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SAR EVALUATION REPORT

Applicant Name:
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Date of Testing:
04/14/14 - 04/24/14
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1404110756.A3L

FCC ID: **A3LSMT705**

APPLICANT: **SAMSUNG ELECTRONICS, CO. LTD.**

DUT Type: Portable Tablet
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): SM-T705

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	0.50
PCB	UMTS 850	826.40 - 846.60 MHz	< 0.1	0.74
PCB	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	0.13	0.99
PCB	UMTS 1900	1852.4 - 1907.6 MHz	0.19	1.01
PCB	LTE Band 5 (Cell)	824.7 - 848.3 MHz	< 0.1	0.69
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.48	1.06
DTS	Bluetooth LE	2402 - 2480 MHz	N/A	
DTS	5.8 GHz WLAN	5745 - 5825 MHz		
NII	5.2 GHz WLAN	5180 - 5240 MHz		
NII	5.3 GHz WLAN	5260 - 5320 MHz		
NII	5.5 GHz WLAN	5500 - 5700 MHz		
DSS	Bluetooth	2402 - 2480 MHz	N/A	0.27
Simultaneous SAR per KDB 690783 D01v01r02:			0.63	1.56

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 1.7 of this report; for North American frequency bands only.

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

Randy Ortanez
President

ACCREDITED
TESTING CERT#2041.01

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TABLE OF CONTENTS

1 DEVICE UNDER TEST 3

2 LTE INFORMATION 9

3 INTRODUCTION 10

4 DOSIMETRIC ASSESSMENT 11

5 DEFINITION OF REFERENCE POINTS 12

6 TEST CONFIGURATION POSITIONS FOR HANDSETS 13

7 RF EXPOSURE LIMITS 15

8 FCC MEASUREMENT PROCEDURES 16

9 RF CONDUCTED POWERS 20

10 SYSTEM VERIFICATION 37

11 SAR DATA SUMMARY 39

12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS 45

13 SAR MEASUREMENT VARIABILITY 66

14 EQUIPMENT LIST 67

15 MEASUREMENT UNCERTAINTIES 68

16 CONCLUSION 69

17 REFERENCES 70

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

APPENDIX G: SENSOR TRIGGERING INFORMATION

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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE 850	Voice/Data	824.20 - 848.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
LTE Band 5 (Cell)	Data	824.7 - 848.3 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
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 and 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.

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**	**31.5**	**30.0**	**28.5**	**27.5**	**26.0**	**24.5**	**23.0**
	Nominal	**32.5**	**32.5**	**31.0**	**29.5**	**28.0**	**27.0**	**25.5**	**24.0**	**22.5**
GSM/GPRS/EDGE 1900	Maximum	**29.0**	**29.0**	**28.5**	**27.5**	**26.0**	**27.0**	**25.5**	**24.0**	**22.5**
	Nominal	**28.5**	**28.5**	**28.0**	**27.0**	**25.5**	**26.5**	**25.0**	**23.5**	**22.0**

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

Mode / Band		Modulated Average (dBm)
LTE Band 5 (Cell)	Maximum	**23.0**
	Nominal	**22.5**

Mode / Band		Modulated Average (dBm)
SISO IEEE 802.11b (2.4 GHz)	Maximum	**12.5**
	Nominal	**12.0**
SISO IEEE 802.11g (2.4 GHz)	Maximum	**11.5**
	Nominal	**11.0**
SISO & MIMO IEEE 802.11n (2.4 GHz)	Maximum	**10.5**
	Nominal	**10.0**
SISO IEEE 802.11a (5 GHz)	Maximum	**8.0**
	Nominal	**7.5**
SISO IEEE 802.11n (5 GHz)	Maximum	**8.0**
	Nominal	**7.5**
MIMO IEEE 802.11n (5.2-5.5 GHz) 20MHz Bandwidth	Maximum	**7.0**
	Nominal	**6.5**
MIMO IEEE 802.11n (5.2-5.3 GHz) 40MHz Bandwidth	Maximum	**6.5**
	Nominal	**6.0**
MIMO IEEE 802.11n (5.5 GHz) 40MHz Bandwidth	Maximum	**7.0**
	Nominal	**6.5**
MIMO IEEE 802.11n (5.8 GHz)	Maximum	**8.0**
	Nominal	**7.5**
SISO IEEE 802.11ac (5 GHz)	Maximum	**8.0**
	Nominal	**7.5**
MIMO IEEE 802.11ac (5.2-5.5 GHz) 80MHz Bandwidth	Maximum	**6.5**
	Nominal	**6.0**
MIMO IEEE 802.11ac (5.8 GHz) 80MHz Bandwidth	Maximum	**8.0**
	Nominal	**7.5**
Bluetooth	Maximum	**10.5**
	Nominal	**10.0**
Bluetooth LE	Maximum	**7.0**
	Nominal	**6.5**

With Power Backoff (Body at 0mm):

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	**25.0**	**25.0**	**23.5**	**22.0**	**20.5**	**21.5**	**20.5**	**19.5**	**18.5**
	Nominal	**24.5**	**24.5**	**23.0**	**21.5**	**20.0**	**21.0**	**20.0**	**19.0**	**18.0**
GSM/GPRS/EDGE 1900	Maximum	**20.5**	**20.5**	**17.5**	**16.0**	**15.0**	**19.0**	**16.0**	**15.0**	**14.0**
	Nominal	**20.0**	**20.0**	**17.0**	**15.5**	**14.5**	**18.5**	**15.5**	**14.5**	**13.5**

Mode / Band		Modulated Average (dBm)		
		3GPP WCDMA Rel. 99	*3GPP HSDPA Rel. 5*	*3GPP HSUPA Rel. 6*
UMTS Band 5 (850 MHz)	Maximum	**16.0**	**16.0**	**16.0**
	Nominal	**15.5**	**15.5**	**15.5**
UMTS Band 2 (1900 MHz)	Maximum	**12.0**	**12.0**	**12.0**
	Nominal	**11.5**	**11.5**	**11.5**

Mode / Band		Modulated Average (dBm)
LTE Band 5 (Cell)	Maximum	**16.5**
	Nominal	**16.0**

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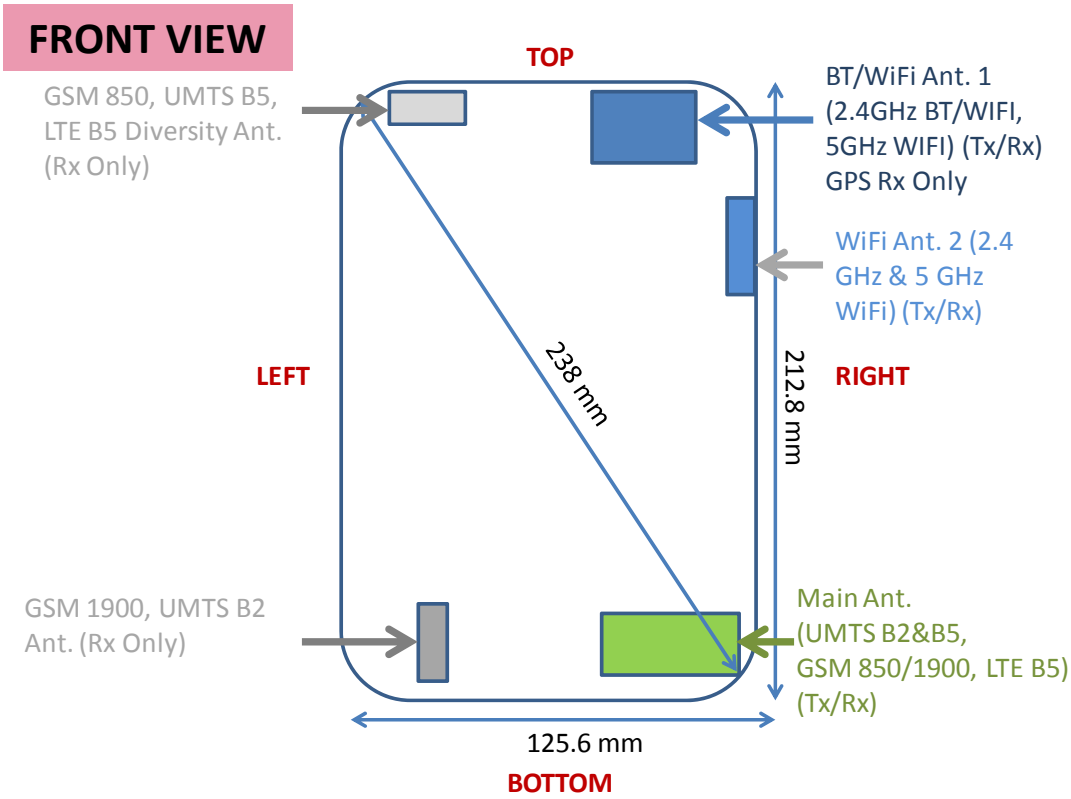
1.4 DUT Antenna Locations



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

Figure 1-1
DUT Antenna Locations

Table 1-1
Body Sides for SAR Testing

Body Sides for SAR Testing						
Mode	Back	Front	Top	Bottom	Right	Left
GPRS 850	Yes	No	No	Yes	Yes	Yes
UMTS 850	Yes	No	No	Yes	Yes	No
GPRS 1900	Yes	No	No	Yes	Yes	No
UMTS 1900	Yes	No	No	Yes	Yes	No
LTE Band 5 (Cell)	Yes	No	No	Yes	Yes	No
2.4 GHz WLAN/BT	Yes	No	Yes	No	Yes	No

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.

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1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D05v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-2 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.

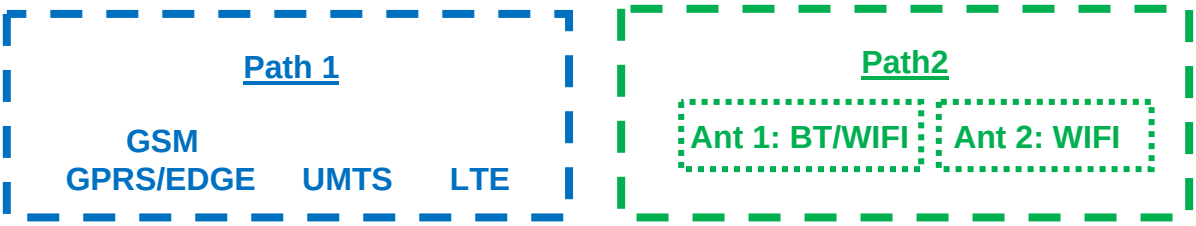

Figure 1-2
Simultaneous Transmission Paths

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

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body	Notes
1	GSM voice + 2.4 GHz WI-FI	Yes	Yes	
2	GSM voice + 5 GHz WI-FI	Yes	Yes	
3	GSM voice + 2.4 GHz Bluetooth	N/A	Yes	
4	UMTS + 2.4 GHz WI-FI	Yes	Yes	
5	UMTS + 5 GHz WI-FI	Yes	Yes	
6	UMTS + 2.4 GHz Bluetooth	N/A	Yes	
7	LTE + 2.4 GHz WI-FI	Yes*	Yes*	*Pre-installed VOIP applications are considered.
8	LTE + 5.8 GHz WI-FI	N/A	Yes*	WIFI Direct
9	LTE + 2.4 GHz Bluetooth	N/A	Yes*	
10	GPRS/EDGE + 2.4 GHz WI-FI	N/A	Yes	
11	GPRS/EDGE + 5.8 GHz WI-FI	N/A	Yes	WIFI Direct
12	GPRS/EDGE + 2.4 GHz Bluetooth	N/A	Yes	

Notes:

1. (*) = for Pre-installed VOIP applications possibly installed and used by the end-user
2. When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.
3. Per the manufacturer, WIFI Direct is not expected to be used in conjunction with a held-to-ear voice call. Therefore, there are no simultaneous transmission scenarios involving WIFI direct beyond that listed in the above table.
4. 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.
5. GSM/GPRS, UMTS and LTE share the same antenna and cannot transmit simultaneously.
6. 2.4 GHz WLAN, 2.4 GHz Bluetooth, and 5 GHz WLAN share the same antenna path and cannot transmit simultaneously.
7. This device supports 2x2 MIMO Tx for WLAN 802.11n/ac. Each WLAN antenna can transmit independently or together when operating with MIMO.

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1.6 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:

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

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth LE SAR was not required; [(5/5)* √2.44] = 1.6< 3.0. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

Based on the maximum conducted power of 5GHz WLAN (rounded to the nearest mW) and the antenna to user separation distance, 5GHz WLAN SAR was not required; [(6/5)* √5.825] = 2.9< 3.0. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

This device supports 40 MHz Bandwidths for IEEE 802.11n for 5 GHz WIFI only.

This device supports IEEE 802.11ac with the following features:

a) Up to 80 MHz Bandwidth only
b) No aggregate channel configurations
c) 2 Tx antenna output
d) 256 QAM is supported
e) No new 5 GHz channels

(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.

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

1.7 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (2G/3G/4G)
- 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 447498 (SAR Measurements up to 6 GHz)
- October 2013 TCB Workshop Notes (GPRS/EDGE)

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1.8 Device Serial Numbers

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

	Head Serial Number	Body Serial Number - Reduced power	Body Serial Number - Max power
GSM/GPRS/EDGE 850	0410-01	0410-03	0410-01
UMTS 850	0410-01	0410-03	0410-01
GSM/GPRS/EDGE 1900	0410-02	0410-03	0410-01
UMTS 1900	0410-02	0410-03	0410-01
LTE Band 5 (Cell)	0410-01	0410-03	0410-01
2.4 GHz WLAN	0410-02	-	1004-1
2.4 GHz BT	-	-	1004-1

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2 LTE INFORMATION

LTE Information			
FCC ID	**A3LSMT705**		
Form Factor	Portable Tablet		
Frequency Range of each LTE transmission band	LTE Band 5 (Cell) (824.7 - 848.3 MHz)		
Channel Bandwidths	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)	836.5 (20525)	848.3 (20643)
LTE Band 5 (Cell): 3 MHz	825.5 (20415)	836.5 (20525)	847.5 (20635)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
UE Category	3		
Modulations Supported in UL	QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		

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3 INTRODUCTION

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

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [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.

3.1 SAR Definition

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

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

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

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

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4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

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

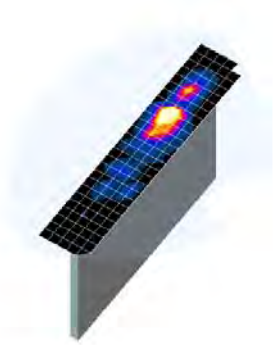

Figure 4-1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01 (See Table 4-1) 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 4-1) 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 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

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

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

*Also compliant to IEEE 1528-2013 Table 6

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5 DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

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

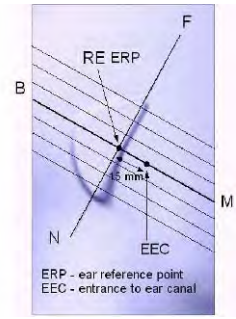

Figure 5-1
Close-Up Side view of ERP

5.2 HANDSET REFERENCE POINTS

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

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

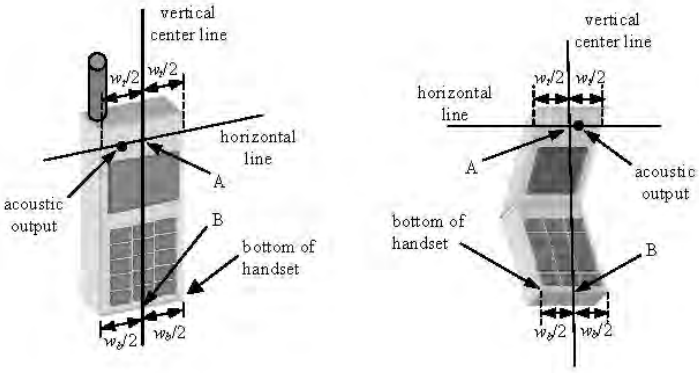

Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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6 TEST CONFIGURATION POSITIONS FOR HANDSETS

6.1 Device Holder

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

6.2 Positioning for Cheek

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

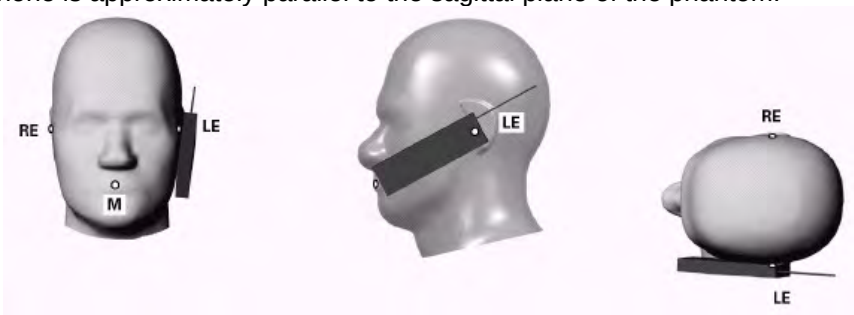

Figure 6-1 Front, Side and Top View of Cheek Position

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

6.3 Positioning for Ear / 15º Tilt

With the test device aligned in the "Cheek Position":

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

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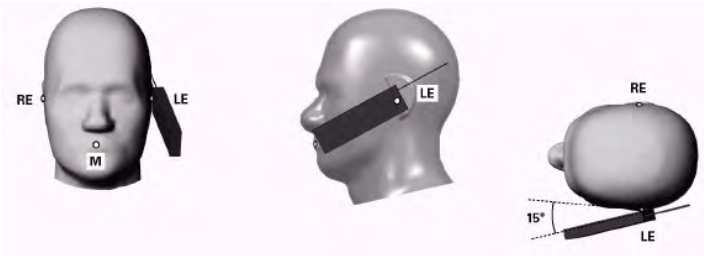

Figure 6-2 Front, Side and Top View of Ear/15º Tilt Position

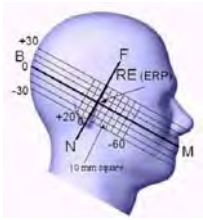

Figure 6-3
Side view w/ relevant markings

6.4 SAR Testing for Tablet per KDB Publication 616217 D04v01

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

6.5 Additional Test Positions due to Proximity Sensor Considerations

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

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

FCC KDB 616217 D04 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional exposure conditions. Since the proximity sensor activation distance for the back side of the device is 16 mm, a conservative distance of 15 mm was tested for SAR on the back side at maximum power. Since the proximity sensor activation distance for the bottom edge of the device is 11 mm, a conservative distance of 10 mm was tested for SAR on the bottom edge at maximum power. Since the proximity sensor activation distance for the right edge of the device is 5 mm, a conservative distance of 4 mm was tested for SAR on the right edge at maximum power. Sensor triggering distance summary data is included in Appendix G.

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

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7 RF EXPOSURE LIMITS

7.1 Uncontrolled Environment

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

7.2 Controlled Environment

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

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

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

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

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8 FCC MEASUREMENT PROCEDURES

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

8.1 Measured and Reported SAR

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

8.2 Procedures Used to Establish RF Signal for SAR

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

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

8.3 SAR Measurement Conditions for UMTS

8.3.1 Output Power Verification

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

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

8.3.2 Head SAR Measurements for Handsets

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

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3.4 kbps SRB (signaling radio bearer) using the exposure configuration that resulted in the highest SAR for that RF channel in the 12.2 kbps RMC mode.

8.3.3 Body SAR Measurements

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

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

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

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

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

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

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

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

8.3.5 SAR Measurements 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

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configurations for HSPA should be configured according to the β values indicated below as well as other applicable procedures described in the 'WCDMA Handset' and 'Release 5 HSDPA Data Devices' sections of the FCC 3G document.

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

Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.
Note 2: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.
Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ 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.

8.4 SAR Measurement Conditions for LTE

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

8.4.1 Spectrum Plots for RB Configurations

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

8.4.2 MPR

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

8.4.3 A-MPR

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

8.4.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r01:

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

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required for the remaining required test channels using the RB offset configuration with highest output power for that channel.

iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.

b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.

c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.

d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to ½ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is <1.45 W/kg.

8.5 SAR Testing with 802.11 Transmitters

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

8.5.1 General Device Setup

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

8.5.2 Frequency Channel Configurations [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.

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.

8.5.3 MIMO SAR considerations

Per KDB 248227, SAR for MIMO was measured with both transmitting simultaneously and was evaluated independently of SISO operation. For 2.4 GHz MIMO, 802.11n was evaluated. 5 GHz WLAN were excluded per FCC KDB 447498 D01v05.

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9 RF CONDUCTED POWERS

9.1 GSM Conducted Powers

Table 9-1
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	32.85	32.86	31.09	**29.65**	28.20	27.49	25.99	24.31	22.80
	190	32.97	32.97	31.19	**29.76**	28.23	27.37	25.86	24.16	22.86
	251	32.90	32.92	31.20	**29.65**	28.12	27.19	25.73	24.02	22.69
GSM 1900	512	28.22	28.22	27.74	**26.71**	25.28	26.50	25.09	23.70	22.14
	661	28.15	28.16	27.66	**26.67**	25.19	26.42	25.10	23.80	22.02
	810	28.27	28.23	27.77	**26.77**	25.31	26.50	25.12	23.79	22.07
		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	23.82	23.83	25.07	**25.39**	25.19	18.46	19.97	20.05	19.79
	190	23.94	23.94	25.17	**25.50**	25.22	18.34	19.84	19.90	19.85
	251	23.87	23.89	25.18	**25.39**	25.11	18.16	19.71	19.76	19.68
GSM 1900	512	19.19	19.19	21.72	**22.45**	22.27	17.47	19.07	19.44	19.13
	661	19.12	19.13	21.64	**22.41**	22.18	17.39	19.08	19.54	19.01
	810	19.24	19.20	21.75	**22.51**	22.30	17.47	19.10	19.53	19.06
GSM 850	**Frame Avg.Targets:**	23.47	23.47	24.98	**25.24**	24.99	17.97	19.48	19.74	19.49
GSM 1900		19.47	19.47	21.98	**22.74**	22.49	17.47	18.98	19.24	18.99

Table 9-2
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	24.86	24.88	23.33	**21.89**	20.33	21.45	20.40	19.41	18.40
	190	24.85	24.81	23.34	**21.88**	20.34	21.34	20.28	19.35	18.28
	251	24.85	24.88	23.35	**21.90**	20.33	21.21	20.15	19.24	18.11
GSM 1900	512	20.08	20.11	17.04	15.60	**14.60**	18.72	15.79	14.83	13.92
	661	20.01	20.04	16.97	15.54	**14.53**	18.72	15.76	14.81	13.94
	810	20.24	20.27	17.23	15.67	**14.74**	18.71	15.75	14.79	13.96

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		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	15.83	15.85	17.31	**17.63**	17.32	12.42	14.38	15.15	15.39
	190	15.82	15.78	17.32	**17.62**	17.33	12.31	14.26	15.09	15.27
	251	15.82	15.85	17.33	**17.64**	17.32	12.18	14.13	14.98	15.10
GSM 1900	512	11.05	11.08	11.02	11.34	**11.59**	9.69	9.77	10.57	10.91
	661	10.98	11.01	10.95	11.28	**11.52**	9.69	9.74	10.55	10.93
	810	11.21	11.24	11.21	11.41	**11.73**	9.68	9.73	10.53	10.95
GSM 850	**Frame Avg.Targets:**	15.47	15.47	16.98	**17.24**	16.99	11.97	13.98	14.74	14.99
GSM 1900		10.97	10.97	10.98	11.24	**11.49**	9.47	9.48	10.24	10.49

Note:

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

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

Figure 9-1
Power Measurement Setup

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9.2 UMTS Conducted Powers

Table 9-3
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	22.74	22.76	22.77	23.00	22.99	22.98	-
99		12.2 kbps AMR	22.63	22.67	22.72	22.99	22.93	23.00	-
6	HSDPA	Subtest 1	22.42	22.51	22.53	22.87	22.96	22.93	0
6		Subtest 2	22.24	22.27	22.31	22.66	22.75	22.85	0
6		Subtest 3	22.02	22.04	22.06	22.43	22.52	22.54	0.5
6		Subtest 4	21.75	21.78	21.84	22.36	22.31	22.37	0.5
6	HSUPA	Subtest 1	21.95	21.93	21.97	22.11	22.15	22.29	0
6		Subtest 2	19.73	19.84	19.80	20.01	19.87	20.02	2
6		Subtest 3	21.54	21.58	21.59	21.81	21.85	21.85	1
6		Subtest 4	21.31	21.13	21.23	21.52	21.31	21.64	2
6		Subtest 5	22.14	22.22	22.18	22.25	22.34	22.45	0

Table 9-4
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	15.66	15.65	15.63	11.94	11.92	12.00	-
99		12.2 kbps AMR	15.69	15.66	15.65	11.91	11.94	11.99	-
6	HSDPA	Subtest 1	15.47	15.45	15.52	11.85	11.84	11.87	0
6		Subtest 2	15.46	15.45	15.48	11.60	11.63	11.70	0
6		Subtest 3	15.46	15.52	15.53	11.35	11.46	11.40	0.5
6		Subtest 4	15.47	15.46	15.52	11.11	11.12	11.18	0.5
6	HSUPA	Subtest 1	14.33	14.11	14.21	10.20	10.22	10.41	0
6		Subtest 2	14.40	14.41	14.36	9.45	9.40	9.52	2
6		Subtest 3	14.21	14.25	14.26	10.31	10.44	10.50	1
6		Subtest 4	14.51	14.47	14.52	10.33	10.40	10.52	2
6		Subtest 5	14.30	15.05	15.17	10.40	10.52	10.67	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 1 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model.

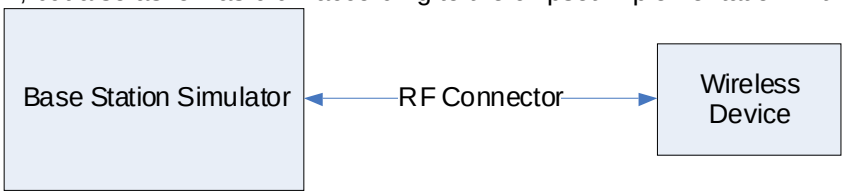

Figure 9-2
Power Measurement Setup

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9.3 LTE Conducted Powers

9.3.1 LTE Band 5 (Cell)

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	836.5	20525	10	QPSK	1	0	22.44	0	0
	836.5	20525	10	QPSK	1	25	**22.45**	0	0
	836.5	20525	10	QPSK	1	49	22.30	0	0
	836.5	20525	10	QPSK	25	0	**21.43**	0-1	1
	836.5	20525	10	QPSK	25	12	21.40	0-1	1
	836.5	20525	10	QPSK	25	25	21.29	0-1	1
	836.5	20525	10	QPSK	50	0	21.42	0-1	1
	836.5	20525	10	16QAM	1	0	21.67	0-1	1
	836.5	20525	10	16QAM	1	25	21.58	0-1	1
	836.5	20525	10	16QAM	1	49	21.41	0-1	1
	836.5	20525	10	16QAM	25	0	20.44	0-2	2
	836.5	20525	10	16QAM	25	12	20.41	0-2	2
	836.5	20525	10	16QAM	25	25	20.39	0-2	2
	836.5	20525	10	16QAM	50	0	20.43	0-2	2

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

Table 9-6
Reduced LTE Band 5 (Cell) Conducted Powers - 10 MHz Bandwidth
Representing Body at 0 mm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	836.5	20525	10	QPSK	1	0	**16.22**	0	0
	836.5	20525	10	QPSK	1	25	16.15	0	0
	836.5	20525	10	QPSK	1	49	15.98	0	0
	836.5	20525	10	QPSK	25	0	**15.10**	0-1	1
	836.5	20525	10	QPSK	25	12	15.06	0-1	1
	836.5	20525	10	QPSK	25	25	14.99	0-1	1
	836.5	20525	10	QPSK	50	0	15.05	0-1	1
	836.5	20525	10	16QAM	1	0	15.25	0-1	1
	836.5	20525	10	16QAM	1	25	15.29	0-1	1
	836.5	20525	10	16QAM	1	49	15.11	0-1	1
	836.5	20525	10	16QAM	25	0	14.03	0-2	2
	836.5	20525	10	16QAM	25	12	13.98	0-2	2
	836.5	20525	10	16QAM	25	25	13.91	0-2	2
	836.5	20525	10	16QAM	50	0	13.97	0-2	2

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

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Table 9-7
Maximum LTE Band 5 (Cell) Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	826.5	20425	5	QPSK	1	0	22.78	0	0
	826.5	20425	5	QPSK	1	12	22.77	0	0
	826.5	20425	5	QPSK	1	24	22.74	0	0
	826.5	20425	5	QPSK	12	0	21.69	0-1	1
	826.5	20425	5	QPSK	12	6	21.67	0-1	1
	826.5	20425	5	QPSK	12	13	21.66	0-1	1
	826.5	20425	5	QPSK	25	0	21.66	0-1	1
	826.5	20425	5	16-QAM	1	0	21.91	0-1	1
	826.5	20425	5	16-QAM	1	12	21.88	0-1	1
	826.5	20425	5	16-QAM	1	24	21.91	0-1	1
	826.5	20425	5	16-QAM	12	0	20.70	0-2	2
	826.5	20425	5	16-QAM	12	6	20.70	0-2	2
	826.5	20425	5	16-QAM	12	13	20.65	0-2	2
	826.5	20425	5	16-QAM	25	0	20.66	0-2	2
Mid	836.5	20525	5	QPSK	1	0	22.68	0	0
	836.5	20525	5	QPSK	1	12	22.64	0	0
	836.5	20525	5	QPSK	1	24	22.61	0	0
	836.5	20525	5	QPSK	12	0	21.59	0-1	1
	836.5	20525	5	QPSK	12	6	21.55	0-1	1
	836.5	20525	5	QPSK	12	13	21.55	0-1	1
	836.5	20525	5	QPSK	25	0	21.54	0-1	1
	836.5	20525	5	16-QAM	1	0	21.82	0-1	1
	836.5	20525	5	16-QAM	1	12	21.81	0-1	1
	836.5	20525	5	16-QAM	1	24	21.79	0-1	1
	836.5	20525	5	16-QAM	12	0	20.63	0-2	2
	836.5	20525	5	16-QAM	12	6	20.57	0-2	2
	836.5	20525	5	16-QAM	12	13	20.58	0-2	2
	836.5	20525	5	16-QAM	25	0	20.55	0-2	2
High	846.5	20625	5	QPSK	1	0	22.66	0	0
	846.5	20625	5	QPSK	1	12	22.58	0	0
	846.5	20625	5	QPSK	1	24	22.57	0	0
	846.5	20625	5	QPSK	12	0	21.54	0-1	1
	846.5	20625	5	QPSK	12	6	21.51	0-1	1
	846.5	20625	5	QPSK	12	13	21.46	0-1	1
	846.5	20625	5	QPSK	25	0	21.51	0-1	1
	846.5	20625	5	16-QAM	1	0	21.80	0-1	1
	846.5	20625	5	16-QAM	1	12	21.79	0-1	1
	846.5	20625	5	16-QAM	1	24	21.74	0-1	1
	846.5	20625	5	16-QAM	12	0	20.54	0-2	2
	846.5	20625	5	16-QAM	12	6	20.49	0-2	2
	846.5	20625	5	16-QAM	12	13	20.46	0-2	2
	846.5	20625	5	16-QAM	25	0	20.48	0-2	2

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Table 9-8
Reduced LTE Band 5 (Cell) Conducted Powers - 5 MHz Bandwidth
Representing Body at 0 mm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	826.5	20425	5	QPSK	1	0	16.33	0	0
	826.5	20425	5	QPSK	1	12	16.34	0	0
	826.5	20425	5	QPSK	1	24	16.31	0	0
	826.5	20425	5	QPSK	12	0	15.24	0-1	1
	826.5	20425	5	QPSK	12	6	15.22	0-1	1
	826.5	20425	5	QPSK	12	13	15.22	0-1	1
	826.5	20425	5	QPSK	25	0	15.21	0-1	1
	826.5	20425	5	16-QAM	1	0	15.44	0-1	1
	826.5	20425	5	16-QAM	1	12	15.46	0-1	1
	826.5	20425	5	16-QAM	1	24	15.42	0-1	1
	826.5	20425	5	16-QAM	12	0	14.19	0-2	2
	826.5	20425	5	16-QAM	12	6	14.17	0-2	2
	826.5	20425	5	16-QAM	12	13	14.15	0-2	2
	826.5	20425	5	16-QAM	25	0	14.12	0-2	2
Mid	836.5	20525	5	QPSK	1	0	16.24	0	0
	836.5	20525	5	QPSK	1	12	16.19	0	0
	836.5	20525	5	QPSK	1	24	16.14	0	0
	836.5	20525	5	QPSK	12	0	15.15	0-1	1
	836.5	20525	5	QPSK	12	6	15.12	0-1	1
	836.5	20525	5	QPSK	12	13	15.11	0-1	1
	836.5	20525	5	QPSK	25	0	15.14	0-1	1
	836.5	20525	5	16-QAM	1	0	15.40	0-1	1
	836.5	20525	5	16-QAM	1	12	15.40	0-1	1
	836.5	20525	5	16-QAM	1	24	15.33	0-1	1
	836.5	20525	5	16-QAM	12	0	14.13	0-2	2
	836.5	20525	5	16-QAM	12	6	14.08	0-2	2
	836.5	20525	5	16-QAM	12	13	14.04	0-2	2
	836.5	20525	5	16-QAM	25	0	14.07	0-2	2
High	846.5	20625	5	QPSK	1	0	16.16	0	0
	846.5	20625	5	QPSK	1	12	16.15	0	0
	846.5	20625	5	QPSK	1	24	16.10	0	0
	846.5	20625	5	QPSK	12	0	15.08	0-1	1
	846.5	20625	5	QPSK	12	6	15.03	0-1	1
	846.5	20625	5	QPSK	12	13	14.98	0-1	1
	846.5	20625	5	QPSK	25	0	15.04	0-1	1
	846.5	20625	5	16-QAM	1	0	15.31	0-1	1
	846.5	20625	5	16-QAM	1	12	15.35	0-1	1
	846.5	20625	5	16-QAM	1	24	15.28	0-1	1
	846.5	20625	5	16-QAM	12	0	14.00	0-2	2
	846.5	20625	5	16-QAM	12	6	13.97	0-2	2
	846.5	20625	5	16-QAM	12	13	13.91	0-2	2
	846.5	20625	5	16-QAM	25	0	13.92	0-2	2

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	825.5	20415	3	QPSK	1	0	22.70	0	0
	825.5	20415	3	QPSK	1	7	22.71	0	0
	825.5	20415	3	QPSK	1	14	22.69	0	0
	825.5	20415	3	QPSK	8	0	21.65	0-1	1
	825.5	20415	3	QPSK	8	4	21.65	0-1	1
	825.5	20415	3	QPSK	8	7	21.67	0-1	1
	825.5	20415	3	QPSK	15	0	21.67	0-1	1
	825.5	20415	3	16-QAM	1	0	21.77	0-1	1
	825.5	20415	3	16-QAM	1	7	21.83	0-1	1
	825.5	20415	3	16-QAM	1	14	21.78	0-1	1
	825.5	20415	3	16-QAM	8	0	20.69	0-2	2
	825.5	20415	3	16-QAM	8	4	20.66	0-2	2
	825.5	20415	3	16-QAM	8	7	20.69	0-2	2
	825.5	20415	3	16-QAM	15	0	20.61	0-2	2
Mid	836.5	20525	3	QPSK	1	0	22.63	0	0
	836.5	20525	3	QPSK	1	7	22.64	0	0
	836.5	20525	3	QPSK	1	14	22.61	0	0
	836.5	20525	3	QPSK	8	0	21.59	0-1	1
	836.5	20525	3	QPSK	8	4	21.57	0-1	1
	836.5	20525	3	QPSK	8	7	21.58	0-1	1
	836.5	20525	3	QPSK	15	0	21.58	0-1	1
	836.5	20525	3	16-QAM	1	0	21.69	0-1	1
	836.5	20525	3	16-QAM	1	7	21.75	0-1	1
	836.5	20525	3	16-QAM	1	14	21.69	0-1	1
	836.5	20525	3	16-QAM	8	0	20.66	0-2	2
	836.5	20525	3	16-QAM	8	4	20.59	0-2	2
	836.5	20525	3	16-QAM	8	7	20.59	0-2	2
	836.5	20525	3	16-QAM	15	0	20.56	0-2	2
High	847.5	20635	3	QPSK	1	0	22.55	0	0
	847.5	20635	3	QPSK	1	7	22.45	0	0
	847.5	20635	3	QPSK	1	14	22.29	0	0
	847.5	20635	3	QPSK	8	0	21.51	0-1	1
	847.5	20635	3	QPSK	8	4	21.42	0-1	1
	847.5	20635	3	QPSK	8	7	21.43	0-1	1
	847.5	20635	3	QPSK	15	0	21.49	0-1	1
	847.5	20635	3	16-QAM	1	0	21.61	0-1	1
	847.5	20635	3	16-QAM	1	7	21.65	0-1	1
	847.5	20635	3	16-QAM	1	14	21.55	0-1	1
	847.5	20635	3	16-QAM	8	0	20.53	0-2	2
	847.5	20635	3	16-QAM	8	4	20.47	0-2	2
	847.5	20635	3	16-QAM	8	7	20.49	0-2	2
	847.5	20635	3	16-QAM	15	0	20.47	0-2	2

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Table 9-10
Reduced LTE Band 5 (Cell) Conducted Powers - 3 MHz Bandwidth
Representing Body at 0 mm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	825.5	20415	3	QPSK	1	0	16.24	0	0
	825.5	20415	3	QPSK	1	7	16.25	0	0
	825.5	20415	3	QPSK	1	14	16.19	0	0
	825.5	20415	3	QPSK	8	0	15.15	0-1	1
	825.5	20415	3	QPSK	8	4	15.15	0-1	1
	825.5	20415	3	QPSK	8	7	15.17	0-1	1
	825.5	20415	3	QPSK	15	0	15.18	0-1	1
	825.5	20415	3	16-QAM	1	0	15.30	0-1	1
	825.5	20415	3	16-QAM	1	7	15.34	0-1	1
	825.5	20415	3	16-QAM	1	14	15.37	0-1	1
	825.5	20415	3	16-QAM	8	0	14.12	0-2	2
	825.5	20415	3	16-QAM	8	4	14.12	0-2	2
	825.5	20415	3	16-QAM	8	7	14.14	0-2	2
	825.5	20415	3	16-QAM	15	0	14.09	0-2	2
Mid	836.5	20525	3	QPSK	1	0	16.18	0	0
	836.5	20525	3	QPSK	1	7	16.13	0	0
	836.5	20525	3	QPSK	1	14	16.11	0	0
	836.5	20525	3	QPSK	8	0	15.12	0-1	1
	836.5	20525	3	QPSK	8	4	15.09	0-1	1
	836.5	20525	3	QPSK	8	7	15.08	0-1	1
	836.5	20525	3	QPSK	15	0	15.10	0-1	1
	836.5	20525	3	16-QAM	1	0	15.30	0-1	1
	836.5	20525	3	16-QAM	1	7	15.35	0-1	1
	836.5	20525	3	16-QAM	1	14	15.20	0-1	1
	836.5	20525	3	16-QAM	8	0	14.07	0-2	2
	836.5	20525	3	16-QAM	8	4	14.02	0-2	2
	836.5	20525	3	16-QAM	8	7	14.04	0-2	2
	836.5	20525	3	16-QAM	15	0	14.00	0-2	2
High	847.5	20635	3	QPSK	1	0	16.05	0	0
	847.5	20635	3	QPSK	1	7	16.06	0	0
	847.5	20635	3	QPSK	1	14	15.99	0	0
	847.5	20635	3	QPSK	8	0	14.98	0-1	1
	847.5	20635	3	QPSK	8	4	14.94	0-1	1
	847.5	20635	3	QPSK	8	7	14.95	0-1	1
	847.5	20635	3	QPSK	15	0	14.98	0-1	1
	847.5	20635	3	16-QAM	1	0	15.15	0-1	1
	847.5	20635	3	16-QAM	1	7	15.10	0-1	1
	847.5	20635	3	16-QAM	1	14	15.14	0-1	1
	847.5	20635	3	16-QAM	8	0	13.95	0-2	2
	847.5	20635	3	16-QAM	8	4	13.91	0-2	2
	847.5	20635	3	16-QAM	8	7	13.89	0-2	2
	847.5	20635	3	16-QAM	15	0	13.87	0-2	2

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Table 9-11
Maximum LTE Band 5 (Cell) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	824.7	20407	1.4	QPSK	1	0	22.47	0	0
	824.7	20407	1.4	QPSK	1	2	22.61	0	0
	824.7	20407	1.4	QPSK	1	5	22.52	0	0
	824.7	20407	1.4	QPSK	3	0	22.56	0	0
	824.7	20407	1.4	QPSK	3	2	22.61	0	0
	824.7	20407	1.4	QPSK	3	3	22.57	0	0
	824.7	20407	1.4	QPSK	6	0	21.68	0-1	1
	824.7	20407	1.4	16-QAM	1	0	21.78	0-1	1
	824.7	20407	1.4	16-QAM	1	2	21.81	0-1	1
	824.7	20407	1.4	16-QAM	1	5	21.87	0-1	1
	824.7	20407	1.4	16-QAM	3	0	21.76	0-1	1
	824.7	20407	1.4	16-QAM	3	2	21.84	0-1	1
	824.7	20407	1.4	16-QAM	3	3	21.82	0-1	1
	824.7	20407	1.4	16-QAM	6	0	20.73	0-2	2
Mid	836.5	20525	1.4	QPSK	1	0	22.45	0	0
	836.5	20525	1.4	QPSK	1	2	22.57	0	0
	836.5	20525	1.4	QPSK	1	5	22.46	0	0
	836.5	20525	1.4	QPSK	3	0	22.54	0	0
	836.5	20525	1.4	QPSK	3	2	22.54	0	0
	836.5	20525	1.4	QPSK	3	3	22.52	0	0
	836.5	20525	1.4	QPSK	6	0	21.64	0-1	1
	836.5	20525	1.4	16-QAM	1	0	21.78	0-1	1
	836.5	20525	1.4	16-QAM	1	2	21.89	0-1	1
	836.5	20525	1.4	16-QAM	1	5	21.86	0-1	1
	836.5	20525	1.4	16-QAM	3	0	21.77	0-1	1
	836.5	20525	1.4	16-QAM	3	2	21.82	0-1	1
	836.5	20525	1.4	16-QAM	3	3	21.77	0-1	1
	836.5	20525	1.4	16-QAM	6	0	20.70	0-2	2
High	848.3	20643	1.4	QPSK	1	0	22.32	0	0
	848.3	20643	1.4	QPSK	1	2	22.44	0	0
	848.3	20643	1.4	QPSK	1	5	22.36	0	0
	848.3	20643	1.4	QPSK	3	0	22.42	0	0
	848.3	20643	1.4	QPSK	3	2	22.47	0	0
	848.3	20643	1.4	QPSK	3	3	22.41	0	0
	848.3	20643	1.4	QPSK	6	0	21.54	0-1	1
	848.3	20643	1.4	16-QAM	1	0	21.67	0-1	1
	848.3	20643	1.4	16-QAM	1	2	21.88	0-1	1
	848.3	20643	1.4	16-QAM	1	5	21.72	0-1	1
	848.3	20643	1.4	16-QAM	3	0	21.70	0-1	1
	848.3	20643	1.4	16-QAM	3	2	21.70	0-1	1
	848.3	20643	1.4	16-QAM	3	3	21.65	0-1	1
	848.3	20643	1.4	16-QAM	6	0	20.62	0-2	2

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Table 9-12
Reduced LTE Band 5 (Cell) Conducted Powers -1.4 MHz Bandwidth
Representing Body at 0 mm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	824.7	20407	1.4	QPSK	1	0	16.30	0	0
	824.7	20407	1.4	QPSK	1	2	16.32	0	0
	824.7	20407	1.4	QPSK	1	5	16.31	0	0
	824.7	20407	1.4	QPSK	3	0	16.33	0	0
	824.7	20407	1.4	QPSK	3	2	16.33	0	0
	824.7	20407	1.4	QPSK	3	3	16.34	0	0
	824.7	20407	1.4	QPSK	6	0	15.19	0-1	1
	824.7	20407	1.4	16-QAM	1	0	15.30	0-1	1
	824.7	20407	1.4	16-QAM	1	2	15.43	0-1	1
	824.7	20407	1.4	16-QAM	1	5	15.42	0-1	1
	824.7	20407	1.4	16-QAM	3	0	15.34	0-1	1
	824.7	20407	1.4	16-QAM	3	2	15.31	0-1	1
	824.7	20407	1.4	16-QAM	3	3	15.37	0-1	1
	824.7	20407	1.4	16-QAM	6	0	14.20	0-2	2
Mid	836.5	20525	1.4	QPSK	1	0	16.23	0	0
	836.5	20525	1.4	QPSK	1	2	16.21	0	0
	836.5	20525	1.4	QPSK	1	5	16.18	0	0
	836.5	20525	1.4	QPSK	3	0	16.24	0	0
	836.5	20525	1.4	QPSK	3	2	16.26	0	0
	836.5	20525	1.4	QPSK	3	3	16.23	0	0
	836.5	20525	1.4	QPSK	6	0	15.13	0-1	1
	836.5	20525	1.4	16-QAM	1	0	15.38	0-1	1
	836.5	20525	1.4	16-QAM	1	2	15.40	0-1	1
	836.5	20525	1.4	16-QAM	1	5	15.39	0-1	1
	836.5	20525	1.4	16-QAM	3	0	15.24	0-1	1
	836.5	20525	1.4	16-QAM	3	2	15.23	0-1	1
	836.5	20525	1.4	16-QAM	3	3	15.28	0-1	1
	836.5	20525	1.4	16-QAM	6	0	14.11	0-2	2
High	848.3	20643	1.4	QPSK	1	0	16.11	0	0
	848.3	20643	1.4	QPSK	1	2	16.13	0	0
	848.3	20643	1.4	QPSK	1	5	16.11	0	0
	848.3	20643	1.4	QPSK	3	0	16.15	0	0
	848.3	20643	1.4	QPSK	3	2	16.13	0	0
	848.3	20643	1.4	QPSK	3	3	16.15	0	0
	848.3	20643	1.4	QPSK	6	0	15.00	0-1	1
	848.3	20643	1.4	16-QAM	1	0	15.21	0-1	1
	848.3	20643	1.4	16-QAM	1	2	15.24	0-1	1
	848.3	20643	1.4	16-QAM	1	5	15.27	0-1	1
	848.3	20643	1.4	16-QAM	3	0	15.16	0-1	1
	848.3	20643	1.4	16-QAM	3	2	15.14	0-1	1
	848.3	20643	1.4	16-QAM	3	3	15.12	0-1	1
	848.3	20643	1.4	16-QAM	6	0	13.97	0-2	2

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9.4 WLAN Conducted Powers

Table 9-13
IEEE 802.11b Average RF Power

	Antenna	Mode	Freq [MHz]	Channel	802.11b Conducted Power [dBm]			
					Data Rate [Mbps]			
					1	2	5.5	11
802.11b	Antenna 1	802.11b	2412	1*	11.85	11.93	11.93	11.95
		802.11b	2437	6*	**12.13**	12.27	12.35	12.19
		802.11b	2462	11*	11.79	11.96	11.97	11.99
	Antenna 2	802.11b	2412	1*	11.88	12.10	12.11	12.12
		802.11b	2437	6*	**12.35**	12.44	12.41	12.42
		802.11b	2462	11*	11.30	11.68	11.64	11.66

Table 9-14
IEEE 802.11g Average RF Power

	Antenna	Mode	Freq [MHz]	Channel	802.11g Conducted Power [dBm]							
					Data Rate [Mbps]							
					6	9	12	18	24	36	48	54
802.11g	Antenna 1	802.11g	2412	1	11.12	11.12	11.13	11.12	11.39	11.33	11.44	11.25
		802.11g	2437	6	11.45	11.35	11.40	11.35	11.45	11.48	11.41	11.40
		802.11g	2462	11	11.29	11.27	11.25	11.26	11.38	11.45	11.46	11.40
	Antenna 2	802.11g	2412	1	10.33	10.29	10.34	10.37	10.61	10.61	10.51	10.60
		802.11g	2437	6	11.05	11.15	10.97	11.11	11.27	11.28	11.22	11.28
		802.11g	2462	11	10.05	10.08	10.08	10.11	10.34	10.36	10.15	10.29

Table 9-15
IEEE 802.11n Average RF Power

	Antenna	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 (2.4GHz)	Antenna 1	802.11n	2412	1	10.22	10.20	10.19	10.44	10.49	10.39	10.39	10.46
		802.11n	2437	6	10.46	10.48	10.48	10.44	10.42	10.41	10.47	10.45
		802.11n	2462	11	10.25	10.26	10.29	10.39	10.40	10.49	10.43	10.46
	Antenna 2	802.11n	2412	1	9.00	9.01	9.05	9.28	9.26	9.21	9.27	9.30
		802.11n	2437	6	9.59	9.56	9.63	9.84	9.88	9.88	9.80	10.01
		802.11n	2462	11	8.66	8.64	8.60	8.96	8.83	8.91	8.76	8.79

Table 9-16
MIMO IEEE 802.11n Average RF Power

	Antenna	Freq [MHz]	Channel	802.11n (2.4GHz) Conducted Power [dBm]
				Data Rate [Mbps]
				13
802.11n (2.4GHz)	MIMO	2412	1*	10.19
		2437	6*	**10.46**
		2462	11*	9.95

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Table 9-17
IEEE 802.11a Average RF Power

	Antenna	Mode	Freq [MHz]	Channel	802.11a Conducted Power [dBm]							
					Data Rate [Mbps]							
					6	9	12	18	24	36	48	54
802.11a	Antenna 1	802.11a	5180	36*	7.07	6.86	6.93	6.90	7.28	7.24	7.38	7.35
		802.11a	5200	40	7.16	6.75	6.78	6.71	7.06	7.11	7.18	7.00
		802.11a	5220	44	7.15	6.92	6.92	6.95	7.20	7.17	7.28	7.14
		802.11a	5240	48*	7.04	6.88	6.85	6.88	7.30	7.14	7.30	7.24
		802.11a	5260	52*	7.21	6.79	6.84	6.90	7.17	7.08	7.19	7.05
		802.11a	5280	56	7.12	7.03	6.99	7.10	7.39	7.27	7.39	7.17
		802.11a	5300	60	7.19	7.18	7.18	7.10	7.40	7.39	7.41	7.31
		802.11a	5320	64*	7.00	6.81	6.79	6.75	7.23	7.07	7.23	7.13
		802.11a	5500	100	7.31	7.14	7.22	7.23	7.54	7.49	7.64	7.42
		802.11a	5520	104*	7.24	7.23	7.12	7.33	7.50	7.40	7.49	7.40
		802.11a	5540	108	7.37	7.21	7.25	7.22	7.62	7.66	7.66	7.56
		802.11a	5560	112	7.37	7.28	7.27	7.30	7.61	7.56	7.65	7.61
		802.11a	5580	116*	7.22	7.16	7.18	7.05	7.53	7.44	7.39	7.17
		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	7.20	7.33	7.13	7.06	7.51	7.32	7.54	7.33
		802.11a	5680	136*	7.28	7.25	7.22	7.30	7.26	7.26	7.53	7.45
		802.11a	5700	140	7.42	7.18	7.08	6.96	7.41	7.25	7.36	7.21
		802.11a	5745	149*	7.14	7.00	7.15	7.05	7.24	7.15	7.24	7.04
		802.11a	5765	153	7.29	7.26	7.19	7.17	7.47	7.23	7.43	7.21
		802.11a	5785	157*	7.35	7.39	7.39	7.28	7.50	7.42	7.47	7.37
		802.11a	5805	161	7.17	7.26	7.25	7.10	7.44	7.28	7.38	7.11
		802.11a	5825	165*	7.05	6.98	7.05	7.05	7.35	7.26	7.25	7.11
	Antenna 2	802.11a	5180	36*	7.38	7.15	7.28	7.10	7.56	7.37	7.31	7.50
		802.11a	5200	40	7.10	7.03	7.11	7.12	7.33	7.37	7.38	7.54
		802.11a	5220	44	7.19	7.21	7.17	7.20	7.42	7.35	7.39	7.53
		802.11a	5240	48*	7.05	7.08	7.06	7.05	7.40	7.20	7.28	7.30
		802.11a	5260	52*	7.21	7.05	7.00	7.01	7.41	7.36	7.36	7.42
		802.11a	5280	56	7.01	6.93	6.99	6.95	7.45	7.37	7.34	7.36
		802.11a	5300	60	7.08	7.08	6.95	7.06	7.35	7.29	7.10	7.27
		802.11a	5320	64*	7.05	6.96	6.97	6.96	7.30	7.13	7.20	7.30
		802.11a	5500	100	6.98	7.02	6.98	6.97	7.22	7.31	7.10	7.31
		802.11a	5520	104*	6.91	6.83	6.77	6.88	7.23	7.21	7.14	7.28
		802.11a	5540	108	7.55	7.03	6.96	7.02	7.26	7.22	7.13	7.26
		802.11a	5560	112	7.04	7.08	7.08	7.18	7.30	7.30	7.22	7.34
		802.11a	5580	116*	6.97	6.78	6.79	6.81	7.11	7.11	7.00	7.24
		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	6.88	6.78	6.95	6.87	7.20	7.17	7.14	7.30
		802.11a	5680	136*	6.85	6.92	6.95	7.05	7.10	7.13	6.98	7.06
		802.11a	5700	140	6.99	7.00	6.86	6.99	6.96	6.98	6.93	7.07
		802.11a	5745	149*	7.22	7.30	7.23	7.25	7.52	7.50	7.54	7.52
		802.11a	5765	153	7.16	6.88	6.84	6.85	7.22	7.21	7.28	7.32
		802.11a	5785	157*	7.22	7.09	7.09	7.08	7.43	7.46	7.32	7.44
		802.11a	5805	161	7.21	7.26	7.23	7.27	7.56	7.50	7.47	7.53
		802.11a	5825	165*	7.35	7.21	7.20	7.16	7.57	7.44	7.50	7.51

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

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

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Table 9-18
IEEE 802.11n Average RF Power – 20 MHz Bandwidth

	Antenna	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
20MHz 802.11n (5GHz)	Antenna 1	802.11n	5180	36	6.95	6.91	6.95	7.13	7.11	7.27	7.32	7.25
		802.11n	5200	40	6.91	6.74	6.87	7.13	7.11	7.30	7.22	7.23
		802.11n	5220	44	6.81	6.76	6.76	6.95	7.00	6.99	7.18	7.07
		802.11n	5240	48	7.07	7.02	7.09	7.35	7.34	7.34	7.30	7.34
		802.11n	5260	52	6.90	6.90	6.90	7.07	7.15	7.21	7.34	7.33
		802.11n	5280	56	7.00	7.00	7.04	7.33	7.26	7.33	7.33	7.42
		802.11n	5300	60	6.94	6.89	6.91	7.12	7.14	7.12	7.31	7.27
		802.11n	5320	64	6.95	7.02	7.01	7.26	7.26	7.45	7.45	7.43
		802.11n	5500	100	7.22	7.20	7.29	7.43	7.53	7.61	7.65	7.60
		802.11n	5520	104	7.11	7.10	7.06	7.33	7.31	7.42	7.42	7.48
		802.11n	5540	108	6.94	6.77	6.65	6.84	6.92	7.20	7.30	7.23
		802.11n	5560	112	7.19	7.23	7.20	7.43	7.49	7.52	7.60	7.66
		802.11n	5580	116	7.12	6.96	7.00	7.43	7.28	7.62	7.47	7.63
		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	7.13	7.10	7.09	7.33	7.32	7.42	7.46	7.34
		802.11n	5680	136	7.11	7.14	7.16	7.38	7.38	7.56	7.58	7.60
		802.11n	5700	140	7.19	7.25	7.22	7.25	7.56	7.63	7.60	7.59
		802.11n	5745	149	7.09	7.09	7.19	7.25	7.31	7.28	7.43	7.37
		802.11n	5765	153	7.01	6.96	7.00	7.28	7.26	7.19	7.22	7.24
		802.11n	5785	157	6.94	6.77	6.79	6.88	7.06	6.99	7.02	7.10
		802.11n	5805	161	6.89	6.79	6.86	7.11	7.11	7.20	7.20	7.14
		802.11n	5825	165	6.84	7.00	6.84	7.19	7.26	7.31	7.21	7.30
	Antenna 2	802.11n	5180	36	6.91	6.84	6.84	7.08	7.20	7.26	7.33	7.39
		802.11n	5200	40	7.11	7.31	7.26	7.47	7.43	7.57	7.51	7.42
		802.11n	5220	44	7.05	7.17	7.21	7.39	7.37	7.55	7.48	7.53
		802.11n	5240	48	6.85	7.08	6.99	7.14	7.16	7.17	7.21	7.22
		802.11n	5260	52	6.65	6.83	6.91	7.02	7.11	7.16	7.21	7.18
		802.11n	5280	56	6.79	6.83	6.85	7.03	7.04	7.00	7.05	7.04
		802.11n	5300	60	6.88	7.03	6.94	7.14	7.17	7.44	7.35	7.22
		802.11n	5320	64	6.75	6.76	6.82	6.85	6.87	7.01	6.82	6.98
		802.11n	5500	100	6.82	6.80	6.84	6.81	6.81	6.92	7.03	7.05
		802.11n	5520	104	6.75	6.74	6.83	6.82	6.87	7.06	7.03	7.09
		802.11n	5540	108	6.67	6.74	6.74	6.90	6.91	6.98	7.02	7.07
		802.11n	5560	112	6.78	6.58	6.75	6.87	6.95	7.06	6.96	7.10
		802.11n	5580	116	6.65	6.62	6.57	6.83	6.81	6.86	6.87	6.95
		802.11n	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		802.11n	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		802.11n	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		802.11n	5660	132	6.62	6.52	6.45	6.67	6.57	6.83	6.79	6.81
		802.11n	5680	136	6.56	6.45	6.51	6.52	6.47	6.68	6.74	6.74
		802.11n	5700	140	6.50	6.52	6.57	6.47	6.57	6.50	6.56	6.58
		802.11n	5745	149	6.94	6.93	7.01	7.29	7.13	7.42	7.41	7.40
		802.11n	5765	153	7.02	7.07	7.17	7.38	7.35	7.52	7.46	7.52
		802.11n	5785	157	6.95	7.00	6.89	6.98	7.19	7.25	7.29	7.21
		802.11n	5805	161	6.91	6.90	7.00	7.21	7.29	7.40	7.28	7.28
		802.11n	5825	165	6.92	6.84	6.90	7.12	7.16	7.35	7.28	7.27

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Table 9-19
MIMO IEEE 802.11n Average RF Power – 20 MHz Bandwidth

	Antenna	Mode	Freq [MHz]	Channel	802.11n (5GHz) Conducted Power [dBm]
					Data Rate [Mbps]
					13
20MHz 802.11n (5GHz)	MIMO	802.11n	5180	36*	6.82
		802.11n	5200	40	6.57
		802.11n	5220	44	6.34
		802.11n	5240	48*	6.04
		802.11n	5260	52*	6.02
		802.11n	5280	56	5.76
		802.11n	5300	60	5.57
		802.11n	5320	64*	5.59
		802.11n	5500	100	6.22
		802.11n	5520	104*	6.06
		802.11n	5540	108	6.17
		802.11n	5560	112	6.47
		802.11n	5580	116*	6.38
		802.11n	5600	120	N/A
		802.11n	5620	124	N/A
		802.11n	5640	128	N/A
		802.11n	5660	132	6.73
		802.11n	5680	136*	6.32
		802.11n	5700	140	6.80
		802.11n	5745	149*	7.92
		802.11n	5765	153	7.89
		802.11n	5785	157*	7.88
		802.11n	5805	161	7.90
		802.11n	5825	165*	7.97

Table 9-20
IEEE 802.11n Average RF Power – 40 MHz Bandwidth

	Antenna	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
40MHz 802.11n (5GHz)	Antenna 1	802.11n	5190	38	6.15	6.06	6.30	6.28	6.35	6.35	6.39	6.35
		802.11n	5230	46	6.52	6.51	6.56	6.82	6.80	6.92	6.93	6.89
		802.11n	5270	54	6.39	6.30	6.56	6.58	6.62	6.54	6.53	6.43
		802.11n	5310	62	6.08	6.17	6.16	6.33	6.35	6.35	6.24	6.14
		802.11n	5510	102	6.32	6.28	6.32	6.36	6.41	6.41	6.50	6.49
		802.11n	5550	110	6.21	6.14	6.17	6.27	6.47	6.39	6.37	6.40
		802.11n	5590	118	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		802.11n	5630	126	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		802.11n	5670	134	6.40	6.43	6.42	6.55	6.47	6.65	6.64	6.62
		802.11n	5755	151	7.35	7.40	7.39	7.45	7.48	7.54	7.58	7.42
		802.11n	5795	159	7.31	7.36	7.40	7.43	7.50	7.54	7.55	7.55
	Antenna 2	802.11n	5190	38	6.06	6.39	6.10	6.33	6.41	6.49	6.52	6.53
		802.11n	5230	46	6.21	6.21	6.13	6.35	6.22	6.38	6.47	6.39
		802.11n	5270	54	6.02	6.14	6.10	6.05	6.05	6.22	6.05	6.18
		802.11n	5310	62	6.05	6.14	6.08	6.22	6.26	6.40	6.44	6.43
		802.11n	5510	102	7.20	7.26	7.12	7.24	7.28	7.21	7.28	7.31
		802.11n	5550	110	7.11	7.12	7.19	7.11	7.23	7.25	7.23	7.28
		802.11n	5590	118	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		802.11n	5630	126	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		802.11n	5670	134	7.15	7.22	7.20	7.22	7.27	7.31	7.33	7.30
		802.11n	5755	151	6.05	6.12	6.13	6.10	6.11	6.18	6.40	6.20
		802.11n	5795	159	6.03	6.06	6.01	6.14	6.18	6.27	6.39	6.34

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Table 9-21
MIMO IEEE 802.11n Average RF Power – 40 MHz Bandwidth

40MHz 802.11n (5GHz)	Antenna	Mode	Freq [MHz]	Channel	40MHz 802.11n (5GHz) Conducted Power [dBm]
					Data Rate [Mbps]
					27
	MIMO	802.11n	5190	38	6.31
		802.11n	5230	46	6.10
		802.11n	5270	54	5.33
		802.11n	5310	62	5.56
		802.11n	5510	102	5.55
		802.11n	5550	110	5.99
		802.11n	5590	118	N/A
		802.11n	5630	126	N/A
		802.11n	5670	134	6.95
		802.11n	5755	151	7.84
		802.11n	5795	159	7.73

Table 9-22
IEEE 802.11ac Average RF Power – 80 MHz Bandwidth

80MHz 802.11ac (5GHz)	Antenna	Mode	Freq [MHz]	Channel	80MHz BW 802.11ac (5GHz) Conducted Power [dBm]									
					Data Rate [Mbps]									
					29.3	58.5	87.8	117	175.5	234	263.3	292.5	351	390
	Antenna 1	802.11ac	5210	42	6.12	6.02	6.03	6.36	6.34	6.21	6.30	6.23	6.04	6.03
		802.11ac	5290	58	6.04	6.01	6.12	6.28	6.25	6.21	6.09	6.22	6.10	6.08
		802.11ac	5530	106	6.24	6.14	6.09	6.43	6.45	6.44	6.39	6.46	6.18	6.15
		802.11ac	5775	155	6.88	6.66	6.69	7.02	7.05	7.00	7.05	7.11	6.69	7.09
	Antenna 2	802.11ac	5210	42	6.25	6.14	6.15	6.22	6.27	6.27	6.18	6.22	6.37	6.35
		802.11ac	5290	58	6.20	6.10	6.19	6.19	6.25	6.18	6.20	6.29	6.34	6.29
		802.11ac	5530	106	6.02	6.14	6.00	6.01	6.08	6.03	6.14	6.11	6.25	6.23
		802.11ac	5775	155	6.22	6.11	6.28	6.33	6.42	6.43	6.34	6.40	6.46	6.39

Table 9-23
MIMO IEEE 802.11ac Average RF Power – 80 MHz Bandwidth

80MHz 802.11ac (5GHz)	Antenna	Mode	Freq [MHz]	Channel	80MHz 802.11ac (5GHz) Conducted Power [dBm]
					Data Rate [Mbps]
					58.5
	MIMO	802.11ac	5210	42	5.53
		802.11ac	5290	58	5.20
		802.11ac	5530	106	5.48
		802.11ac	5775	155	7.14

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

- For SISO 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 MIMO 2.4 GHz, highest average RF output power channel for the lowest data rate for IEEE 802.11n was selected for SAR evaluation.
- 5 GHz WLAN were excluded per FCC KDB 447498 D01v05.
- 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 individual spectra for each 2x2 MIMO WIFI Antenna were summed mathematically in linear power units for the MIMO output power measurements.
- The bolded data rate and channel above were tested for SAR.

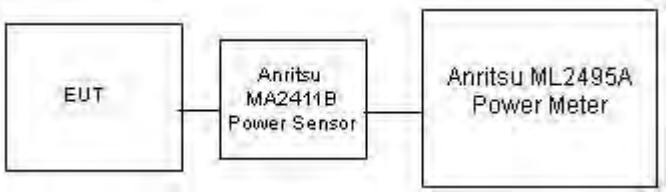

Figure 9-3
Power Measurement Setup for SISO Bandwidths < 50 MHz

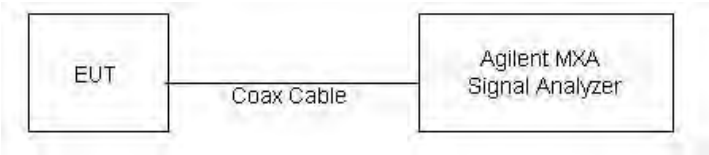

Figure 9-4
Power Measurement Setup for SISO Bandwidths > 50 MHz

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9.5 Bluetooth Conducted Powers

Table 9-24
Bluetooth RF Conducted Powers

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
			[dBm]	[mW]
2402	1	0	7.2	5.253
2441	1	39	**9.61**	9.138
2480	1	78	8.71	7.431
2402	2	0	3.36	2.167
2441	2	39	5.97	3.957
2480	2	78	5.24	3.342
2402	3	0	3.44	2.21
2441	3	39	6.02	3.995
2480	3	78	5.28	3.372

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

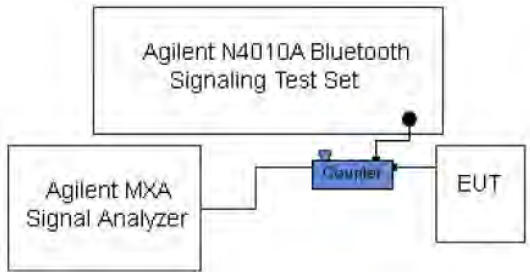

Figure 9-5
Power Measurement Setup

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10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C°)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	%dev σ	%dev ε
04/17/2014	835H	23.2	820	0.894	40.846	0.899	41.578	-0.56%	-1.76%
			835	0.906	40.624	0.900	41.500	0.67%	-2.11%
			850	0.920	40.469	0.916	41.500	0.44%	-2.48%
04/21/2014	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%
04/17/2014	1900H	22.8	1850	1.371	41.381	1.400	40.000	-2.07%	3.45%
			1880	1.402	41.224	1.400	40.000	0.14%	3.06%
			1910	1.437	41.115	1.400	40.000	2.64%	2.79%
04/14/2014	2450H	23.4	2401	1.720	39.335	1.756	39.287	-2.05%	0.12%
			2450	1.773	39.159	1.800	39.200	-1.50%	-0.10%
			2499	1.828	38.982	1.853	39.138	-1.35%	-0.40%
04/17/2014	835B	21.9	820	1.000	54.226	0.969	55.258	3.20%	-1.87%
			835	1.014	54.052	0.970	55.200	4.54%	-2.08%
			850	1.027	53.927	0.988	55.154	3.95%	-2.22%
04/21/2014	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%
04/21/2014	1900B	23.8	1850	1.491	51.864	1.520	53.300	-1.91%	-2.69%
			1880	1.522	51.770	1.520	53.300	0.13%	-2.87%
			1910	1.558	51.607	1.520	53.300	2.50%	-3.18%
04/24/2014	1900B	22.7	1850	1.489	52.786	1.520	53.300	-2.04%	-0.96%
			1880	1.520	52.699	1.520	53.300	0.00%	-1.13%
			1910	1.557	52.586	1.520	53.300	2.43%	-1.34%
04/14/2014	2450B	23.1	2401	1.962	52.784	1.903	52.765	3.10%	0.04%
			2450	2.031	52.620	1.950	52.700	4.15%	-0.15%
			2499	2.097	52.430	2.019	52.638	3.86%	-0.40%
04/21/2014	2450B	22.8	2401	1.968	51.220	1.903	52.765	3.42%	-2.93%
			2450	2.032	50.970	1.950	52.700	4.21%	-3.28%
			2499	2.100	50.831	2.019	52.638	4.01%	-3.43%

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.

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10.2 Test System Verification

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

Table 10-2
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	$Deviation_{1g}$ (%)
E	835	HEAD	04/17/2014	24.5	23.5	0.100	4d132	3914	0.976	9.200	9.760	6.09%
E	835	HEAD	04/21/2014	23.8	22.5	0.100	4d132	3914	0.985	9.200	9.850	7.07%
J	1900	HEAD	04/17/2014	23.3	21.0	0.100	5d149	3332	4.220	40.400	42.200	4.46%
K	2450	HEAD	04/14/2014	24.2	23.4	0.100	797	3287	5.450	51.800	54.500	5.21%
D	835	BODY	04/17/2014	23.2	21.9	0.100	4d132	3022	0.989	9.310	9.890	6.23%
D	835	BODY	04/21/2014	23.3	22.0	0.100	4d132	3022	0.998	9.310	9.980	7.20%
H	1900	BODY	04/21/2014	23.8	23.1	0.100	5d149	3589	4.090	40.500	40.900	0.99%
H	1900	BODY	04/24/2014	23.8	22.9	0.100	5d149	3589	4.010	40.500	40.100	-0.99%
G	2450	BODY	04/14/2014	24.4	23.9	0.100	797	3258	4.890	49.400	48.900	-1.01%
G	2450	BODY	04/21/2014	24.3	23.0	0.100	797	3258	4.900	49.400	49.000	-0.81%

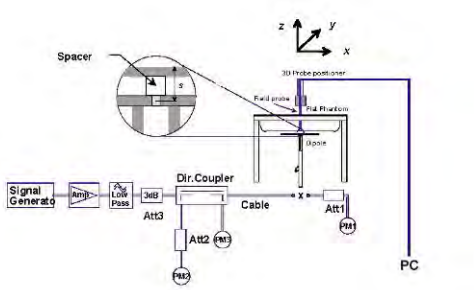

Figure 10-1
System Verification Setup Diagram

Figure 10-2
System Verification Setup Photo

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11 SAR DATA SUMMARY

11.1 Standalone Head SAR Data

Table 11-1
GSM 850 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.0	32.97	0.15	Right	Cheek	0410-01	1:8.3	0.059	1.007	0.059	
836.60	190	GSM 850	GSM	33.0	32.97	0.06	Right	Tilt	0410-01	1:8.3	0.078	1.007	0.079	A1
836.60	190	GSM 850	GSM	33.0	32.97	-0.18	Left	Cheek	0410-01	1:8.3	0.054	1.007	0.054	
836.60	190	GSM 850	GSM	33.0	32.97	-0.03	Left	Tilt	0410-01	1:8.3	0.075	1.007	0.076	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 11-2
UMTS 850 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	23.0	22.76	0.13	Right	Cheek	0410-01	1:1	0.050	1.057	0.053	
836.60	4183	UMTS 850	RMC	23.0	22.76	0.00	Right	Tilt	0410-01	1:1	0.060	1.057	0.063	
836.60	4183	UMTS 850	RMC	23.0	22.76	0.11	Left	Cheek	0410-01	1:1	0.038	1.057	0.040	
836.60	4183	UMTS 850	RMC	23.0	22.76	0.02	Left	Tilt	0410-01	1:1	0.064	1.057	0.068	A2
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 11-3
GSM 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	661	GSM 1900	GSM	29.0	28.15	0.15	Right	Cheek	0410-02	1:8.3	0.109	1.216	0.133	A3
1880.00	661	GSM 1900	GSM	29.0	28.15	-0.04	Right	Tilt	0410-02	1:8.3	0.072	1.216	0.088	
1880.00	661	GSM 1900	GSM	29.0	28.15	-0.03	Left	Cheek	0410-02	1:8.3	0.058	1.216	0.071	
1880.00	661	GSM 1900	GSM	29.0	28.15	0.02	Left	Tilt	0410-02	1:8.3	0.087	1.216	0.106	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

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Table 11-4
UMTS 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	23.0	22.99	0.10	Right	Cheek	0410-02	1:1	0.190	1.002	**0.190**	A4
1880.00	9400	UMTS 1900	RMC	23.0	22.99	0.01	Right	Tilt	0410-02	1:1	0.102	1.002	0.102	
1880.00	9400	UMTS 1900	RMC	23.0	22.99	0.10	Left	Cheek	0410-02	1:1	0.100	1.002	0.100	
1880.00	9400	UMTS 1900	RMC	23.0	22.99	0.06	Left	Tilt	0410-02	1:1	0.158	1.002	0.158	

ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population	Head 1.6 W/kg (mW/g) averaged over 1 gram

Table 11-5
LTE Band 5 (Cell) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.45	-0.06	0	Right	Cheek	QPSK	1	25	0410-01	1:1	0.047	1.135	0.053	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.43	0.00	1	Right	Cheek	QPSK	25	0	0410-01	1:1	0.036	1.140	0.041	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.45	-0.10	0	Right	Tilt	QPSK	1	25	0410-01	1:1	0.053	1.135	0.060	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.43	0.10	1	Right	Tilt	QPSK	25	0	0410-01	1:1	0.040	1.140	0.046	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.45	-0.05	0	Left	Cheek	QPSK	1	25	0410-01	1:1	0.032	1.135	0.036	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.43	0.12	1	Left	Cheek	QPSK	25	0	0410-01	1:1	0.026	1.140	0.030	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.45	0.09	0	Left	Tilt	QPSK	1	25	0410-01	1:1	0.055	1.135	0.062	A5
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.43	0.06	1	Left	Tilt	QPSK	25	0	0410-01	1:1	0.042	1.140	0.048	

ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population	Head 1.6 W/kg (mW/g) averaged over 1 gram

Table 11-6
DTS Head SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Antenna #	Device Serial Number	Data Rate (Mbps)	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
2437	6	IEEE 802.11b	DSSS	12.5	12.13	0.00	Right	Cheek	Antenna 1	0410-02	1	1:1	0.117	1.089	0.127	
2437	6	IEEE 802.11b	DSSS	12.5	12.13	0.03	Right	Tilt	Antenna 1	0410-02	1	1:1	0.116	1.089	0.126	
2437	6	IEEE 802.11b	DSSS	12.5	12.13	0.21	Left	Cheek	Antenna 1	0410-02	1	1:1	0.436	1.089	**0.475**	
2437	6	IEEE 802.11b	DSSS	12.5	12.13	0.03	Left	Tilt	Antenna 1	0410-02	1	1:1	0.378	1.089	0.412	
2437	6	IEEE 802.11b	DSSS	12.5	12.35	0.20	Right	Cheek	Antenna 2	0410-02	1	1:1	0.032	1.035	0.033	
2437	6	IEEE 802.11b	DSSS	12.5	12.35	0.05	Right	Tilt	Antenna 2	0410-02	1	1:1	0.025	1.035	0.026	
2437	6	IEEE 802.11b	DSSS	12.5	12.35	0.20	Left	Cheek	Antenna 2	0410-02	1	1:1	0.153	1.035	0.158	
2437	6	IEEE 802.11b	DSSS	12.5	12.35	0.21	Left	Tilt	Antenna 2	0410-02	1	1:1	0.169	1.035	0.175	
2437	6	IEEE 802.11n	OFDM	10.5	10.46	0.03	Right	Cheek	MIMO	0410-02	13	1:1	0.129	1.009	0.130	
2437	6	IEEE 802.11n	OFDM	10.5	10.46	0.20	Right	Tilt	MIMO	0410-02	13	1:1	0.123	1.009	0.124	
2437	6	IEEE 802.11n	OFDM	10.5	10.46	0.08	Left	Cheek	MIMO	0410-02	13	1:1	0.449	1.009	0.453	
2437	6	IEEE 802.11n	OFDM	10.5	10.46	0.11	Left	Tilt	MIMO	0410-02	13	1:1	0.467	1.009	0.471	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

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11.2 Standalone Body SAR Data

Table 11-8
GPRS/UMTS Body SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of GPRS Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GPRS	30.0	29.76	0.02	15 mm	0410-01	3	1:2.76	back	0.473	1.057	0.500	A7
836.60	190	GSM 850	GPRS	30.0	29.76	-0.02	10 mm	0410-01	3	1:2.76	bottom	0.436	1.057	0.461	
836.60	190	GSM 850	GPRS	30.0	29.76	0.03	4 mm	0410-01	3	1:2.76	right	0.448	1.057	0.474	
836.60	190	GSM 850	GPRS	30.0	29.76	-0.03	0 mm	0410-01	3	1:2.76	left	0.142	1.057	0.150	
836.60	190	GSM 850	GPRS	22.0	21.88	-0.02	0 mm	0410-03	3	1:2.76	back	0.314	1.028	0.323	
836.60	190	GSM 850	GPRS	22.0	21.88	-0.02	0 mm	0410-03	3	1:2.76	bottom	0.115	1.028	0.118	
836.60	190	GSM 850	GPRS	22.0	21.88	-0.04	0 mm	0410-03	3	1:2.76	right	0.053	1.028	0.054	
836.60	4183	UMTS 850	RMC	23.0	22.76	0.00	15 mm	0410-01	N/A	1:1	back	0.361	1.057	0.382	
836.60	4183	UMTS 850	RMC	23.0	22.76	0.01	10 mm	0410-01	N/A	1:1	bottom	0.408	1.057	0.431	
836.60	4183	UMTS 850	RMC	23.0	22.76	0.05	4 mm	0410-01	N/A	1:1	right	0.250	1.057	0.264	
836.60	4183	UMTS 850	RMC	16.0	15.65	-0.04	0 mm	0410-03	N/A	1:1	back	0.681	1.084	0.738	A8
836.60	4183	UMTS 850	RMC	16.0	15.65	-0.06	0 mm	0410-03	N/A	1:1	bottom	0.265	1.084	0.287	
836.60	4183	UMTS 850	RMC	16.0	15.65	0.06	0 mm	0410-03	N/A	1:1	right	0.096	1.084	0.104	
1880.00	661	GSM 1900	GPRS	27.5	26.67	0.01	15 mm	0410-01	3	1:2.76	back	0.571	1.211	0.691	
1850.20	512	GSM 1900	GPRS	27.5	26.71	0.01	10 mm	0410-01	3	1:2.76	bottom	0.576	1.199	0.691	
1880.00	661	GSM 1900	GPRS	27.5	26.67	-0.02	10 mm	0410-01	3	1:2.76	bottom	0.694	1.211	0.840	
1909.80	810	GSM 1900	GPRS	27.5	26.77	0.00	10 mm	0410-01	3	1:2.76	bottom	0.689	1.183	0.815	
1850.20	512	GSM 1900	GPRS	27.5	26.71	-0.07	4 mm	0410-01	3	1:2.76	right	0.707	1.199	0.848	
1880.00	661	GSM 1900	GPRS	27.5	26.67	0.00	4 mm	0410-01	3	1:2.76	right	0.756	1.211	0.916	
1909.80	810	GSM 1900	GPRS	27.5	26.77	0.06	4 mm	0410-01	3	1:2.76	right	0.837	1.183	0.990	A9
1850.20	512	GSM 1900	GPRS	15.0	14.60	0.05	0 mm	0410-03	4	1:2.076	back	0.655	1.096	0.718	
1880.00	661	GSM 1900	GPRS	15.0	14.53	0.05	0 mm	0410-03	4	1:2.076	back	0.741	1.114	0.825	
1909.80	810	GSM 1900	GPRS	15.0	14.74	-0.07	0 mm	0410-03	4	1:2.076	back	0.749	1.062	0.795	
1880.00	661	GSM 1900	GPRS	15.0	14.53	0.04	0 mm	0410-03	4	1:2.076	bottom	0.259	1.114	0.289	
1880.00	661	GSM 1900	GPRS	15.0	14.53	0.07	0 mm	0410-03	4	1:2.076	right	0.116	1.114	0.129	
1880.00	9400	UMTS 1900	RMC	23.0	22.99	-0.02	15 mm	0410-01	N/A	1:1	back	0.658	1.002	0.659	
1880.00	9400	UMTS 1900	RMC	23.0	22.99	0.00	10 mm	0410-01	N/A	1:1	bottom	0.780	1.002	0.782	
1852.40	9262	UMTS 1900	RMC	23.0	23.00	0.02	4 mm	0410-01	N/A	1:1	right	0.825	1.000	0.825	
1880.00	9400	UMTS 1900	RMC	23.0	22.99	-0.04	4 mm	0410-01	N/A	1:1	right	0.898	1.002	0.900	
1907.60	9538	UMTS 1900	RMC	23.0	22.98	-0.04	4 mm	0410-01	N/A	1:1	right	0.959	1.005	0.964	
1852.40	9262	UMTS 1900	RMC	12.0	11.94	0.06	0 mm	0410-03	N/A	1:1	back	0.974	1.014	0.988	
1880.00	9400	UMTS 1900	RMC	12.0	11.92	-0.01	0 mm	0410-03	N/A	1:1	back	0.971	1.019	0.989	
1907.60	9538	UMTS 1900	RMC	12.0	12.00	-0.01	0 mm	0410-03	N/A	1:1	back	1.000	1.000	1.000	
1880.00	9400	UMTS 1900	RMC	12.0	11.92	-0.01	0 mm	0410-03	N/A	1:1	bottom	0.304	1.019	0.310	
1880.00	9400	UMTS 1900	RMC	12.0	11.92	0.02	0 mm	0410-03	N/A	1:1	right	0.137	1.019	0.140	
1907.60	9538	UMTS 1900	RMC	12.0	12.00	0.01	0 mm	0410-03	N/A	1:1	back	1.010	1.000	**1.010**	A10
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							**Body 1.6 W/kg (mW/g) averaged over 1 gram**								

Blue entry represents variability measurement.

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Table 11-9
LTE Band 5 (Cell) Body SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.45	0.03	0	0410-01	QPSK	1	25	15 mm	back	1:1	0.322	1.135	0.365	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.43	0.05	1	0410-01	QPSK	25	0	15 mm	back	1:1	0.258	1.140	0.294	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.45	-0.11	0	0410-01	QPSK	1	25	10 mm	bottom	1:1	0.420	1.135	0.477	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.43	-0.01	1	0410-01	QPSK	25	0	10 mm	bottom	1:1	0.325	1.140	0.371	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.45	-0.01	0	0410-01	QPSK	1	25	4 mm	right	1:1	0.192	1.135	0.218	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.43	0.04	1	0410-01	QPSK	25	0	4 mm	right	1:1	0.191	1.140	0.218	
836.50	20525	Mid	LTE Band 5 (Cell)	10	16.5	16.22	0.05	0	0410-03	QPSK	1	0	0 mm	back	1:1	0.648	1.067	0.691	A11
836.50	20525	Mid	LTE Band 5 (Cell)	10	15.5	15.10	0.06	1	0410-03	QPSK	25	0	0 mm	back	1:1	0.510	1.096	0.559	
836.50	20525	Mid	LTE Band 5 (Cell)	10	16.5	16.22	0.01	0	0410-03	QPSK	1	0	0 mm	bottom	1:1	0.290	1.067	0.309	
836.50	20525	Mid	LTE Band 5 (Cell)	10	15.5	15.10	-0.01	1	0410-03	QPSK	25	0	0 mm	bottom	1:1	0.224	1.096	0.246	
836.50	20525	Mid	LTE Band 5 (Cell)	10	16.5	16.22	0.04	0	0410-03	QPSK	1	0	0 mm	right	1:1	0.114	1.067	0.122	
836.50	20525	Mid	LTE Band 5 (Cell)	10	15.5	15.10	0.03	1	0410-03	QPSK	25	0	0 mm	right	1:1	0.091	1.096	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													

Table 11-10
DTS Body SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna #	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	12.5	11.85	0.00	0 mm	Antenna 1	1004-1	1	back	1:1	0.870	1.161	1.010	
2437	6	IEEE 802.11b	DSSS	12.5	12.13	0.05	0 mm	Antenna 1	1004-1	1	back	1:1	0.915	1.089	0.996	
2462	11	IEEE 802.11b	DSSS	12.5	11.79	0.08	0 mm	Antenna 1	1004-1	1	back	1:1	0.724	1.178	0.853	
2437	6	IEEE 802.11b	DSSS	12.5	12.13	0.07	0 mm	Antenna 1	1004-1	1	top	1:1	0.621	1.089	0.676	
2437	6	IEEE 802.11b	DSSS	12.5	12.13	0.18	0 mm	Antenna 1	1004-1	1	right	1:1	0.039	1.089	0.042	
2412	1	IEEE 802.11b	DSSS	12.5	11.88	0.02	0 mm	Antenna 2	1004-1	1	back	1:1	0.896	1.153	1.033	
2437	6	IEEE 802.11b	DSSS	12.5	12.35	0.20	0 mm	Antenna 2	1004-1	1	back	1:1	1.020	1.035	**1.056**	A12
2462	11	IEEE 802.11b	DSSS	12.5	11.30	0.12	0 mm	Antenna 2	1004-1	1	back	1:1	0.774	1.318	1.020	
2437	6	IEEE 802.11b	DSSS	12.5	12.35	0.10	0 mm	Antenna 2	1004-1	1	top	1:1	0.160	1.035	0.166	
2437	6	IEEE 802.11b	DSSS	12.5	12.35	-0.02	0 mm	Antenna 2	1004-1	1	right	1:1	0.389	1.035	0.403	
2437	6	IEEE 802.11n	OFDM	10.5	10.46	0.14	0 mm	MIMO	1004-1	13	back	1:1	0.291	1.009	0.294	
2437	6	IEEE 802.11n	OFDM	10.5	10.46	-0.05	0 mm	MIMO	1004-1	13	top	1:1	0.001	1.009	0.001	
2437	6	IEEE 802.11b	OFDM	10.5	10.46	0.03	0 mm	MIMO	1004-1	13	right	1:1	0.000	1.009	0.000	
2437	6	IEEE 802.11b	DSSS	12.5	12.35	0.12	0 mm	Antenna 2	1004-1	1	back	1:1	0.893	1.035	0.924	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram										

Blue entry represents variability measurement.

Table 11-12
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	10.5	9.61	-0.04	0 mm	1004-1	1	back	1:1	0.221	1.227	0.271	A13
2441	39	Bluetooth	FHSS	10.5	9.61	0.00	0 mm	1004-1	1	top	1:1	0.153	1.227	0.188	
2441	39	Bluetooth	FHSS	10.5	9.61	0.01	0 mm	1004-1	1	right	1:1	0.009	1.227	0.011	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram									

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11.3 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 KBD 616217 and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements. A standard battery 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 13 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 and right edges SAR tests were required for the main antenna (GSM 1900, UMTS B2 & B5, and LTE B5). Bottom, right, and left edges SAR tests were required for GSM 850 main antenna. Top and right edges SAR tests were required for the WLAN/BT antennas.
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. Head SAR tests for main antenna were performed at max 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 > ½ 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 > ½ dB, instead of the middle channel, the highest output power channel was used.

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LTE Notes:

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

WLAN Notes:

1. Justification for reduced test configurations for SISO 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. For 5GHz WLAN, SAR was not required based on the maximum conducted power and the antenna to user separation distance. See section 1.6.
3. WIFI transmission was verified using an uncalibrated spectrum analyzer.
4. Since the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is >1.6 W/kg and the reported 1g averaged SAR is >0.8 W/kg, SAR testing on other default channels was required.
5. Per KDB 248227, SAR for MIMO was measured with both transmitting simultaneously and was evaluated independently of SISO operation. For 2.4 GHz MIMO, 802.11n was evaluated. 5 GHz WLAN were excluded per FCC KDB Publication 447498 D01v05.
6. There is no power reduction to WLAN antenna

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12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

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

12.2 Simultaneous Transmission Procedures

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

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

Table 12-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Configuration	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]		[mm]	[W/kg]
5GHz WLAN Ant. 1	5825	8.00	Head, Back Side & Top Edge Touching (*)	5	**0.386**
5GHz WLAN Ant. 1	5825	8.00	Right Edge, Touching	17	**0.114**
5GHz WLAN Ant. 2	5825	8.00	Head, Back Side & Right Edge Touching (*)	5	**0.386**
5GHz WLAN Ant. 2	5825	8.00	Top Edge, Touching	13	**0.149**
5GHz WLAN MIMO	5825	8.00	Head, and Body Touching (*)	5	**0.386**
Bluetooth LE	2440	7.00	Right Edge, Touching	17	**0.061**

Note:

1. Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission.
2. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.
3. When the test separation distance was > 50 mm, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion, for configurations excluded per FCC KDB Publication 447498 D01v05. When the test separation distance was < 50 mm, an estimated SAR was determined per FCC KDB Publication 447498 D01v05.
4. (*) - Per FCC KDB 447498, when the test separation distance is <5 mm, a distance of 5 mm is applied to determine estimated SAR.

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12.3 Head SAR Simultaneous Transmission Analysis

Table 12-2
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant. 1 (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	(Ant.1) 2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	(Ant.1) 2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.059	0.127	0.186	Head SAR	Right Cheek	0.053	0.127	0.180
	Right Tilt	0.079	0.126	0.205		Right Tilt	0.063	0.126	0.189
	Left Cheek	0.054	0.475	**0.529**		Left Cheek	0.040	0.475	**0.515**
	Left Tilt	0.076	0.412	0.488		Left Tilt	0.068	0.412	0.480
Simult Tx	Configuration	GSM 1900 SAR (W/kg)	(Ant.1) 2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	(Ant.1) 2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.133	0.127	0.260	Head SAR	Right Cheek	0.190	0.127	0.317
	Right Tilt	0.088	0.126	0.214		Right Tilt	0.102	0.126	0.228
	Left Cheek	0.071	0.475	**0.546**		Left Cheek	0.100	0.475	**0.575**
	Left Tilt	0.106	0.412	0.518		Left Tilt	0.158	0.412	0.570

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	(Ant.1) 2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.053	0.127	0.180
	Right Tilt	0.060	0.126	0.186
	Left Cheek	0.036	0.475	**0.511**
	Left Tilt	0.062	0.412	0.474

Table 12-3
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant. 2 (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	(Ant. 2) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	(Ant. 2) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.059	0.033	0.092	Head SAR	Right Cheek	0.053	0.033	0.086
	Right Tilt	0.079	0.026	0.105		Right Tilt	0.063	0.026	0.089
	Left Cheek	0.054	0.158	0.212		Left Cheek	0.040	0.158	0.198
	Left Tilt	0.076	0.175	**0.251**		Left Tilt	0.068	0.175	**0.243**
Simult Tx	Configuration	GSM 1900 SAR (W/kg)	(Ant. 2) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	(Ant. 2) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.133	0.033	0.166	Head SAR	Right Cheek	0.190	0.033	0.223
	Right Tilt	0.088	0.026	0.114		Right Tilt	0.102	0.026	0.128
	Left Cheek	0.071	0.158	0.229		Left Cheek	0.100	0.158	0.258
	Left Tilt	0.106	0.175	**0.281**		Left Tilt	0.158	0.175	**0.333**

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	(Ant. 2) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.053	0.033	0.086
	Right Tilt	0.060	0.026	0.086
	Left Cheek	0.036	0.158	0.194
	Left Tilt	0.062	0.175	**0.237**

Table 12-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN MIMO (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	(MIMO) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	(MIMO) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.059	0.130	0.189	Head SAR	Right Cheek	0.053	0.130	0.183
	Right Tilt	0.079	0.124	0.203		Right Tilt	0.063	0.124	0.187
	Left Cheek	0.054	0.453	0.507		Left Cheek	0.040	0.453	0.493
	Left Tilt	0.076	0.471	**0.547**		Left Tilt	0.068	0.471	**0.539**

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Simult Tx	Configuration	GSM 1900 SAR (W/kg)	(MIMO) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	(MIMO) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.133	0.130	0.263	Head SAR	Right Cheek	0.190	0.130	0.320
	Right Tilt	0.088	0.124	0.212		Right Tilt	0.102	0.124	0.226
	Left Cheek	0.071	0.453	0.524		Left Cheek	0.100	0.453	0.553
	Left Tilt	0.106	0.471	**0.577**		Left Tilt	0.158	0.471	**0.629**

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	(MIMO) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.053	0.130	0.183
	Right Tilt	0.060	0.124	0.184
	Left Cheek	0.036	0.453	0.489
	Left Tilt	0.062	0.471	**0.533**

Table 12-5
Simultaneous Transmission Scenario with 5 GHz WLAN Ant. 1, 2 and MIMO (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	0.059	0.386	0.445	Head SAR	Right Cheek	0.053	0.386	0.439
	Right Tilt	0.079	0.386	**0.465**		Right Tilt	0.063	0.386	0.449
	Left Cheek	0.054	0.386	0.440		Left Cheek	0.040	0.386	0.426
	Left Tilt	0.076	0.386	0.462		Left Tilt	0.068	0.386	**0.454**
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	0.133	0.386	**0.519**	Head SAR	Right Cheek	0.190	0.386	**0.576**
	Right Tilt	0.088	0.386	0.474		Right Tilt	0.102	0.386	0.488
	Left Cheek	0.071	0.386	0.457		Left Cheek	0.100	0.386	0.486
	Left Tilt	0.106	0.386	0.492		Left Tilt	0.158	0.386	0.544

12.4 Body Simultaneous Transmission Analysis

Table 12-6
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant. 1 (Body at 0.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	(Ant.1) 2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	(Ant.1) 2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.323	1.010	**1.333**	N/A	Body SAR	Back	0.738	1.010	See Note 1	0.01
	Top	0.400	0.676	1.076	N/A		Top	0.400	0.676	1.076	N/A
	Bottom	0.118	0.400	0.518	N/A		Bottom	0.287	0.400	0.687	N/A
	Right	0.054	0.042	0.096	N/A		Right	0.104	0.042	0.146	N/A
	Left	0.150	0.400	0.550	N/A		Left	0.400	0.400	0.800	N/A
Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	(Ant.1) 2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	(Ant.1) 2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.825	1.010	See Note 1	0.01	Body SAR	Back	1.010	1.010	See Note 1	0.01
	Top	0.400	0.676	1.076	N/A		Top	0.400	0.676	1.076	N/A
	Bottom	0.289	0.400	0.689	N/A		Bottom	0.310	0.400	0.710	N/A
	Right	0.129	0.042	0.171	N/A		Right	0.140	0.042	0.182	N/A
	Left	0.400	0.400	0.800	N/A		Left	0.400	0.400	0.800	N/A

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	(Ant.1) 2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.691	1.010	See Note 1	0.01
	Top	0.400	0.676	1.076	N/A
	Bottom	0.309	0.400	0.709	N/A
	Right	0.122	0.042	0.164	N/A
	Left	0.400	0.400	0.800	N/A

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Table 12-7
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant. 2 (Body at 0.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	(Ant. 2) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	(Ant. 2) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.323	1.056	**1.379**	N/A	Body SAR	Back	0.738	1.056	See Note 1	0.01
	Top	0.400	0.166	0.566	N/A		Top	0.400	0.166	0.566	N/A
	Bottom	0.118	0.400	0.518	N/A		Bottom	0.287	0.400	0.687	N/A
	Right	0.054	0.403	0.457	N/A		Right	0.104	0.403	0.507	N/A
	Left	0.150	0.400	0.550	N/A		Left	0.400	0.400	0.800	N/A
Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	(Ant. 2) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	(Ant. 2) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.825	1.056	See Note 1	0.01	Body SAR	Back	1.010	1.056	See Note 1	0.02
	Top	0.400	0.166	0.566	N/A		Top	0.400	0.166	0.566	N/A
	Bottom	0.289	0.400	0.689	N/A		Bottom	0.310	0.400	0.710	N/A
	Right	0.129	0.403	0.532	N/A		Right	0.140	0.403	0.543	N/A
	Left	0.400	0.400	0.800	N/A		Left	0.400	0.400	0.800	N/A

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	(Ant. 2) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.691	1.056	See Note 1	0.01
	Top	0.400	0.166	0.566	N/A
	Bottom	0.309	0.400	0.709	N/A
	Right	0.122	0.403	0.525	N/A
	Left	0.400	0.400	0.800	N/A

Table 12-8
Simultaneous Transmission Scenario with 2.4 GHz WLAN MIMO (Body at 0.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	(MIMO) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	(MIMO) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.323	0.294	**0.617**	N/A	Body SAR	Back	0.738	0.294	**1.032**	N/A
	Top	0.400	0.001	0.401	N/A		Top	0.400	0.001	0.401	N/A
	Bottom	0.118	0.400	0.518	N/A		Bottom	0.287	0.400	0.687	N/A
	Right	0.054	0.000	0.054	N/A		Right	0.104	0.000	0.104	N/A
	Left	0.150	0.400	0.550	N/A		Left	0.400	0.400	0.800	N/A
Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	(MIMO) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	(MIMO) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.825	0.294	**1.119**	N/A	Body SAR	Back	1.010	0.294	**1.304**	N/A
	Top	0.400	0.001	0.401	N/A		Top	0.400	0.001	0.401	N/A
	Bottom	0.289	0.400	0.689	N/A		Bottom	0.310	0.400	0.710	N/A
	Right	0.129	0.000	0.129	N/A		Right	0.140	0.000	0.140	N/A
	Left	0.400	0.400	0.800	N/A		Left	0.400	0.400	0.800	N/A

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	(MIMO) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.691	0.294	**0.985**	N/A
	Top	0.400	0.001	0.401	N/A
	Bottom	0.309	0.400	0.709	N/A
	Right	0.122	0.000	0.122	N/A
	Left	0.400	0.400	0.800	N/A

Table 12-9
Simultaneous Transmission Scenario with 5 GHz WLAN Ant. 1 (Body at 0.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	(Ant. 1) 5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	(Ant. 1) 5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.323	0.386	0.709	N/A	Body SAR	Back	0.738	0.386	**1.124**	N/A
	Top	0.400	0.386	**0.786**	N/A		Top	0.400	0.386	0.786	N/A
	Bottom	0.118	0.400	0.518	N/A		Bottom	0.287	0.400	0.687	N/A
	Right	0.054	0.114	0.168	N/A		Right	0.104	0.114	0.218	N/A
	Left	0.150	0.400	0.550	N/A		Left	0.400	0.400	0.800	N/A

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Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	(Ant. 1) 5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	(Ant. 1) 5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.825	0.386	**1.211**	N/A	Body SAR	Back	1.010	0.386	**1.396**	N/A
	Top	0.400	0.386	0.786	N/A		Top	0.400	0.386	0.786	N/A
	Bottom	0.289	0.400	0.689	N/A		Bottom	0.310	0.400	0.710	N/A
	Right	0.129	0.114	0.243	N/A		Right	0.140	0.114	0.254	N/A
	Left	0.400	0.400	0.800	N/A		Left	0.400	0.400	0.800	N/A

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	(Ant. 1) 5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.691	0.386	**1.077**	N/A
	Top	0.400	0.386	0.786	N/A
	Bottom	0.309	0.400	0.709	N/A
	Right	0.122	0.114	0.236	N/A
	Left	0.400	0.400	0.800	N/A

Table 12-10
Simultaneous Transmission Scenario with 5 GHz WLAN Ant. 2 (Body at 0.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	(Ant.2) 5GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	(Ant.2) 5GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.323	0.386	**0.709**	N/A	Body SAR	Back	0.738	0.386	**1.124**	N/A
	Top	0.400	0.149	0.549	N/A		Top	0.400	0.149	0.549	N/A
	Bottom	0.118	0.400	0.518	N/A		Bottom	0.287	0.400	0.687	N/A
	Right	0.054	0.386	0.440	N/A		Right	0.104	0.386	0.490	N/A
	Left	0.150	0.400	0.550	N/A		Left	0.400	0.400	0.800	N/A
Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	(Ant.2) 5GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	(Ant.2) 5GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.825	0.386	**1.211**	N/A	Body SAR	Back	1.010	0.386	**1.396**	N/A
	Top	0.400	0.149	0.549	N/A		Top	0.400	0.149	0.549	N/A
	Bottom	0.289	0.400	0.689	N/A		Bottom	0.310	0.400	0.710	N/A
	Right	0.129	0.386	0.515	N/A		Right	0.140	0.386	0.526	N/A
	Left	0.400	0.400	0.800	N/A		Left	0.400	0.400	0.800	N/A

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	(Ant.2) 5GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.691	0.386	**1.077**	N/A
	Top	0.400	0.149	0.549	N/A
	Bottom	0.309	0.400	0.709	N/A
	Right	0.122	0.386	0.508	N/A
	Left	0.400	0.400	0.800	N/A

Table 12-11
Simultaneous Transmission Scenario with 5 GHz WLAN MIMO (Body at 0.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	(MIMO) 5GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	(MIMO) 5GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.323	0.386	0.709	N/A	Body SAR	Back	0.738	0.386	**1.124**	N/A
	Top	0.400	0.386	**0.786**	N/A		Top	0.400	0.386	0.786	N/A
	Bottom	0.118	0.400	0.518	N/A		Bottom	0.287	0.400	0.687	N/A
	Right	0.054	0.386	0.440	N/A		Right	0.104	0.386	0.490	N/A
	Left	0.150	0.400	0.550	N/A		Left	0.400	0.400	0.800	N/A
Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	(MIMO) 5GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	(MIMO) 5GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.825	0.386	**1.211**	N/A	Body SAR	Back	1.010	0.386	**1.396**	N/A
	Top	0.400	0.386	0.786	N/A		Top	0.400	0.386	0.786	N/A
	Bottom	0.289	0.400	0.689	N/A		Bottom	0.310	0.400	0.710	N/A
	Right	0.129	0.386	0.515	N/A		Right	0.140	0.386	0.526	N/A
	Left	0.400	0.400	0.800	N/A		Left	0.400	0.400	0.800	N/A

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Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	(MIMO) 5GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.691	0.386	**1.077**	N/A
	Top	0.400	0.386	0.786	N/A
	Bottom	0.309	0.400	0.709	N/A
	Right	0.122	0.386	0.508	N/A
	Left	0.400	0.400	0.800	N/A

Table 12-12
Simultaneous Transmission Scenario with Bluetooth (Body at 0.0 cm)

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	0.323	0.271	**0.594**	N/A	Body SAR	Back	0.738	0.271	**1.009**	N/A
	Top	0.400	0.188	0.588	N/A		Top	0.400	0.188	0.588	N/A
	Bottom	0.118	0.400	0.518	N/A		Bottom	0.287	0.400	0.687	N/A
	Right	0.054	0.061	0.115	N/A		Right	0.104	0.061	0.165	N/A
	Left	0.150	0.400	0.550	N/A		Left	0.400	0.400	0.800	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	0.825	0.271	**1.096**	N/A	Body SAR	Back	1.010	0.271	**1.281**	N/A
	Top	0.400	0.188	0.588	N/A		Top	0.400	0.188	0.588	N/A
	Bottom	0.289	0.400	0.689	N/A		Bottom	0.310	0.400	0.710	N/A
	Right	0.129	0.061	0.190	N/A		Right	0.140	0.061	0.201	N/A
	Left	0.400	0.400	0.800	N/A		Left	0.400	0.400	0.800	N/A

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.691	0.271	**0.962**	N/A
	Top	0.400	0.188	0.588	N/A
	Bottom	0.309	0.400	0.709	N/A
	Right	0.122	0.061	0.183	N/A
	Left	0.400	0.400	0.800	N/A

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

Table 12-13
Simultaneous Transmission Scenario (2.4 GHz Body Back side at 1.5 cm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	(Ant. 1) 2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GPRS 850	0.500	<1.010	<1.510	N/A
Back Side	UMTS 850	0.382	<1.010	<1.392	N/A
Back Side	GPRS 1900	0.691	<1.010	See Note 1	<0.01
Back Side	UMTS 1900	0.659	<1.010	See Note 1	<0.01
Back Side	LTE Band 5 (Cell)	0.365	<1.010	<1.375	N/A

Configuration	Mode	2G/3G/4G SAR (W/kg)	(Ant. 2) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GPRS 850	0.500	<1.056	**<1.556**	N/A
Back Side	UMTS 850	0.382	<1.056	<1.438	N/A
Back Side	GPRS 1900	0.691	<1.056	See Note 1	<0.01
Back Side	UMTS 1900	0.659	<1.056	See Note 1	<0.01
Back Side	LTE Band 5 (Cell)	0.365	<1.056	<1.421	N/A

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Configuration	Mode	2G/3G/4G SAR (W/kg)	(MIMO) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GPRS 850	0.500	<0.294	<0.794	N/A
Back Side	UMTS 850	0.382	<0.294	<0.676	N/A
Back Side	GPRS 1900	0.691	<0.294	<0.985	N/A
Back Side	UMTS 1900	0.659	<0.294	<0.953	N/A
Back Side	LTE Band 5 (Cell)	0.365	<0.294	<0.659	N/A

Table 12-14
Simultaneous Transmission Scenario (5 GHz Body Back side at 1.5 cm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GPRS 850	0.500	<0.386	<0.886	N/A
Back Side	UMTS 850	0.382	<0.386	<0.768	N/A
Back Side	GPRS 1900	0.691	<0.386	<1.077	N/A
Back Side	UMTS 1900	0.659	<0.386	<1.045	N/A
Back Side	LTE Band 5 (Cell)	0.365	<0.386	<0.751	N/A

Table 12-15
Simultaneous Transmission Scenario (Bluetooth Body Back side at 1.5 cm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GPRS 850	0.500	<0.271	<0.771	N/A
Back Side	UMTS 850	0.382	<0.271	<0.653	N/A
Back Side	GPRS 1900	0.691	<0.271	**<0.962**	N/A
Back Side	UMTS 1900	0.659	<0.271	<0.930	N/A
Back Side	LTE Band 5 (Cell)	0.365	<0.271	<0.636	N/A

Table 12-16
Simultaneous Transmission Scenario (2.4 GHz Body Bottom Edge at 1.0 cm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Bottom Edge	GPRS 850	0.461	0.400	0.861	N/A
Bottom Edge	UMTS 850	0.431	0.400	0.831	N/A
Bottom Edge	GPRS 1900	0.840	0.400	**1.240**	N/A
Bottom Edge	UMTS 1900	0.782	0.400	1.182	N/A
Bottom Edge	LTE Band 5 (Cell)	0.477	0.400	0.877	N/A

Table 12-17
Simultaneous Transmission Scenario (5 GHz Body Bottom Edge at 1.0 cm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Bottom Edge	GPRS 850	0.461	0.400	0.861	N/A
Bottom Edge	UMTS 850	0.431	0.400	0.831	N/A
Bottom Edge	GPRS 1900	0.840	0.400	**1.240**	N/A
Bottom Edge	UMTS 1900	0.782	0.400	1.182	N/A
Bottom Edge	LTE Band 5 (Cell)	0.477	0.400	0.877	N/A

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Table 12-18
Simultaneous Transmission Scenario (Bluetooth Body Bottom Edge at 1.0 cm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Bottom Edge	GPRS 850	0.461	0.400	0.861	N/A
Bottom Edge	UMTS 850	0.431	0.400	0.831	N/A
Bottom Edge	GPRS 1900	0.840	0.400	**1.240**	N/A
Bottom Edge	UMTS 1900	0.782	0.400	1.182	N/A
Bottom Edge	LTE Band 5 (Cell)	0.477	0.400	0.877	N/A

Table 12-19
Simultaneous Transmission Scenario (2.4 GHz Body Right Edge at 0.4 cm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	(Ant. 1) 2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Right Edge	GPRS 850	0.474	<0.042	<0.516	N/A
Right Edge	UMTS 850	0.264	<0.042	<0.306	N/A
Right Edge	GPRS 1900	0.990	<0.042	**<1.032**	N/A
Right Edge	UMTS 1900	0.964	<0.042	<1.006	N/A
Right Edge	LTE Band 5 (Cell)	0.218	<0.042	<0.260	N/A
Configuration	Mode	2G/3G/4G SAR (W/kg)	(Ant. 2) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Right Edge	GPRS 850	0.474	<0.403	<0.877	N/A
Right Edge	UMTS 850	0.264	<0.403	<0.667	N/A
Right Edge	GPRS 1900	0.990	<0.403	**<1.393**	N/A
Right Edge	UMTS 1900	0.964	<0.403	<1.367	N/A
Right Edge	LTE Band 5 (Cell)	0.218	<0.403	<0.621	N/A
Configuration	Mode	2G/3G/4G SAR (W/kg)	(MIMO) 2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Right Edge	GPRS 850	0.474	0.000	0.474	N/A
Right Edge	UMTS 850	0.264	0.000	0.264	N/A
Right Edge	GPRS 1900	0.990	0.000	**0.990**	N/A
Right Edge	UMTS 1900	0.964	0.000	0.964	N/A
Right Edge	LTE Band 5 (Cell)	0.218	0.000	0.218	N/A

Table 12-20
Simultaneous Transmission Scenario (5 GHz Body Right Edge at 0.4 cm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	(Ant. 1) 5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Right Edge	GPRS 850	0.474	<0.114	<0.588	N/A
Right Edge	UMTS 850	0.264	<0.114	<0.378	N/A
Right Edge	GPRS 1900	0.990	<0.114	**<1.104**	N/A
Right Edge	UMTS 1900	0.964	<0.114	<1.078	N/A
Right Edge	LTE Band 5 (Cell)	0.218	<0.114	<0.332	N/A

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Configuration	Mode	2G/3G/4G SAR (W/kg)	(Ant.2) 5GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Right Edge	GPRS 850	0.474	<0.386	<0.860	N/A
Right Edge	UMTS 850	0.264	<0.386	<0.650	N/A
Right Edge	GPRS 1900	0.990	<0.386	**<1.376**	N/A
Right Edge	UMTS 1900	0.964	<0.386	<1.350	N/A
Right Edge	LTE Band 5 (Cell)	0.218	<0.386	<0.604	N/A
Configuration	Mode	2G/3G/4G SAR (W/kg)	(MIMO) 5GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Right Edge	GPRS 850	0.474	<0.386	<0.860	N/A
Right Edge	UMTS 850	0.264	<0.386	<0.650	N/A
Right Edge	GPRS 1900	0.990	<0.386	**<1.376**	N/A
Right Edge	UMTS 1900	0.964	<0.386	<1.350	N/A
Right Edge	LTE Band 5 (Cell)	0.218	<0.386	<0.604	N/A

Table 12-21
Simultaneous Transmission Scenario (Bluetooth Body Right Edge at 0.4 cm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Right Edge	GPRS 850	0.474	<0.061	<0.535	N/A
Right Edge	UMTS 850	0.264	<0.061	<0.325	N/A
Right Edge	GPRS 1900	0.990	<0.061	**<1.051**	N/A
Right Edge	UMTS 1900	0.964	<0.061	<1.025	N/A
Right Edge	LTE Band 5 (Cell)	0.218	<0.061	<0.279	N/A

Notes:

1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was not higher than 0.04 per FCC KDB 447498 D01v05. See Section 12.5 for detailed SPLS ratio analysis.
2. For SAR summations for body (back side at 15mm and right edge at 4mm), WLAN and Bluetooth SAR values for 0.0 mm were used since the 0.0 mm test distance for WLAN and Bluetooth SAR values were more conservative. "<" denotes that the 0.0 mm WLAN and Bluetooth SAR values were used for summation purposes.
3. Estimated Bluetooth LE SAR result for right edge was used for Bluetooth Right Edge SAR to determine simultaneous transmission SAR test exclusion because estimated Bluetooth LE SAR was more conservative than measured Bluetooth SAR.
4. For SAR summations for body bottom edge 10 mm, estimated WLAN and Bluetooth SAR values of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion, for configurations excluded per FCC KDB Publication 447498 D01v05, since the antenna separation distance is greater than 50mm.
5. 5 GHz WLAN was excluded per FCC KDB 447498 D01v05 (See section 1.6). Therefore, estimated 5 GHz SAR values in table 12-1 were used for summation purposes.

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12.5 SPLSR Evaluation and Analysis

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

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

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

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with UMTS 850 antenna operating at limited output power with 2.4 GHz WIFI Antenna 1.

Table 12-22
Peak SAR Locations for Body Back Side at 0 mm UMTS 850 and 2.4 GHz WLAN Ant. 1

Mode/Band	x (mm)	y (mm)
UMTS 850 MHz (at 0 mm)	-63.50	-88.50
802.11b (Ant. 1)	-65.60	91.80

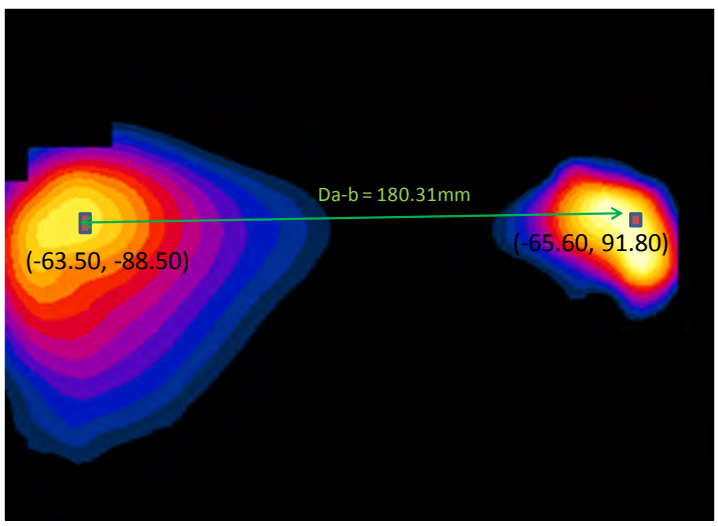

Figure 12-1
Peak SAR Locations of 2.4 GHz WLAN Ant. 1 and UMTS 850 at 0 mm

Table 12-23
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 850 MHz (at 0 mm)	802.11b (Ant. 1)	0.738	1.010	1.748	180.31	0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with GPRS 1900 antenna operating at limited output power with 2.4 GHz WIFI Antenna 1.

Table 12-24
Peak SAR Locations for Body Back Side at 0 mm GPRS 1900 and 2.4 GHz WLAN Ant. 1

Mode/Band	x (mm)	y (mm)
GPRS 1900 MHz (at 0 mm)	-62.00	-100.50
802.11b (Ant. 1)	-65.60	91.80

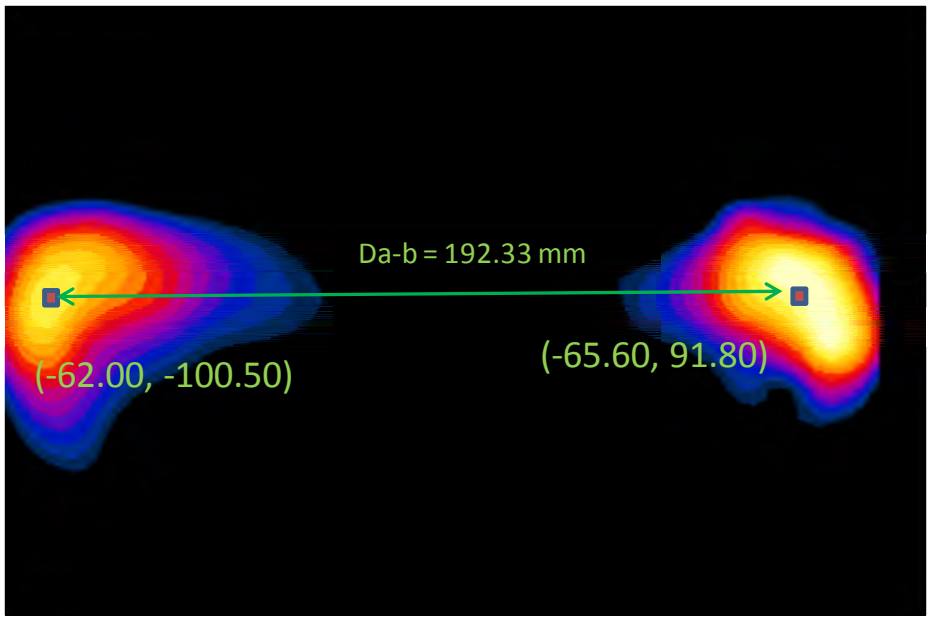

Figure 12-2
Peak SAR Locations of 2.4 GHz WLAN Ant. 1 and GPRS 1900 at 0 mm

Table 12-25
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900 MHz (at 0 mm)	802.11b (Ant. 1)	0.825	1.010	1.835	192.33	0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with UMTS 1900 antenna operating at limited output power with 2.4 GHz WIFI Antenna 1.

Table 12-26
Peak SAR Locations for Body Back Side at 0 mm UMTS 1900 and 2.4 GHz WLAN Ant. 1

Mode/Band	x (mm)	y (mm)
UMTS 1900 MHz (at 0 mm)	-60.00	-105.00
802.11b (Ant. 1)	-65.60	91.80

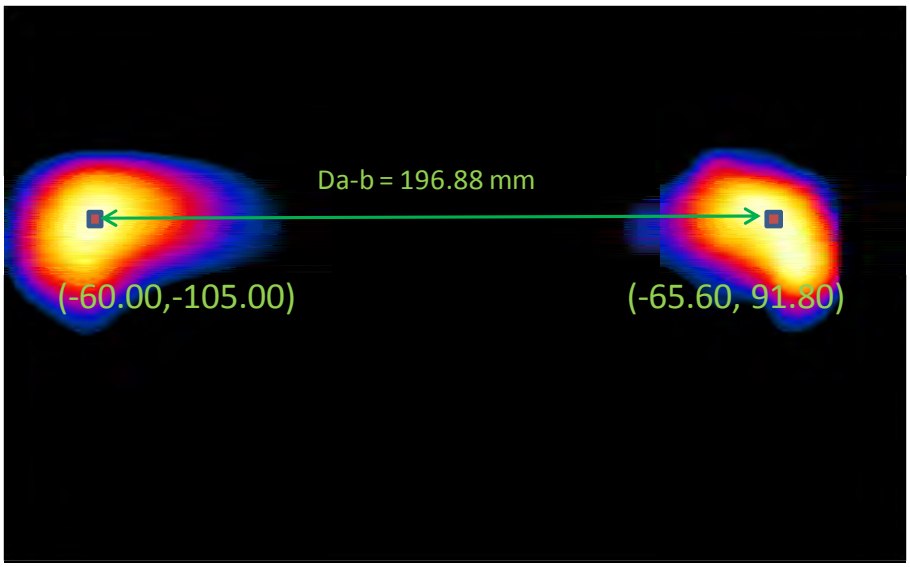

Figure 12-3
Peak SAR Locations of 2.4 GHz WLAN Ant. 1 and UMTS 1900 at 0 mm

Table 12-27
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 1900 MHz (at 0 mm)	802.11b (Ant. 1)	1.010	1.010	2.020	196.88	0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with LTE Band 5 antenna operating at limited output power with 2.4 GHz WIFI Antenna 1.

Table 12-28
Peak SAR Locations for Body Back Side at 0 mm LTE Band 5 and 2.4 GHz WLAN Ant. 1

Mode/Band	x (mm)	y (mm)
LTE Band 5 (at 0 mm)	-70.00	-86.00
802.11b (Ant. 1)	-65.60	91.80

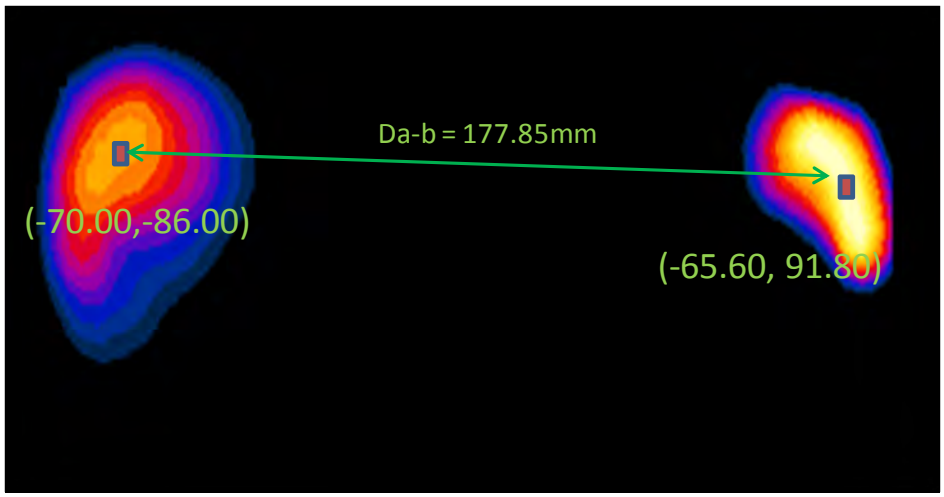

Figure 12-4
Peak SAR Locations of 2.4 GHz WLAN Ant. 1 and LTE Band 5 at 0 mm

Table 12-29
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}	$(a+b)^{1.5}/D_{a-b}$
LTE Band 5 (at 0 mm)	802.11b (Ant. 1)	0.691	1.010	1.701	177.85	0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with UMTS 850 antenna operating at limited output power with 2.4 GHz WIFI Antenna 2.

Table 12-30
Peak SAR Locations for Body Back Side at 0 mm UMTS 850 and 2.4 GHz WLAN Ant. 2

Mode/Band	x (mm)	y (mm)
UMTS 850 MHz (at 0 mm)	-63.50	-88.50
802.11b (Ant. 2)	-69.80	77.20

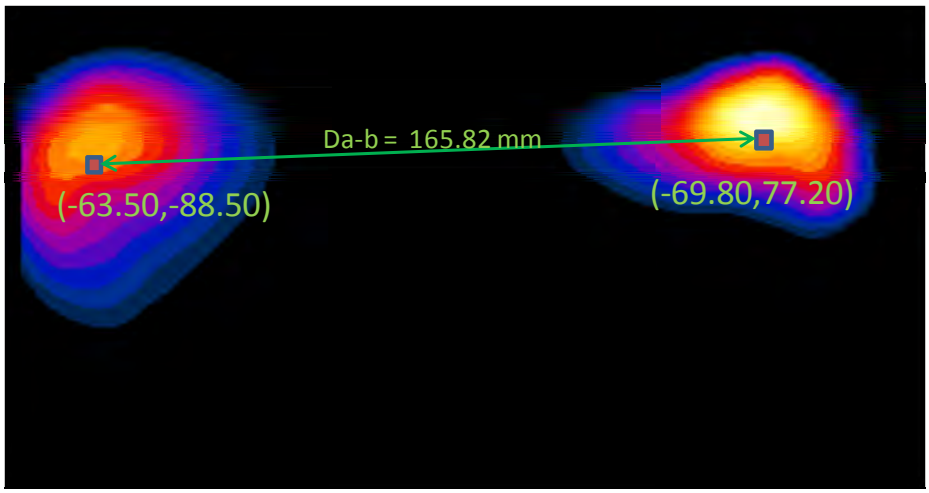

Figure 12-5
Peak SAR Locations of 2.4 GHz WLAN Ant. 2 and UMTS 850 at 0 mm

Table 12-31
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 850 MHz (at 0 mm)	802.11b (Ant. 2)	0.738	1.056	1.794	165.82	0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with GPRS 1900 antenna operating at limited output power with 2.4 GHz WIFI Antenna 2.

Table 12-32
Peak SAR Locations for Body Back Side at 0 mm GPRS 1900 and 2.4 GHz WLAN Ant. 2

Mode/Band	x (mm)	y (mm)
GPRS 1900 MHz (at 0 mm)	-62.00	-100.50
802.11b (Ant. 2)	-69.80	77.20

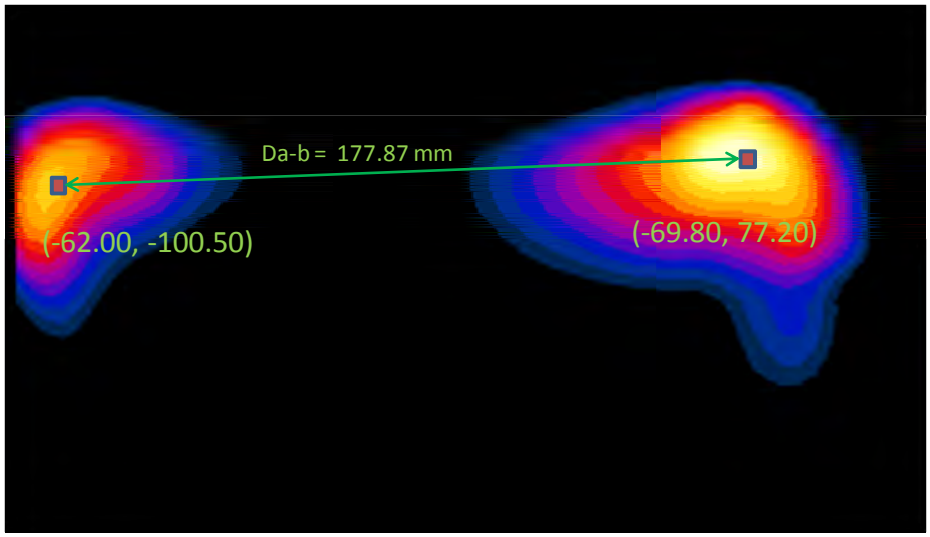

Figure 12-6
Peak SAR Locations of 2.4 GHz WLAN Ant. 2 and GPRS 1900 at 0 mm

Table 12-33
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900 MHz (at 0 mm)	802.11b (Ant. 2)	0.825	1.056	1.881	177.87	0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with UMTS 1900 antenna operating at limited output power with 2.4 GHz WIFI Antenna 2.

Table 12-34
Peak SAR Locations for Body Back Side at 0 mm UMTS 1900 and 2.4 GHz WLAN Ant. 2

Mode/Band	x (mm)	y (mm)
UMTS 1900 MHz (at 0 mm)	-60.00	-105.00
802.11b (Ant. 2)	-69.80	77.20

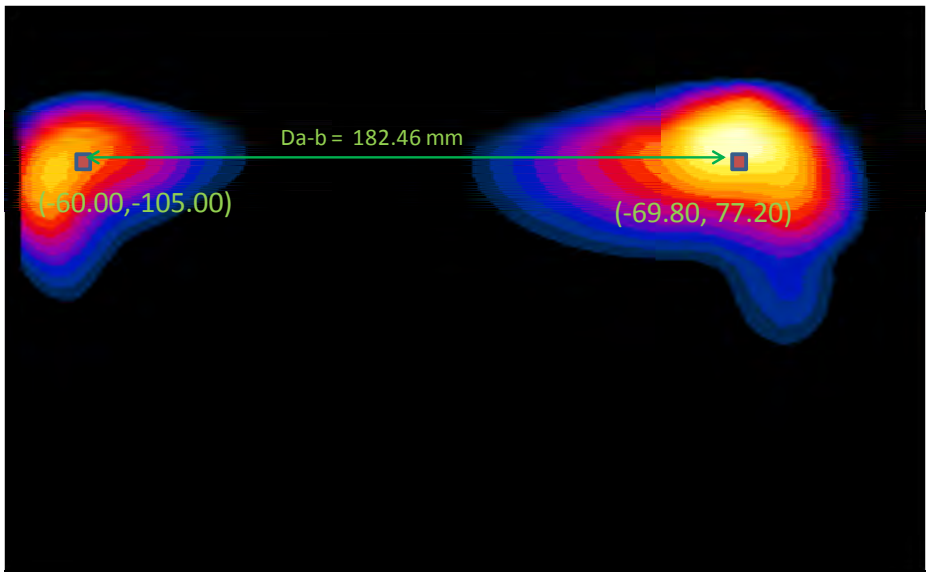

Figure 12-7
Peak SAR Locations of 2.4 GHz WLAN Ant. 2 and UMTS 1900 at 0 mm

Table 12-35
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 1900 MHz (at 0 mm)	802.11b (Ant. 2)	1.010	1.056	2.066	182.46	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with LTE Band 5 antenna operating at limited output power with 2.4 GHz WIFI Antenna 2.

Table 12-36
Peak SAR Locations for Body Back Side at 0 mm LTE Band 5 and 2.4 GHz WLAN Ant. 2

Mode/Band	x (mm)	y (mm)
LTE Band 5 (at 0 mm)	-70.00	-86.00
802.11b (Ant. 2)	-69.80	77.20

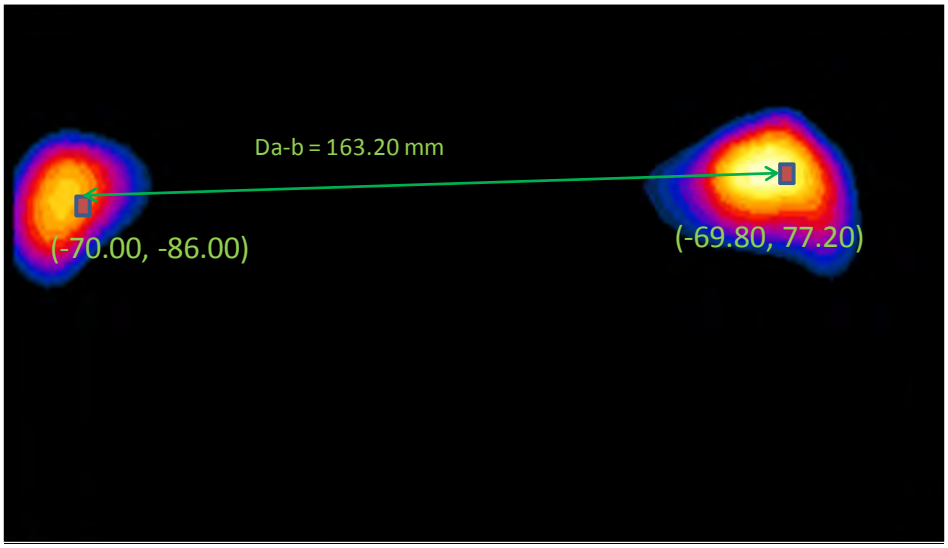

Figure 12-8
Peak SAR Locations of 2.4 GHz WLAN Ant. 2 and LTE Band 5 at 0 mm

Table 12-37
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}	$(a+b)^{1.5}/D_{a-b}$
LTE Band 5 (at 0 mm)	802.11b (Ant. 2)	0.691	1.056	1.747	163.2	0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 15 mm with GPRS 1900 antenna operating at maximum output power with 2.4 GHz WIFI Antenna 1.

Table 12-38
Peak SAR Locations for Body Back Side at 15 mm GPRS 1900 and 2.4 GHz WLAN Ant. 1

Mode/Band	x (mm)	y (mm)
GPRS 1900 MHz (at 15mm)	-60.50	-106.00
802.11b (Ant. 1)	-65.60	91.80

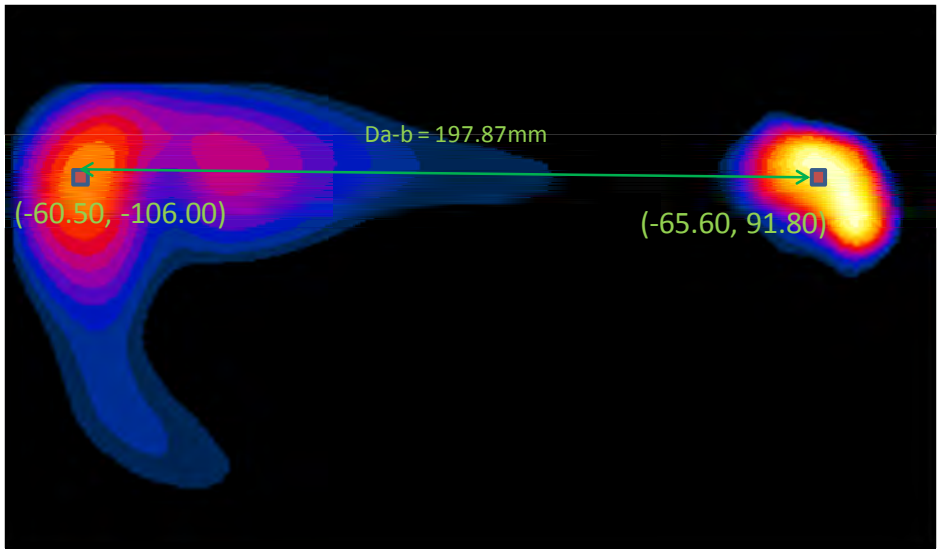

Figure 12-9
Peak SAR Locations of 2.4 GHz WLAN Ant. 1 and GPRS 1900 at 15 mm

Table 12-39
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900 MHz (at 15mm)	802.11b (Ant. 1)	0.691	<1.010	<1.701	197.87	<0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 15 mm with UMTS 1900 antenna operating at maximum output power with 2.4 GHz WIFI Antenna 1.

Table 12-40
Peak SAR Locations for Body Back Side at 15 mm UMTS 1900 and 2.4 GHz WLAN Ant. 1

Mode/Band	x (mm)	y (mm)
UMTS 1900 MHz (at 15mm)	-60.50	-103.00
802.11b (Ant. 1)	-65.60	91.80

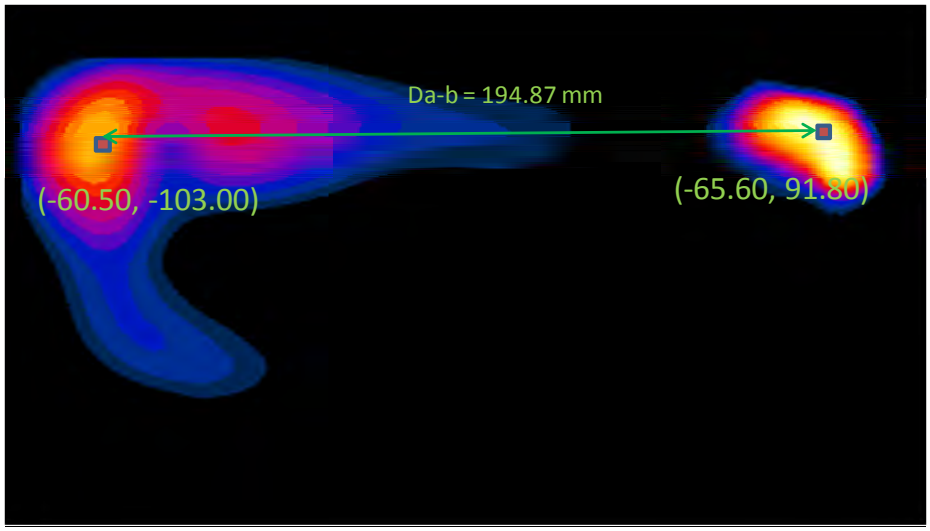

Figure 12-10
Peak SAR Locations of 2.4 GHz WLAN Ant. 1 and UMTS 1900 at 15 mm

Table 12-41
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 1900 MHz (at 15mm)	802.11b (Ant. 1)	0.659	<1.010	<1.669	194.87	<0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 15 mm with GPRS 1900 antenna operating at maximum output power with 2.4 GHz WIFI Antenna 2.

Table 12-42
Peak SAR Locations for Body Back Side at 15 mm GPRS 1900 and 2.4 GHz WLAN Ant. 2

Mode/Band	x (mm)	y (mm)
GPRS 1900 MHz (at 15mm)	-60.50	-106.00
802.11b (Ant. 2)	-69.80	77.20

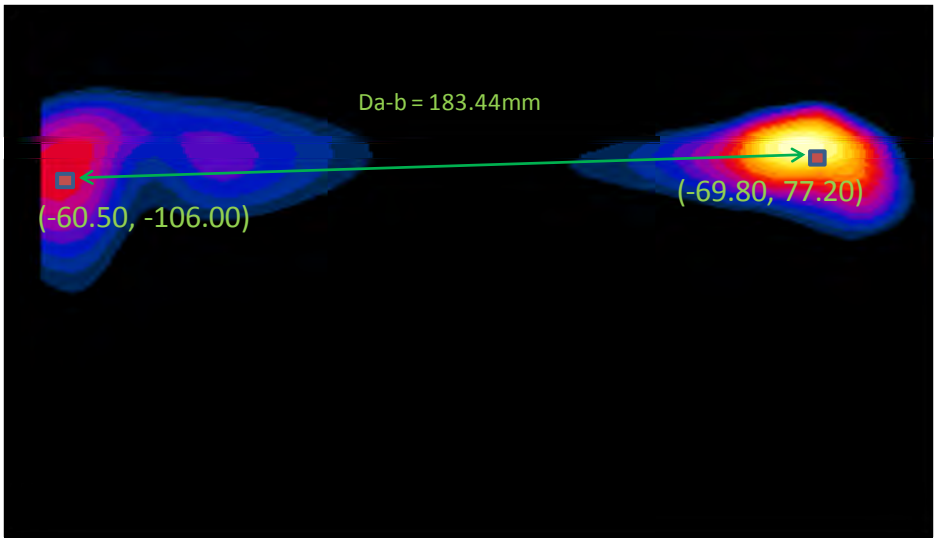

Figure 12-11
Peak SAR Locations of 2.4 GHz WLAN Ant. 2 and GPRS 1900 at 15 mm

Table 12-43
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900 MHz (at 15mm)	802.11b (Ant. 2)	0.691	<1.056	<1.747	183.44	<0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 15 mm with UMTS 1900 antenna operating at maximum output power with 2.4 GHz WIFI Antenna 2.

Table 12-44
Peak SAR Locations for Body Back Side at 15 mm UMTS 1900 and 2.4 GHz WLAN Ant. 2

Mode/Band	x (mm)	y (mm)
UMTS 1900 MHz (at 15mm)	-60.50	-103.00
802.11b (Ant. 2)	-69.80	77.20

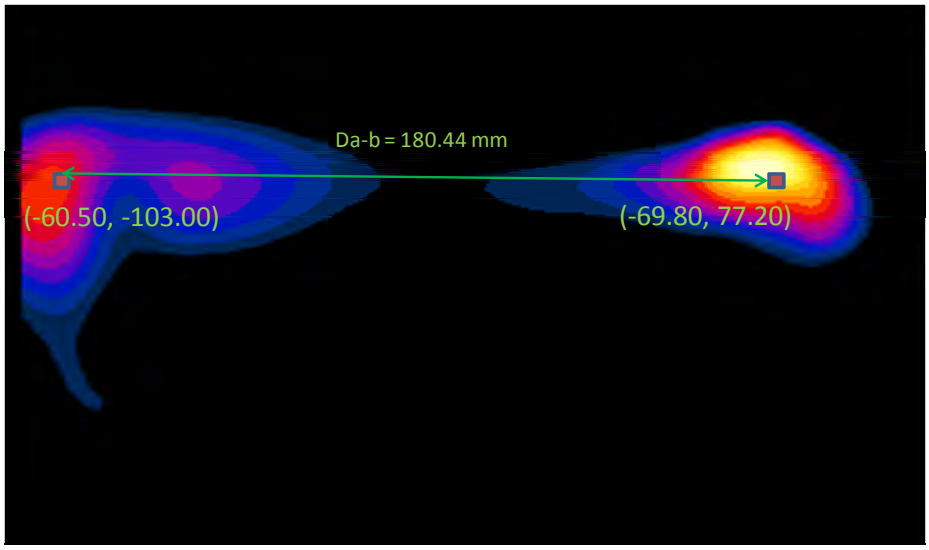

Figure 12-12
Peak SAR Locations of 2.4 GHz WLAN Ant. 2 and UMTS 1900 at 15 mm

Table 12-45
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 1900 MHz (at 15mm)	802.11b (Ant. 2)	0.659	<1.056	<1.715	180.44	<0.01

12.6 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.

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13 SAR MEASUREMENT VARIABILITY

13.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

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

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

Table 13-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS															
Band	FREQUENCY		Mode	Service	Antenna #	Data Rate (Mbps)	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.							(W/kg)	(W/kg)		(W/kg)		(W/kg)	
1900	1907.60	9538	UMTS 1900	RMC	N/A	N/A	back	0 mm	1.000	1.010	1.01	N/A	N/A	N/A	N/A
2450	2437.00	6	IEEE 802.11b	DSSS	Antenna 2	1	back	0 mm	1.020	0.893	1.14	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram							

13.2 Measurement Uncertainty

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

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14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/30/2013	Annual	10/30/2014	1833460
Agilent	8753E	(30kHz-6GHz) Network Analyzer	7/23/2013	Annual	7/23/2014	US37390350
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
SPEAG	D1900V2	1900 MHz SAR Dipole	7/22/2013	Annual	7/22/2014	5d149
SPEAG	D2450V2	2450 MHz SAR Dipole	1/21/2014	Annual	1/21/2015	797
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
SPEAG	D835V2	835 MHz SAR Dipole	1/22/2014	Annual	1/22/2015	4d132
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433974
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Rohde & Schwarz	CMU200	Base Station Simulator	5/3/2013	Annual	5/3/2014	836371/0079
Rohde & Schwarz	CMU200	Base Station Simulator	9/23/2013	Annual	9/23/2014	109892
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/21/2013	Annual	8/21/2014	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/18/2013	Annual	11/18/2014	1407
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	1/22/2014	Annual	1/22/2015	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/26/2014	Annual	2/26/2015	665
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/14/2013	Annual	5/14/2014	1070
SPEAG	DAK-3.5	Dielectric Assessment Kit	11/13/2013	Annual	11/13/2014	1091
Fisher Scientific	15-077-960	Digital Thermometer	12/4/2013	Biennial	12/4/2015	130764558
Rohde & Schwarz	NRVD	Dual Channel Power Meter	10/12/2012	Biennial	10/12/2014	101695
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
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
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
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	6/6/2013	Annual	6/6/2014	111427
Agilent	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Rohde & Schwarz	NRV-Z32	Peak Power Sensor	10/12/2012	Biennial	10/12/2014	836019/013
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Anritsu	ML2495A	Power Meter	10/31/2013	Annual	10/31/2014	1039008
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	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
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/16/2014	Annual	4/16/2015	B010177
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	11/20/2013	Annual	11/20/2014	3287
SPEAG	ES3DV3	SAR Probe	11/25/2013	Annual	11/25/2014	3332
SPEAG	EX3DV4	SAR Probe	1/29/2014	Annual	1/29/2015	3589
SPEAG	ES3DV3	SAR Probe	2/25/2014	Annual	2/25/2015	3258
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
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
Agilent	8753ES	S-Parameter Network Analyzer	10/29/2013	Annual	10/29/2014	US39170122
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00579
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
Gigatronics	8651A	Universal Power Meter	10/30/2013	Annual	10/30/2014	8650319
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
VWR	36934-158	Wall-Mounted Thermometer	8/8/2013	Biennial	8/8/2015	130477877
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464

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

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15 MEASUREMENT UNCERTAINTIES

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

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

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16 CONCLUSION

16.1 Measurement Conclusion

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

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

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APPENDIX A: SAR TEST DATA

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PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 0410-01

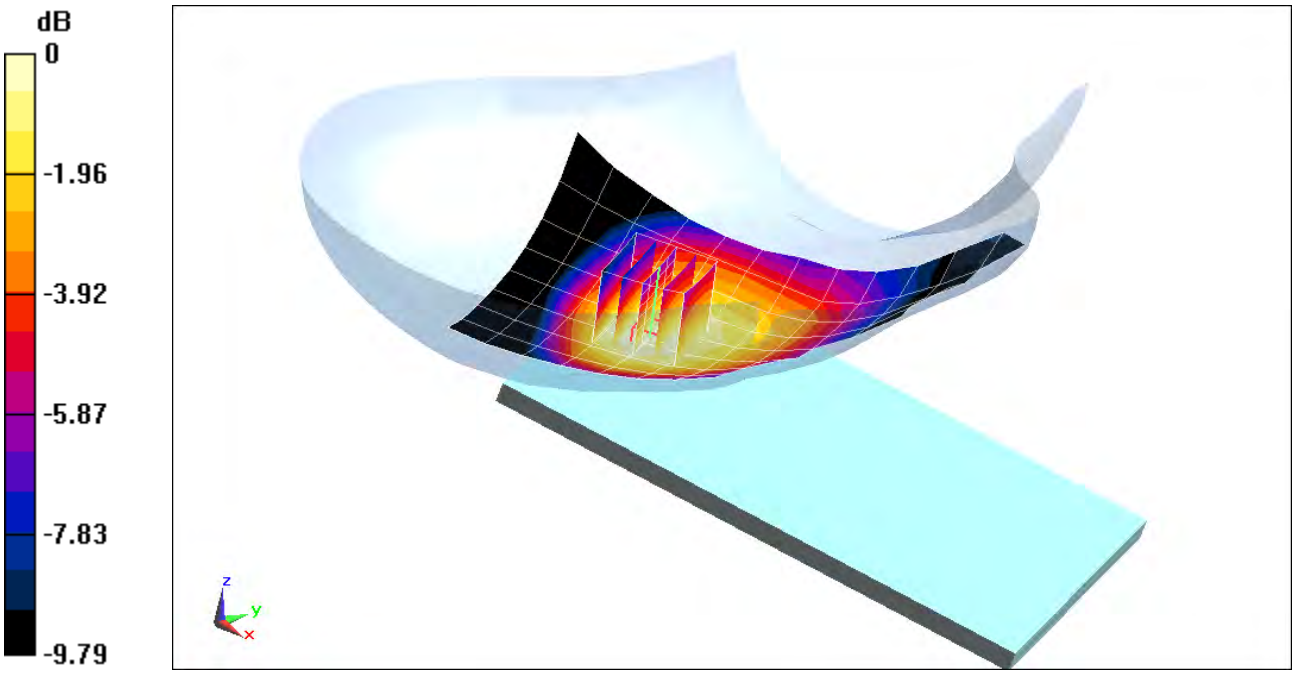
Communication System: UID 0, GSM; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium: 835 Head Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.907 S/m; ε_r = 40.607; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 04-17-2014; Ambient Temp: 24.5°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, Tilt, 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 = 9.389 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.0990 W/kg
SAR(1 g) = 0.078 W/kg



0 dB = 0.0816 W/kg = -10.88 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 0410-01

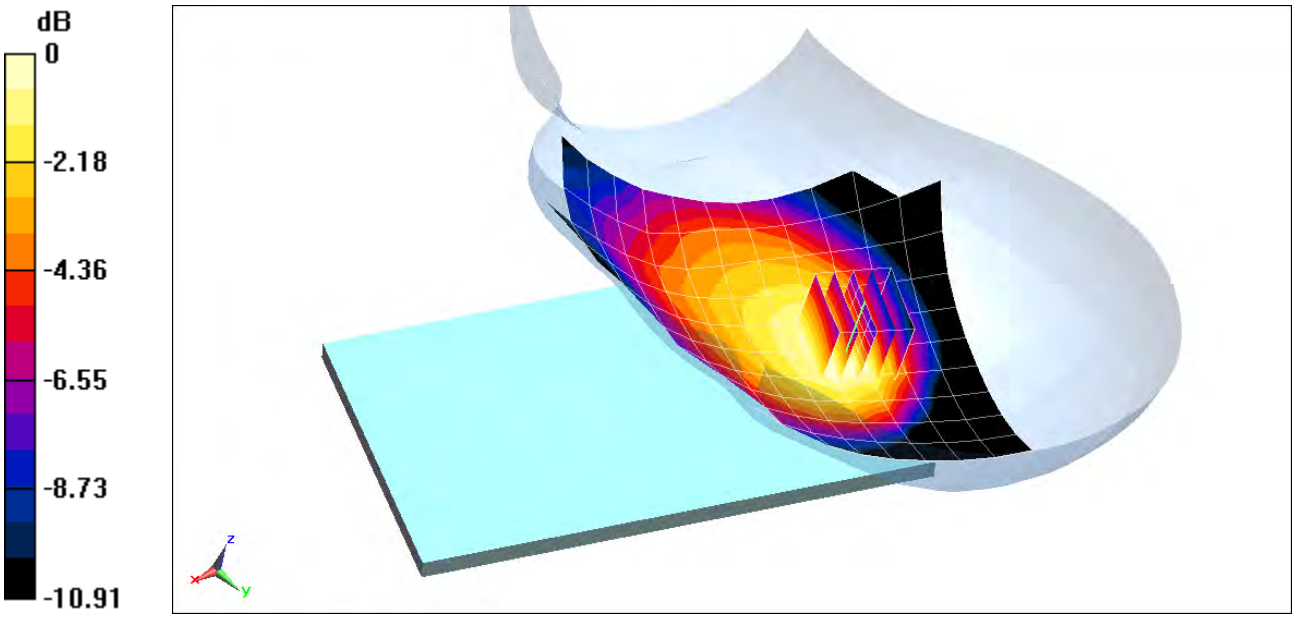
Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Head Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.901 S/m; ε_r = 39.876; ρ = 1000 kg/m^3
Phantom section: Left Section

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, Left Head, Tilt, 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 = 8.555 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.0850 W/kg
SAR(1 g) = 0.064 W/kg



0 dB = 0.0669 W/kg = -11.75 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 0410-02

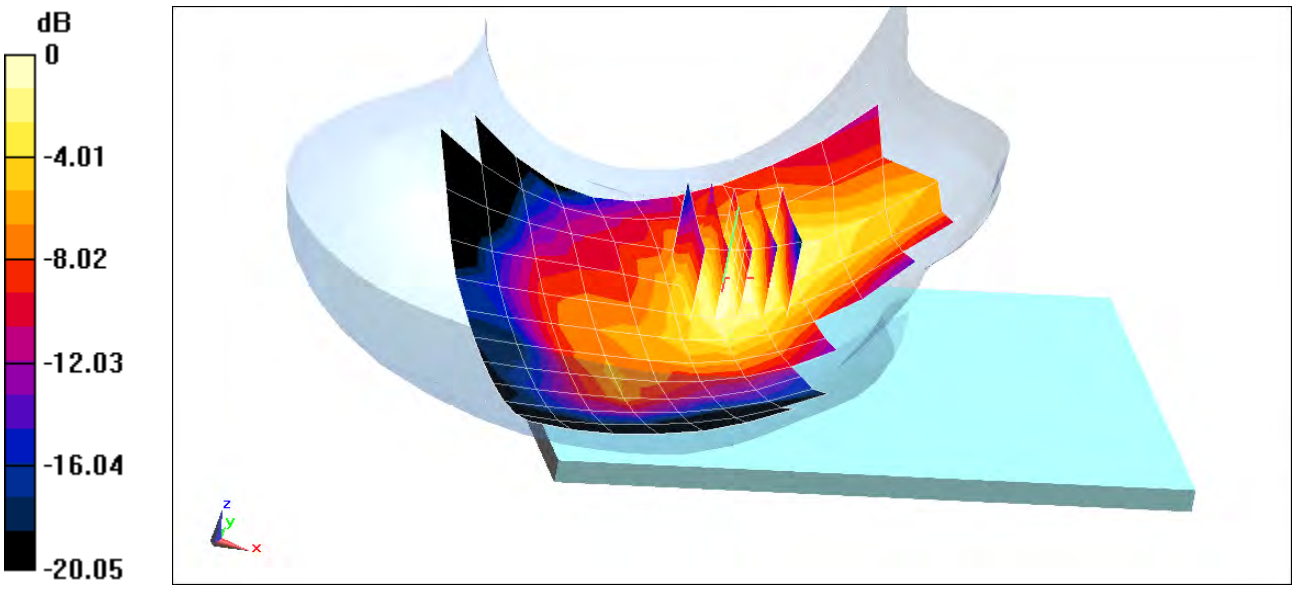
Communication System: UID 0, GSM; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.402 S/m; ε_r = 41.224; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 04-17-2014; Ambient Temp: 23.3°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3332; ConvF(5.06, 5.06, 5.06); Calibrated: 11/25/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1407; Calibrated: 11/18/2013
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

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

Area Scan (12x17x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.622 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 0.148 W/kg
SAR(1 g) = 0.109 W/kg



0 dB = 0.115 W/kg = -9.39 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 0410-02

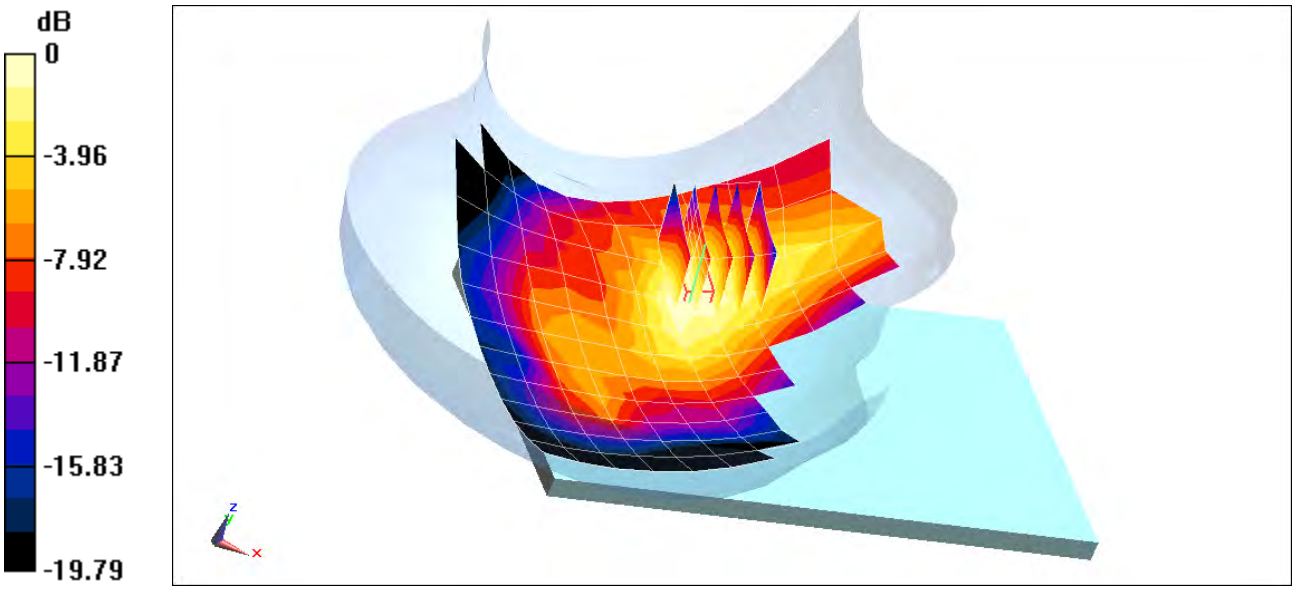
Communication System: UID 0, UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.402 S/m; ε_r = 41.224; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 04-17-2014; Ambient Temp: 23.3°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3332; ConvF(5.06, 5.06, 5.06); Calibrated: 11/25/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1407; Calibrated: 11/18/2013
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

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

Area Scan (12x17x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.396 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.260 W/kg
SAR(1 g) = 0.190 W/kg



0 dB = 0.198 W/kg = -7.03 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 0410-01

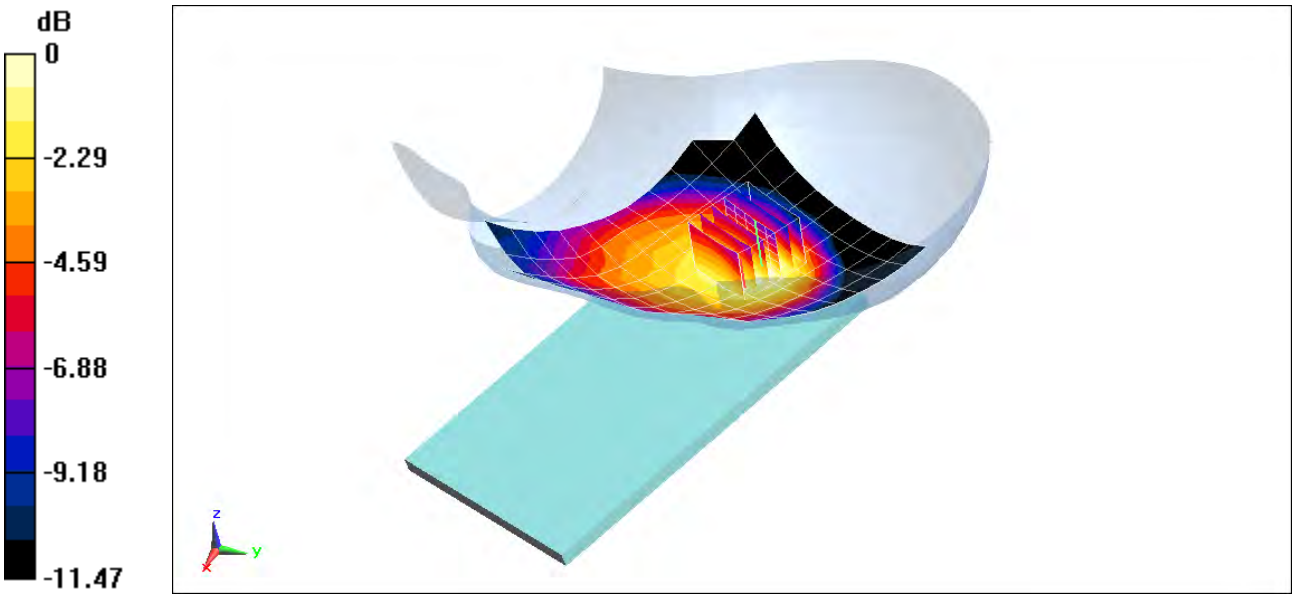
Communication System: UID 0, LTE Band 5 (Cell.) (0); Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium: 835 Head Medium parameters used (interpolated):
f = 836.5 MHz; σ = 0.901 S/m; ε_r = 39.878; ρ = 1000 kg/m^3
Phantom section: Left Section

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: LTE Band 5 (Cell), Left Head, Tilt, Mid.ch
QPSK, 10 MHz Bandwidth, 1 RB, 25 RB Offset

Area Scan (11x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.297 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.0740 W/kg
SAR(1 g) = 0.055 W/kg



0 dB = 0.0582 W/kg = -12.35 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 0410-02

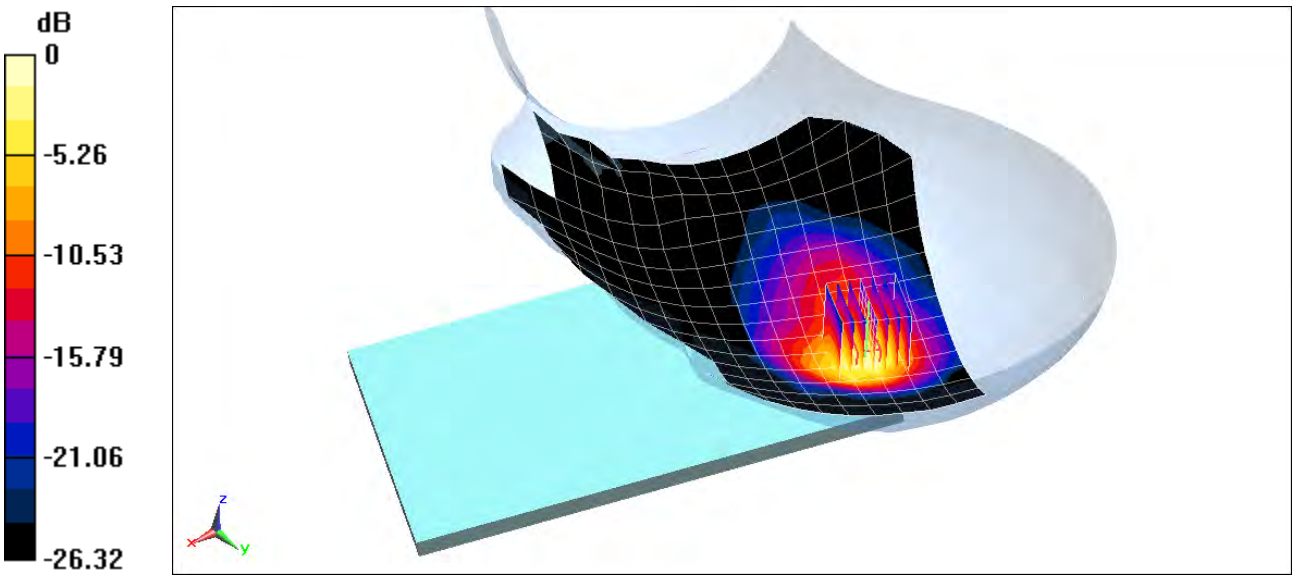
Communication System: UID 0, IEEE 802.11n (0); Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used (interpolated):
f = 2437 MHz; σ = 1.759 S/m; ε_r = 39.206; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 04-14-2014; Ambient Temp: 24.2°C; Tissue Temp: 23.4°C

Probe: ES3DV3 - SN3287; ConvF(4.43, 4.43, 4.43); Calibrated: 11/20/2013;
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 802.11n MIMO, Left Head, Tilt, Ch 06, 13 Mbps

Area Scan (16x23x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 16.657 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.963 W/kg
SAR(1 g) = 0.467 W/kg



0 dB = 0.631 W/kg = -2.00 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 0410-01

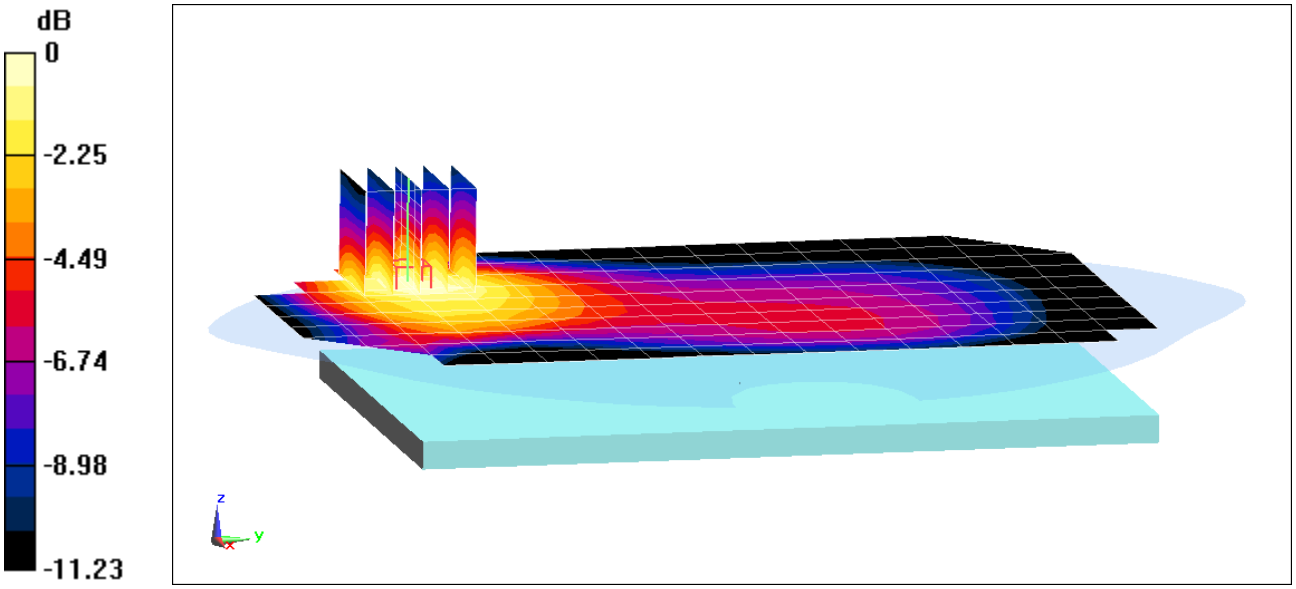
Communication System: UID 0, GSM GPRS; 3 Tx slots; Frequency: 836.6 MHz; Duty Cycle: 1:2.76
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.015 S/m; ε_r = 54.039; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-17-2014; Ambient Temp: 23.2°C; Tissue Temp: 21.9°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, Back side, Mid.ch, 3 Tx Slots

Area Scan (11x17x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.212 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.679 W/kg
SAR(1 g) = 0.473 W/kg



0 dB = 0.504 W/kg = -2.98 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 0410-03

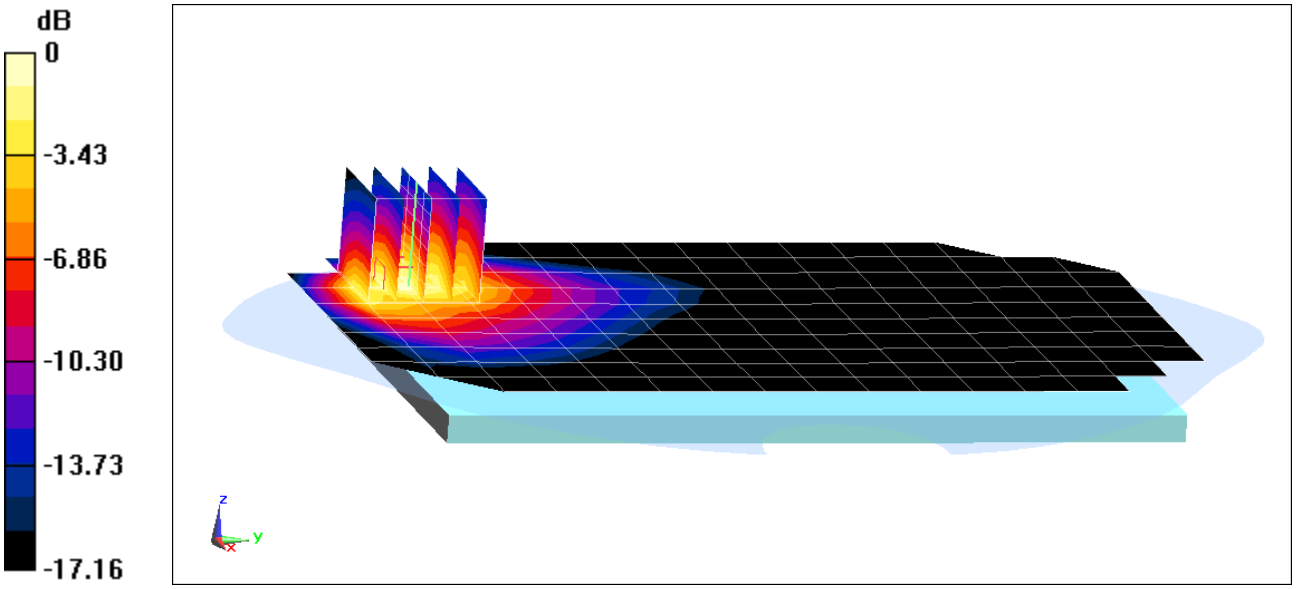
Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.013 S/m; ε_r = 54.104; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

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, Back side, Mid.ch

Area Scan (11x17x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.919 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.40 W/kg
SAR(1 g) = 0.681 W/kg



0 dB = 0.738 W/kg = -1.32 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 0410-01

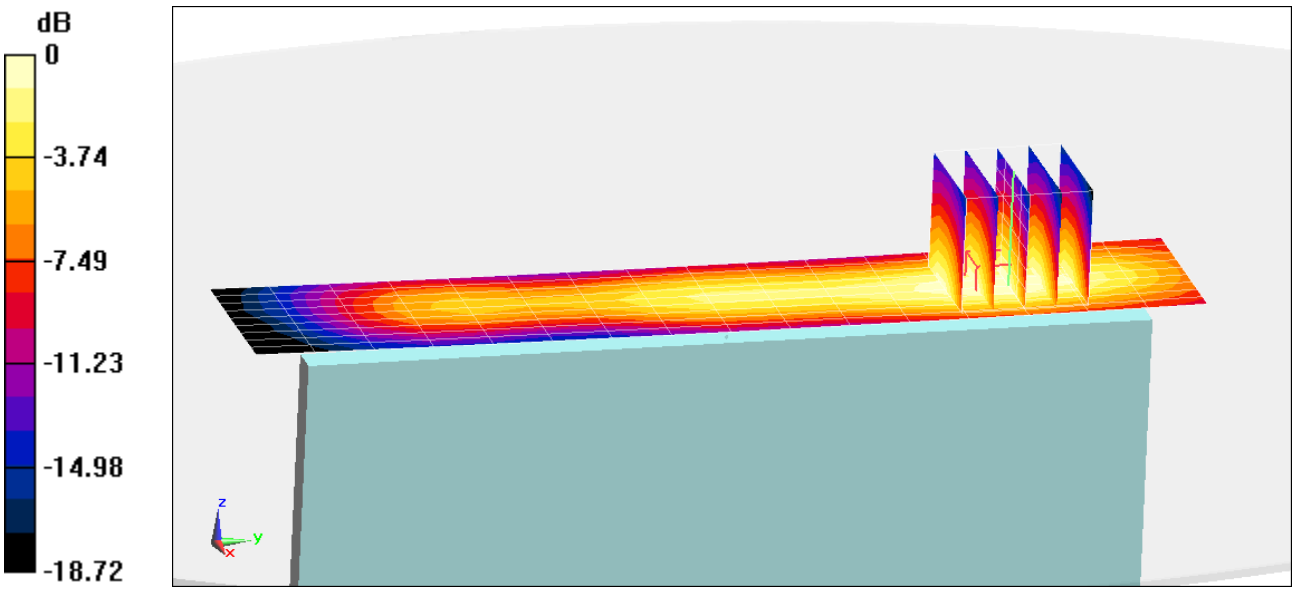
Communication System: UID 0, GSM GPRS; 3 Tx slots (0); Frequency: 1909.8 MHz; Duty Cycle: 1:2.76
Medium: 1900 Body Medium parameters used:
f = 1910 MHz; σ = 1.558 S/m; ε_r = 51.607; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.4 cm

Test Date: 04-21-2014; Ambient Temp: 23.8°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: GPRS 1900, Body SAR, Right Edge, High.ch, 3 Tx Slots

Area Scan (10x17x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.614 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 1.43 W/kg
SAR(1 g) = 0.837 W/kg



0 dB = 0.872 W/kg = -0.59 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 0410-03

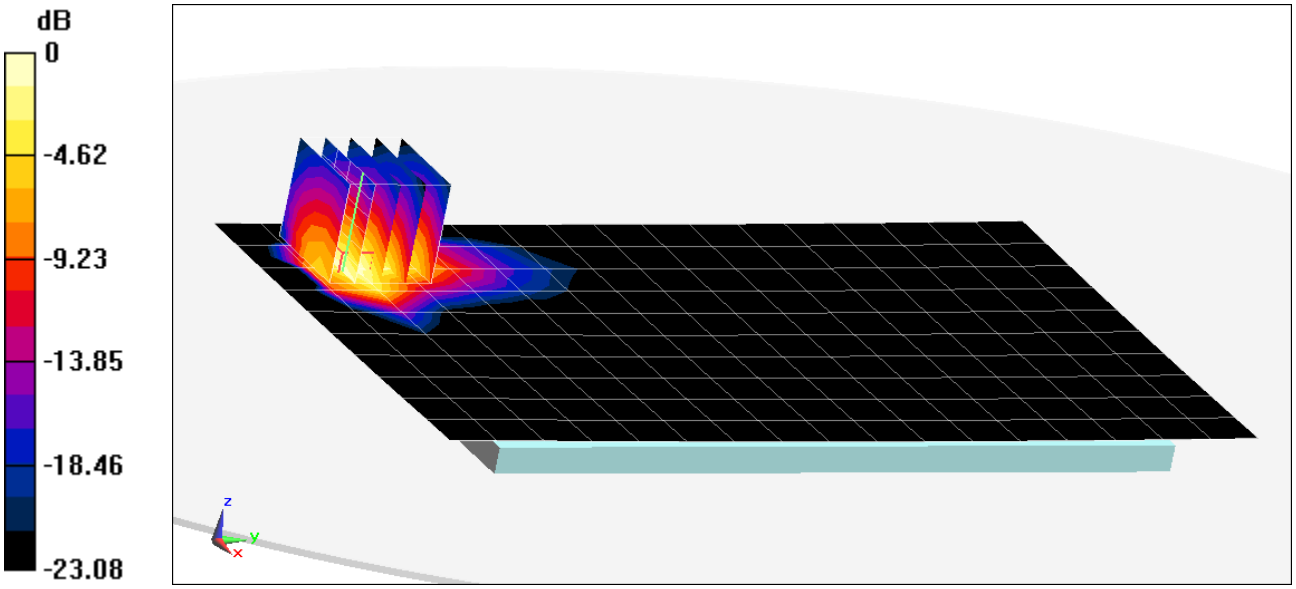
Communication System: UID 0, UMTS (0); Frequency: 1907.6 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1907.6 MHz; σ = 1.554 S/m; ε_r = 52.595; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-24-2014; Ambient Temp: 23.8°C; Tissue Temp: 22.9°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, High.ch

Area Scan (11x18x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.440 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 2.43 W/kg
SAR(1 g) = 1.01 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 0410-03

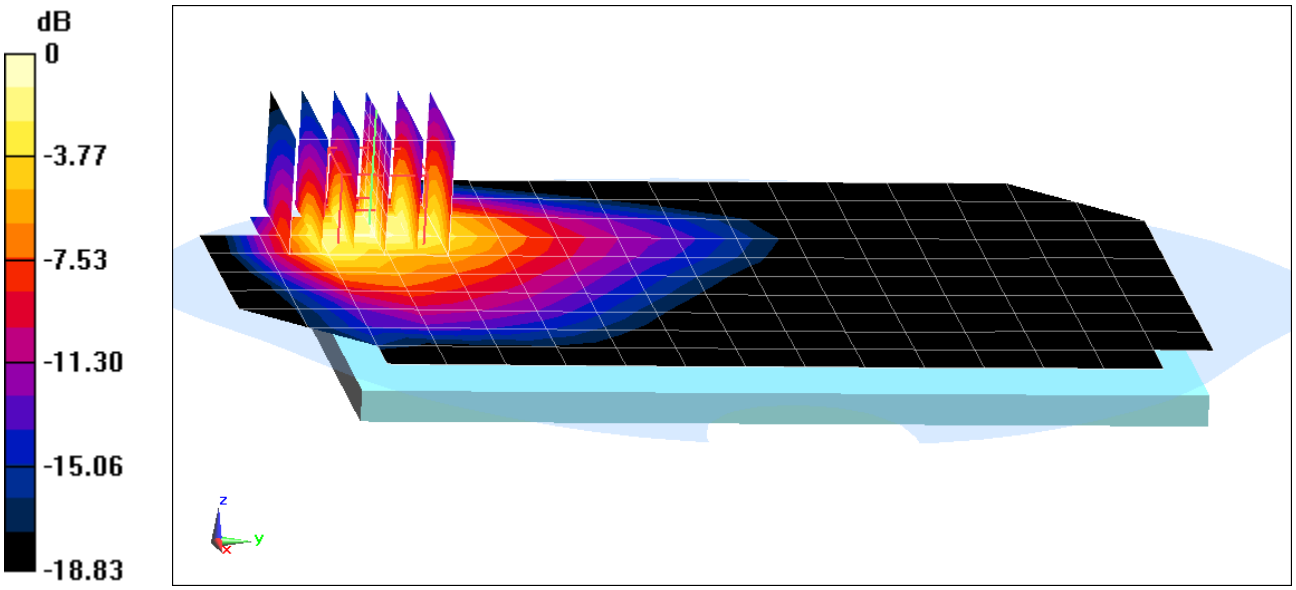
Communication System: UID 0, LTE Band 5; Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.5 MHz; σ = 1.013 S/m; ε_r = 54.105; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-21-2013; 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: LTE Band 5 (Cell.), Body SAR, Back side, Mid.ch
QPSK, 10 MHz Bandwidth, 1 RB, 0 RB Offset

Area Scan (11x17x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.452 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 1.29 W/kg
SAR(1 g) = 0.648 W/kg



0 dB = 0.705 W/kg = -1.52 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 1004-1

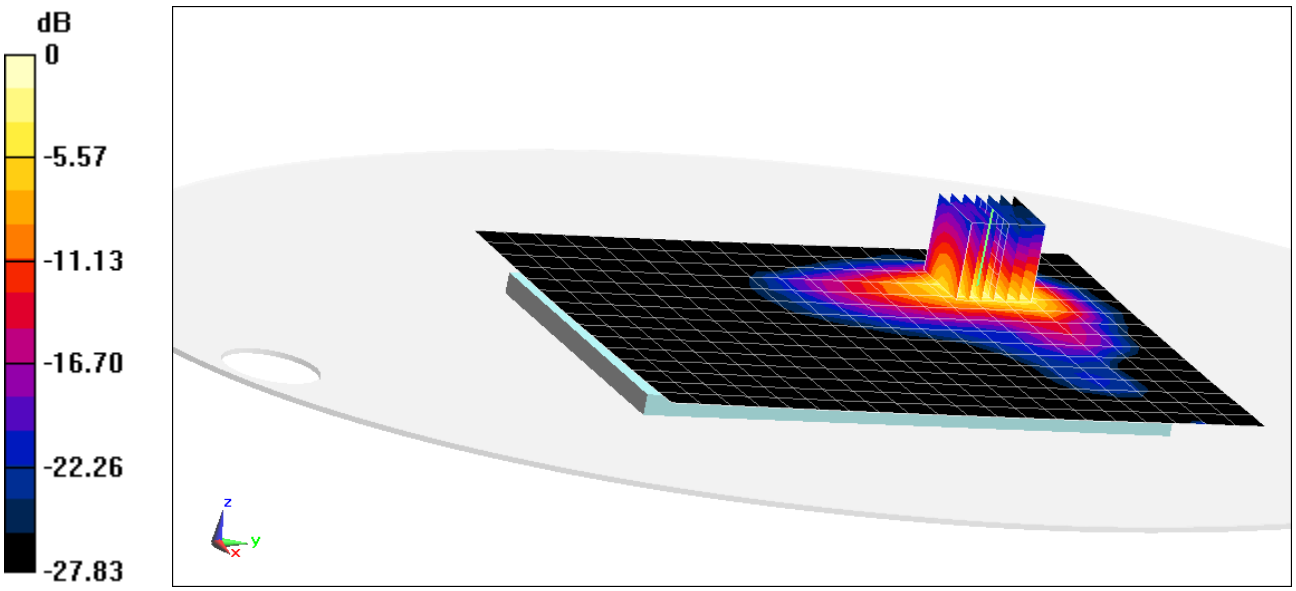
Communication System: UID 0, IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2437 MHz; σ = 2.013 S/m; ε_r = 52.664; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-14-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.9°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 Antenna 2, Body SAR, Back Side, Ch 06, 1 Mbps

Area Scan (16x21x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 26.718 V/m; Power Drift = 0.20 dB
Peak SAR (extrapolated) = 3.35 W/kg
SAR(1 g) = 1.02 W/kg



0 dB = 1.48 W/kg = 1.70 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT705; Type: Portable Tablet; Serial: 1004-1

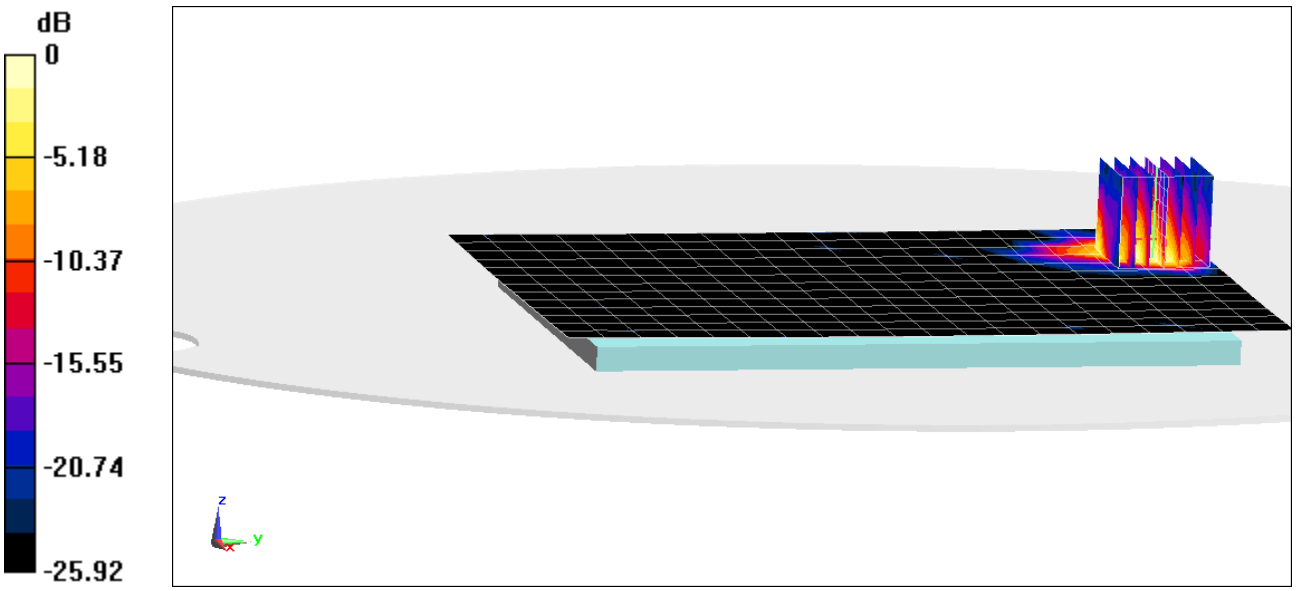
Communication System: UID 0, Bluetooth (0); Frequency: 2441 MHz; Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2441 MHz; σ = 2.02 S/m; ε_r = 51.016; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-21-2014; Ambient Temp: 24.3°C; Tissue Temp: 23.0°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: Bluetooth, Body SAR, Back Side, Ch 39, 1 Mbps

Area Scan (14x21x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.196 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.600 W/kg
SAR(1 g) = 0.221 W/kg



0 dB = 0.307 W/kg = -5.13 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

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PCTEST ENGINEERING LABORATORY, INC.

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

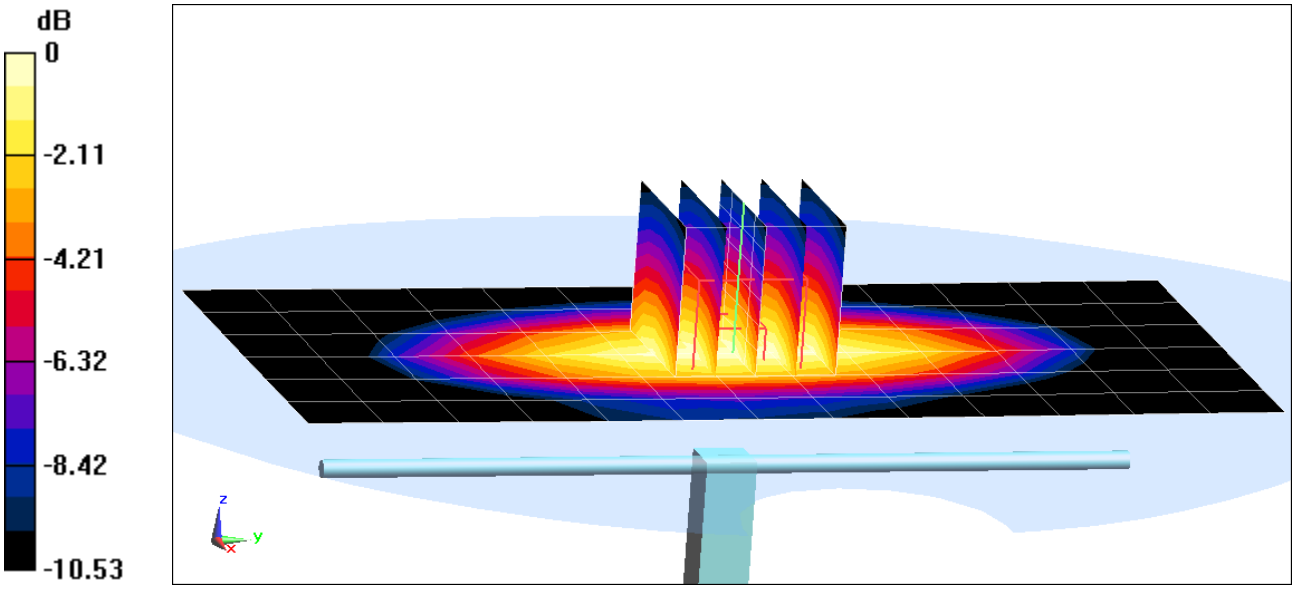
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Head Medium parameters used:
f = 835 MHz; σ = 0.9 S/m; ε_r = 39.901; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

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%



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

PCTEST ENGINEERING LABORATORY, INC.

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

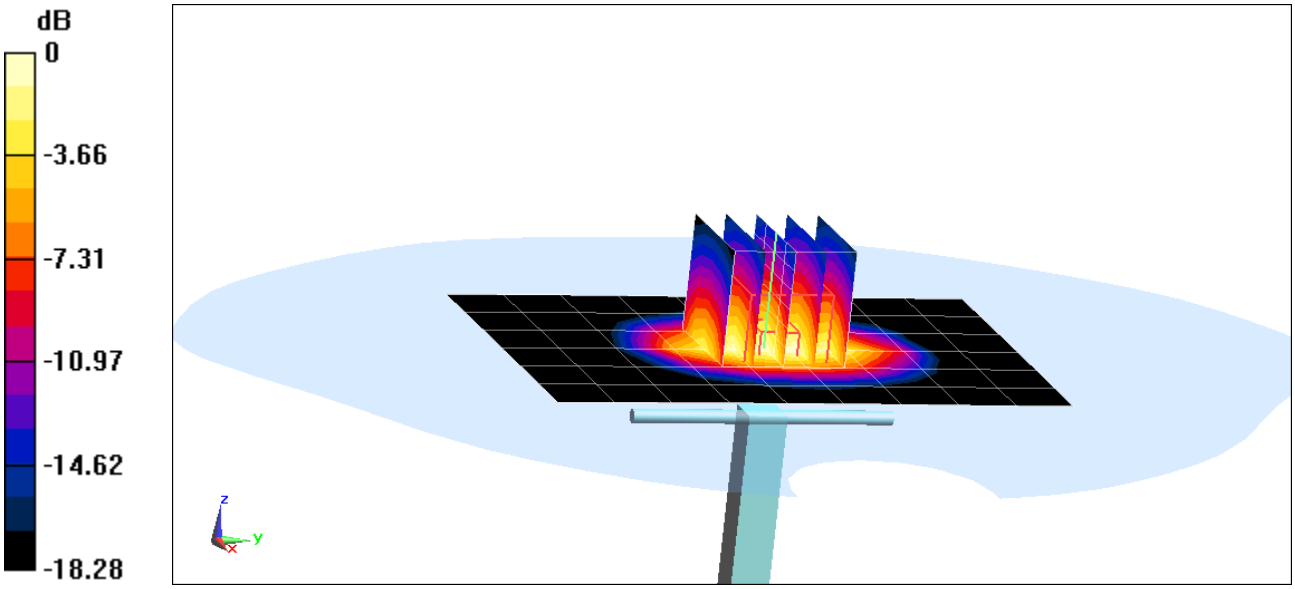
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.425 S/m; ε_r = 41.151; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-17-2014; Ambient Temp: 23.3°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3332; ConvF(5.06, 5.06, 5.06); Calibrated: 11/25/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1407; Calibrated: 11/18/2013
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
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) = 7.89 W/kg
SAR(1 g) = 4.22 W/kg
Deviation = 4.46%



0 dB = 4.71 W/kg = 6.73 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

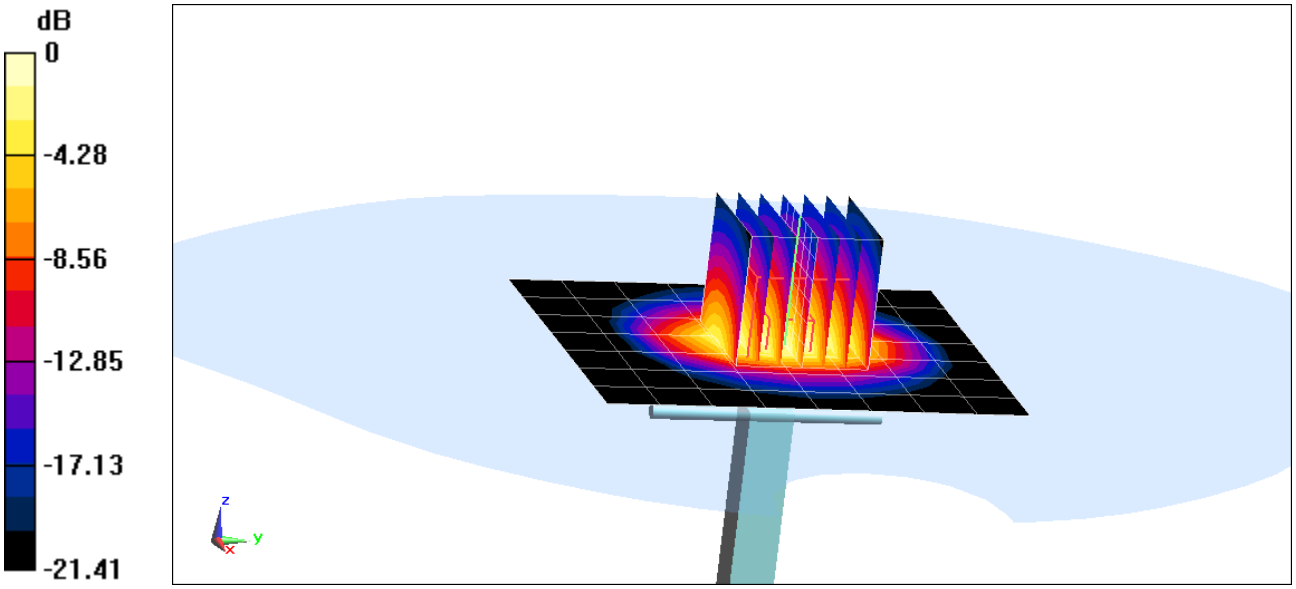
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used:
f = 2450 MHz; σ = 1.773 S/m; ε_r = 39.159; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-14-2014; Ambient Temp: 24.2°C; Tissue Temp: 23.4°C

Probe: ES3DV3 - SN3287; ConvF(4.43, 4.43, 4.43); Calibrated: 11/20/2013;
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 = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 11.1 W/kg
SAR(1 g) = 5.45 W/kg
Deviation = 5.21%



0 dB = 7.03 W/kg = 8.47 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

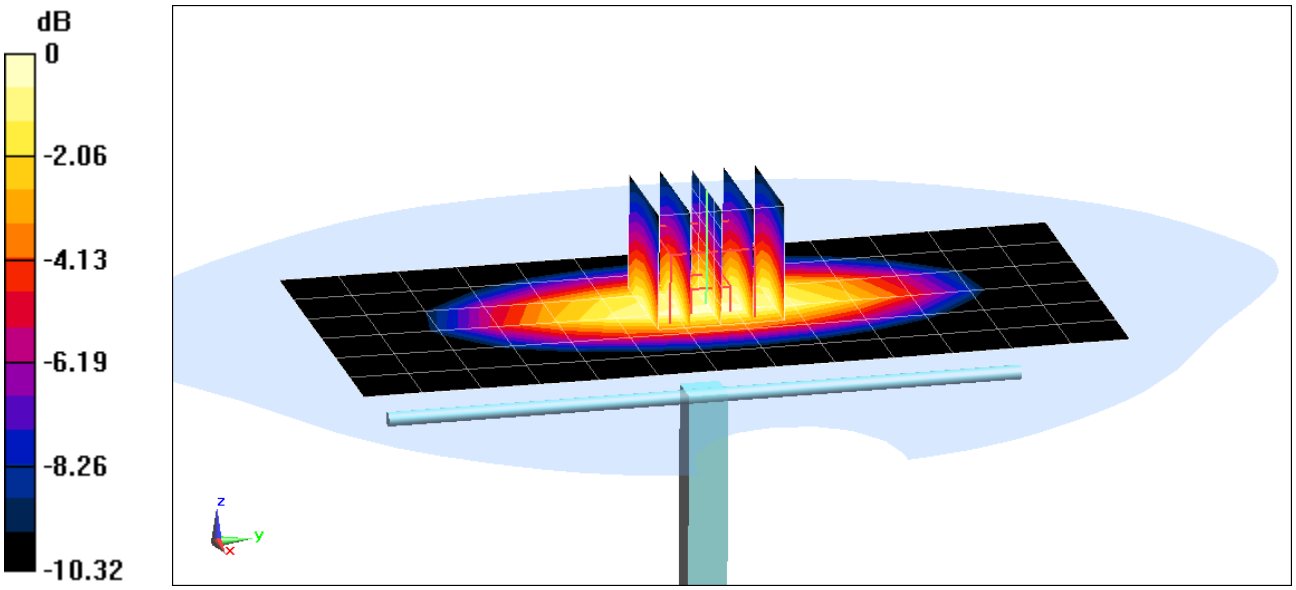
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Body Medium parameters used:
f = 835 MHz; σ = 1.012 S/m; ε_r = 54.122; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

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

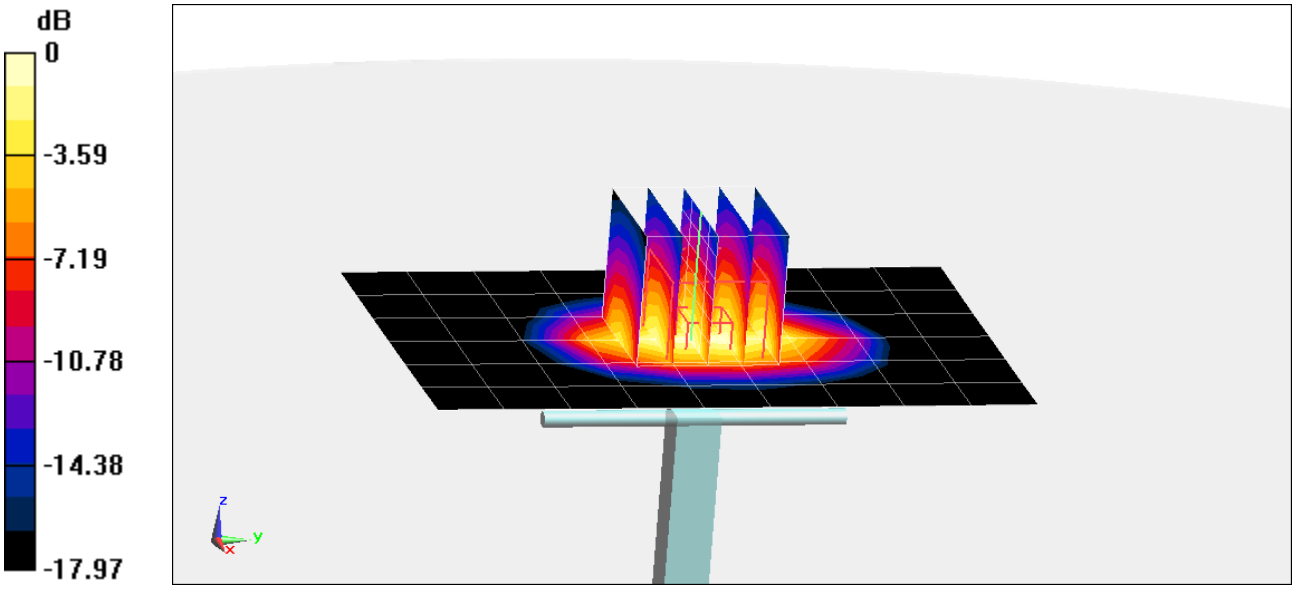
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.546 S/m; ε_r = 51.661; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-21-2014; Ambient Temp: 23.8°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=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) = 7.54 W/kg
SAR(1 g) = 4.09 W/kg
Deviation = 0.99%



0 dB = 4.55 W/kg = 6.58 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

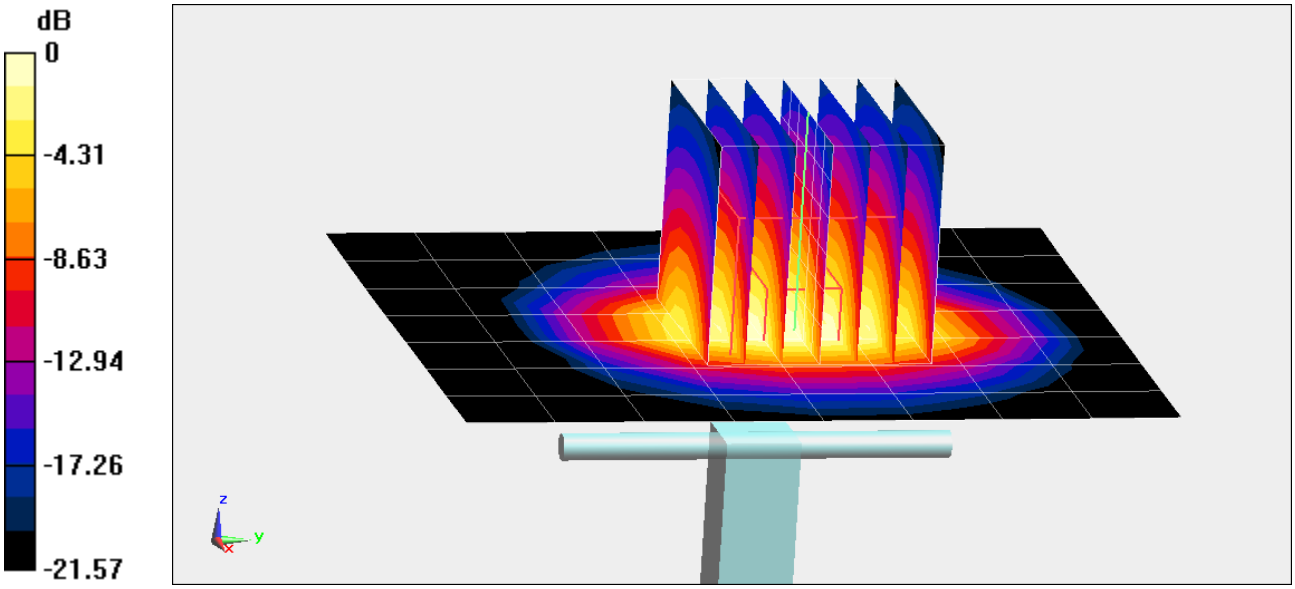
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used:
f = 2450 MHz; σ = 2.031 S/m; ε_r = 52.62; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-14-2014; Ambient Temp: 24.4°C; Tissue Temp: 23.9°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=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 10.3 W/kg
SAR(1 g) = 4.89 W/kg
Deviation = -1.01%



0 dB = 6.40 W/kg = 8.06 dBW/kg

APPENDIX C: PROBE CALIBRATION

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

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

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

Accreditation No.: SCS 108

Client PC Test

Certificate No: 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 2/5/14 ✓

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: January 22, 2014

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

PCT#80832

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 ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.6 ± 6 %	0.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.20 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.02 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.6 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.31 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.56 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.08 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.9 Ω - 1.4 jΩ
Return Loss	- 32.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.0 Ω - 2.9 jΩ
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

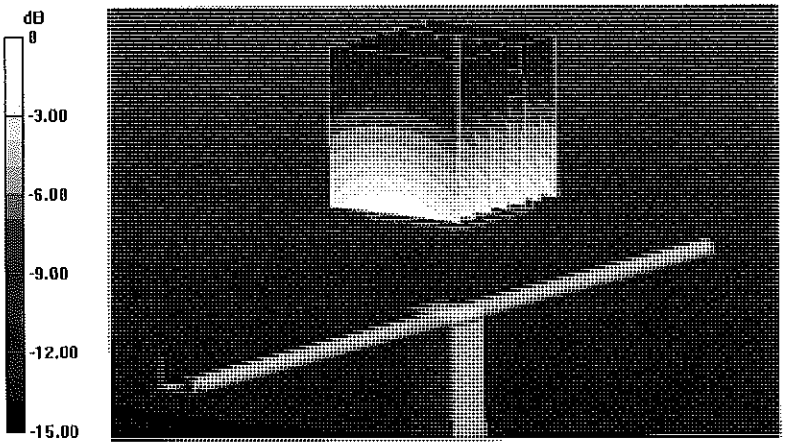
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.93 S/m; ε_r = 40.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(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)

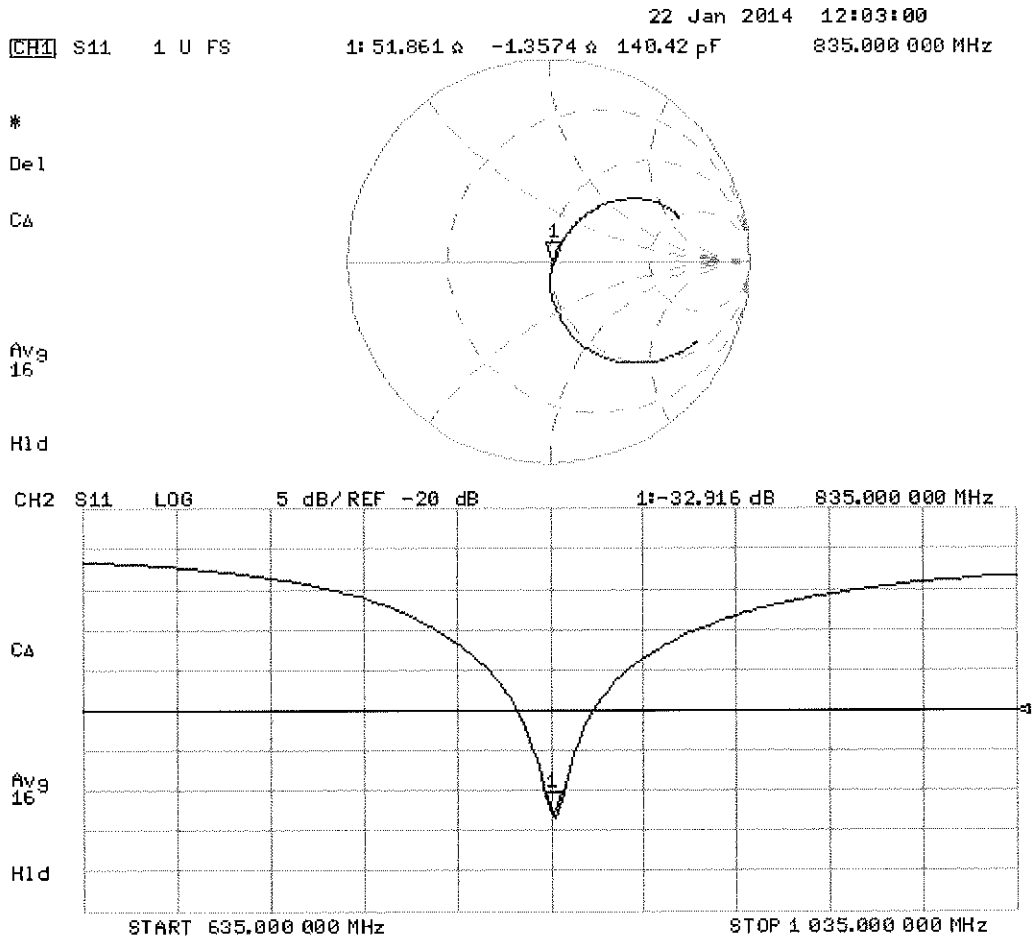
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

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



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

Impedance Measurement Plot for Head TSL



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

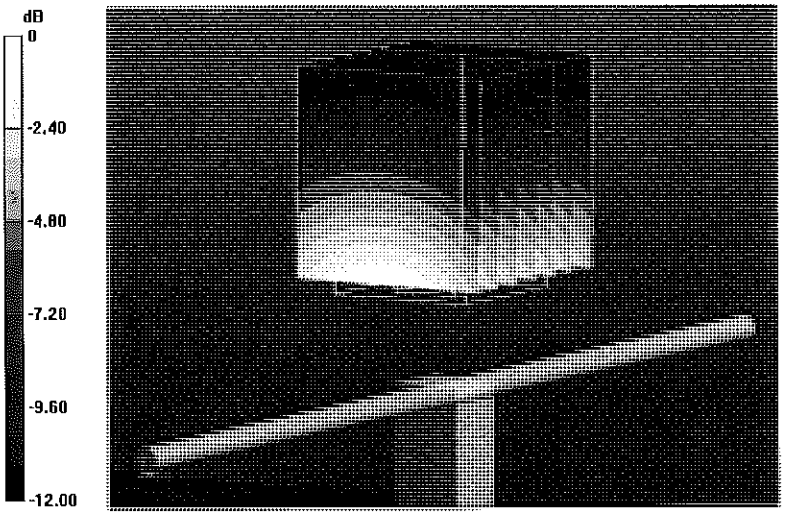
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.007 S/m; ε_r = 53.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(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)

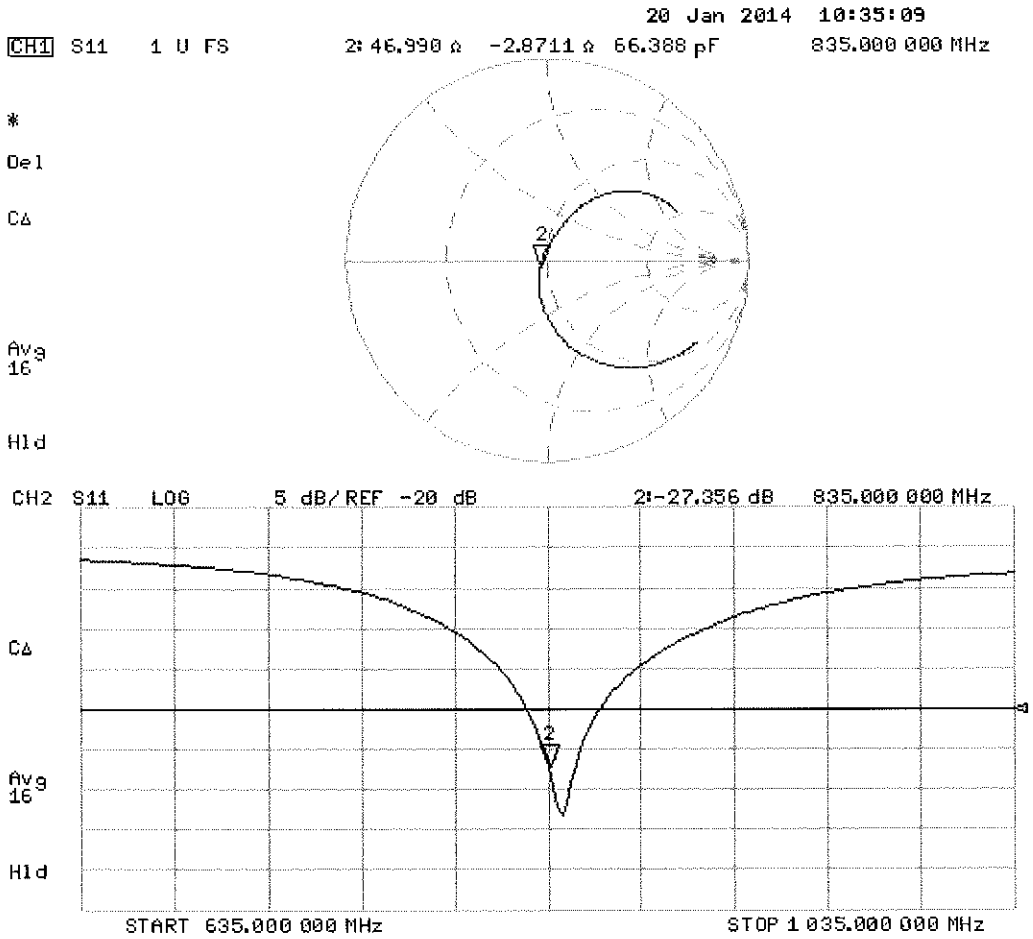
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.687 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



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

S Schweizerischer Kalibrierdienst
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Servizio svizzero di taratura
S Swiss Calibration Service

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D1900V2-5d149_Jul13

CALIBRATION CERTIFICATE

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

✓ KOK 8/19/13

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

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

Issued: July 22, 2013

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.36 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.4 W/kg ± 17.0 % (k=2)**

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

Body TSL parameters

The following parameters and calculations were applied.

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

SAR result with Body TSL

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

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

Appendix

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.196 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

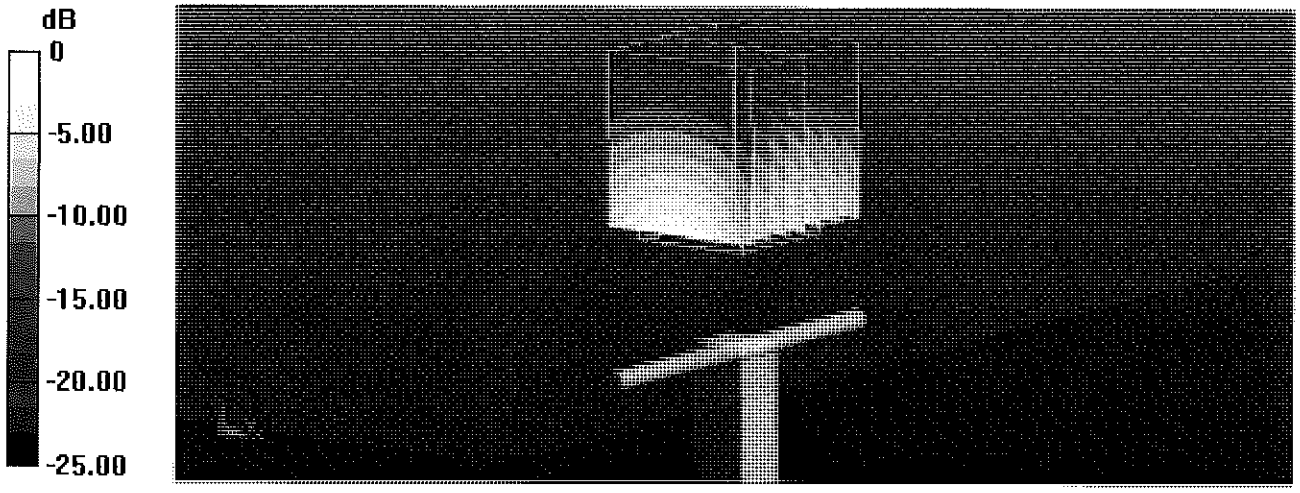
Communication System: UID 0 - CW ; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.36 S/m; ε_r = 38.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

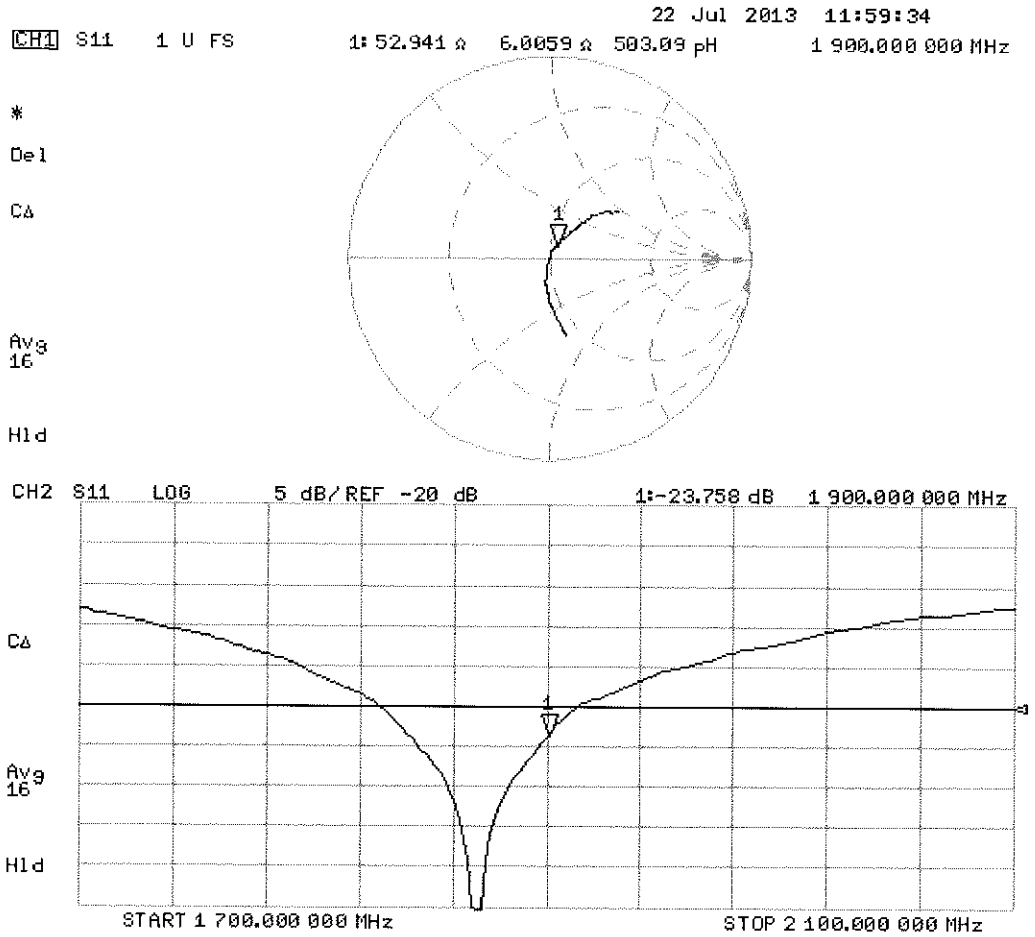
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

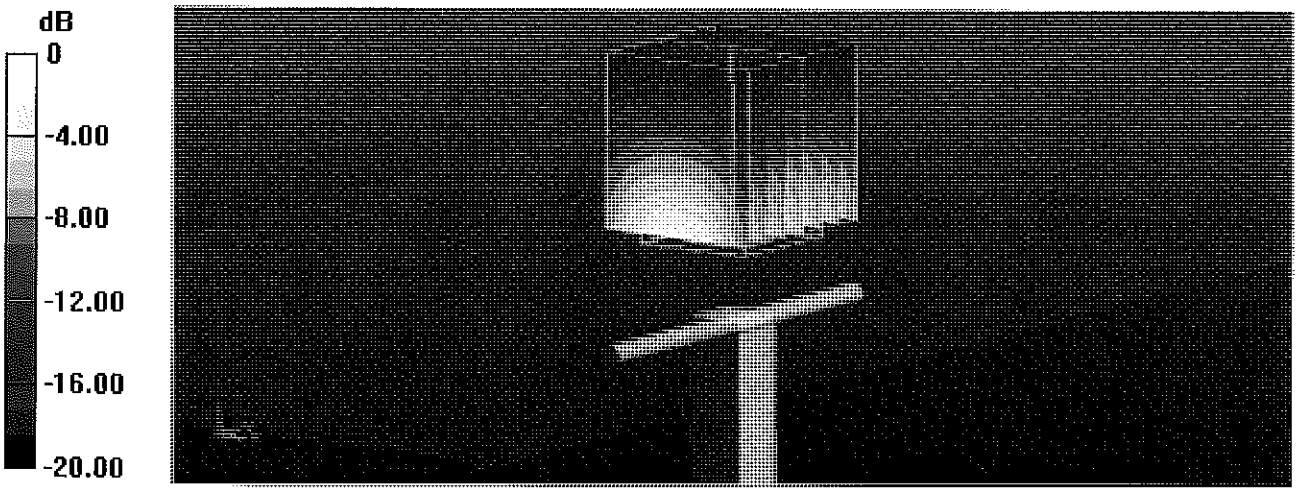
Communication System: UID 0 - CW ; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.49 S/m; ε_r = 53.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

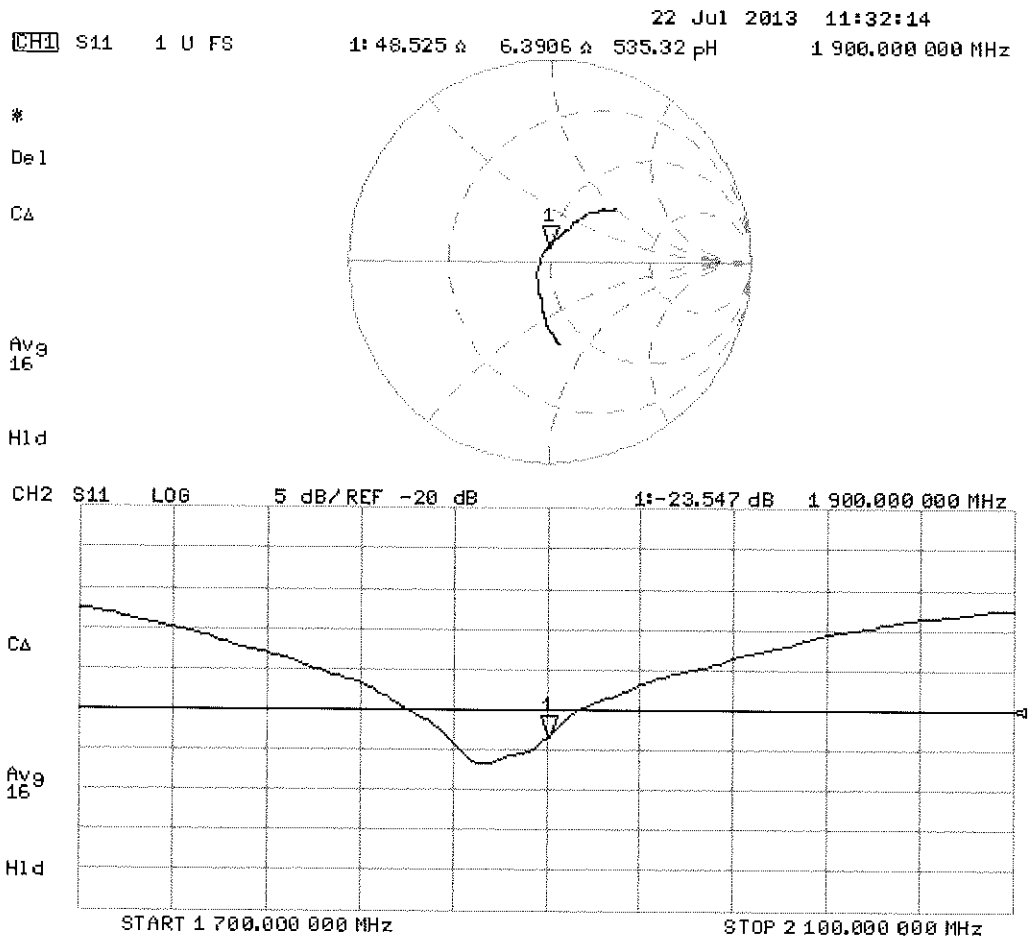
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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



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

Impedance Measurement Plot for Body TSL



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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D2450V2-797_Jan14

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 797
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	January 21, 2014

CC ✓
2/5/14

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: January 21, 2014

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

PCT# 751

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	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.7 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.3 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.3 ± 6 %	2.04 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**49.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.86 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.1 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.0 Ω + 4.9 jΩ
Return Loss	- 26.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.151 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 24, 2006

DASY5 Validation Report for Head TSL

Date: 21.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

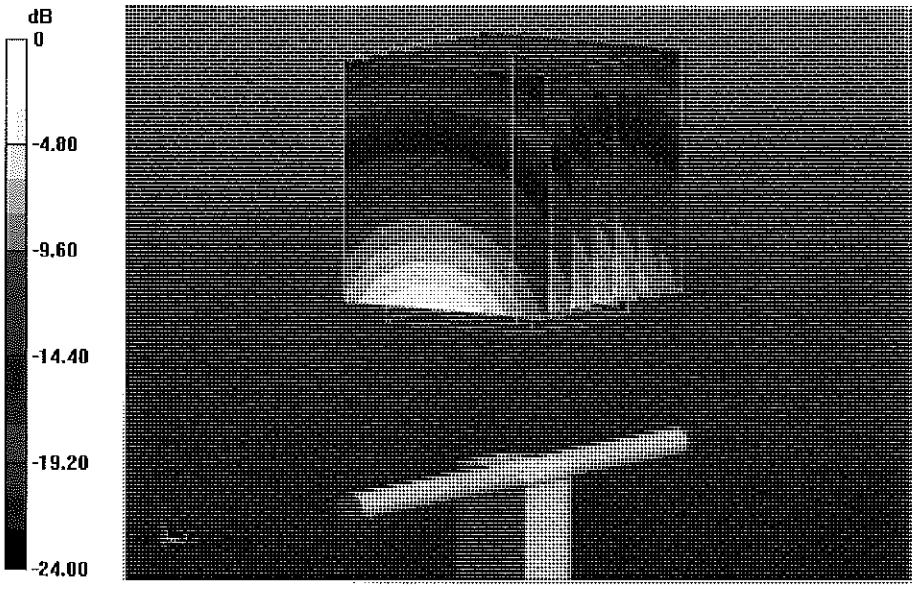
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ε_r = 38.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2013;
- 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)

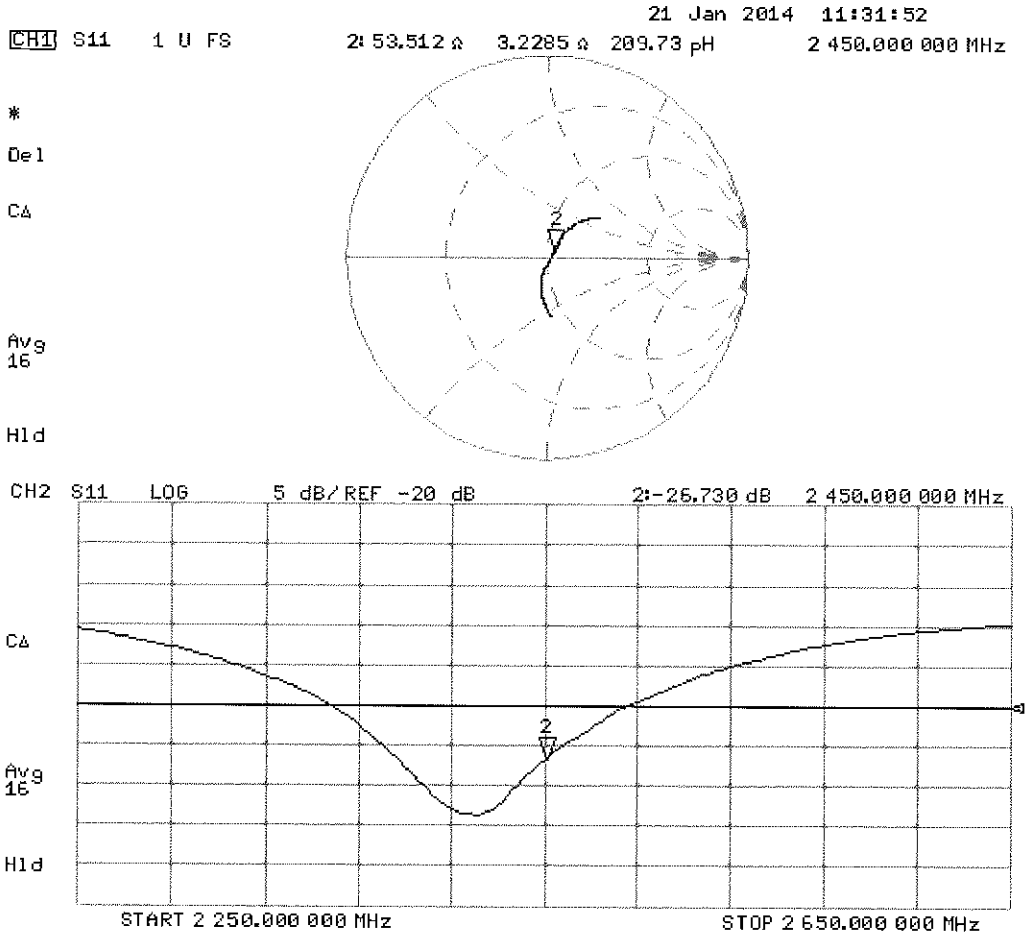
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.151 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 27.5 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.13 W/kg
Maximum value of SAR (measured) = 16.9 W/kg



0 dB = 16.9 W/kg = 12.28 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 21.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

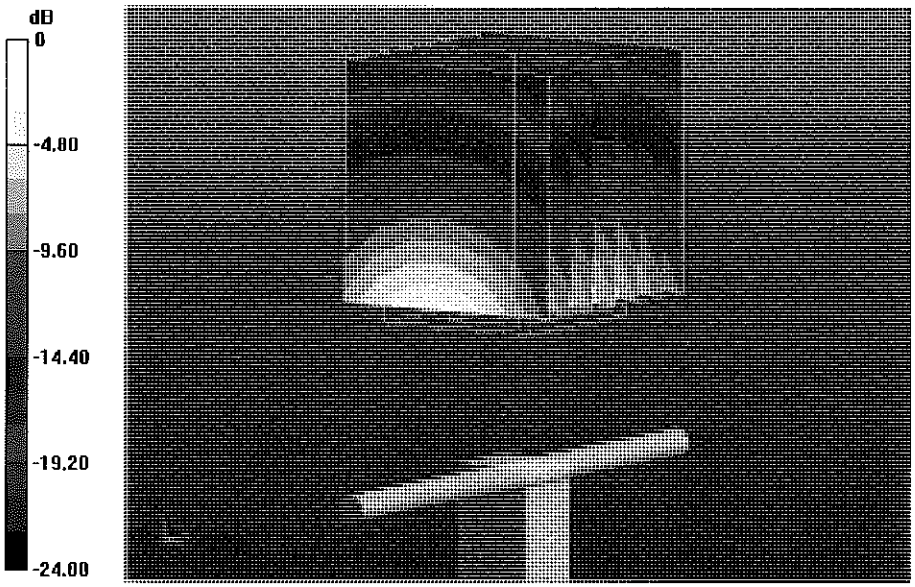
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.04 S/m; ε_r = 51.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2013;
- 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)

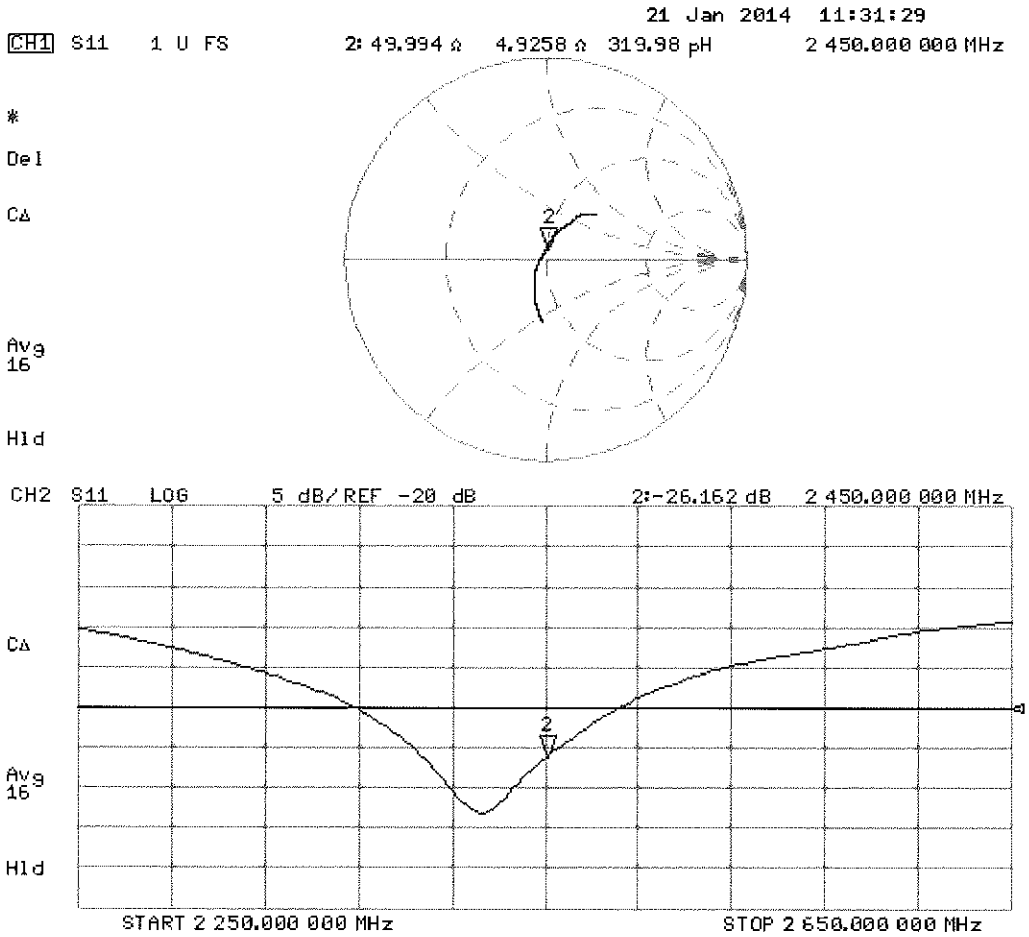
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.709 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 26.4 W/kg
SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.86 W/kg
Maximum value of SAR (measured) = 16.8 W/kg



0 dB = 16.8 W/kg = 12.25 dBW/kg

Impedance Measurement Plot for Body TSL



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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.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: October 23, 2013

VCC
11/26/2013

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: October 25, 2013

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

PCT # 81072

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:3914

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

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

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

Basic Calibration Parameters

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

Modulation Calibration Parameters

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

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

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

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

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 8 and 9).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

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

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

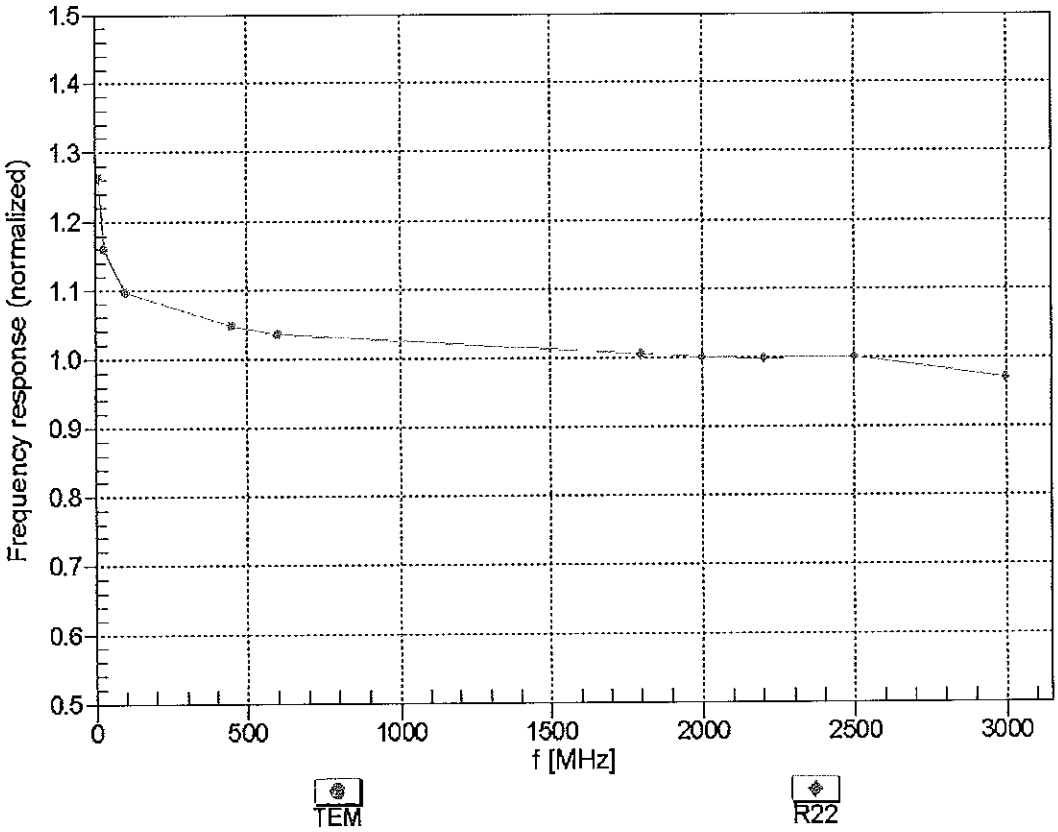
Calibration Parameter Determined in Body Tissue Simulating Media

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

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

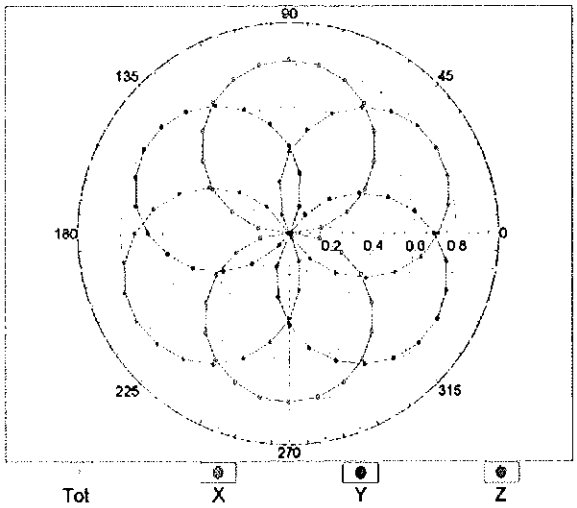
(TEM-Cell:ifi110 EXX, Waveguide: R22)



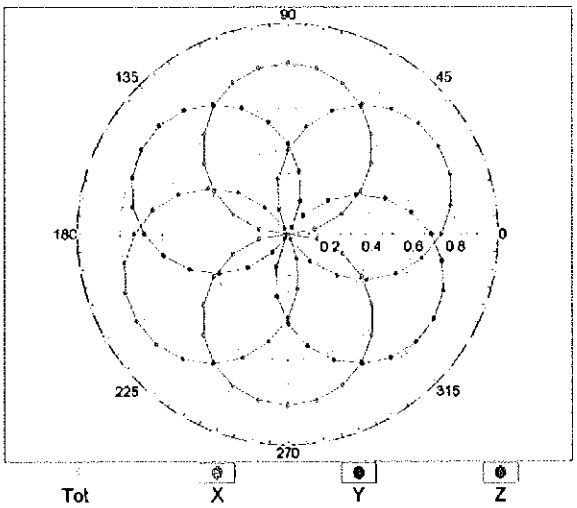
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

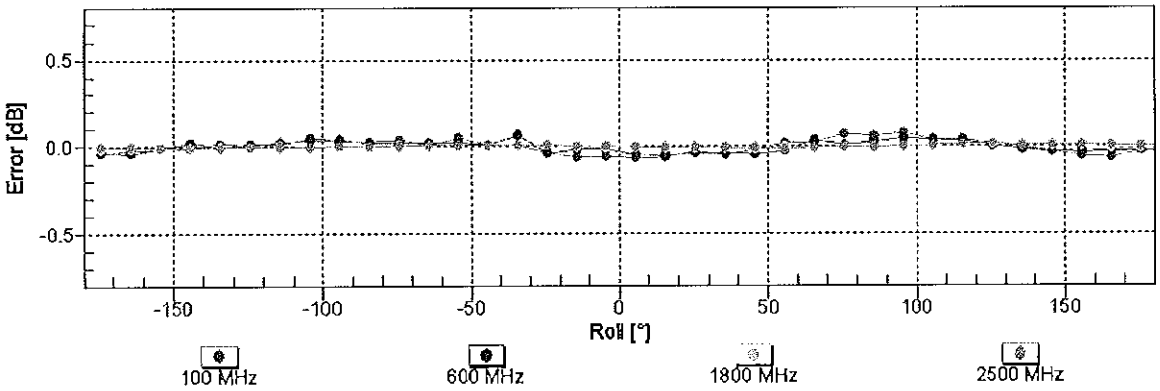
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



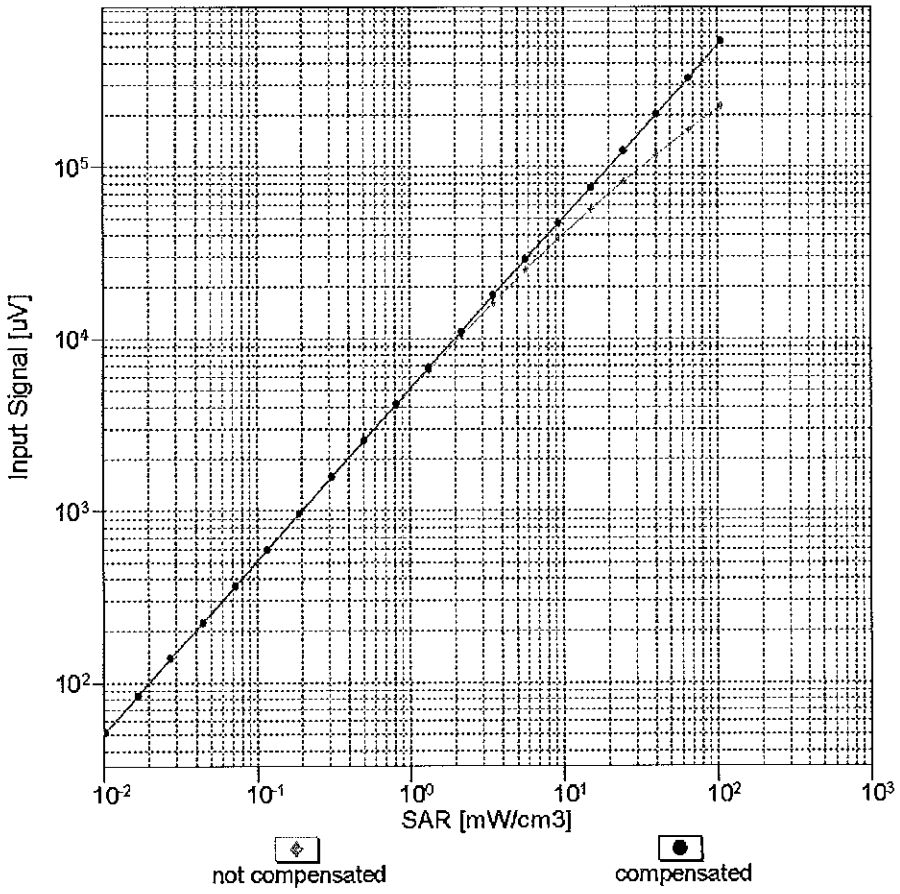
f=1800 MHz,R22

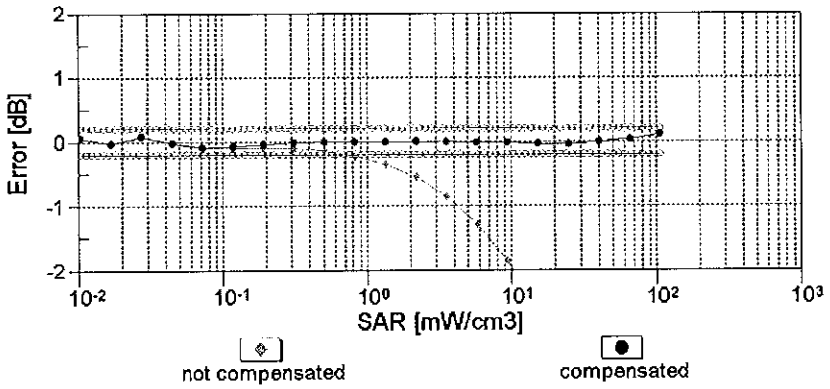




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

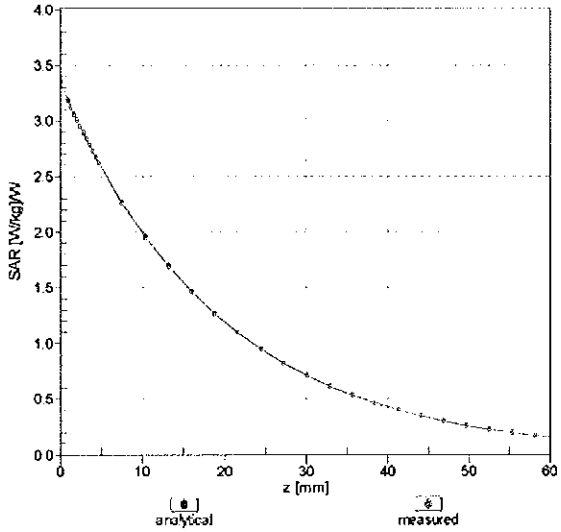




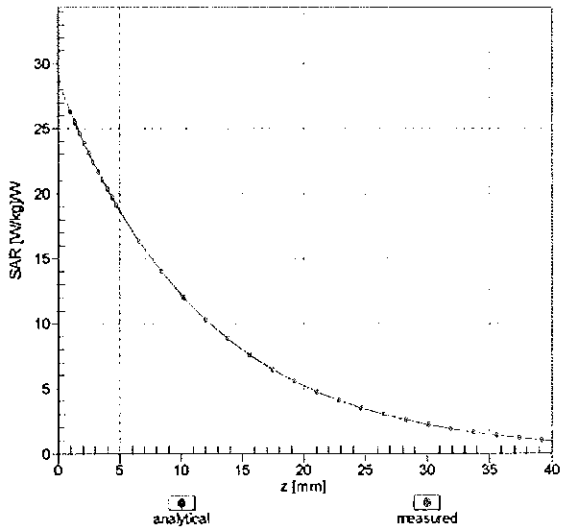
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

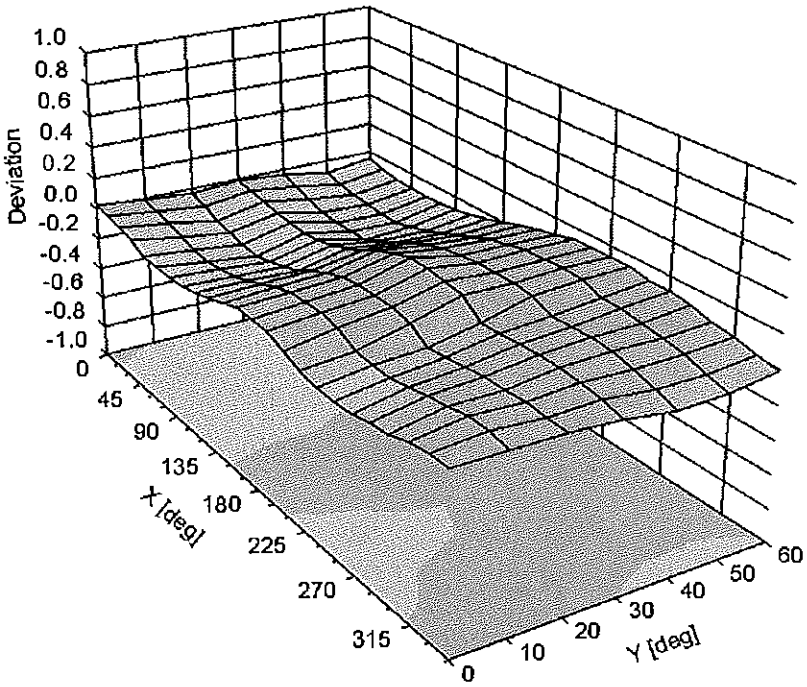


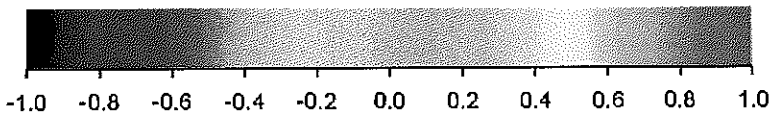
f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

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

Other Probe Parameters

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

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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: ES3-3332_Nov13

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3332
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	November 25, 2013

JCC 1/12/14

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: November 25, 2013

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3332

Manufactured: January 24, 2012
Calibrated: November 25, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3332

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.94	1.16	0.97	± 10.1 %
DCP (mV)[B]	103.5	101.0	111.0	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	179.7	±2.5 %
		Y	0.0	0.0	1.0		147.3	
		Z	0.0	0.0	1.0		188.8	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3332

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	6.46	6.46	6.46	0.52	1.42	± 12.0 %
850	41.5	0.92	6.29	6.29	6.29	0.78	1.17	± 12.0 %
1750	40.1	1.37	5.27	5.27	5.27	0.80	1.10	± 12.0 %
1900	40.0	1.40	5.06	5.06	5.06	0.80	1.18	± 12.0 %
2450	39.2	1.80	4.50	4.50	4.50	0.80	1.19	± 12.0 %
2600	39.0	1.96	4.38	4.38	4.38	0.76	1.31	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[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.

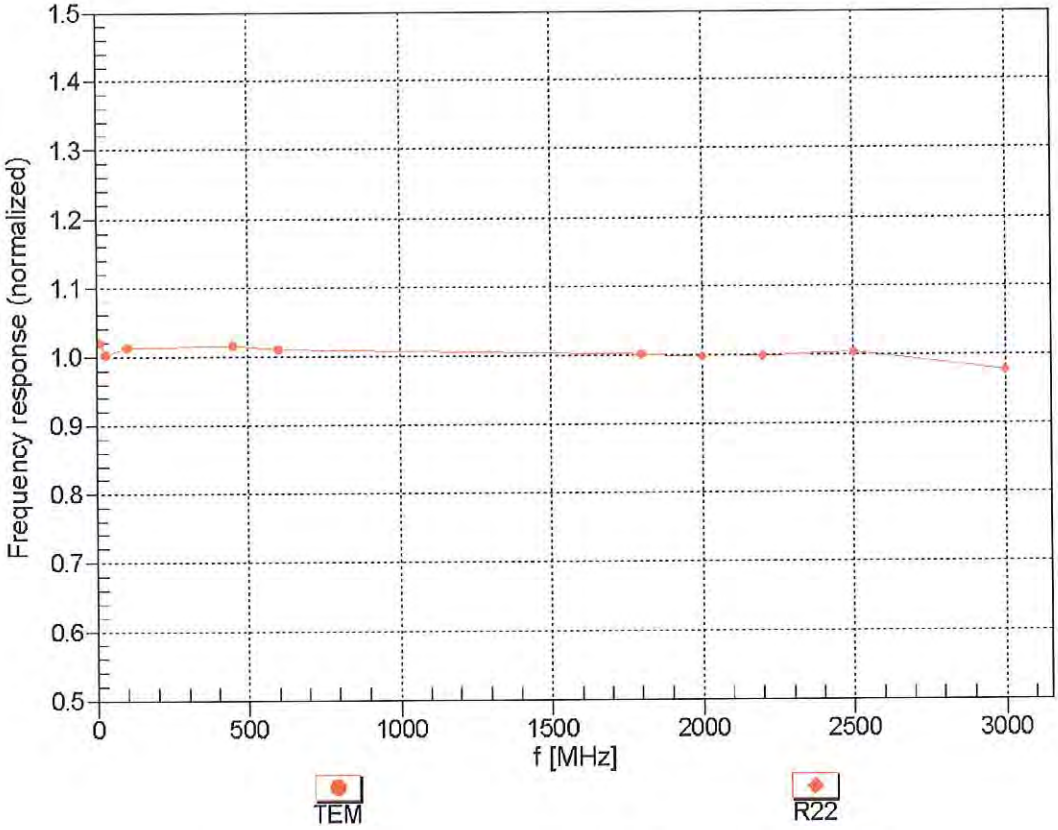
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3332

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	6.21	6.21	6.21	0.80	1.19	± 12.0 %
850	55.2	0.99	6.08	6.08	6.08	0.51	1.48	± 12.0 %
1750	53.4	1.49	4.93	4.93	4.93	0.42	1.72	± 12.0 %
1900	53.3	1.52	4.70	4.70	4.70	0.48	1.59	± 12.0 %
2450	52.7	1.95	4.24	4.24	4.24	0.80	1.01	± 12.0 %
2600	52.5	2.16	4.07	4.07	4.07	0.80	0.50	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

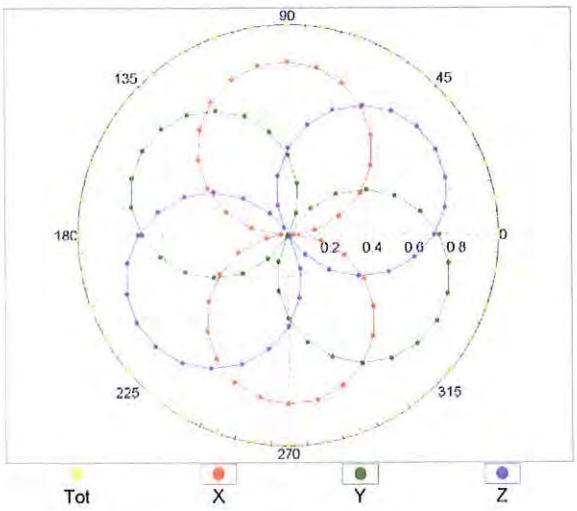
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



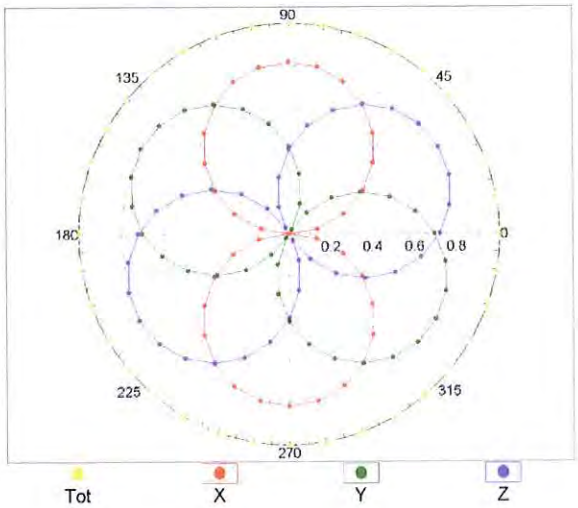
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

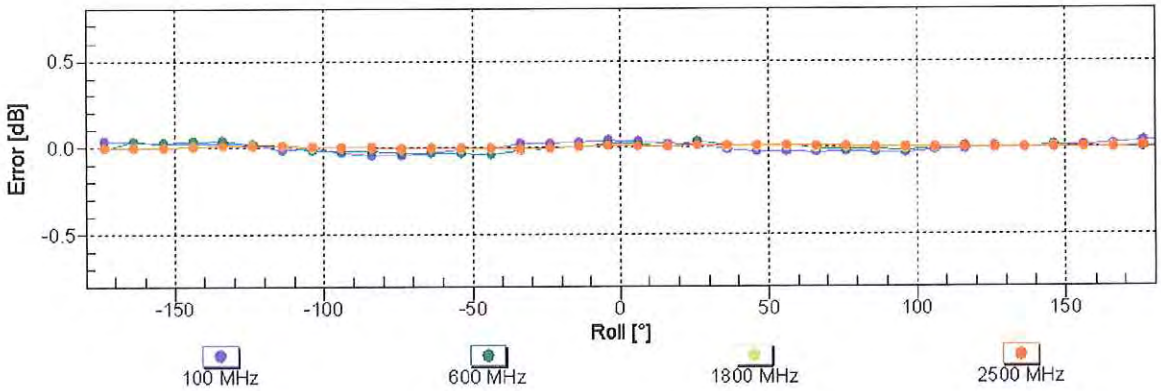
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



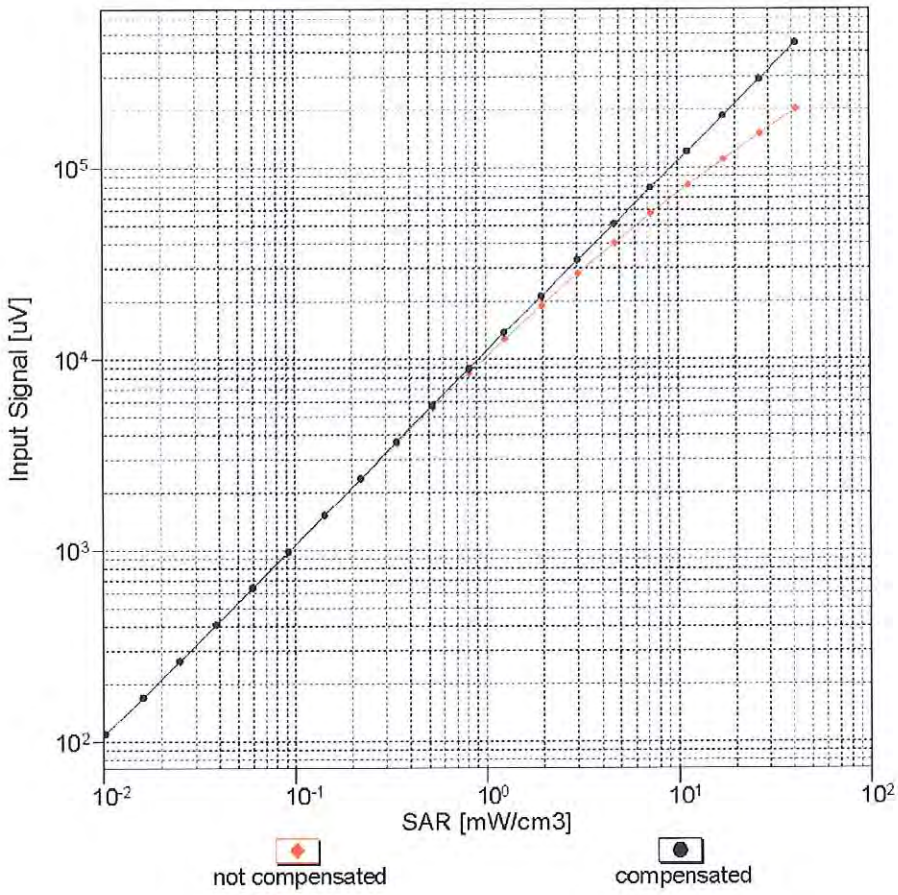
f=1800 MHz,R22

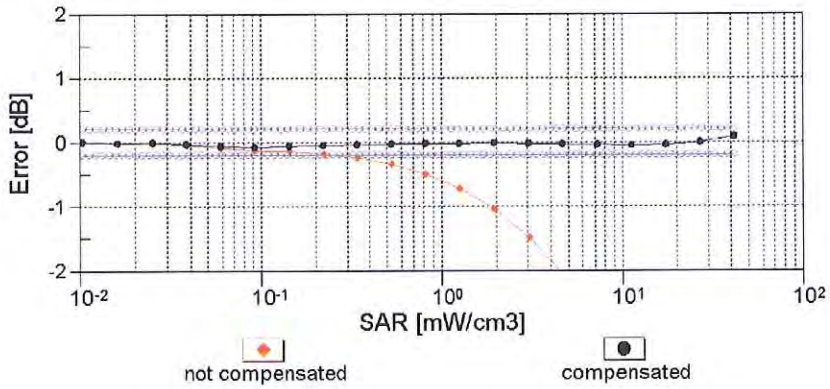




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

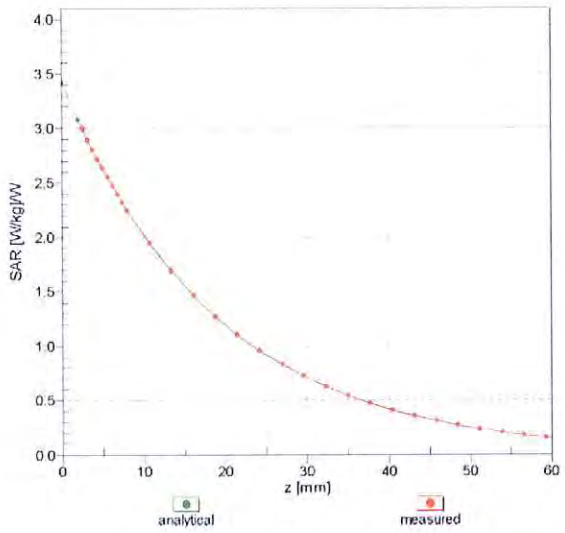




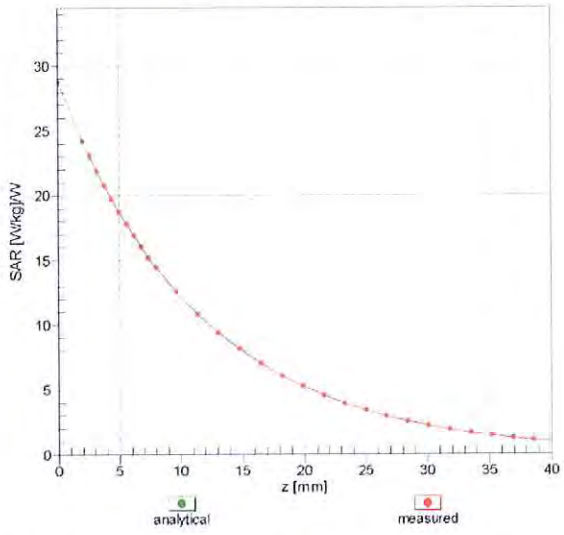
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 850 MHz,WGLS R9 (H_convF)

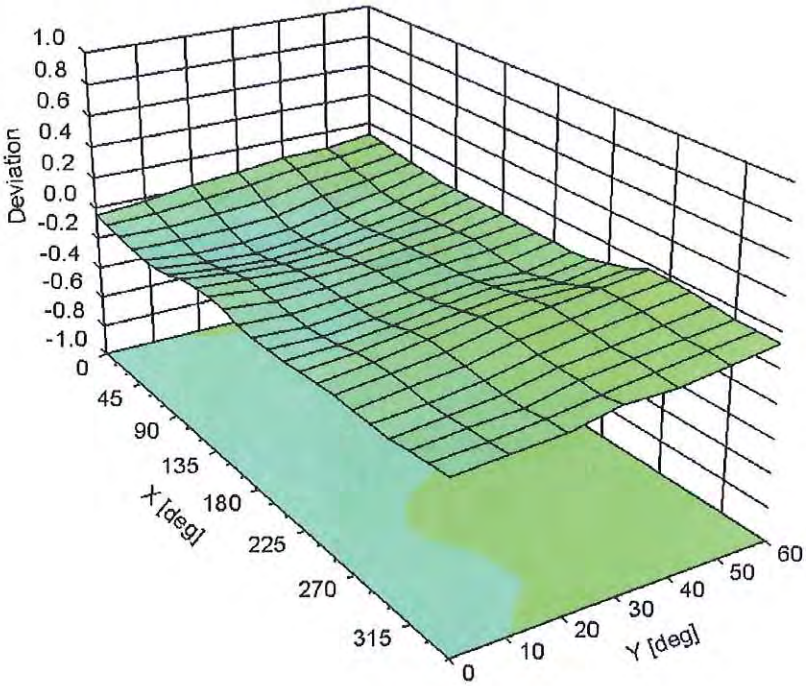


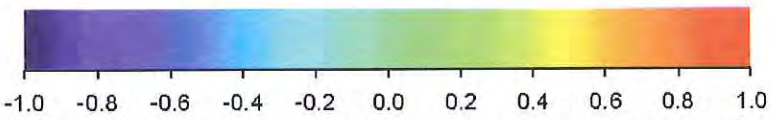
f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3332

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-3.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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

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

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

Accreditation No.: SCS 108

Client PC Test

Certificate No: ES3-3287_Nov13

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3287
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	November 20, 2013 ✓ CC 11/26/2013

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: November 20, 2013

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3287

Manufactured: June 7, 2010
Calibrated: November 20, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.31	1.25	1.25	± 10.1 %
DCP (mV)[B]	102.6	102.5	100.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	157.3	±2.7 %
		Y	0.0	0.0	1.0		159.9	
		Z	0.0	0.0	1.0		152.5	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	2.23	57.9	9.9	10.00	45.7	±1.4 %
		Y	2.13	57.6	9.8		46.6	
		Z	3.31	61.1	11.8		47.6	
10011-CAA	UMTS-FDD (WCDMA)	X	3.25	66.3	17.9	2.91	124.8	±0.5 %
		Y	3.16	65.7	17.4		127.4	
		Z	3.15	65.5	17.4		122.8	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.08	68.7	18.3	1.87	127.2	±0.7 %
		Y	3.03	68.2	17.9		129.4	
		Z	2.87	67.0	17.3		126.5	
10021-DAA	GSM-FDD (TDMA, GMSK)	X	15.99	90.6	25.0	9.39	99.9	±1.2 %
		Y	12.41	86.6	23.6		101.5	
		Z	29.18	99.9	28.5		109.2	
10023-DAA	GPRS-FDD (TDMA, GMSK, TN 0)	X	25.67	98.9	27.8	9.57	97.9	±1.7 %
		Y	14.20	88.5	24.3		100.6	
		Z	27.68	99.8	28.8		107.7	
10024-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	42.95	99.6	24.9	6.56	124.4	±1.4 %
		Y	45.27	99.9	24.8		128.8	
		Z	42.64	99.6	25.5		135.7	
10027-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	27.78	91.3	21.1	4.80	136.0	±1.4 %
		Y	32.74	93.9	21.9		146.6	
		Z	23.93	89.5	21.1		144.8	
10028-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	59.17	99.6	22.4	3.55	142.5	±1.2 %
		Y	78.76	99.7	21.7		104.9	
		Z	38.06	94.2	21.4		148.8	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	93.35	99.7	19.5	1.16	108.1	±0.9 %
		Y	96.67	94.0	16.9		114.7	
		Z	98.17	96.2	18.2		108.9	
10039-CAA	CDMA2000 (1xRTT, RC1)	X	4.84	66.7	18.8	4.57	126.5	±0.9 %
		Y	4.83	66.6	18.6		134.4	
		Z	4.76	66.0	18.3		125.9	
10081-CAA	CDMA2000 (1xRTT, RC3)	X	4.00	66.2	18.5	3.97	121.9	±0.7 %
		Y	3.91	65.5	17.9		128.9	
		Z	3.88	65.2	17.8		120.7	

10098-CAA	UMTS-FDD (HSUPA, Subtest 2)	X	4.66	66.6	18.4	3.98	132.5	±0.7 %
		Y	4.66	66.5	18.2		141.3	
		Z	4.54	65.9	17.9		130.7	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.65	68.3	20.1	5.67	139.5	±1.4 %
		Y	6.69	68.3	19.9		148.9	
		Z	6.60	67.9	19.8		137.5	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.52	67.8	20.0	5.80	137.3	±1.4 %
		Y	6.53	67.6	19.7		147.5	
		Z	6.51	67.6	19.8		135.3	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.19	67.2	19.7	5.75	134.3	±1.2 %
		Y	6.24	67.3	19.6		142.9	
		Z	6.23	67.1	19.6		132.3	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	11.56	79.1	27.9	9.28	130.1	±3.0 %
		Y	11.01	76.8	26.2		141.9	
		Z	12.98	81.2	28.7		135.7	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.25	67.4	19.8	5.75	135.1	±1.2 %
		Y	6.17	66.9	19.3		143.6	
		Z	6.16	66.8	19.4		132.8	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.66	67.8	20.0	5.82	140.3	±1.4 %
		Y	6.72	67.9	19.9		148.8	
		Z	6.66	67.6	19.8		137.4	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.05	66.7	19.5	5.73	117.8	±0.9 %
		Y	4.93	66.0	18.9		125.0	
		Z	5.08	66.3	19.3		116.3	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	8.47	76.8	26.9	9.21	100.3	±2.2 %
		Y	8.06	74.6	25.3		107.5	
		Z	9.43	78.2	27.4		102.5	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.98	66.3	19.3	5.72	118.2	±0.9 %
		Y	4.96	66.1	19.0		119.9	
		Z	5.03	66.1	19.1		116.1	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.06	66.7	19.6	5.72	118.7	±0.9 %
		Y	4.97	66.2	19.1		120.0	
		Z	5.03	66.1	19.1		116.3	
10225-CAA	UMTS-FDD (HSPA+)	X	6.78	66.1	18.9	5.97	105.3	±1.2 %
		Y	6.68	65.7	18.6		106.8	
		Z	7.32	67.6	19.7		148.0	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	8.56	77.1	27.1	9.21	100.8	±1.9 %
		Y	8.33	75.8	26.1		103.8	
		Z	9.39	78.0	27.3		101.9	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	10.58	77.8	27.4	9.24	123.3	±2.5 %
		Y	10.48	76.9	26.5		128.1	
		Z	11.79	79.6	28.0		127.0	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	11.52	79.1	27.9	9.30	130.1	±2.7 %
		Y	11.24	77.7	26.9		136.0	
		Z	12.96	81.2	28.8		134.8	

10274-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.14	67.4	19.0	4.87	145.5	±1.2 %
		Y	6.19	67.4	19.0		149.2	
		Z	6.10	66.9	18.8		142.3	
10275-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.41	66.4	18.3	3.96	126.4	±0.7 %
		Y	4.43	66.3	18.2		130.4	
		Z	4.36	65.9	18.0		123.8	
10291-AAA	CDMA2000, RC3, SO55, Full Rate	X	3.57	65.9	17.9	3.46	120.0	±0.5 %
		Y	3.55	65.6	17.6		121.7	
		Z	3.50	65.1	17.5		117.2	
10292-AAA	CDMA2000, RC3, SO32, Full Rate	X	3.55	66.1	18.0	3.39	121.3	±0.5 %
		Y	3.54	66.0	17.8		123.6	
		Z	3.45	65.2	17.4		118.9	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.53	67.8	20.0	5.81	136.2	±1.2 %
		Y	6.48	67.5	19.6		139.3	
		Z	6.52	67.6	19.8		134.1	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.12	68.4	20.4	6.06	141.7	±1.4 %
		Y	7.11	68.3	20.1		145.3	
		Z	7.14	68.4	20.3		139.8	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.79	67.6	18.0	1.71	125.5	±0.5 %
		Y	2.71	66.9	17.3		128.2	
		Z	2.64	66.2	17.0		123.5	
10403-AAA	CDMA2000 (1xEV-DO, Rev. 0)	X	4.78	67.5	18.3	3.76	130.6	±0.5 %
		Y	4.77	67.5	18.2		133.8	
		Z	4.65	66.5	17.8		130.0	
10404-AAA	CDMA2000 (1xEV-DO, Rev. A)	X	4.83	68.2	18.6	3.77	129.2	±0.7 %
		Y	4.68	67.4	18.0		131.9	
		Z	4.52	66.3	17.7		128.7	

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 7 and 8).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	6.52	6.52	6.52	0.47	1.46	± 12.0 %
835	41.5	0.90	6.30	6.30	6.30	0.40	1.59	± 12.0 %
1750	40.1	1.37	5.27	5.27	5.27	0.63	1.34	± 12.0 %
1900	40.0	1.40	5.08	5.08	5.08	0.62	1.37	± 12.0 %
2450	39.2	1.80	4.43	4.43	4.43	0.79	1.28	± 12.0 %
2600	39.0	1.96	4.29	4.29	4.29	0.77	1.38	± 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:3287

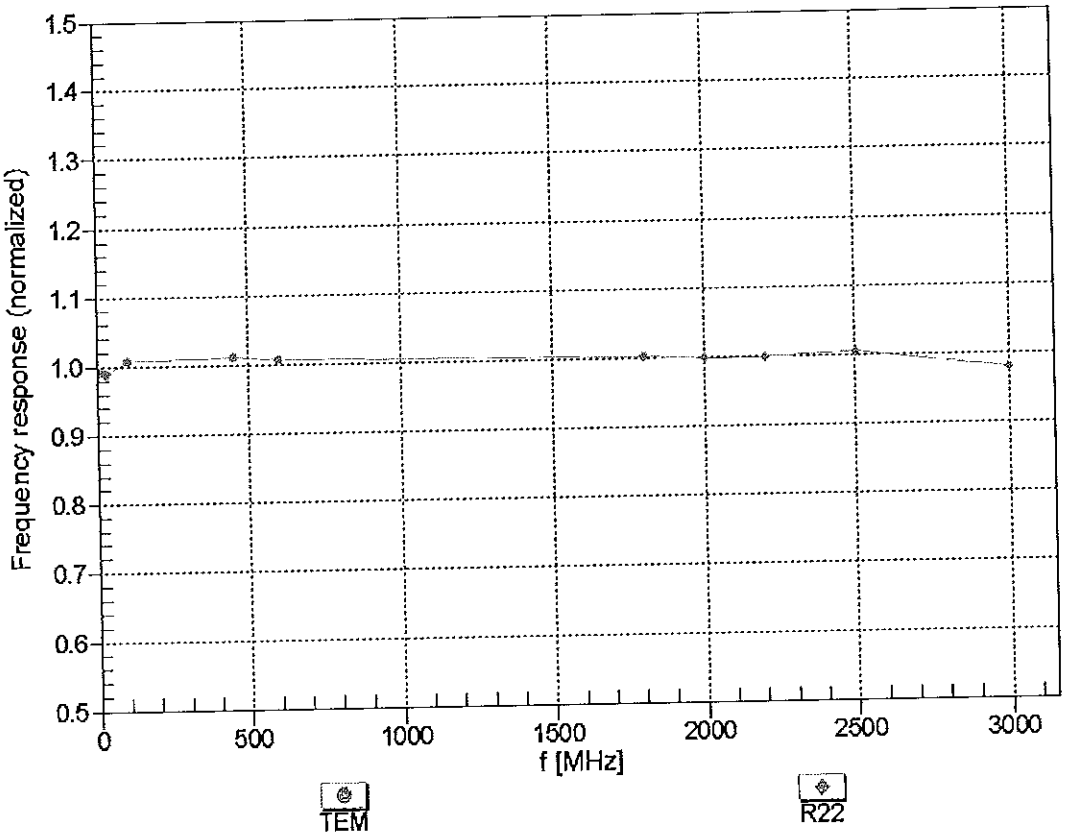
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	6.09	6.09	6.09	0.55	1.37	± 12.0 %
835	55.2	0.97	6.04	6.04	6.04	0.55	1.39	± 12.0 %
1750	53.4	1.49	4.93	4.93	4.93	0.39	1.73	± 12.0 %
1900	53.3	1.52	4.67	4.67	4.67	0.38	1.75	± 12.0 %
2450	52.7	1.95	4.17	4.17	4.17	0.60	1.20	± 12.0 %
2600	52.5	2.16	4.00	4.00	4.00	0.60	1.10	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

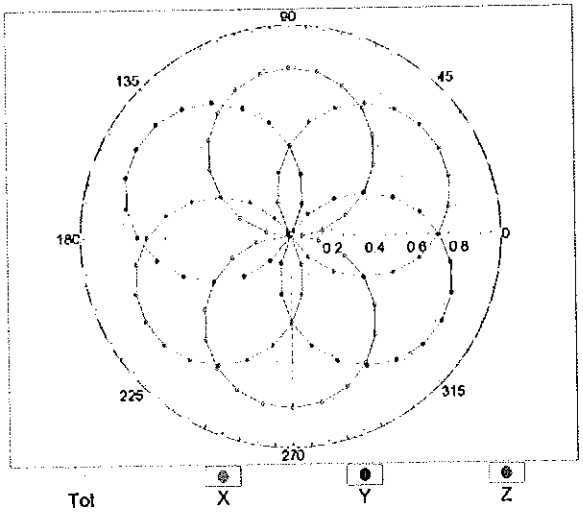
(TEM-Cell:ifi110 EXX, Waveguide: R22)



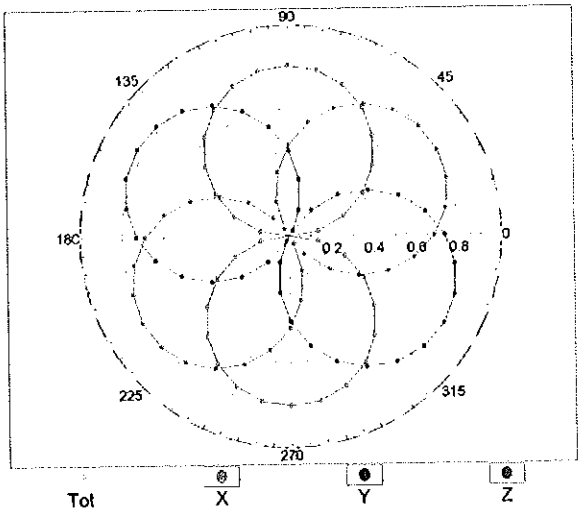
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

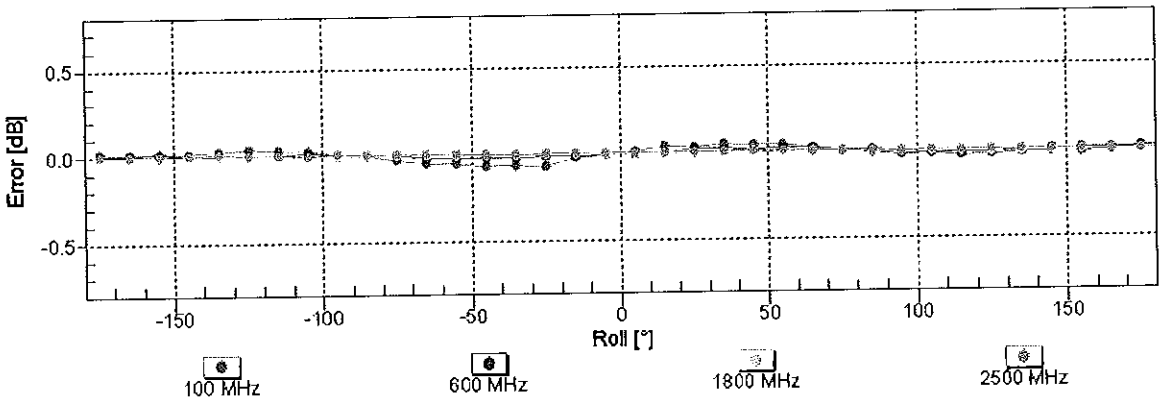
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



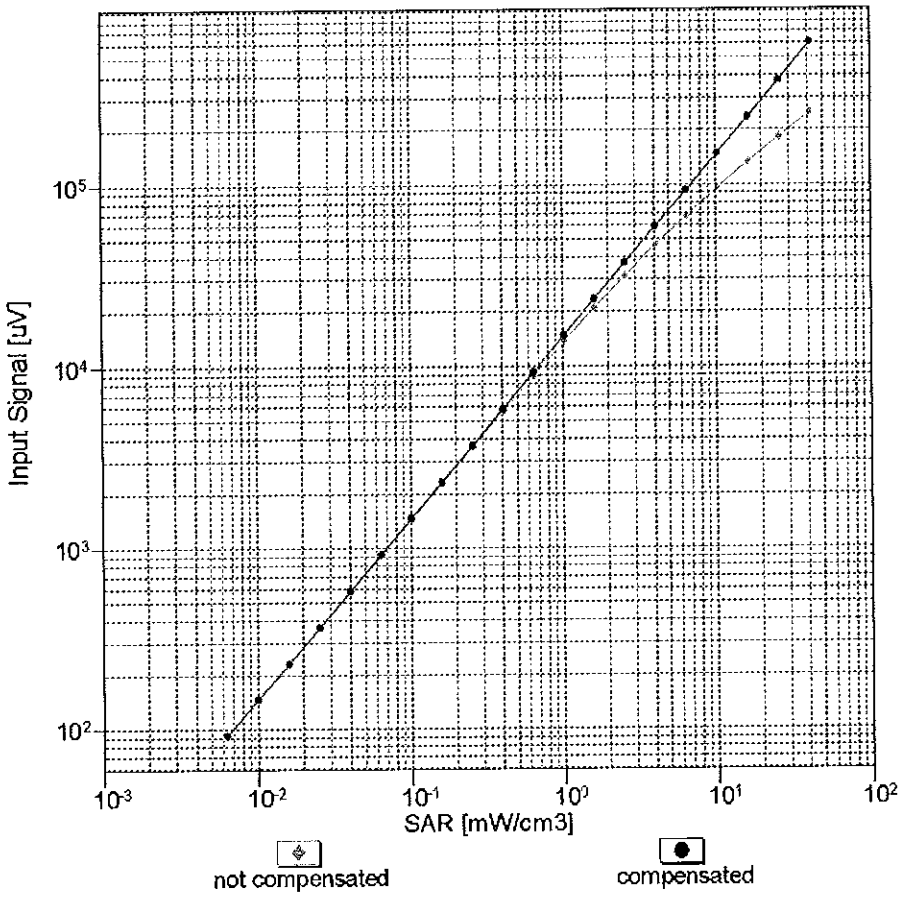
f=1800 MHz,R22

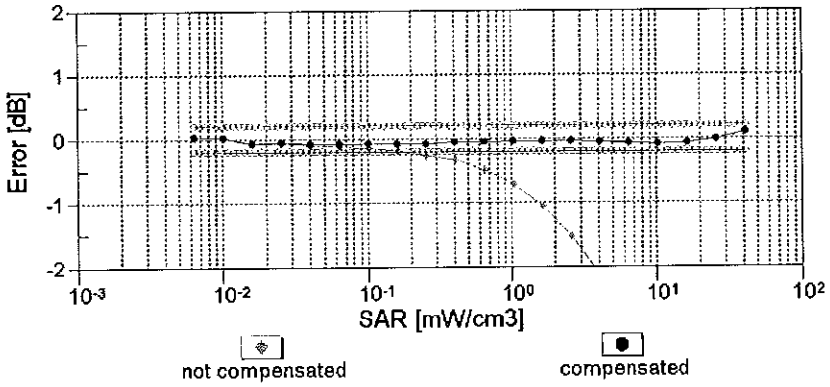




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

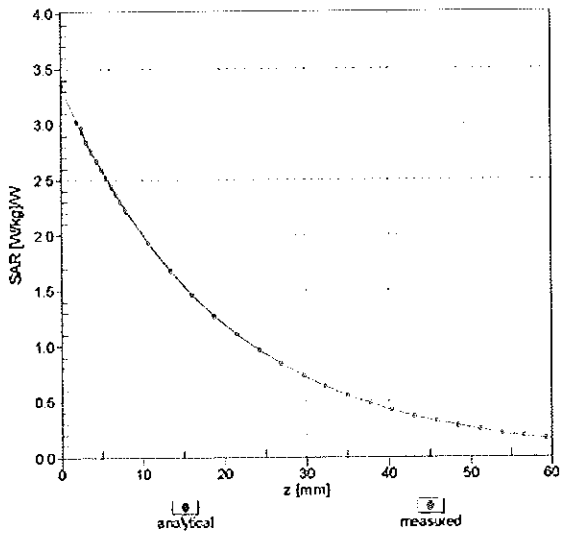




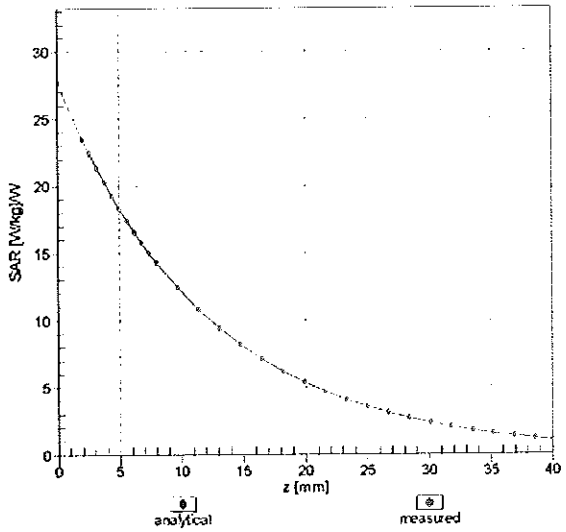
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

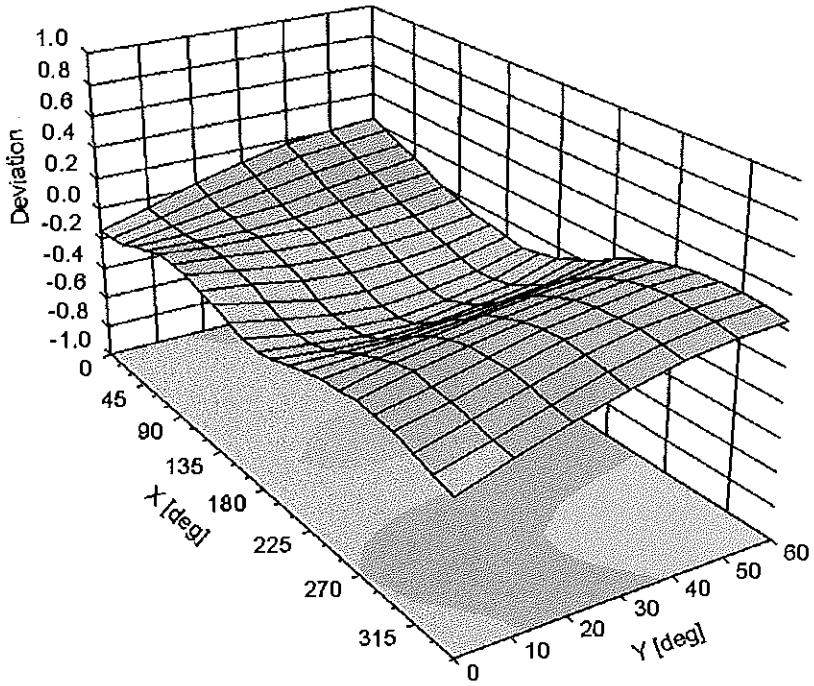


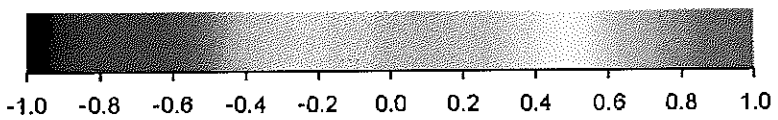
f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-15
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: ES3-3022_Aug13

CALIBRATION CERTIFICATE

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

UCC 9/13/13

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: August 23, 2013

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

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV2

SN:3022

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

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

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

Basic Calibration Parameters

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

Modulation Calibration Parameters

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

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

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

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

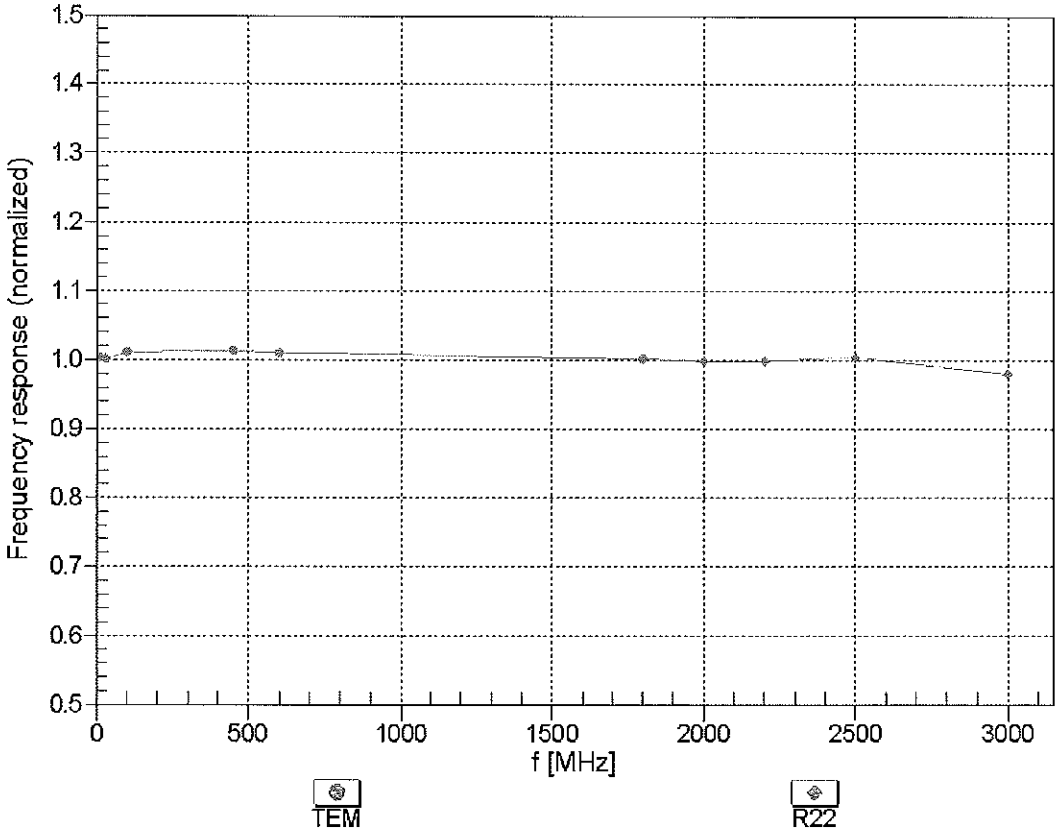
Calibration Parameter Determined in Body Tissue Simulating Media

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

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

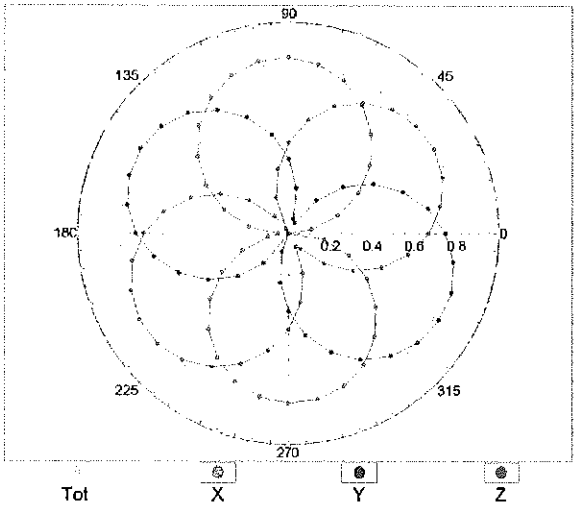
(TEM-Cell:ifi110 EXX, Waveguide: R22)



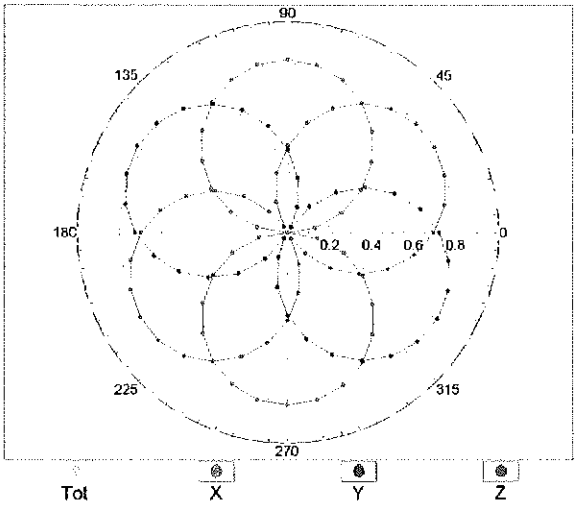
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

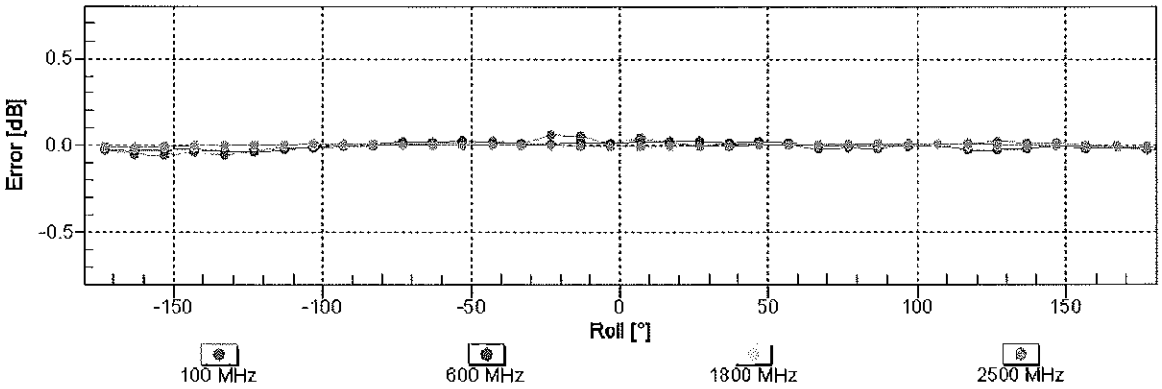
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



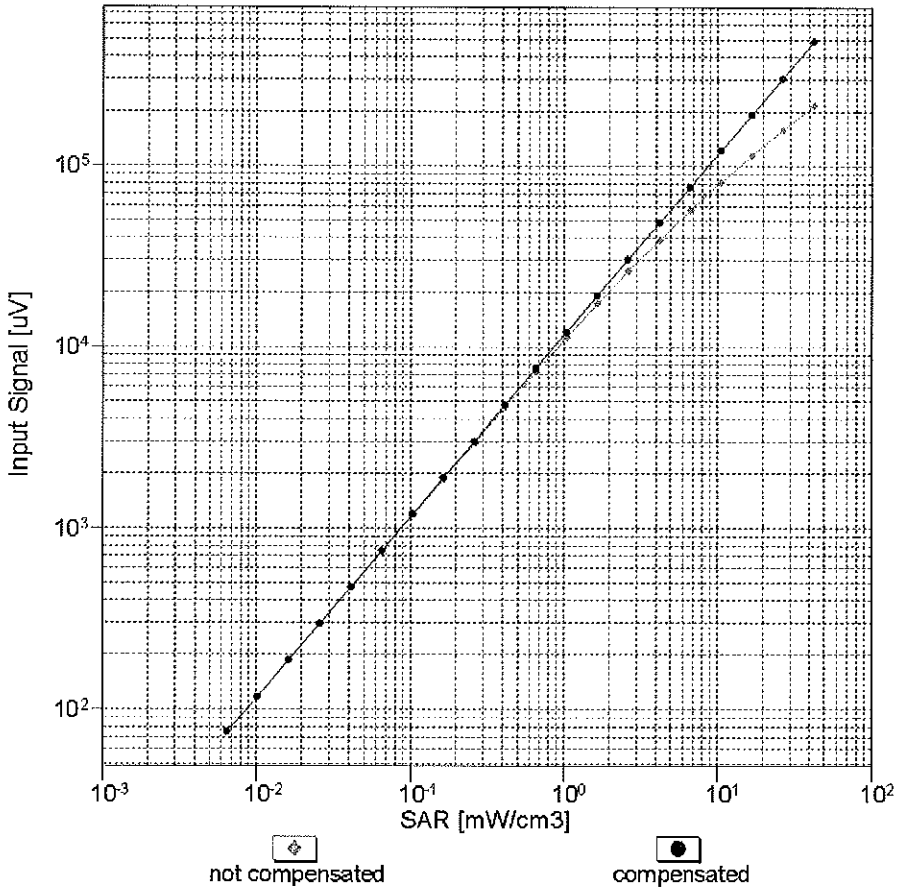
f=1800 MHz,R22

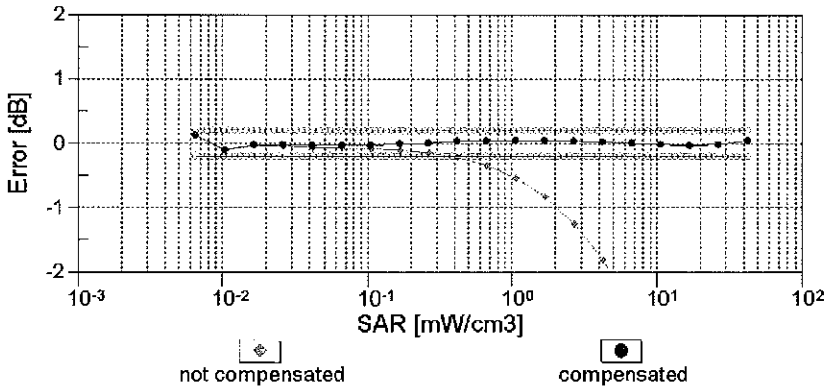




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

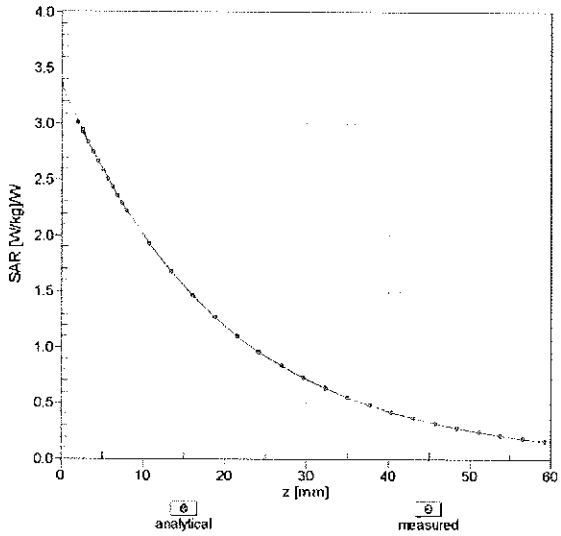




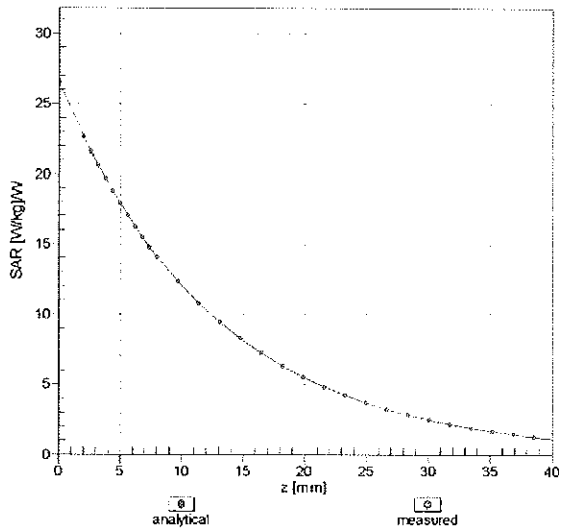
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

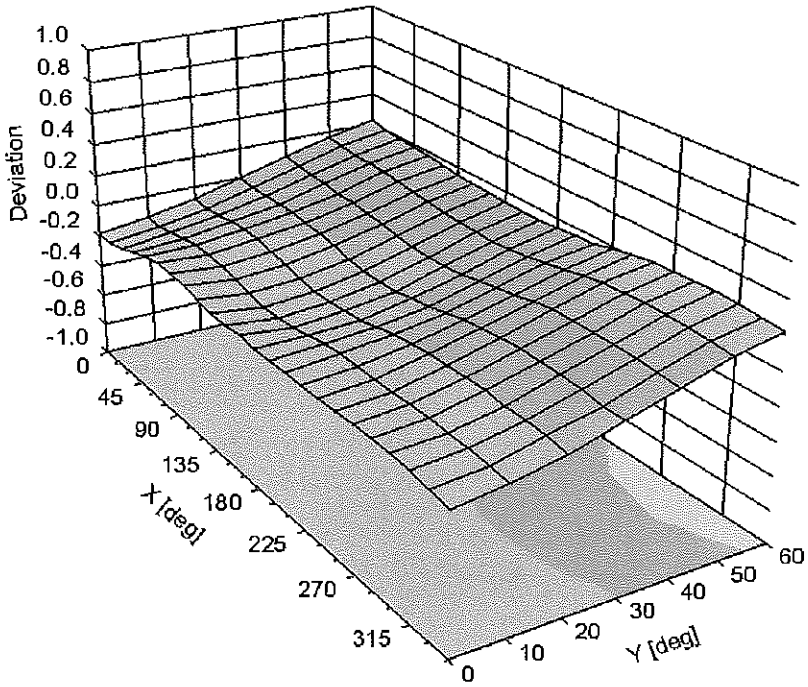


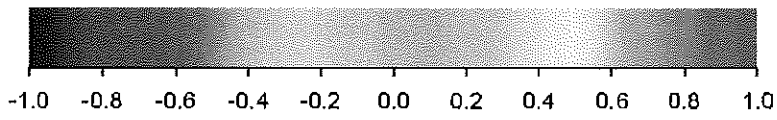
f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

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

Other Probe Parameters

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

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

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

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

Accreditation No.: SCS 108

Client PC Test

Certificate No: EX3-3589_Jan14

CALIBRATION CERTIFICATE

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

CC 2/5/14

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: January 30, 2014

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

PCT# 783

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:3589

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

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

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

Basic Calibration Parameters

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

Modulation Calibration Parameters

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

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

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

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

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 8 and 9).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

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

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

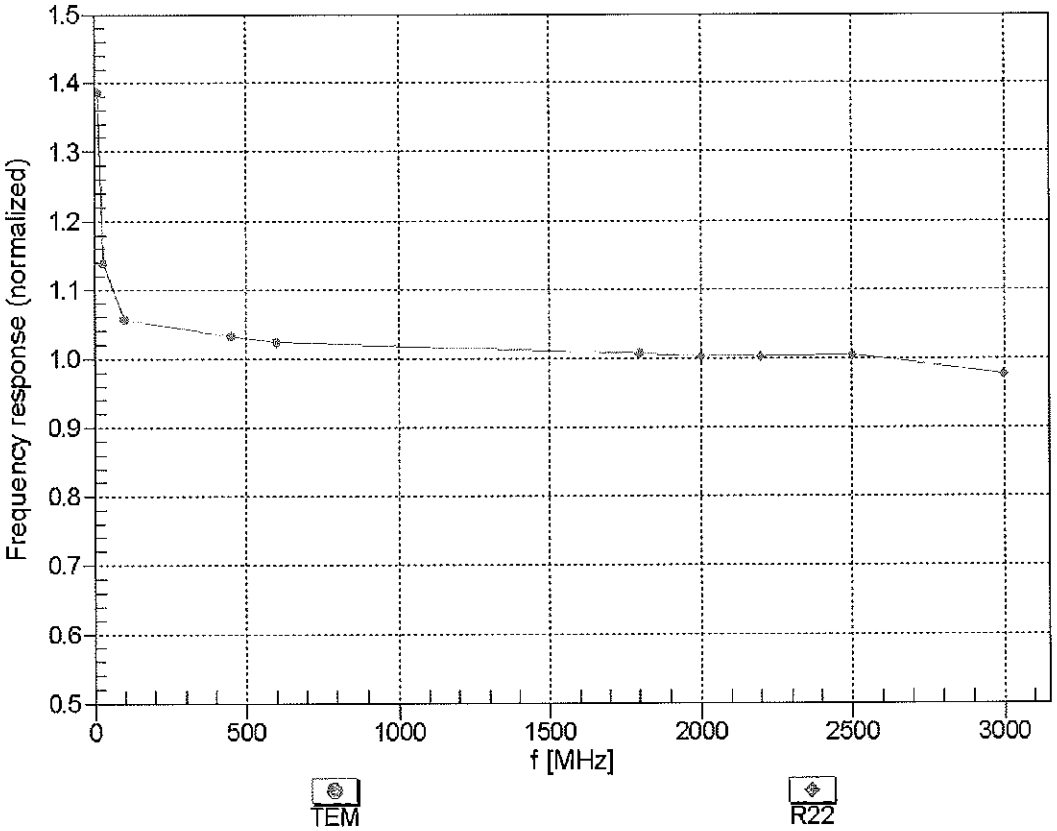
Calibration Parameter Determined in Body Tissue Simulating Media

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

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

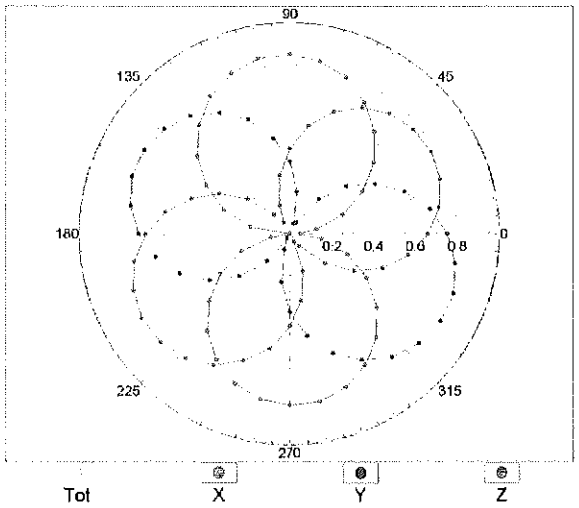
(TEM-Cell:ifi110 EXX, Waveguide: R22)



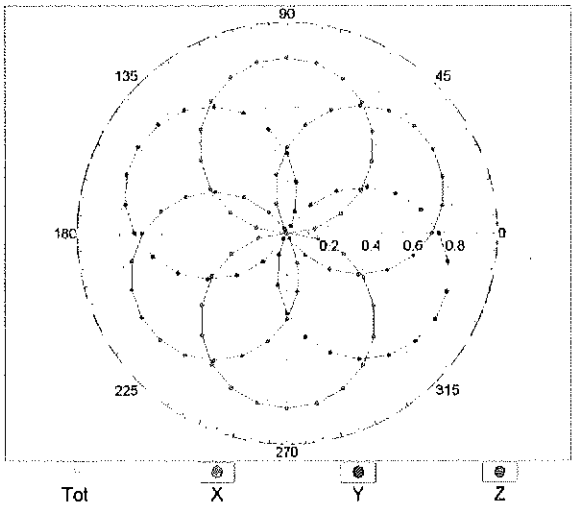
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

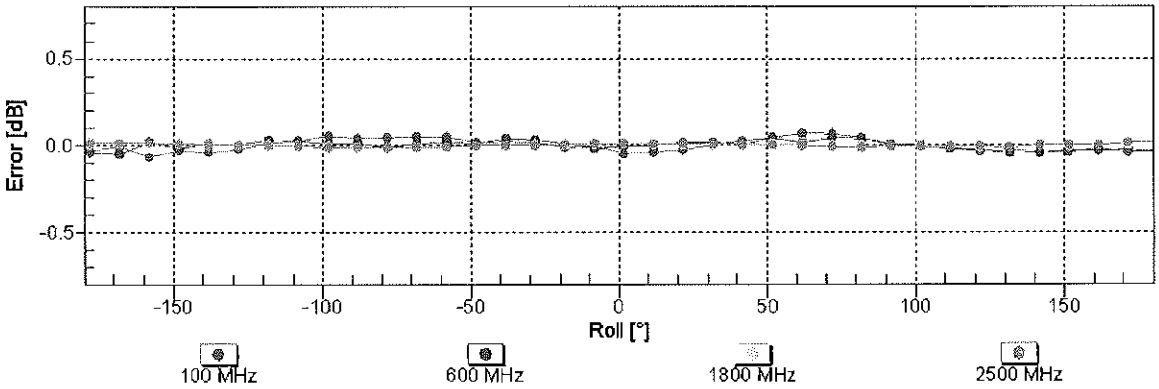
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



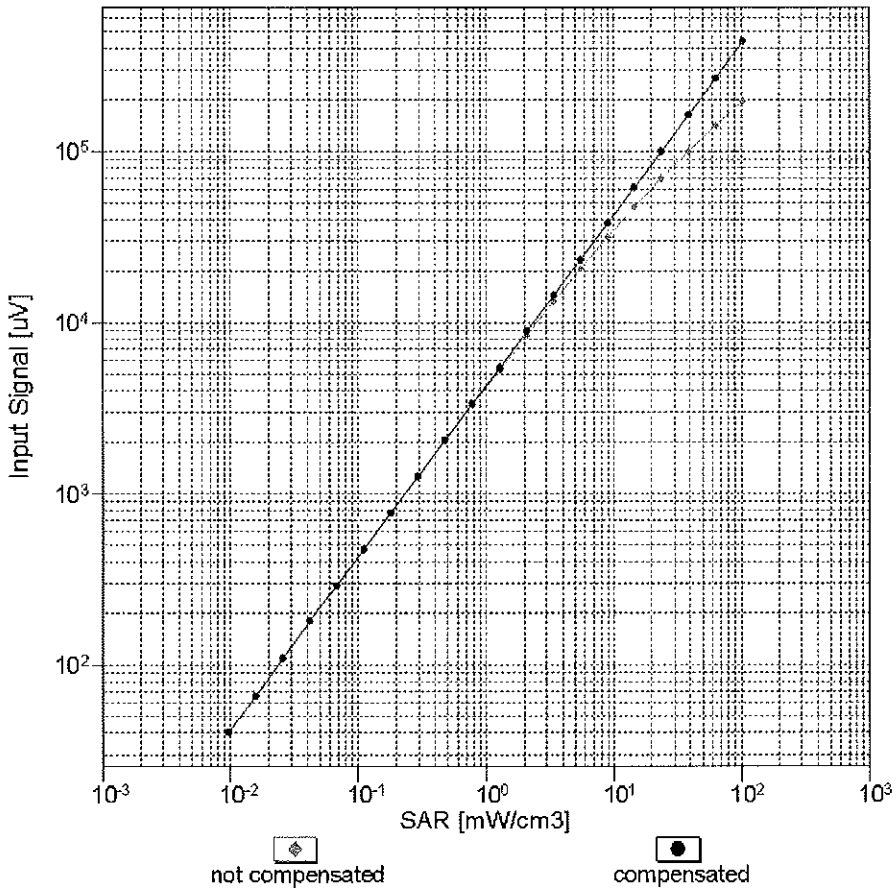
f=1800 MHz,R22

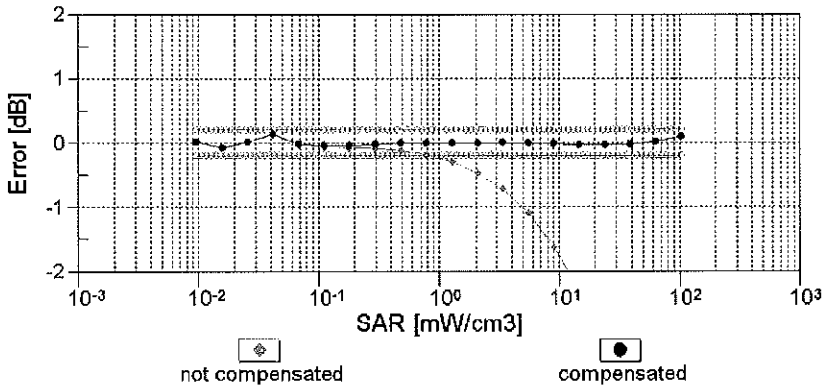




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

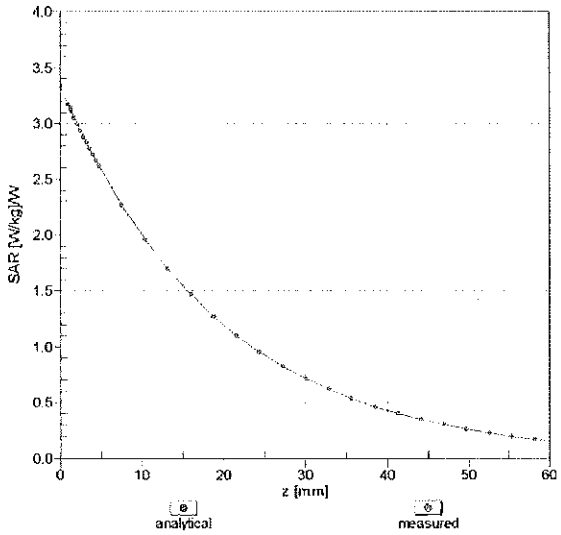




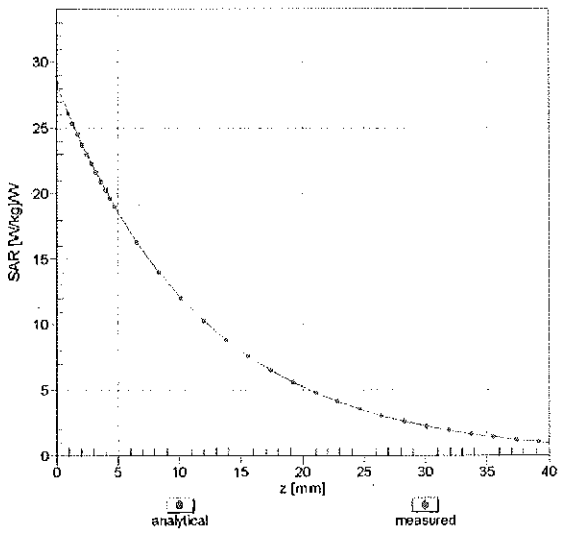
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

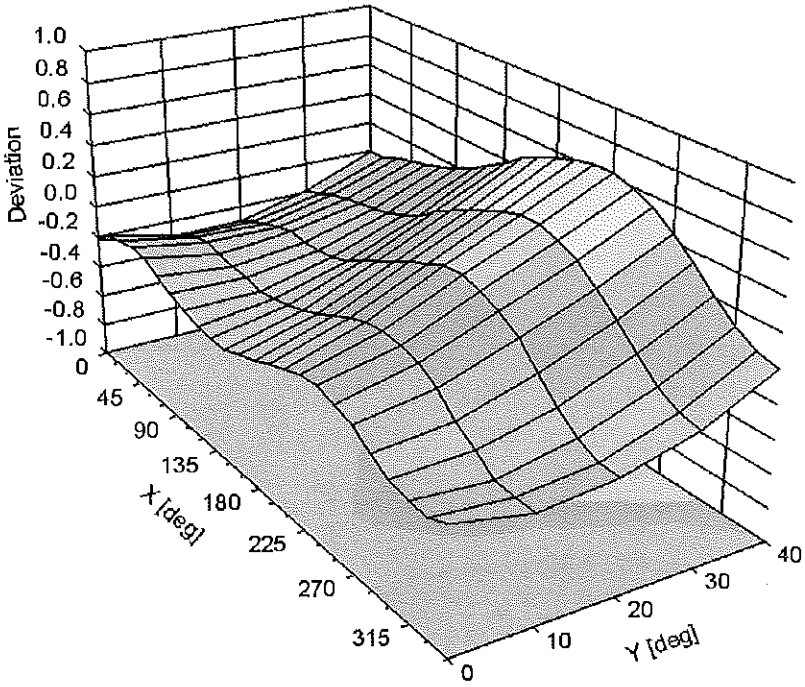


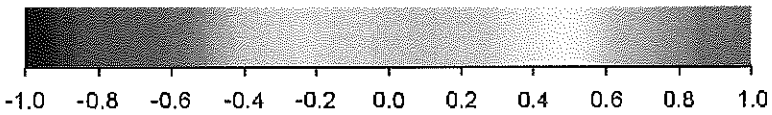
f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

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

Other Probe Parameters

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

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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: ES3-3258_Feb14

CALIBRATION CERTIFICATE

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

CCV 3/6/14

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: February 27, 2014

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

PCT# 80615

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3258

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

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

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

Basic Calibration Parameters

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

Modulation Calibration Parameters

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

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

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

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

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 8 and 9).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

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

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

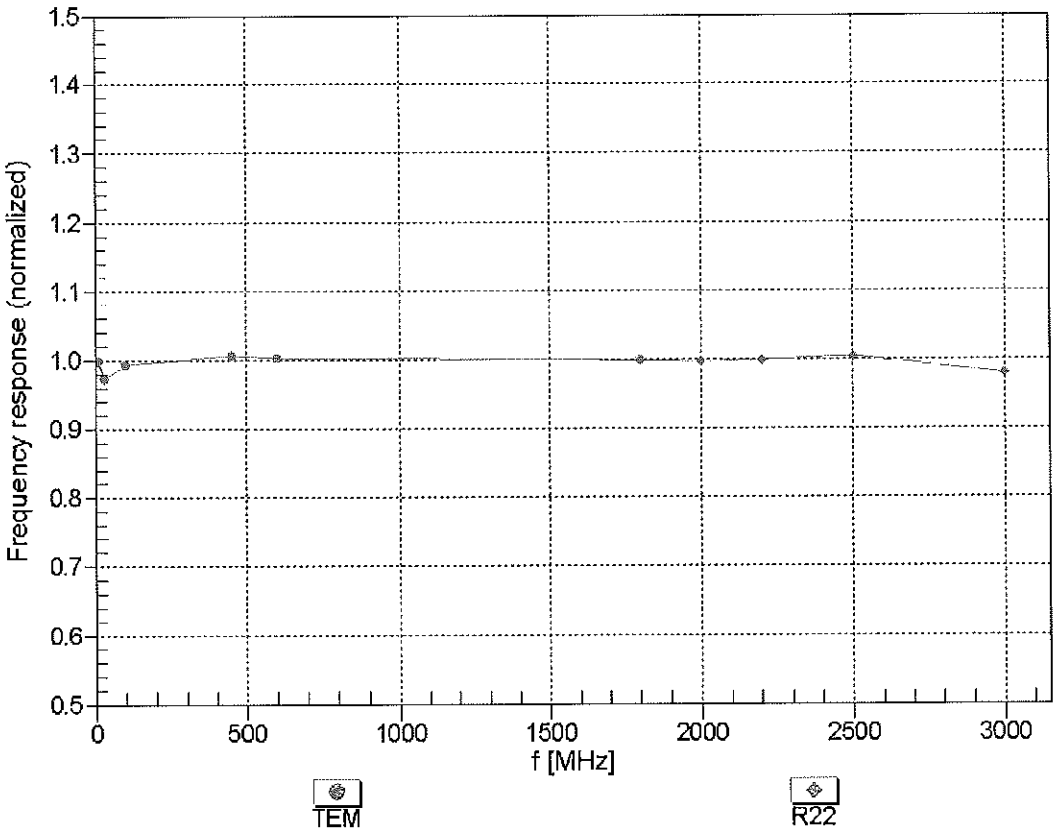
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	6.15	6.15	6.15	0.61	1.32	± 12.0 %
835	55.2	0.97	6.11	6.11	6.11	0.80	1.15	± 12.0 %
1750	53.4	1.49	4.83	4.83	4.83	0.47	1.74	± 12.0 %
1900	53.3	1.52	4.61	4.61	4.61	0.55	1.59	± 12.0 %
2450	52.7	1.95	4.14	4.14	4.14	0.80	1.11	± 12.0 %
2600	52.5	2.16	3.91	3.91	3.91	0.80	1.00	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

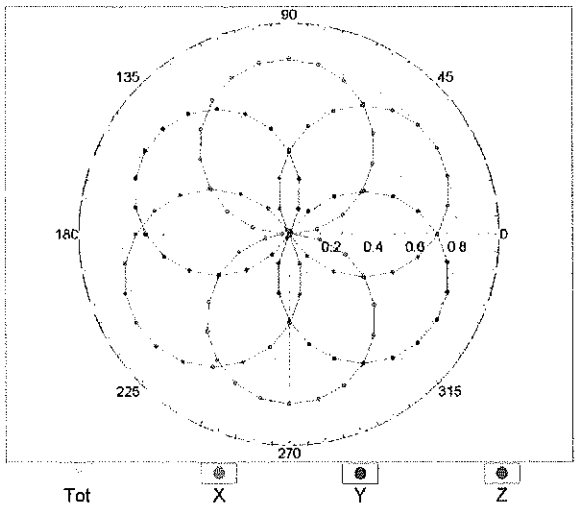
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



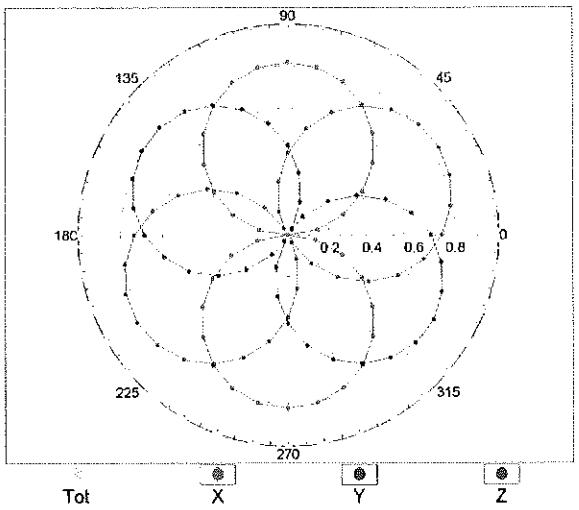
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

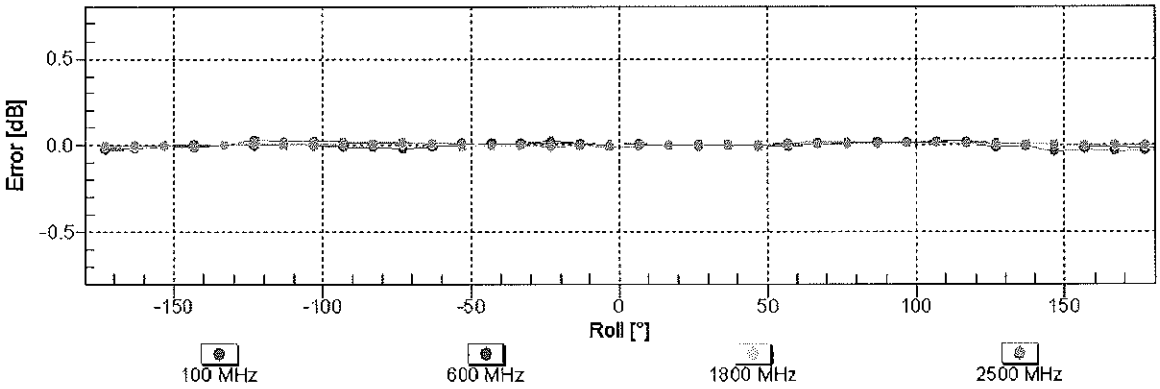
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

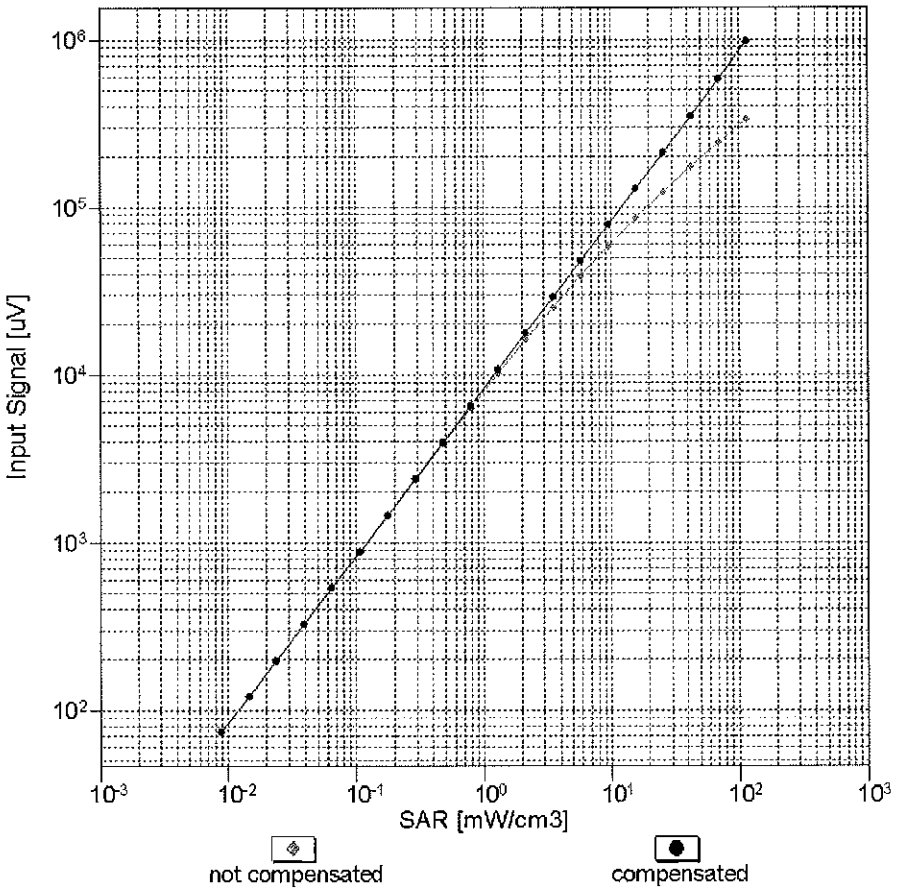


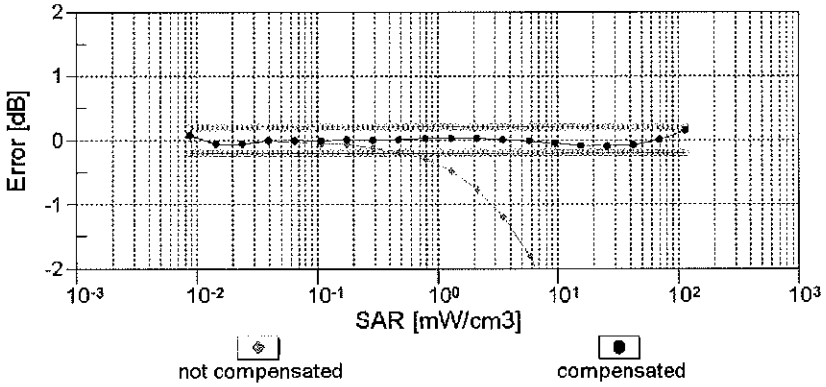


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

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

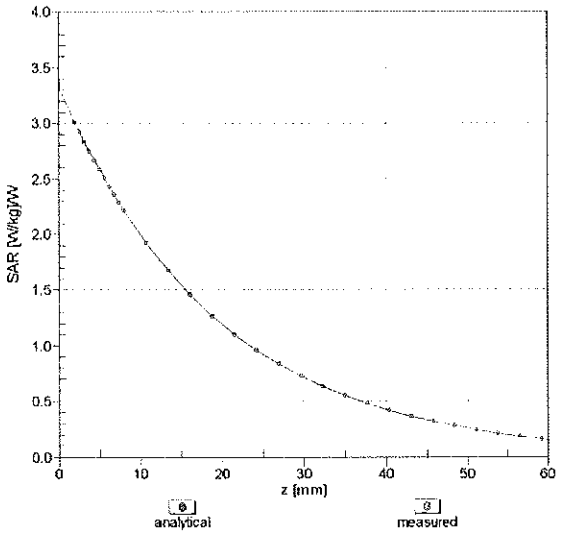




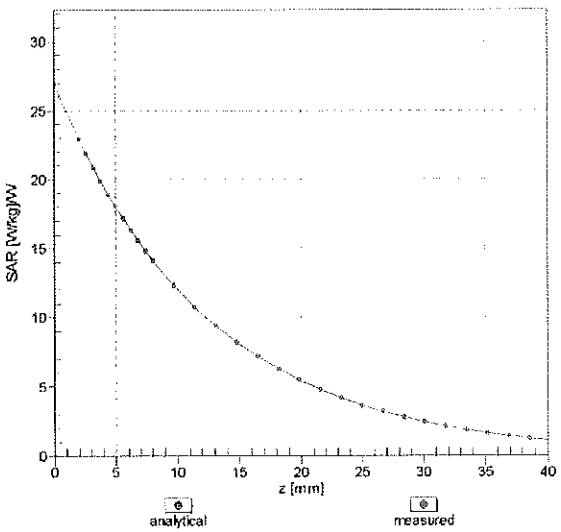
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

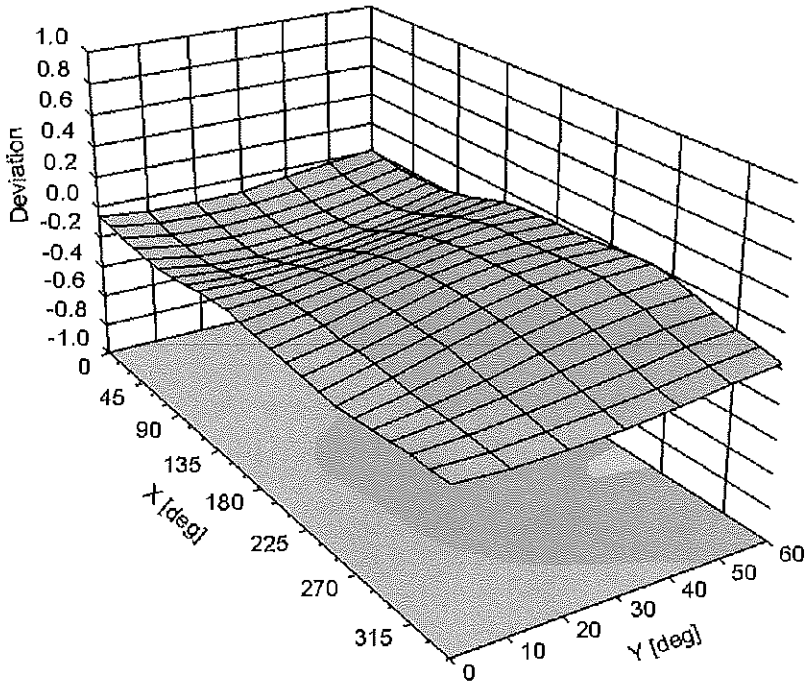


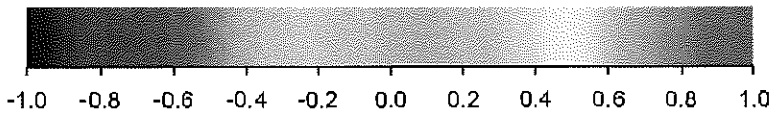
f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-123.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

APPENDIX D: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue verification:

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the tissue. The tissue was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
3) The complex admittance with respect to the probe aperture was measured
4) The complex relative permittivity $\varepsilon_r^{'}$ can be calculated from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon_r\varepsilon_0}{[\ln(b/a)]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi' \frac{\exp\left[-j\omega r(\mu_0\varepsilon_r^{'}\varepsilon_0)^{1/2}\right]}{r} d\phi' d\rho' d\rho$$

where *Y* is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

Table D-I
Composition of the Tissue Equivalent Matter

Frequency (MHz)	835	835	1900	1900	2450	2450
Tissue	Head	Body	Head	Body	Head	Body
Ingredients (% by weight)						
Bactericide	0.1	0.1			See Page 2	
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						
Water	40.45	53.06	54.9	70.17		73.2

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2 Composition / Information on ingredients

The Item is composed of the following ingredients:

H2O	Water, 52 – 75%
C8H18O3	Diethylene glycol monobutyl ether (DGBE), 25 – 48% (CAS-No. 112-34-5, EC-No. 203-961-6, EC-index-No. 603-096-00-8) Relevant for safety; Refer to the respective Safety Data Sheet*.
NaCl	Sodium Chloride, <1.0%

Figure D-1
Composition of 2.4 GHz Head Tissue Equivalent Matter

Note: 2.4 GHz head liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

Item Name	**Head Tissue Simulating Liquid (HSL2450V2)**
Product No.	SL AAH 245 BA (Charge: 130212-2)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within ± 2.5% towards the target values of Methanol.

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

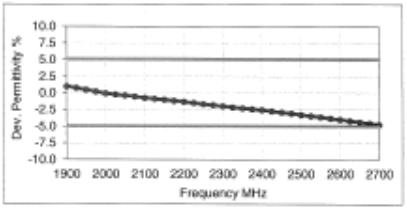
Test Condition

Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	23°C
Test Date	13-Feb-13
Operator	DI

Additional Information

TSL Density	0.988 g/cm³
TSL Heat-capacity	3.680 kJ/(kg*K)

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e"	sigma	eps	sigma	Δ-eps	Δ-sigma
1900	40.4	11.94	1.26	40.0	1.40	1.0	-9.9
1925	40.3	12.02	1.29	40.0	1.40	0.7	-8.0
1950	40.2	12.11	1.31	40.0	1.40	0.5	-6.2
1975	40.1	12.20	1.34	40.0	1.40	0.2	-4.2
2000	40.0	12.29	1.37	40.0	1.40	-0.1	-2.3
2025	39.9	12.39	1.40	40.0	1.42	-0.2	-1.9
2050	39.8	12.49	1.42	39.9	1.44	-0.4	-1.4
2075	39.6	12.57	1.45	39.9	1.47	-0.6	-1.1
2100	39.5	12.65	1.48	39.8	1.49	-0.7	-0.7
2125	39.4	12.74	1.51	39.8	1.51	-0.9	-0.4
2150	39.3	12.82	1.53	39.7	1.53	-1.0	0.0
2175	39.2	12.89	1.56	39.7	1.56	-1.2	0.3
2200	39.1	12.97	1.59	39.6	1.58	-1.3	0.6
2225	39.0	13.04	1.61	39.6	1.60	-1.5	0.9
2250	38.9	13.11	1.64	39.6	1.62	-1.7	1.2
2275	38.8	13.20	1.67	39.5	1.64	-1.8	1.6
2300	**38.7**	**13.28**	**1.70**	**39.5**	**1.67**	**-2.0**	**2.0**
2325	38.6	13.35	1.73	39.4	1.69	-2.1	2.3
2350	38.5	13.42	1.75	39.4	1.71	-2.3	2.6
2375	38.4	13.50	1.78	39.3	1.73	-2.4	2.9
2400	38.3	13.58	1.81	39.3	1.76	-2.6	3.3
2425	38.2	13.65	1.84	39.2	1.78	-2.7	3.6
2450	**38.1**	**13.73**	**1.87**	**39.2**	**1.80**	**-2.9**	**4.0**
2475	38.0	13.79	1.90	39.2	1.83	-3.1	3.9
2500	37.9	13.85	1.93	39.1	1.85	-3.3	3.9
2525	37.8	13.94	1.96	39.1	1.88	-3.4	4.0
2550	37.7	14.02	1.99	39.1	1.91	-3.6	4.2
2575	37.6	14.09	2.02	39.0	1.94	-3.8	4.3
2600	**37.5**	**14.17**	**2.05**	**39.0**	**1.96**	**-4.0**	**4.4**
2625	37.4	14.23	2.08	39.0	1.99	-4.2	4.4
2650	37.3	14.29	2.11	38.9	2.02	-4.3	4.4
2675	37.1	14.36	2.14	38.9	2.05	-4.5	4.5
2700	37.0	14.43	2.17	38.9	2.07	-4.8	4.6



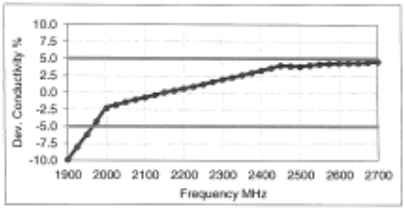


Figure D-2
2.4 GHz Head Tissue Equivalent Matter

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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
J	1900	1/17/2014	3332	ES3DV3	1900	Head	1.450	33.18	PASS	PASS	PASS	GMSK	PASS	N/A
K	2450	2/8/2014	3287	ES3DV3	2450	Head	1.832	38.03	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
G	2450	3/5/2014	3258	ES3DV3	2450	Body	2.044	51.30	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both a CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.

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APPENDIX G: SENSOR TRIGGERING DATA SUMMARY

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A3LSMT705 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, right and bottom edge of the device. The measured output power within ± 5 mm of the triggering points (or until touching the phantom) is included for back side and each applicable edge.

To ensure all production units are compliant it is necessary to test SAR at a distance 1 mm less than the smallest distance from the device and SAR phantom (determined from these triggering tests according to the KDB 616217 D04v01) with the device at maximum output power without power reduction. These SAR Tests are included in addition to the SAR tests for the device touching the SAR phantom, with reduced power.

The operational description contains information explaining how this device remains compliant in the event of a sensor malfunction.

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Back Side

Moving device toward the phantom:

KDB 616217 6.2.6 Measured Power [dBm]											
Distance[mm]	21	20	19	18	17	16	15	14	13	12	11
GSM 850	32.61	32.81	32.64	32.63	32.84	24.92	24.95	24.6	24.62	24.88	24.82
GSM 1900	28.8	28.66	28.74	28.87	28.6	20.45	20.28	20.2	20.41	20.26	20.14
GPRS 850 1Tx	32.71	32.8	32.64	32.79	32.85	24.9	24.82	24.76	24.64	24.84	24.78
GPRS 850 2Tx	31.26	31.26	31.16	31.15	31.29	23.28	23.26	23.19	23.21	23.21	23.17
GPRS 850 3Tx	29.64	29.8	29.94	29.8	29.81	21.8	21.72	21.75	21.7	21.95	21.73
GPRS 850 4Tx	28.26	28.4	28.26	28.18	28.39	20.15	20.14	20.43	20.45	20.16	20.45
GPRS 1900 1Tx	28.79	28.68	28.62	28.91	28.71	20.27	20.36	20.4	20.33	20.12	20.27
GPRS 1900 2Tx	28.41	28.22	28.41	28.29	28.35	17.2	17.44	17.13	17.37	17.39	17.22
GPRS 1900 3Tx	27.27	27.11	27.29	27.39	27.25	15.69	15.65	15.82	15.6	15.85	15.67
GPRS 1900 4Tx	25.69	25.84	25.92	25.82	25.75	14.66	14.65	14.84	14.82	14.78	14.64
EDGE850 1Tx	27.44	27.15	27.43	27.44	27.18	21.31	21.27	21.11	21.14	21.17	21.14
EDGE850 2Tx	25.65	25.8	25.89	25.74	25.66	20.42	20.14	20.2	20.27	20.12	20.34
EDGE850 3Tx	24.1	24.13	24.3	24.21	24.34	19.19	19.4	19.44	19.17	19.24	19.39
EDGE850 4Tx	22.76	22.73	22.71	22.61	22.92	18.13	18.25	18.43	18.35	18.12	18.44
EDGE1900 1Tx	26.84	26.67	26.67	26.9	26.72	18.61	18.88	18.64	18.84	18.73	18.89
EDGE1900 2Tx	25.41	25.35	25.26	25.34	25.41	15.63	15.66	15.69	15.82	15.63	15.9
EDGE1900 3Tx	23.81	23.93	23.68	23.71	23.76	14.88	14.69	14.94	14.81	14.89	14.86
EDGE1900 4Tx	22.29	22.45	22.25	22.28	22.25	13.79	13.75	13.72	13.69	13.84	13.93
WCDMA 850	22.7	22.79	22.94	22.61	22.67	15.82	15.92	15.92	15.83	15.89	15.85
WCDMA 1900	22.76	22.78	22.95	22.79	22.84	11.65	11.74	11.7	11.71	11.91	11.84
LTE B5	22.82	22.7	22.64	22.62	22.85	16.44	16.29	16.35	16.25	16.23	16.27

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
GSM 850	32.8	32.66	32.67	32.62	32.83	24.75	24.92	24.92	24.84	24.75	24.9
GSM 1900	28.8	28.87	28.66	28.61	28.86	20.33	20.15	20.33	20.43	20.24	20.42
GPRS 850 1Tx	32.63	32.66	32.79	32.68	32.68	24.68	24.62	24.69	24.74	24.73	24.69
GPRS 850 2Tx	31.31	31.32	31.13	31.35	31.15	23.41	23.13	23.29	23.44	23.13	23.25
GPRS 850 3Tx	29.78	29.7	29.83	29.62	29.92	21.61	21.86	21.8	21.7	21.6	21.6
GPRS 850 4Tx	28.37	28.13	28.15	28.34	28.37	20.24	20.12	20.21	20.18	20.41	20.1
GPRS 1900 1Tx	28.71	28.92	28.73	28.76	28.92	20.39	20.27	20.19	20.16	20.25	20.27
GPRS 1900 2Tx	28.19	28.24	28.15	28.33	28.14	17.17	17.39	17.41	17.39	17.35	17.42
GPRS 1900 3Tx	27.45	27.44	27.15	27.12	27.31	15.66	15.63	15.76	15.7	15.92	15.88
GPRS 1900 4Tx	25.85	25.81	25.92	25.65	25.6	14.91	14.93	14.61	14.61	14.66	14.76
EDGE850 1Tx	27.32	27.13	27.23	27.34	27.43	21.29	21.11	21.18	21.45	21.25	21.36
EDGE850 2Tx	25.81	25.78	25.79	25.88	25.76	20.37	20.22	20.15	20.45	20.34	20.32
EDGE850 3Tx	24.26	24.32	24.26	24.45	24.18	19.26	19.19	19.44	19.21	19.39	19.1
EDGE850 4Tx	22.87	22.69	22.84	22.93	22.94	18.41	18.24	18.43	18.17	18.39	18.31
EDGE1900 1Tx	26.91	26.75	26.62	26.95	26.63	18.62	18.79	18.83	18.71	18.68	18.69
EDGE1900 2Tx	25.44	25.26	25.3	25.21	25.37	15.66	15.79	15.64	15.93	15.76	15.72
EDGE1900 3Tx	23.63	23.71	23.88	23.77	23.78	14.79	14.92	14.9	14.91	14.92	14.74
EDGE1900 4Tx	22.2	22.22	22.34	22.26	22.36	13.76	13.95	13.67	13.88	13.83	13.66
WCDMA 850	22.61	22.6	22.92	22.76	22.6	15.93	15.69	15.91	15.62	15.94	15.92
WCDMA 1900	22.74	22.74	22.64	22.71	22.68	11.85	11.94	11.88	11.66	11.91	11.71
LTE B5	22.76	22.84	22.91	22.94	22.65	16.32	16.16	16.36	16.18	16.1	16.14

Based on the most conservative measured triggering distance of 16 mm, additional SAR measurements were required at 15 mm from the back side.

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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
GSM 850	32.73	32.89	32.7	32.81	32.78	24.68	24.69	24.64	24.95	24.88	24.66
GSM 1900	28.63	28.94	28.72	28.66	28.75	20.44	20.38	20.39	20.32	20.19	20.22
GPRS 850 1Tx	32.7	32.75	32.61	32.9	32.84	24.74	24.94	24.62	24.83	24.94	24.92
GPRS 850 2Tx	31.19	31.29	31.42	31.44	31.23	23.42	23.1	23.33	23.31	23.3	23.12
GPRS 850 3Tx	29.72	29.66	29.62	29.87	29.88	21.77	21.66	21.62	21.94	21.93	21.88
GPRS 850 4Tx	28.26	28.27	28.37	28.32	28.17	20.34	20.14	20.25	20.23	20.14	20.24
GPRS 1900 1Tx	28.85	28.62	28.86	28.79	28.8	20.23	20.16	20.1	20.25	20.21	20.36
GPRS 1900 2Tx	28.19	28.15	28.44	28.26	28.33	17.12	17.15	17.12	17.29	17.35	17.33
GPRS 1900 3Tx	27.39	27.38	27.34	27.18	27.11	15.87	15.64	15.76	15.65	15.61	15.74
GPRS 1900 4Tx	25.61	25.66	25.68	25.95	25.81	14.74	14.86	14.83	14.79	14.79	14.86
EDGE850 1Tx	27.12	27.32	27.37	27.29	27.12	21.38	21.3	21.24	21.14	21.1	21.23
EDGE850 2Tx	25.64	25.86	25.91	25.67	25.69	20.44	20.18	20.2	20.16	20.41	20.22
EDGE850 3Tx	24.24	24.36	24.15	24.21	24.1	19.26	19.27	19.25	19.16	19.19	19.29
EDGE850 4Tx	22.76	22.75	22.82	22.89	22.91	18.16	18.43	18.25	18.42	18.41	18.42
EDGE1900 1Tx	26.9	26.6	26.79	26.62	26.72	18.87	18.89	18.79	18.61	18.61	18.76
EDGE1900 2Tx	25.17	25.21	25.19	25.45	25.15	15.68	15.94	15.63	15.94	15.75	15.87
EDGE1900 3Tx	23.67	23.61	23.94	23.7	23.81	14.95	14.61	14.68	14.75	14.65	14.91
EDGE1900 4Tx	22.26	22.21	22.11	22.35	22.34	13.82	13.8	13.67	13.93	13.68	13.89
WCDMA 850	22.77	22.67	22.85	22.81	22.9	15.74	15.79	15.68	15.8	15.91	15.66
WCDMA 1900	22.66	22.81	22.95	22.64	22.95	11.63	11.81	11.78	11.77	11.83	11.91
LTE B5	22.68	22.84	22.61	22.77	22.62	16.41	16.41	16.36	16.35	16.44	16.16

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
GSM 850	32.86	32.81	32.82	32.67	32.91	24.88	24.86	24.95	24.69	24.87	24.95
GSM 1900	28.79	28.81	28.95	28.71	28.67	20.36	20.41	20.37	20.41	20.19	20.22
GPRS 850 1Tx	32.84	32.77	32.94	32.88	32.9	24.71	24.83	24.84	24.8	24.73	24.65
GPRS 850 2Tx	31.18	31.12	31.29	31.25	31.43	23.17	23.19	23.44	23.14	23.33	23.13
GPRS 850 3Tx	29.68	29.93	29.65	29.94	29.89	21.76	21.89	21.78	21.85	21.64	21.62
GPRS 850 4Tx	28.39	28.32	28.36	28.25	28.14	20.28	20.21	20.43	20.28	20.33	20.3
GPRS 1900 1Tx	28.65	28.7	28.69	28.68	28.67	20.18	20.35	20.21	20.23	20.23	20.44
GPRS 1900 2Tx	28.4	28.39	28.25	28.17	28.14	17.27	17.43	17.38	17.13	17.29	17.35
GPRS 1900 3Tx	27.24	27.12	27.23	27.37	27.41	15.9	15.73	15.93	15.69	15.71	15.62
GPRS 1900 4Tx	25.67	25.85	25.66	25.85	25.61	14.8	14.72	14.84	14.65	14.89	14.91
EDGE850 1Tx	27.35	27.26	27.16	27.44	27.1	21.45	21.4	21.31	21.3	21.33	21.39
EDGE850 2Tx	25.87	25.62	25.84	25.94	25.61	20.3	20.1	20.37	20.21	20.35	20.28
EDGE850 3Tx	24.21	24.44	24.27	24.22	24.1	19.44	19.4	19.21	19.44	19.41	19.35
EDGE850 4Tx	22.84	22.94	22.75	22.86	22.64	18.39	18.29	18.14	18.21	18.39	18.13
EDGE1900 1Tx	26.74	26.7	26.79	26.66	26.69	18.89	18.71	18.62	18.87	18.89	18.92
EDGE1900 2Tx	25.19	25.38	25.19	25.11	25.31	15.69	15.71	15.67	15.69	15.8	15.64
EDGE1900 3Tx	23.81	23.69	23.68	23.6	23.8	14.84	14.68	14.75	14.73	14.87	14.85
EDGE1900 4Tx	22.31	22.28	22.1	22.29	22.24	13.81	13.73	13.83	13.84	13.75	13.61
WCDMA 850	22.68	22.9	22.82	22.71	22.66	15.77	15.67	15.74	15.62	15.71	15.95
WCDMA 1900	22.68	22.87	22.86	22.74	22.68	11.78	11.89	11.76	11.71	11.68	11.79
LTE B5	22.78	22.76	22.92	22.84	22.63	16.19	16.35	16.1	16.42	16.26	16.17

Based on the most conservative measured triggering distance of 11 mm, additional SAR measurements were required at 10 mm from the bottom edge.

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Right Edge

Moving device toward the phantom:

KDB 616217 6.2.6 Measured Power [dBm]											
Distance[mm]	10	9	8	7	6	5	4	3	2	1	0
GSM 850	32.92	32.65	32.85	32.91	32.8	24.84	24.6	24.74	24.69	24.75	24.73
GSM 1900	28.72	28.67	28.66	28.85	28.76	20.1	20.34	20.18	20.29	20.43	20.39
GPRS 850 1Tx	32.76	32.63	32.81	32.9	32.67	24.83	24.83	24.66	24.62	24.88	24.74
GPRS 850 2Tx	31.37	31.31	31.42	31.29	31.12	23.11	23.38	23.31	23.13	23.16	23.29
GPRS 850 3Tx	29.67	29.76	29.91	29.68	29.73	21.7	21.91	21.81	21.9	21.66	21.71
GPRS 850 4Tx	28.42	28.37	28.33	28.22	28.39	20.38	20.42	20.34	20.29	20.39	20.34
GPRS 1900 1Tx	28.63	28.62	28.84	28.66	28.86	20.24	20.37	20.37	20.16	20.2	20.3
GPRS 1900 2Tx	28.4	28.31	28.4	28.45	28.21	17.39	17.15	17.15	17.23	17.29	17.44
GPRS 1900 3Tx	27.12	27.35	27.15	27.36	27.35	15.88	15.76	15.86	15.76	15.65	15.79
GPRS 1900 4Tx	25.71	25.88	25.6	25.86	25.9	14.71	14.75	14.67	14.88	14.95	14.7
EDGE850 1Tx	27.2	27.19	27.25	27.45	27.45	21.39	21.31	21.18	21.24	21.22	21.42
EDGE850 2Tx	25.63	25.72	25.85	25.8	25.68	20.36	20.24	20.28	20.22	20.21	20.44
EDGE850 3Tx	24.21	24.22	24.42	24.24	24.37	19.33	19.15	19.33	19.44	19.35	19.23
EDGE850 4Tx	22.67	22.68	22.86	22.84	22.91	18.22	18.35	18.22	18.35	18.34	18.31
EDGE1900 1Tx	26.94	26.65	26.74	26.91	26.93	18.63	18.81	18.95	18.81	18.72	18.91
EDGE1900 2Tx	25.37	25.24	25.15	25.33	25.32	15.78	15.77	15.67	15.63	15.81	15.71
EDGE1900 3Tx	23.78	23.61	23.61	23.77	23.72	14.83	14.72	14.95	14.9	14.7	14.65
EDGE1900 4Tx	22.43	22.15	22.26	22.35	22.31	13.72	13.7	13.77	13.64	13.83	13.72
WCDMA 850	22.75	22.61	22.79	22.69	22.79	15.6	15.6	15.62	15.76	15.6	15.88
WCDMA 1900	22.6	22.8	22.71	22.76	22.86	11.6	11.77	11.6	11.86	11.9	11.67
LTE B5	22.86	22.7	22.8	22.71	22.66	16.13	16.1	16.17	16.23	16.23	16.34

Moving device away from the phantom:

KDB 616217 6.2.8 Measured Power [dBm]											
Distance[mm]	10	9	8	7	6	5	4	3	2	1	0
GSM 850	32.62	32.65	32.64	32.84	32.88	24.83	24.92	24.86	24.67	24.83	24.91
GSM 1900	28.67	28.86	28.8	28.64	28.79	20.18	20.14	20.26	20.33	20.26	20.11
GPRS 850 1Tx	32.92	32.72	32.62	32.81	32.67	24.73	24.88	24.81	24.74	24.9	24.85
GPRS 850 2Tx	31.27	31.14	31.14	31.15	31.17	23.29	23.34	23.37	23.19	23.13	23.16
GPRS 850 3Tx	29.84	29.63	29.65	29.6	29.91	21.88	21.73	21.7	21.69	21.67	21.61
GPRS 850 4Tx	28.27	28.12	28.38	28.22	28.35	20.38	20.44	20.45	20.35	20.44	20.24
GPRS 1900 1Tx	28.66	28.89	28.81	28.68	28.74	20.33	20.41	20.38	20.17	20.3	20.31
GPRS 1900 2Tx	28.44	28.19	28.45	28.45	28.2	17.41	17.28	17.39	17.17	17.39	17.13
GPRS 1900 3Tx	27.34	27.27	27.2	27.25	27.22	15.77	15.66	15.9	15.69	15.86	15.95
GPRS 1900 4Tx	25.66	25.88	25.79	25.67	25.76	14.64	14.81	14.83	14.73	14.9	14.92
EDGE850 1Tx	27.39	27.29	27.26	27.25	27.2	21.19	21.12	21.33	21.12	21.41	21.3
EDGE850 2Tx	25.8	25.78	25.81	25.88	25.66	20.34	20.12	20.25	20.39	20.18	20.13
EDGE850 3Tx	24.4	24.16	24.42	24.41	24.12	19.42	19.2	19.29	19.4	19.23	19.21
EDGE850 4Tx	22.87	22.63	22.92	22.76	22.83	18.32	18.41	18.26	18.19	18.33	18.19
EDGE1900 1Tx	26.6	26.77	26.63	26.73	26.95	18.67	18.89	18.74	18.93	18.84	18.89
EDGE1900 2Tx	25.41	25.31	25.27	25.29	25.22	15.72	15.82	15.94	15.91	15.74	15.88
EDGE1900 3Tx	23.79	23.86	23.71	23.64	23.83	14.78	14.76	14.9	14.7	14.95	14.71
EDGE1900 4Tx	22.43	22.16	22.44	22.33	22.25	13.78	13.93	13.89	13.63	13.8	13.67
WCDMA 850	22.81	22.73	22.9	22.88	22.62	15.83	15.82	15.68	15.68	15.9	15.68
WCDMA 1900	22.9	22.78	22.75	22.75	22.62	11.88	11.82	11.7	11.88	11.87	11.69
LTE B5	22.71	22.89	22.89	22.67	22.86	16.28	16.44	16.3	16.33	16.31	16.32

Based on the most conservative measured triggering distance of 5 mm, additional SAR measurements were required at 4 mm from the right edge.

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