 4Tx	22.72	22.6	22.75	22.87	22.73	19.32	19.18	19.34	19.1	19.1	19.19

Moving device away from the phantom:

KDB 616217 6.2.8 Measured Power [dBm]											
Distance[mm]	21	20	19	18	17	16	15	14	13	12	11
GSM850	32.79	32.79	32.63	32.72	32.82	24.31	24.65	24.57	24.37	24.58	24.6
GSM1900	29.71	29.95	29.62	29.83	29.88	19.84	19.78	19.66	19.87	19.75	19.94
GPRS 850 1Tx	32.73	32.74	32.8	32.78	32.83	24.33	24.31	24.37	24.63	24.44	24.65
GPRS 850 2Tx	30.65	30.95	30.77	30.77	30.92	20.93	20.88	20.81	20.64	20.61	20.85
GPRS 850 3Tx	29.3	29.4	29.42	29.43	29.44	18.73	18.77	18.74	18.87	18.85	18.68
GPRS 850 4Tx	26.92	26.66	26.81	26.65	26.8	17.31	17.41	17.4	17.38	17.4	17.28
GPRS 1900 1Tx	29.7	29.61	29.88	29.93	29.6	19.72	19.83	19.67	19.63	19.88	19.82
GPRS 1900 2Tx	27.89	27.67	27.67	27.6	27.91	19.95	19.87	19.91	19.6	19.76	19.72
GPRS 1900 3Tx	26.13	26.41	26.2	26.29	26.19	19.8	19.8	19.82	19.91	19.87	19.84
GPRS 1900 4Tx	24.29	24.32	24.42	24.43	24.22	19.32	19.3	19.32	19.45	19.42	19.39
WCDMA 850	23.13	23.45	23.13	23.41	23.22	12.26	12.41	12.3	12.54	12.2	12.42
WCDMA 1900	23.32	23.23	23.13	23.45	23.29	12.6	12.48	12.53	12.42	12.58	12.68
EDGE850 1Tx	27.33	27.3	27.24	27.14	27.42	18.41	18.35	18.44	18.39	18.29	18.12
EDGE850 2Tx	26.13	26.33	26.26	26.26	26.43	16.92	16.81	16.81	16.61	16.9	16.85
EDGE850 3Tx	25.36	25.13	25.25	25.21	25.26	15.6	15.93	15.93	15.6	15.68	15.79
EDGE850 4Tx	23.28	23.35	23.28	23.13	23.42	14.35	14.27	14.3	14.33	14.28	14.22
EDGE1900 1Tx	26.67	26.61	26.86	26.8	26.65	19.76	19.87	19.69	19.62	19.69	19.69
EDGE1900 2Tx	25.45	25.29	25.24	25.43	25.26	19.61	19.87	19.62	19.85	19.87	19.67
EDGE1900 3Tx	23.26	23.2	23.22	23.12	23.28	19.65	19.67	19.79	19.95	19.95	19.78
EDGE1900 4Tx	22.63	22.85	22.69	22.76	22.63	19.22	19.13	19.4	19.33	19.17	19.12

Based on the most conservative measured triggering distance of 16 mm, additional SAR measurements were required at 15 mm from the back side.

FCC ID: A3LSMT2558	 PCTEST Engineering Laboratory, Inc.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			APPENDIX G: Page 3 of 6

Bottom Edge

Moving device toward the phantom:

KDB 616217 6.2.6 Measured Power [dBm]											
Distance[mm]	16	15	14	13	12	11	10	9	8	7	6
GSM850	32.84	32.67	32.71	32.89	32.73	24.65	24.53	24.31	24.32	24.59	24.31
GSM1900	29.83	29.61	29.6	29.63	29.67	19.8	19.93	19.84	19.85	19.9	19.88
GPRS 850 1Tx	32.87	32.85	32.76	32.6	32.64	24.54	24.41	24.61	24.58	24.62	24.64
GPRS 850 2Tx	30.64	30.71	30.67	30.63	30.78	20.64	20.72	20.78	20.84	20.87	20.95
GPRS 850 3Tx	29.14	29.38	29.39	29.34	29.44	18.68	18.69	18.66	18.92	18.86	18.8
GPRS 850 4Tx	26.71	26.83	26.6	26.61	26.73	17.11	17.22	17.1	17.36	17.18	17.29
GPRS 1900 1Tx	29.8	29.84	29.84	29.76	29.87	19.94	19.88	19.89	19.87	19.86	19.94
GPRS 1900 2Tx	27.94	27.9	27.69	27.64	27.78	19.62	19.78	19.84	19.86	19.81	19.95
GPRS 1900 3Tx	26.12	26.26	26.44	26.31	26.32	19.87	19.92	19.65	19.7	19.87	19.76
GPRS 1900 4Tx	24.13	24.33	24.15	24.3	24.1	19.43	19.33	19.23	19.15	19.16	19.35
WCDMA 850	23.13	23.23	23.15	23.23	23.24	12.27	12.28	12.49	12.34	12.28	12.51
WCDMA 1900	23.25	23.2	23.31	23.19	23.31	12.67	12.75	12.52	12.67	12.5	12.49
EDGE850 1Tx	27.39	27.31	27.36	27.24	27.4	18.13	18.19	18.32	18.4	18.35	18.36
EDGE850 2Tx	26.3	26.33	26.29	26.1	26.29	16.61	16.81	16.93	16.78	16.92	16.88
EDGE850 3Tx	25.22	25.32	25.16	25.42	25.35	15.67	15.86	15.9	15.65	15.82	15.8
EDGE850 4Tx	23.41	23.19	23.22	23.22	23.44	14.31	14.11	14.45	14.34	14.38	14.34
EDGE1900 1Tx	26.63	26.6	26.75	26.88	26.78	19.87	19.81	19.8	19.66	19.82	19.93
EDGE1900 2Tx	25.16	25.29	25.32	25.43	25.44	19.9	19.87	19.95	19.95	19.74	19.74
EDGE1900 3Tx	23.11	23.3	23.25	23.16	23.37	19.94	19.63	19.92	19.71	19.67	19.77
EDGE1900 4Tx	22.73	22.91	22.61	22.77	22.77	19.19	19.3	19.15	19.36	19.35	19.19

Moving device away from the phantom:

KDB 616217 6.2.8 Measured Power [dBm]											
Distance[mm]	16	15	14	13	12	11	10	9	8	7	6
GSM850	32.72	32.72	32.79	32.67	32.93	24.4	24.31	24.42	24.3	24.36	24.3
GSM1900	29.91	29.66	29.95	29.89	29.72	19.79	19.72	19.78	19.63	19.66	19.74
GPRS 850 1Tx	32.77	32.94	32.89	32.83	32.7	24.46	24.44	24.45	24.57	24.44	24.4
GPRS 850 2Tx	30.83	30.91	30.62	30.62	30.8	20.83	20.94	20.72	20.85	20.88	20.72
GPRS 850 3Tx	29.16	29.11	29.31	29.4	29.36	18.84	18.7	18.88	18.89	18.94	18.79
GPRS 850 4Tx	26.92	26.91	26.69	26.84	26.81	17.4	17.4	17.12	17.37	17.25	17.19
GPRS 1900 1Tx	29.89	29.83	29.63	29.85	29.8	19.64	19.9	19.6	19.84	19.76	19.81
GPRS 1900 2Tx	27.89	27.88	27.74	27.8	27.91	19.92	19.69	19.74	19.86	19.69	19.67
GPRS 1900 3Tx	26.31	26.32	26.22	26.45	26.42	19.69	19.82	19.6	19.83	19.79	19.85
GPRS 1900 4Tx	24.26	24.39	24.12	24.31	24.14	19.33	19.14	19.31	19.2	19.39	19.38
WCDMA 850	23.14	23.2	23.45	23.34	23.39	12.53	12.4	12.48	12.43	12.29	12.24
WCDMA 1900	23.35	23.39	23.19	23.16	23.17	12.75	12.58	12.54	12.7	12.52	12.47
EDGE850 1Tx	27.14	27.22	27.39	27.3	27.13	18.33	18.32	18.4	18.31	18.4	18.26
EDGE850 2Tx	26.24	26.27	26.1	26.25	26.25	16.66	16.82	16.61	16.87	16.76	16.88
EDGE850 3Tx	25.2	25.2	25.12	25.35	25.28	15.69	15.79	15.71	15.88	15.63	15.91
EDGE850 4Tx	23.37	23.28	23.37	23.36	23.33	14.44	14.29	14.34	14.14	14.28	14.18
EDGE1900 1Tx	26.82	26.65	26.63	26.79	26.74	19.92	19.93	19.66	19.73	19.82	19.94
EDGE1900 2Tx	25.14	25.34	25.22	25.34	25.21	19.93	19.87	19.63	19.7	19.81	19.73
EDGE1900 3Tx	23.37	23.38	23.33	23.35	23.45	19.85	19.76	19.87	19.73	19.61	19.91
EDGE1900 4Tx	22.94	22.91	22.69	22.77	22.76	19.3	19.12	19.33	19.25	19.33	19.43

Based on the most conservative measured triggering distance of 11 mm, additional SAR measurements were required at 10 mm from the bottom edge.

FCC ID: A3LSMT2558	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			APPENDIX G: Page 4 of 6

Right Edge

Moving device toward the phantom:

KDB 616217 6.2.6 Measured Power [dBm]											
Distance[mm]	21	20	19	18	17	16	15	14	13	12	11
GSM850	32.71	32.95	32.6	32.76	32.61	24.45	24.53	24.33	24.6	24.52	24.31
GSM1900	29.9	29.93	29.89	29.77	29.64	19.92	19.75	19.63	19.65	19.76	19.95
GPRS 850 1Tx	32.81	32.89	32.78	32.6	32.92	24.58	24.43	24.35	24.3	24.45	24.37
GPRS 850 2Tx	30.74	30.8	30.91	30.88	30.89	20.69	20.63	20.67	20.69	20.64	20.78
GPRS 850 3Tx	29.42	29.43	29.36	29.17	29.16	18.75	18.69	18.75	18.8	18.94	18.79
GPRS 850 4Tx	26.92	26.86	26.93	26.64	26.71	17.28	17.25	17.44	17.1	17.1	17.3
GPRS 1900 1Tx	29.71	29.77	29.84	29.93	29.78	19.95	19.79	19.85	19.95	19.67	19.88
GPRS 1900 2Tx	27.76	27.86	27.6	27.68	27.63	19.64	19.64	19.6	19.71	19.74	19.66
GPRS 1900 3Tx	26.27	26.35	26.25	26.4	26.29	19.84	19.66	19.94	19.94	19.86	19.75
GPRS 1900 4Tx	24.34	24.4	24.38	24.43	24.22	19.45	19.13	19.36	19.38	19.18	19.19
WCDMA 850	23.26	23.45	23.45	23.4	23.45	12.5	12.46	12.2	12.26	12.53	12.39
WCDMA 1900	23.31	23.41	23.35	23.27	23.42	12.45	12.52	12.73	12.41	12.44	12.71
EDGE850 1Tx	27.28	27.45	27.28	27.4	27.13	18.16	18.38	18.2	18.45	18.26	18.38
EDGE850 2Tx	26.36	26.26	26.1	26.32	26.28	16.87	16.74	16.7	16.75	16.82	16.64
EDGE850 3Tx	25.26	25.44	25.33	25.32	25.42	15.65	15.71	15.71	15.81	15.79	15.76
EDGE850 4Tx	23.3	23.11	23.18	23.43	23.1	14.32	14.18	14.33	14.19	14.28	14.37
EDGE1900 1Tx	26.85	26.84	26.81	26.85	26.77	19.95	19.94	19.81	19.9	19.61	19.71
EDGE1900 2Tx	25.41	25.23	25.14	25.13	25.36	19.95	19.62	19.64	19.81	19.63	19.9
EDGE1900 3Tx	23.11	23.34	23.41	23.12	23.12	19.71	19.91	19.71	19.73	19.72	19.85
EDGE1900 4Tx	22.75	22.61	22.71	22.91	22.78	19.16	19.32	19.39	19.45	19.21	19.31

Moving device away from the phantom:

KDB 616217 6.2.8 Measured Power [dBm]											
Distance[mm]	21	20	19	18	17	16	15	14	13	12	11
GSM850	32.71	32.94	32.87	32.74	32.6	24.56	24.53	24.3	24.57	24.46	24.45
GSM1900	29.78	29.6	29.64	29.89	29.85	19.95	19.67	19.89	19.82	19.66	19.91
GPRS 850 1Tx	32.77	32.67	32.91	32.64	32.78	24.65	24.52	24.38	24.59	24.47	24.45
GPRS 850 2Tx	30.73	30.93	30.61	30.65	30.8	20.62	20.68	20.67	20.83	20.69	20.95
GPRS 850 3Tx	29.11	29.43	29.18	29.36	29.36	18.91	18.8	18.86	18.7	18.66	18.88
GPRS 850 4Tx	26.77	26.81	26.66	26.82	26.88	17.35	17.41	17.33	17.36	17.15	17.1
GPRS 1900 1Tx	29.93	29.94	29.66	29.91	29.73	19.72	19.9	19.69	19.77	19.68	19.77
GPRS 1900 2Tx	27.93	27.88	27.69	27.82	27.95	19.95	19.79	19.79	19.9	19.86	19.79
GPRS 1900 3Tx	26.34	26.21	26.41	26.15	26.25	19.82	19.85	19.79	19.9	19.62	19.71
GPRS 1900 4Tx	24.14	24.19	24.24	24.44	24.26	19.4	19.3	19.2	19.1	19.43	19.19
WCDMA 850	23.45	23.17	23.23	23.29	23.35	12.27	12.32	12.49	12.37	12.41	12.24
WCDMA 1900	23.24	23.28	23.39	23.37	23.13	12.43	12.44	12.41	12.57	12.63	12.6
EDGE850 1Tx	27.3	27.31	27.26	27.22	27.32	18.35	18.25	18.18	18.42	18.36	18.13
EDGE850 2Tx	26.31	26.29	26.12	26.11	26.42	16.76	16.95	16.69	16.8	16.75	16.9
EDGE850 3Tx	25.26	25.45	25.36	25.41	25.41	15.76	15.86	15.89	15.61	15.81	15.65
EDGE850 4Tx	23.32	23.2	23.12	23.19	23.16	14.39	14.22	14.41	14.33	14.32	14.27
EDGE1900 1Tx	26.69	26.89	26.94	26.94	26.83	19.72	19.87	19.67	19.77	19.71	19.62
EDGE1900 2Tx	25.21	25.35	25.15	25.28	25.37	19.95	19.93	19.64	19.92	19.94	19.77
EDGE1900 3Tx	23.11	23.44	23.25	23.38	23.27	19.66	19.76	19.69	19.93	19.75	19.63
EDGE1900 4Tx	22.75	22.64	22.89	22.7	22.92	19.19	19.25	19.28	19.36	19.43	19.19

Based on the most conservative measured triggering distance of 16 mm, additional SAR measurements were required at 15 mm from the right edge.

FCC ID: A3LSMT2558	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			APPENDIX G: Page 5 of 6

Left Edge

Moving device toward the phantom:

KDB 616217 6.2.6 Measured Power [dBm]											
Distance[mm]	21	20	19	18	17	16	15	14	13	12	11
GSM850	32.71	32.92	32.83	32.64	32.93	24.54	24.43	24.41	24.5	24.53	24.47
GSM1900	29.64	29.65	29.71	29.86	29.69	19.86	19.7	19.88	19.77	19.66	19.63
GPRS 850 1Tx	32.72	32.84	32.84	32.76	32.78	24.6	24.44	24.33	24.62	24.65	24.6
GPRS 850 2Tx	30.62	30.79	30.6	30.8	30.89	20.93	20.68	20.66	20.64	20.79	20.79
GPRS 850 3Tx	29.38	29.42	29.23	29.19	29.45	18.69	18.68	18.63	18.63	18.69	18.92
GPRS 850 4Tx	26.84	26.88	26.74	26.77	26.61	17.14	17.16	17.27	17.23	17.11	17.37
GPRS 1900 1Tx	29.93	29.8	29.91	29.91	29.92	19.88	19.87	19.92	19.69	19.67	19.6
GPRS 1900 2Tx	27.67	27.9	27.7	27.92	27.92	19.74	19.73	19.71	19.94	19.81	19.89
GPRS 1900 3Tx	26.22	26.34	26.18	26.11	26.23	19.6	19.84	19.84	19.9	19.62	19.94
GPRS 1900 4Tx	24.44	24.34	24.14	24.25	24.28	19.38	19.37	19.42	19.34	19.25	19.33
WCDMA 850	23.16	23.36	23.11	23.31	23.32	12.21	12.32	12.41	12.23	12.23	12.35
WCDMA 1900	23.36	23.24	23.33	23.44	23.39	12.54	12.62	12.43	12.51	12.74	12.44
EDGE850 1Tx	27.3	27.45	27.13	27.32	27.2	18.32	18.2	18.3	18.17	18.22	18.11
EDGE850 2Tx	26.11	26.41	26.37	26.16	26.19	16.74	16.76	16.84	16.95	16.69	16.76
EDGE850 3Tx	25.15	25.18	25.32	25.36	25.45	15.65	15.81	15.71	15.68	15.63	15.69
EDGE850 4Tx	23.12	23.36	23.2	23.25	23.43	14.19	14.12	14.26	14.17	14.13	14.11
EDGE1900 1Tx	26.68	26.66	26.67	26.68	26.88	19.77	19.73	19.71	19.95	19.74	19.77
EDGE1900 2Tx	25.4	25.19	25.26	25.24	25.3	19.67	19.77	19.78	19.9	19.95	19.73
EDGE1900 3Tx	23.17	23.36	23.35	23.23	23.19	19.95	19.81	19.85	19.75	19.61	19.81
EDGE1900 4Tx	22.87	22.67	22.76	22.79	22.74	19.25	19.33	19.28	19.43	19.27	19.41

Moving device away from the phantom:

KDB 616217 6.2.8 Measured Power [dBm]											
Distance[mm]	21	20	19	18	17	16	15	14	13	12	11
GSM850	32.81	32.64	32.68	32.6	32.66	24.46	24.57	24.47	24.36	24.34	24.4
GSM1900	29.91	29.81	29.76	29.68	29.83	19.81	19.9	19.63	19.73	19.6	19.95
GPRS 850 1Tx	32.95	32.88	32.82	32.81	32.71	24.34	24.64	24.44	24.44	24.56	24.37
GPRS 850 2Tx	30.65	30.94	30.89	30.88	30.86	20.84	20.74	20.92	20.68	20.76	20.72
GPRS 850 3Tx	29.22	29.39	29.24	29.37	29.19	18.84	18.87	18.85	18.67	18.9	18.95
GPRS 850 4Tx	26.61	26.71	26.79	26.68	26.87	17.26	17.26	17.43	17.12	17.36	17.3
GPRS 1900 1Tx	29.62	29.93	29.88	29.61	29.64	19.87	19.74	19.62	19.87	19.73	19.74
GPRS 1900 2Tx	27.84	27.64	27.78	27.92	27.73	19.66	19.85	19.63	19.86	19.82	19.95
GPRS 1900 3Tx	26.1	26.37	26.19	26.22	26.33	19.92	19.94	19.78	19.64	19.89	19.67
GPRS 1900 4Tx	24.39	24.23	24.22	24.26	24.3	19.33	19.36	19.16	19.43	19.41	19.12
WCDMA 850	23.15	23.14	23.17	23.2	23.38	12.54	12.49	12.32	12.29	12.44	12.33
WCDMA 1900	23.4	23.14	23.41	23.11	23.26	12.48	12.72	12.51	12.74	12.41	12.41
EDGE850 1Tx	27.14	27.15	27.44	27.42	27.27	18.3	18.11	18.19	18.12	18.15	18.18
EDGE850 2Tx	26.35	26.17	26.31	26.29	26.36	16.83	16.93	16.6	16.83	16.93	16.92
EDGE850 3Tx	25.13	25.44	25.16	25.12	25.13	15.84	15.74	15.61	15.61	15.85	15.83
EDGE850 4Tx	23.11	23.26	23.36	23.27	23.42	14.18	14.16	14.41	14.23	14.35	14.44
EDGE1900 1Tx	26.61	26.86	26.79	26.62	26.95	19.95	19.66	19.78	19.78	19.72	19.89
EDGE1900 2Tx	25.45	25.3	25.42	25.31	25.34	19.91	19.85	19.8	19.7	19.7	19.92
EDGE1900 3Tx	23.4	23.26	23.31	23.24	23.39	19.88	19.69	19.83	19.72	19.92	19.63
EDGE1900 4Tx	22.87	22.61	22.83	22.73	22.68	19.31	19.16	19.38	19.29	19.44	19.34

Based on the most conservative measured triggering distance of 16 mm, additional SAR measurements were required at 15 mm from the left edge.

FCC ID: A3LSMT2558	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/02/14-05/21/14	DUT Type: Portable Tablet			APPENDIX G: Page 6 of 6