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SAR EVALUATION REPORT

Applicant Name:
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Date of Testing:
01/22/15 - 02/02/15
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1501220212.A3L

FCC ID: **A3LSMG9200**

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

DUT Type: Portable Handset
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): SM-G9200, SM-G9208, SM-G9208/SS, SM-G9209

Equipment Class	Band & Mode	Tx Frequency	SAR		
			1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Hotspot (W/kg)
PCE	GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	0.18	0.43	0.61
PCE	UMTS 850	826.40 - 846.60 MHz	0.18	0.34	0.46
PCE	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	< 0.1	0.34	0.77
PCE	UMTS 1900	1852.4 - 1907.6 MHz	0.14	0.65	1.07
PCE	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	0.19	0.80	1.02
PCE	LTE Band 41	2498.5 - 2687.5 MHz	0.17	0.78	0.78
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.89	0.12	0.25
NII	U-NII-1	5180 - 5240 MHz	N/A		
NII	U-NII-2A	5260 - 5320 MHz	0.55	< 0.1	
NII	U-NII-2C < 5.65 GHz	5500 - 5580 MHz	0.64	< 0.1	
NII	U-NII-2C > 5.65 GHz + U-NII-3	5660 - 5825 MHz	0.47	< 0.1	
DSS/DTS	Bluetooth	2402 - 2480 MHz	N/A		
Simultaneous SAR per KDB 690783 D01v01r03:			1.58	1.01	1.45

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

The SAR Tick is an initiative of the Mobile Manufacturers Forum (MMF). While a product may be considered eligible, use of the SAR Tick logo requires an agreement with the MMF. Further details can be obtained by emailing: sartick@mmfai.info.

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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 4 (AWS)	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 41	Voice/Data	2498.5 - 2687.5 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
U-NII-1	Data	5180 - 5240 MHz
U-NII-2A	Data	5260 - 5320 MHz
U-NII-2C < 5.65 GHz	Data	5500 - 5580 MHz
U-NII-2C > 5.65 GHz + U-NII-3	Data	5660 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
NFC	Data	13.56 MHz
ANT+	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

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

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.

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slot	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*
GSM/GPRS/EDGE 850	Maximum	**33.0**	**33.0**	**31.0**	**29.5**	**29.0**	**27.0**	**25.0**	**23.0**	**23.0**
	Nominal	**32.5**	**32.5**	**30.5**	**29.0**	**28.5**	**26.5**	**24.5**	**22.5**	**22.5**
GSM/GPRS/EDGE 1900	Maximum	**30.0**	**30.0**	**29.0**	**27.0**	**25.5**	**26.5**	**24.5**	**22.5**	**21.5**
	Nominal	**29.5**	**29.5**	**28.5**	**26.5**	**25.0**	**26.0**	**24.0**	**22.0**	**21.0**

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA Rel 99	*3GPP HSDPA Rel 5*	*3GPP HSUPA Rel 6*	*3GPP DC-HSDPA Rel 8*
UMTS Band 5 (850 MHz)	Maximum	**23.5**	**23.5**	**23.5**	**23.5**
	Nominal	**23.0**	**23.0**	**23.0**	**23.0**
UMTS Band 2 (1900 MHz)	Maximum	**23.5**	**23.5**	**23.5**	**23.5**
	Nominal	**23.0**	**23.0**	**23.0**	**23.0**

Mode / Band		Modulated Average (dBm)
LTE Band 4 (AWS)	Maximum	**23.0**
	Nominal	**22.5**
LTE Band 41	Maximum	**23.5**
	Nominal	**23.0**

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz) - Single Transmission Chain	Maximum	**17.5**
	Nominal	**17.0**
IEEE 802.11g (2.4 GHz) - Single Transmission Chain	Maximum	**14.5**
	Nominal	**14.0**
IEEE 802.11n (2.4 GHz) - Single Transmission Chain	Maximum	**13.5**
	Nominal	**13.0**
IEEE 802.11n (2.4 GHz) - MIMO	Maximum	**16.5**
	Nominal	**16.0**
IEEE 802.11a/n/ac 20 MHz (5 GHz) - Single Transmission Chain	Maximum	**12.5**
	Nominal	**12.0**
IEEE 802.11 n/ac 20 MHz (5 GHz) - MIMO	Maximum	**15.5**
	Nominal	**15.0**
IEEE 802.11n/ac 40 MHz (5 GHz) - Single Transmission Chain	Maximum	**12.5**
	Nominal	**12.0**
IEEE 802.11n/ac 40 MHz (5 GHz) - MIMO	Maximum	**15.5**
	Nominal	**15.0**
IEEE 802.11ac 80 MHz (5 GHz) - Single Transmission Chain	Maximum	**11.5**
	Nominal	**11.0**
IEEE 802.11ac 80 MHz (5 GHz) - MIMO	Maximum	**14.5**
	Nominal	**14.0**
Bluetooth	Maximum	**9.5**
	Nominal	**9.0**
Bluetooth LE	Maximum	**7.0**
	Nominal	**6.5**

1.4 DUT Antenna Locations

- A diagram showing the location of the device antennas can be found in Appendix F. Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC filing.
- The overall dimensions of this device are > 9 x 5 cm. The overall diagonal dimension of the device is <160 mm and the diagonal display is <150 mm.

Table 1-1
Mobile Hotspot Sides for SAR Testing

Mobile Hotspot Sides for SAR Testing						
Mode	Back	Front	Top	Bottom	Right	Left
GPRS 850	Yes	Yes	No	Yes	Yes	Yes
UMTS 850	Yes	Yes	No	Yes	Yes	Yes
GPRS 1900	Yes	Yes	No	Yes	Yes	Yes
UMTS 1900	Yes	Yes	No	Yes	Yes	Yes
LTE Band 4 (AWS)	Yes	Yes	No	Yes	Yes	Yes
LTE Band 41	Yes	Yes	No	Yes	Yes	Yes
2.4 GHz WLAN Ant 1	Yes	Yes	Yes	No	No	Yes
2.4 GHz WLAN Ant 2	Yes	Yes	Yes	No	Yes	No

Note: Particular DUT edges were not required to be evaluated for Wireless Router SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v02 guidance, page 2. The distances between the transmit antennas and the edges of the device are included in the filing. When wireless router mode is enabled, all 5 GHz operations are disabled. Therefore they are not considered in this section.

1.5 Near Field Communications (NFC) Antenna

This DUT has NFC Operations. The NFC antenna is integrated into the device for this model. Therefore, all SAR tests were performed with the device which already incorporates the NFC antenna. A diagram showing the location of the NFC antenna can be found in Appendix F.

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 1-1 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.

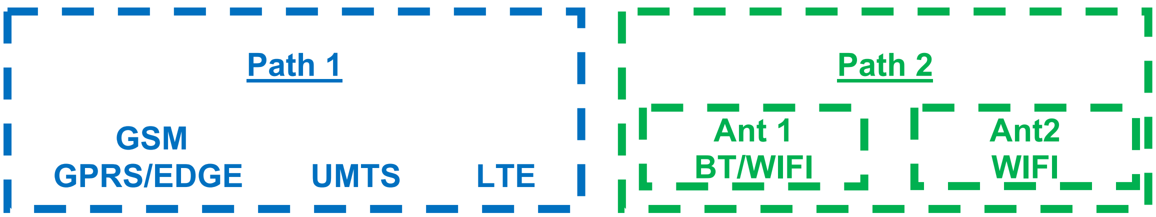


Figure 1-1
Simultaneous Transmission Paths

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-Worn Accessory	Wireless Router	Notes
1	GSM voice + 2.4 GHz WI-FI	Yes	Yes	N/A	
2	GSM voice + 5 GHz WI-FI	Yes	Yes	N/A	
3	GSM voice + 2.4 GHz Bluetooth	N/A	Yes	N/A	
4	UMTS + 2.4 GHz WI-FI	Yes	Yes	Yes	
5	UMTS + 5 GHz WI-FI	Yes	Yes	N/A	
6	UMTS + 2.4 GHz Bluetooth	N/A	Yes	N/A	
7	LTE + 2.4 GHz WI-FI	Yes	Yes	Yes	
8	LTE + 5 GHz WI-FI	Yes	Yes	N/A	
9	LTE + 2.4 GHz Bluetooth	N/A	Yes	N/A	
10	GPRS/EDGE + 2.4 GHz WI-FI	N/A	N/A	Yes	
11	GPRS/EDGE + 5 GHz WI-FI	N/A	N/A	N/A	Not supported by SW

1. 2.4 GHz WLAN, 5 GHz WLAN, and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously.
2. All licensed modes share the same antenna path and cannot transmit simultaneously.
3. 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.
4. Per the manufacturer, WIFI Direct is not expected to be used in conjunction with a held-to-ear or body-worn accessory voice call. Therefore, there are no simultaneous transmission scenarios involving WIFI direct beyond that listed in the above table.
5. When wireless router mode is enabled, all 5GHz bands are disabled.
6. This device supports 2x2 MIMO Tx for WLAN 802.11n/ac. Each WLAN antenna can transmit independently or together when operating with MIMO.
7. This device supports VoLTE.

1.6 Miscellaneous SAR Test Considerations

(A) WIFI/BT

Since Wireless Router operations are not allowed by the chipset firmware using NII WIFI, only 2.4 GHz WIFI Hotspot SAR tests and combinations are considered for SAR with respect to Wireless Router configurations according to FCC KDB 941225 D06v02.

Since U-NII-1 and U-NII-2A bands have the same maximum output power and the highest reported SAR for U-NII-2A is less than 1.2 W/kg, SAR is not required for U-NII-1 band according to FCC KDB 248227 D01 DR02-41929.

Since this device supports the band gap channels, the channels in the U-NII-2C band above 5.65 GHz were grouped with the channels in the U-NII-3 as a single aggregate band. The channels in U-NII-2C below 5.65 GHz were considered separately for SAR evaluation.

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) Band gap channels are supported

Per FCC KDB 447498 D01v05, the 1g 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, body-worn Bluetooth SAR was not required; [(9/10)* √2.480] = 1.4< 3.0. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

(B) Licensed Transmitter(s)

GSM/GPRS/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 D01v03.

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 D05v02r03.

This device supports intra-band LTE Carrier Aggregation (CA) in the downlink only. All uplink communications are identical to Release 8 specifications. Per FCC KDB Publication 941225 D05A v01r01, SAR for LTE CA operations was not needed since the maximum average output power in LTE CA mode was not >0.25 dB higher than the maximum output power when downlink carrier aggregation was inactive.

1.7 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D01v03, D05v02r03, D05Av01, D06v02 (2G/3G/4G and Hotspot)
- FCC KDB Publication 248227 D01 DR02-41929 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r03, D02v01r01 (SAR Measurements up to 6 GHz)
- October 2013 TCB Workshop Notes (GPRS Testing Considerations)

1.8 Device Serial Numbers

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

	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
GSM/GPRS/EDGE 850	085EA	085EA	085EA
UMTS 850	085EA	085EA	085EA
GSM/GPRS/EDGE 1900	085EA	085EA	085EA
UMTS 1900	085EA	085EA	085EA
LTE Band 4 (AWS)	085EA	085EA	085EA
LTE Band 41	085EA	085EA	085EA
2.4 GHz WLAN	08602	08602	08602
5 GHz WLAN	08602	08602	N/A

2 LTE INFORMATION

LTE Information					
FCC ID	**A3LSMG9200**				
Form Factor	Portable Handset				
Frequency Range of each LTE transmission band	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)				
	LTE Band 41 (2498.5 - 2687.5 MHz)				
Channel Bandwidths	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 41: 5 MHz, 10 MHz, 15 MHz, 20 MHz				
Channel Numbers and Frequencies (MHz)	Low	Low-Mid	Mid	High-Mid	High
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)		1732.5 (20175)	1754.3 (20393)	
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)		1732.5 (20175)	1753.5 (20385)	
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)		1732.5 (20175)	1752.5 (20375)	
LTE Band 4 (AWS): 10 MHz	1715 (20000)		1732.5 (20175)	1750 (20350)	
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)		1732.5 (20175)	1747.5 (20325)	
LTE Band 4 (AWS): 20 MHz	1720 (20050)		1732.5 (20175)	1745 (20300)	
LTE Band 41: 5 MHz	2498.5 (39675)	2545.8 (40148)	2593 (40620)	2640.3 (41093)	2687.5 (41565)
LTE Band 41: 10 MHz	2501 (39700)	2547 (40160)	2593 (40620)	2639 (41080)	2685 (41540)
LTE Band 41: 15 MHz	2503.5 (39725)	2548.3 (40173)	2593 (40620)	2637.8 (41068)	2682.5 (41515)
LTE Band 41: 20 MHz	2506 (39750)	2549.5 (40185)	2593 (40620)	2636.5 (41055)	2680 (41490)
UE Category	6				
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				

LTE Carrier Aggregation Possible Combinations	LTE B41 (PCC) + LTE B41 (SCC)		
	10MHz (B41) + 20MHz (B41)	15MHz (B41) + 15MHz (B41)	20MHz (B41) + 10MHz (B41)
		15MHz (B41) + 20MHz (B41)	20MHz (B41) + 15MHz (B41)
			20MHz (B41) + 20MHz (B41)
LTE Carrier Aggregation Additional Information	This device does not support full CA features on 3GPP Release 10. It supports a maximum of 2 carriers in the downlink only. All uplink communications are identical to the Release 8 Specifications. Uplink communications are done on the PCC. Due to carrier capability, only the combinations listed above are supported. The following LTE Release 10 Features are not supported: Relay, HetNet, Enhanced MIMO, eICI, WIFI Offloading, MDH, eMBMA, Cross-Carrier Scheduling, Enhanced SC-FDMA.		

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]

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:

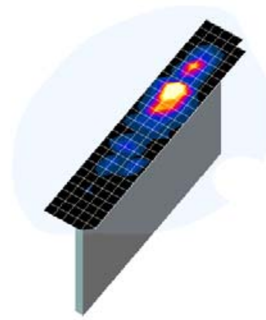


Figure 4-1
Sample SAR Area Scan

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

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].

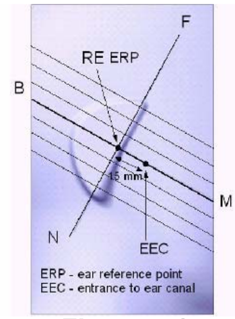


Figure 5-1
Close-Up Side view of ERP

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

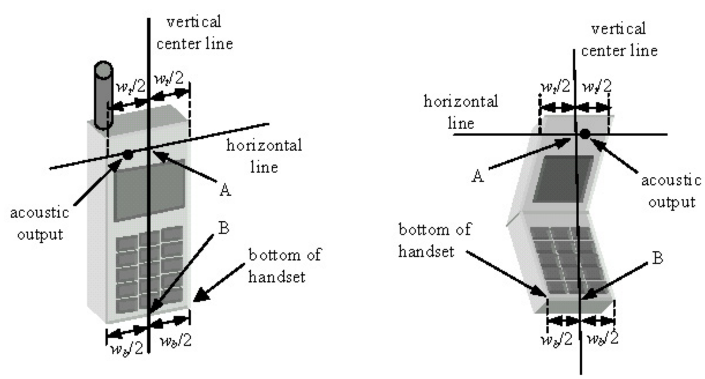


Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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 $\varepsilon = 3$ and loss tangent $\delta = 0.02$.

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).

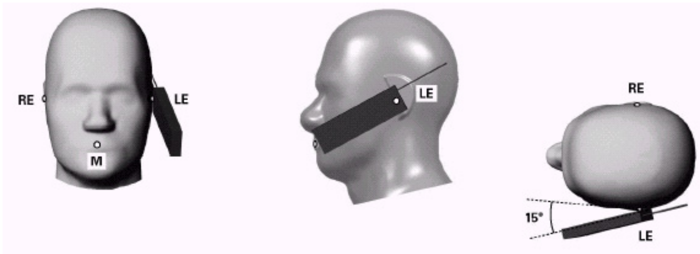


Figure 6-2 Front, Side and Top View of Ear/15º Tilt Position

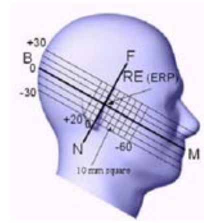


Figure 6-3
Side view w/ relevant markings

6.4 SAR Evaluations near the Mouth/Jaw Regions of the SAM Phantom

Antennas located near the bottom of a phone may require SAR measurements around the mouth and jaw regions of the SAM head phantom. This typically applies to clam-shell style phones that are generally longer in the unfolded normal use positions or to certain older style long rectangular phones. Per IEEE 1528-2013, a rotated SAM phantom is necessary to allow probe access to such regions. Both SAM heads of the TwinSAM-Chin20 are rotated 20 degrees around the NF line. Each head can be removed from the table for emptying and cleaning.

Under these circumstances, the following procedures apply, adopted from the FCC guidance on SAR handsets document FCC KDB Publication 648474 D04_v01. The SAR required in these regions of SAM should be measured using a flat phantom. The phone should be positioned with a separation distance of 4 mm between the ear reference point (ERP) and the outer surface of the flat phantom shell. While maintaining this distance at the ERP location, the low (bottom) edge of the phone should be lowered from the phantom to establish the same separation distance between the peak SAR location identified by the truncated partial SAR distribution measured with the SAM phantom. The distance from the peak SAR location to the phone is determined by the straight line passing perpendicularly through the phantom surface. When it is not feasible to maintain 4 mm separation at the ERP while also establishing the required separation at the peak SAR location, the top edge of the phone will be allowed to touch the phantom with a separation < 4 mm at the ERP. The phone should not be tilted to the left or right while placed in this inclined position to the flat phantom.

6.5 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6-4). Per FCC KDB Publication 648474 D04v01, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v05 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

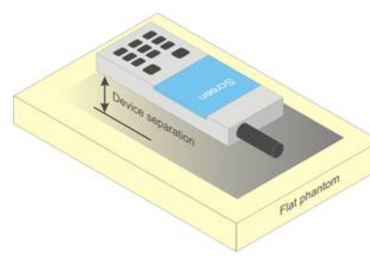


Figure 6-4
Sample Body-Worn Diagram

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

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented.
Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

6.6 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 44798 D01v05 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D01v05, Cell phones (handsets) are not normally designed to be used on extremities or operated in extremity only exposure conditions. The maximum output power levels of handsets generally do not require extremity SAR testing to show compliance. Therefore, extremity SAR was not evaluated for this device.

6.7 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06v02 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v05 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

7 RF EXPOSURE LIMITS

7.1 Uncontrolled Environment

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

7.2 Controlled Environment

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

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

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

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

8 FCC MEASUREMENT PROCEDURES

Power measurements for licensed transmitters are 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 3G SAR Test Reduction Procedure

In FCC KDB Publication 941225 D01v03, certain transmission modes within a frequency band and wireless mode evaluated for SAR are defined as primary modes. The equivalent modes considered for SAR test reduction are denoted as secondary modes. When the maximum output power including tune-up tolerance specified for production units in a secondary mode is ≤ 0.25 dB higher than the primary mode or when the highest reported SAR of the primary mode, scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode, is ≤ 1.2 W/kg, SAR measurements are not required for the secondary mode. These criteria are referred to as the 3G SAR test reduction procedure. When the 3G SAR test reduction procedure is not satisfied, SAR measurements are additionally required for the secondary mode.

8.3 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01v03 “3G SAR Measurement Procedures.”

The device is 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 are 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 is 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 deviates by more than 5%, the SAR test and drift measurements are repeated.

8.4 SAR Measurement Conditions for UMTS

8.4.1 Output Power Verification

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, 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.

8.4.2 Head SAR Measurements

SAR for next to the ear head exposure is measured using a 12.2 kbps RMC with TPC bits configured to all "1's". The 3G SAR test reduction procedure is applied to AMR configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for 12.2 kbps AMR in 3.4 kbps SRB (signaling radio bearer) using the highest reported SAR configuration in 12.2 kbps RMC for head exposure.

8.4.3 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all "1s". The 3G SAR test reduction procedure is applied to other spreading codes and multiple $DPDCH_n$ configurations supported by the handset with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured using an applicable RMC configuration with the corresponding spreading code or $DPDCH_n$, for the highest reported SAR configuration in 12.2 kbps RMC.

8.4.4 SAR Measurements with Rel 5 HSDPA

The 3G SAR test reduction procedure is applied to HSDPA body configurations with 12.2 kbps RMC as the primary mode. Otherwise, Body SAR for HSDPA is measured using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, for the highest reported SAR configuration in 12.2 kbps RMC without HSDPA. Handsets with both HSDPA and HSUPA are tested according to Release 6 HSPA test procedures.

8.4.5 SAR Measurements with Rel 6 HSUPA

The 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body configurations with 12.2 kbps RMC as the primary mode. Otherwise, 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 and power control algorithm 2, according to the highest reported body SAR configuration in 12.2 kbps RMC without HSPA.

When VOIP applies to head exposure, the 3G SAR test reduction procedure is applied with 12.2 kbps RMC as the primary mode; otherwise, the same HSPA configuration used for body SAR measurements are applied to head exposure testing.

8.4.6 SAR Measurement Conditions for DC-HSDPA

SAR is required for Rel. 8 DC-HSDPA when SAR is required for Rel. 5 HSDPA; otherwise, the 3G SAR test reduction procedure is applied to DC-HSDPA with 12.2 kbps RMC as the primary mode. Power is measured for DC-HSDPA according to the H-Set 12, FRC configuration in Table C.8.1.12 of 3GPP TS 34.121-1 to determine SAR test reduction. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to be acceptable.

8.5 SAR Measurement Conditions for LTE

LTE modes are tested according to FCC KDB 941225 D05v02r03 publication. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 or Anritsu MT8820C simulators are 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).

8.5.1 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.

8.5.2 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.

8.5.3 A-MPR

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

8.5.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r03:

a. Per Section 5.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
    i. The required channel and offset combination with the highest maximum output power is required for SAR.
    ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
    iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.
c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to ½ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is <1.45 W/kg.

8.5.5 TDD

LTE TDD testing is performed using guidance from FCC KDB 941225 D05v02r03 and the SAR test guidance provided in April 2013 TCB workshop notes. TDD is tested at the highest duty factor using UL-DL configuration 0 with special subframe configuration 6 and applying the FDD LTE procedures in KDB 941225 D05v02r03. SAR testing is performed using the extended cyclic prefix listed in 3GPP TS 36.211 Section 4.

8.5.6 Downlink Carrier Aggregation

LTE Carrier Aggregation (CA) measurements are made in accordance to 3GPP TS 36.521-1 V10.4.0 (2012-12). The RRC connection is only handled by one cell, the Primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds the Secondary component carrier (SCC) on the downlink only. All uplink communications and acknowledgements remain identical to release 8 specifications on the PCC. Additional output powers are measured using two carriers in the downlink for the release 8 configurations with the highest output power among all channels, RB configurations and bandwidths for each uplink band. Per FCC KDB Publication 941225 D05A v01r01, no SAR measurements are required when the average output power with downlink carrier aggregation active is not more than 0.25 dB higher than the average output power with downlink carrier aggregation inactive.

8.6 SAR Testing with 802.11 Transmitters

The normal network operating configurations of 802.11 transmitters are not suitable for SAR measurements. 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 D01 DR02-41929 for more details.

8.6.1 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.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

8.6.2 U-NII-1 and U-NII-2A

For devices that operate in both U-NII-1 and U-NII-2A bands, when the same maximum output power is specified for both bands, SAR measurement using OFDM SAR test procedures is not required for U-NII-1 unless the highest reported SAR for U-NII-2A is > 1.2 W/kg. When different maximum output powers are specified for the bands, SAR measurement for the U-NII band with the lower maximum output power is not required unless the highest reported SAR for the U-NII band with the higher maximum output power, adjusted by the ratio of lower to higher specified maximum output power for the two bands, is > 1.2 W/kg.

8.6.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. When Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification.

Unless band gap channels are permanently disabled, SAR must be considered for these channels. To maintain SAR measurement accuracy and to facilitate test reduction, the channels in U-NII-2C band above 5.65 GHz are grouped with the 5.8 GHz channels in U-NII-3 band or §15.247 5.8 GHz band to enable two SAR probe calibration frequency points to cover the bands, including the band gap channels. When band gap channels are disabled, each band is tested independently according to the normally required OFDM SAR measurement and probe calibration frequency points requirements.

8.6.4 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating next to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all positions in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.

8.6.5 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is › 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

8.6.6 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 GHz and 5 GHz bands, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a, 802.11n and 802.11ac or 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. When the maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

8.6.7 Initial Test Configuration Procedure

For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. If the average RF output powers of the highest identical transmission modes are within 0.25 dB of each other, mid channel of the transmission mode with highest average RF output power is the initial test channel. Otherwise, the channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements (See Section 8.6.6).

8.6.8 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg, no additional SAR tests for the subsequent test configurations are required.

8.6.9 MIMO SAR considerations

Per KDB 248227 D01 DR02-41929, the simultaneous SAR provisions in KDB Publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WIFI MIMO. If the sum of 1g single transmission chain SAR measurements is <1.6 W/kg, no additional SAR measurements for MIMO are required. Alternatively, SAR for MIMO can be measured with all antennas transmitting simultaneously at the specified maximum output power of MIMO operation.

9 RF CONDUCTED POWERS

9.1 GSM Conducted Powers

		Maximum Burst-Averaged Output Power								
		Voice	*GPRS/EDGE Data (GMSK)*				*EDGE Data (8-PSK)*			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	31.91	31.95	30.89	28.94	**28.49**	26.49	24.61	22.84	22.66
	190	31.96	32.02	30.97	29.15	**28.89**	26.55	24.93	22.95	22.68
	251	31.96	32.01	30.96	29.05	**28.79**	26.50	24.91	22.86	22.63
GSM 1900	512	29.15	29.25	28.85	**25.91**	24.63	25.35	24.21	22.39	21.06
	661	29.27	29.43	28.86	**26.00**	24.70	25.25	24.19	22.43	20.99
	810	29.36	29.37	28.41	**25.97**	25.01	25.01	24.11	22.30	21.02
		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	22.88	22.92	24.87	24.68	**25.48**	17.46	18.59	18.58	19.65
	190	22.93	22.99	24.95	24.89	**25.88**	17.52	18.91	18.69	19.67
	251	22.93	22.98	24.94	24.79	**25.78**	17.47	18.89	18.60	19.62
GSM 1900	512	20.12	20.22	22.83	**21.65**	21.62	16.32	18.19	18.13	18.05
	661	20.24	20.40	22.84	**21.74**	21.69	16.22	18.17	18.17	17.98
	810	20.33	20.34	22.39	**21.71**	22.00	15.98	18.09	18.04	18.01
GSM 850	Frame Avg.Targets:	23.47	23.47	24.48	24.74	**25.49**	17.47	18.48	18.24	19.49
GSM 1900		20.47	20.47	22.48	**22.24**	21.99	16.97	17.98	17.74	17.99

Note:

1. Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
2. 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.
3. 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

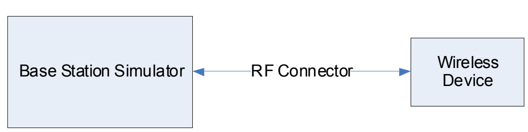


Figure 9-1
Power Measurement Setup

9.2 UMTS Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	23.39	23.46	23.50	23.23	23.41	23.09	-
99		12.2 kbps AMR	23.33	23.36	23.48	23.32	23.44	23.08	-
6	HSDPA	Subtest 1	22.82	22.77	22.74	22.61	22.58	22.47	0
6		Subtest 2	22.60	22.64	22.70	22.46	22.55	22.48	0
6		Subtest 3	22.32	22.39	22.34	22.05	22.12	21.95	0.5
6		Subtest 4	22.30	22.45	22.37	22.04	22.10	22.07	0.5
6	HSUPA	Subtest 1	21.53	21.52	21.58	21.56	21.59	21.52	0
6		Subtest 2	20.27	20.12	20.34	19.92	20.11	20.30	2
6		Subtest 3	20.75	20.80	20.77	20.50	20.55	20.72	1
6		Subtest 4	20.98	20.75	20.87	20.85	20.95	20.78	2
6		Subtest 5	22.08	21.80	21.91	21.53	21.57	21.50	0
8	DC-HSDPA	Subtest 1	22.67	22.84	22.76	22.55	22.59	22.54	0
8		Subtest 2	22.73	22.77	22.73	22.47	22.50	22.48	0
8		Subtest 3	22.10	22.33	22.28	22.39	22.30	22.18	0.5
8		Subtest 4	21.07	21.25	21.10	22.18	22.02	22.09	0.5

DC-HSDPA considerations

- 3GPP TS 34.121-1 was used for DC-HSDPA guidance
- 3G SAR test reduction procedure is applied to DC-HSDPA with 12.2 kbps RMC as the primary mode
- H-Set 12 (QPSK) was confirmed to be used during DC-HSDPA measurements
- The DUT supports UE category 24 for HSDPA

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

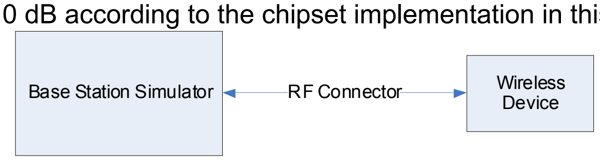


Figure 9-2
Power Measurement Setup

9.3 LTE Conducted Powers

9.3.1 LTE Band 4

Table 9-1
LTE Band 4 Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	1732.5	20175	20	QPSK	1	0	**22.74**	0	0
	1732.5	20175	20	QPSK	1	50	22.33	0	0
	1732.5	20175	20	QPSK	1	99	22.36	0	0
	1732.5	20175	20	QPSK	50	0	**20.83**	0-1	1
	1732.5	20175	20	QPSK	50	25	20.77	0-1	1
	1732.5	20175	20	QPSK	50	50	20.78	0-1	1
	1732.5	20175	20	QPSK	100	0	20.76	0-1	1
	1732.5	20175	20	16QAM	1	0	21.50	0-1	1
	1732.5	20175	20	16QAM	1	50	21.10	0-1	1
	1732.5	20175	20	16QAM	1	99	21.13	0-1	1
	1732.5	20175	20	16QAM	50	0	19.83	0-2	2
	1732.5	20175	20	16QAM	50	25	19.75	0-2	2
	1732.5	20175	20	16QAM	50	50	19.80	0-2	2
	1732.5	20175	20	16QAM	100	0	19.75	0-2	2

Note: LTE Band 4 (AWS) at 20 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 9-2
LTE Band 4 Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1717.5	20025	15	QPSK	1	0	22.29	0	0
	1717.5	20025	15	QPSK	1	36	21.75	0	0
	1717.5	20025	15	QPSK	1	74	21.84	0	0
	1717.5	20025	15	QPSK	36	0	20.61	0-1	1
	1717.5	20025	15	QPSK	36	18	20.51	0-1	1
	1717.5	20025	15	QPSK	36	37	20.40	0-1	1
	1717.5	20025	15	QPSK	75	0	20.64	0-1	1
	1717.5	20025	15	16QAM	1	0	21.32	0-1	1
	1717.5	20025	15	16QAM	1	36	20.65	0-1	1
	1717.5	20025	15	16QAM	1	74	20.64	0-1	1
	1717.5	20025	15	16QAM	36	0	19.59	0-2	2
	1717.5	20025	15	16QAM	36	18	19.56	0-2	2
	1717.5	20025	15	16QAM	36	37	19.50	0-2	2
	1717.5	20025	15	16QAM	75	0	19.62	0-2	2
Mid	1732.5	20175	15	QPSK	1	0	22.34	0	0
	1732.5	20175	15	QPSK	1	36	22.04	0	0
	1732.5	20175	15	QPSK	1	74	22.05	0	0
	1732.5	20175	15	QPSK	36	0	20.70	0-1	1
	1732.5	20175	15	QPSK	36	18	20.60	0-1	1
	1732.5	20175	15	QPSK	36	37	20.58	0-1	1
	1732.5	20175	15	QPSK	75	0	20.68	0-1	1
	1732.5	20175	15	16QAM	1	0	21.36	0-1	1
	1732.5	20175	15	16QAM	1	36	20.77	0-1	1
	1732.5	20175	15	16QAM	1	74	20.73	0-1	1
	1732.5	20175	15	16QAM	36	0	19.78	0-2	2
	1732.5	20175	15	16QAM	36	18	19.70	0-2	2
	1732.5	20175	15	16QAM	36	37	19.49	0-2	2
	1732.5	20175	15	16QAM	75	0	19.63	0-2	2
High	1747.5	20325	15	QPSK	1	0	22.25	0	0
	1747.5	20325	15	QPSK	1	36	21.89	0	0
	1747.5	20325	15	QPSK	1	74	21.69	0	0
	1747.5	20325	15	QPSK	36	0	20.69	0-1	1
	1747.5	20325	15	QPSK	36	18	20.54	0-1	1
	1747.5	20325	15	QPSK	36	37	20.46	0-1	1
	1747.5	20325	15	QPSK	75	0	20.46	0-1	1
	1747.5	20325	15	16QAM	1	0	21.33	0-1	1
	1747.5	20325	15	16QAM	1	36	20.75	0-1	1
	1747.5	20325	15	16QAM	1	74	20.67	0-1	1
	1747.5	20325	15	16QAM	36	0	19.80	0-2	2
	1747.5	20325	15	16QAM	36	18	19.56	0-2	2
	1747.5	20325	15	16QAM	36	37	19.50	0-2	2
	1747.5	20325	15	16QAM	75	0	19.51	0-2	2

Table 9-3
LTE Band 4 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]
Low	1715	20000	10	QPSK	1	0	22.26	0	0
	1715	20000	10	QPSK	1	25	21.76	0	0
	1715	20000	10	QPSK	1	49	21.86	0	0
	1715	20000	10	QPSK	25	0	20.62	0-1	1
	1715	20000	10	QPSK	25	12	20.55	0-1	1
	1715	20000	10	QPSK	25	25	20.45	0-1	1
	1715	20000	10	QPSK	50	0	20.66	0-1	1
	1715	20000	10	16QAM	1	0	21.32	0-1	1
	1715	20000	10	16QAM	1	25	20.65	0-1	1
	1715	20000	10	16QAM	1	49	20.61	0-1	1
	1715	20000	10	16QAM	25	0	19.57	0-2	2
	1715	20000	10	16QAM	25	12	19.61	0-2	2
	1715	20000	10	16QAM	25	25	19.45	0-2	2
	1715	20000	10	16QAM	50	0	19.65	0-2	2
Mid	1732.5	20175	10	QPSK	1	0	22.31	0	0
	1732.5	20175	10	QPSK	1	25	22.09	0	0
	1732.5	20175	10	QPSK	1	49	22.04	0	0
	1732.5	20175	10	QPSK	25	0	20.75	0-1	1
	1732.5	20175	10	QPSK	25	12	20.62	0-1	1
	1732.5	20175	10	QPSK	25	25	20.53	0-1	1
	1732.5	20175	10	QPSK	50	0	20.70	0-1	1
	1732.5	20175	10	16QAM	1	0	21.38	0-1	1
	1732.5	20175	10	16QAM	1	25	20.77	0-1	1
	1732.5	20175	10	16QAM	1	49	20.74	0-1	1
	1732.5	20175	10	16QAM	25	0	19.74	0-2	2
	1732.5	20175	10	16QAM	25	12	19.68	0-2	2
	1732.5	20175	10	16QAM	25	25	19.48	0-2	2
	1732.5	20175	10	16QAM	50	0	19.60	0-2	2
High	1750	20350	10	QPSK	1	0	22.21	0	0
	1750	20350	10	QPSK	1	25	21.91	0	0
	1750	20350	10	QPSK	1	49	21.68	0	0
	1750	20350	10	QPSK	25	0	20.73	0-1	1
	1750	20350	10	QPSK	25	12	20.52	0-1	1
	1750	20350	10	QPSK	25	25	20.43	0-1	1
	1750	20350	10	QPSK	50	0	20.47	0-1	1
	1750	20350	10	16QAM	1	0	21.37	0-1	1
	1750	20350	10	16QAM	1	25	20.71	0-1	1
	1750	20350	10	16QAM	1	49	20.72	0-1	1
	1750	20350	10	16QAM	25	0	19.80	0-2	2
	1750	20350	10	16QAM	25	12	19.60	0-2	2
	1750	20350	10	16QAM	25	25	19.45	0-2	2
	1750	20350	10	16QAM	50	0	19.55	0-2	2

Table 9-4
LTE Band 4 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	1712.5	19975	5	QPSK	1	0	22.27	0	0
	1712.5	19975	5	QPSK	1	12	21.77	0	0
	1712.5	19975	5	QPSK	1	24	21.81	0	0
	1712.5	19975	5	QPSK	12	0	20.60	0-1	1
	1712.5	19975	5	QPSK	12	6	20.57	0-1	1
	1712.5	19975	5	QPSK	12	13	20.42	0-1	1
	1712.5	19975	5	QPSK	25	0	20.66	0-1	1
	1712.5	19975	5	16-QAM	1	0	21.29	0-1	1
	1712.5	19975	5	16-QAM	1	12	20.64	0-1	1
	1712.5	19975	5	16-QAM	1	24	20.61	0-1	1
	1712.5	19975	5	16-QAM	12	0	19.62	0-2	2
	1712.5	19975	5	16-QAM	12	6	19.60	0-2	2
	1712.5	19975	5	16-QAM	12	13	19.42	0-2	2
	1712.5	19975	5	16-QAM	25	0	19.70	0-2	2
Mid	1732.5	20175	5	QPSK	1	0	22.40	0	0
	1732.5	20175	5	QPSK	1	12	22.13	0	0
	1732.5	20175	5	QPSK	1	24	22.08	0	0
	1732.5	20175	5	QPSK	12	0	20.72	0-1	1
	1732.5	20175	5	QPSK	12	6	20.59	0-1	1
	1732.5	20175	5	QPSK	12	13	20.49	0-1	1
	1732.5	20175	5	QPSK	25	0	20.74	0-1	1
	1732.5	20175	5	16-QAM	1	0	21.37	0-1	1
	1732.5	20175	5	16-QAM	1	12	20.74	0-1	1
	1732.5	20175	5	16-QAM	1	24	20.73	0-1	1
	1732.5	20175	5	16-QAM	12	0	19.76	0-2	2
	1732.5	20175	5	16-QAM	12	6	19.64	0-2	2
	1732.5	20175	5	16-QAM	12	13	19.53	0-2	2
	1732.5	20175	5	16-QAM	25	0	19.59	0-2	2
High	1752.5	20375	5	QPSK	1	0	22.19	0	0
	1752.5	20375	5	QPSK	1	12	21.90	0	0
	1752.5	20375	5	QPSK	1	24	21.64	0	0
	1752.5	20375	5	QPSK	12	0	20.73	0-1	1
	1752.5	20375	5	QPSK	12	6	20.51	0-1	1
	1752.5	20375	5	QPSK	12	13	20.47	0-1	1
	1752.5	20375	5	QPSK	25	0	20.50	0-1	1
	1752.5	20375	5	16-QAM	1	0	21.33	0-1	1
	1752.5	20375	5	16-QAM	1	12	20.66	0-1	1
	1752.5	20375	5	16-QAM	1	24	20.77	0-1	1
	1752.5	20375	5	16-QAM	12	0	19.84	0-2	2
	1752.5	20375	5	16-QAM	12	6	19.63	0-2	2
	1752.5	20375	5	16-QAM	12	13	19.40	0-2	2
	1752.5	20375	5	16-QAM	25	0	19.56	0-2	2

Table 9-5
LTE Band 4 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	1711.5	19965	3	QPSK	1	0	22.26	0	0
	1711.5	19965	3	QPSK	1	7	21.79	0	0
	1711.5	19965	3	QPSK	1	14	21.85	0	0
	1711.5	19965	3	QPSK	8	0	20.60	0-1	1
	1711.5	19965	3	QPSK	8	4	20.60	0-1	1
	1711.5	19965	3	QPSK	8	7	20.41	0-1	1
	1711.5	19965	3	QPSK	15	0	20.64	0-1	1
	1711.5	19965	3	16-QAM	1	0	21.28	0-1	1
	1711.5	19965	3	16-QAM	1	7	20.61	0-1	1
	1711.5	19965	3	16-QAM	1	14	20.65	0-1	1
	1711.5	19965	3	16-QAM	8	0	19.57	0-2	2
	1711.5	19965	3	16-QAM	8	4	19.57	0-2	2
	1711.5	19965	3	16-QAM	8	7	19.47	0-2	2
	1711.5	19965	3	16-QAM	15	0	19.75	0-2	2
Mid	1732.5	20175	3	QPSK	1	0	22.40	0	0
	1732.5	20175	3	QPSK	1	7	22.14	0	0
	1732.5	20175	3	QPSK	1	14	22.03	0	0
	1732.5	20175	3	QPSK	8	0	20.74	0-1	1
	1732.5	20175	3	QPSK	8	4	20.64	0-1	1
	1732.5	20175	3	QPSK	8	7	20.50	0-1	1
	1732.5	20175	3	QPSK	15	0	20.72	0-1	1
	1732.5	20175	3	16-QAM	1	0	21.40	0-1	1
	1732.5	20175	3	16-QAM	1	7	20.69	0-1	1
	1732.5	20175	3	16-QAM	1	14	20.74	0-1	1
	1732.5	20175	3	16-QAM	8	0	19.75	0-2	2
	1732.5	20175	3	16-QAM	8	4	19.64	0-2	2
	1732.5	20175	3	16-QAM	8	7	19.57	0-2	2
	1732.5	20175	3	16-QAM	15	0	19.61	0-2	2
High	1753.5	20385	3	QPSK	1	0	22.23	0	0
	1753.5	20385	3	QPSK	1	7	21.94	0	0
	1753.5	20385	3	QPSK	1	14	21.61	0	0
	1753.5	20385	3	QPSK	8	0	20.68	0-1	1
	1753.5	20385	3	QPSK	8	4	20.56	0-1	1
	1753.5	20385	3	QPSK	8	7	20.46	0-1	1
	1753.5	20385	3	QPSK	15	0	20.52	0-1	1
	1753.5	20385	3	16-QAM	1	0	21.29	0-1	1
	1753.5	20385	3	16-QAM	1	7	20.68	0-1	1
	1753.5	20385	3	16-QAM	1	14	20.74	0-1	1
	1753.5	20385	3	16-QAM	8	0	19.89	0-2	2
	1753.5	20385	3	16-QAM	8	4	19.65	0-2	2
	1753.5	20385	3	16-QAM	8	7	19.46	0-2	2
	1753.5	20385	3	16-QAM	15	0	19.61	0-2	2

Table 9-6
LTE Band 4 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	1710.7	19957	1.4	QPSK	1	0	22.27	0	0
	1710.7	19957	1.4	QPSK	1	2	21.79	0	0
	1710.7	19957	1.4	QPSK	1	5	21.86	0	0
	1710.7	19957	1.4	QPSK	3	0	21.64	0	0
	1710.7	19957	1.4	QPSK	3	2	21.65	0	0
	1710.7	19957	1.4	QPSK	3	3	21.46	0	0
	1710.7	19957	1.4	QPSK	6	0	20.60	0-1	1
	1710.7	19957	1.4	16-QAM	1	0	21.26	0-1	1
	1710.7	19957	1.4	16-QAM	1	2	20.61	0-1	1
	1710.7	19957	1.4	16-QAM	1	5	20.65	0-1	1
	1710.7	19957	1.4	16-QAM	3	0	20.54	0-1	1
	1710.7	19957	1.4	16-QAM	3	2	20.62	0-1	1
	1710.7	19957	1.4	16-QAM	3	3	20.45	0-1	1
	1710.7	19957	1.4	16-QAM	6	0	19.71	0-2	2
Mid	1732.5	20175	1.4	QPSK	1	0	22.37	0	0
	1732.5	20175	1.4	QPSK	1	2	22.15	0	0
	1732.5	20175	1.4	QPSK	1	5	21.98	0	0
	1732.5	20175	1.4	QPSK	3	0	21.77	0	0
	1732.5	20175	1.4	QPSK	3	2	21.66	0	0
	1732.5	20175	1.4	QPSK	3	3	21.45	0	0
	1732.5	20175	1.4	QPSK	6	0	20.73	0-1	1
	1732.5	20175	1.4	16-QAM	1	0	21.37	0-1	1
	1732.5	20175	1.4	16-QAM	1	2	20.72	0-1	1
	1732.5	20175	1.4	16-QAM	1	5	20.78	0-1	1
	1732.5	20175	1.4	16-QAM	3	0	20.77	0-1	1
	1732.5	20175	1.4	16-QAM	3	2	20.63	0-1	1
	1732.5	20175	1.4	16-QAM	3	3	20.58	0-1	1
	1732.5	20175	1.4	16-QAM	6	0	19.65	0-2	2
High	1754.3	20393	1.4	QPSK	1	0	22.21	0	0
	1754.3	20393	1.4	QPSK	1	2	21.99	0	0
	1754.3	20393	1.4	QPSK	1	5	21.60	0	0
	1754.3	20393	1.4	QPSK	3	0	21.67	0	0
	1754.3	20393	1.4	QPSK	3	2	21.56	0	0
	1754.3	20393	1.4	QPSK	3	3	21.43	0	0
	1754.3	20393	1.4	QPSK	6	0	20.52	0-1	1
	1754.3	20393	1.4	16-QAM	1	0	21.25	0-1	1
	1754.3	20393	1.4	16-QAM	1	2	20.73	0-1	1
	1754.3	20393	1.4	16-QAM	1	5	20.78	0-1	1
	1754.3	20393	1.4	16-QAM	3	0	20.93	0-1	1
	1754.3	20393	1.4	16-QAM	3	2	20.60	0-1	1
	1754.3	20393	1.4	16-QAM	3	3	20.46	0-1	1
	1754.3	20393	1.4	16-QAM	6	0	19.56	0-2	2

9.3.2 LTE Band 41

Table 9-7
LTE Band 41 Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	2506	39750	20	QPSK	1	0	**23.48**	0	0
	2506	39750	20	QPSK	1	50	23.43	0	0
	2506	39750	20	QPSK	1	99	23.11	0	0
	2506	39750	20	QPSK	50	0	**22.42**	0-1	1
	2506	39750	20	QPSK	50	25	22.41	0-1	1
	2506	39750	20	QPSK	50	50	22.33	0-1	1
	2506	39750	20	QPSK	100	0	22.41	0-1	1
	2506	39750	20	16QAM	1	0	22.16	0-1	1
	2506	39750	20	16QAM	1	50	22.48	0-1	1
	2506	39750	20	16QAM	1	99	22.01	0-1	1
	2506	39750	20	16QAM	50	0	21.36	0-2	2
	2506	39750	20	16QAM	50	25	21.23	0-2	2
	2506	39750	20	16QAM	50	50	21.02	0-2	2
	2506	39750	20	16QAM	100	0	21.02	0-2	2
Low Mid	2549.5	40185	20	QPSK	1	0	23.35	0	0
	2549.5	40185	20	QPSK	1	50	23.34	0	0
	2549.5	40185	20	QPSK	1	99	22.71	0	0
	2549.5	40185	20	QPSK	50	0	22.37	0-1	1
	2549.5	40185	20	QPSK	50	25	22.26	0-1	1
	2549.5	40185	20	QPSK	50	50	22.09	0-1	1
	2549.5	40185	20	QPSK	100	0	22.00	0-1	1
	2549.5	40185	20	16-QAM	1	0	22.09	0-1	1
	2549.5	40185	20	16-QAM	1	50	22.38	0-1	1
	2549.5	40185	20	16-QAM	1	99	22.07	0-1	1
	2549.5	40185	20	16-QAM	50	0	21.18	0-2	2
	2549.5	40185	20	16-QAM	50	25	21.23	0-2	2
	2549.5	40185	20	16-QAM	50	50	20.99	0-2	2
	2549.5	40185	20	16-QAM	100	0	21.06	0-2	2
Mid	2593	40620	20	QPSK	1	0	23.34	0	0
	2593	40620	20	QPSK	1	50	23.26	0	0
	2593	40620	20	QPSK	1	99	22.87	0	0
	2593	40620	20	QPSK	50	0	22.16	0-1	1
	2593	40620	20	QPSK	50	25	22.08	0-1	1
	2593	40620	20	QPSK	50	50	21.91	0-1	1
	2593	40620	20	QPSK	100	0	22.11	0-1	1
	2593	40620	20	16-QAM	1	0	22.31	0-1	1
	2593	40620	20	16-QAM	1	50	22.26	0-1	1
	2593	40620	20	16-QAM	1	99	21.87	0-1	1
	2593	40620	20	16-QAM	50	0	21.06	0-2	2
	2593	40620	20	16-QAM	50	25	21.12	0-2	2
	2593	40620	20	16-QAM	50	50	20.77	0-2	2
	2593	40620	20	16-QAM	100	0	20.87	0-2	2
Mid High	2636.5	41055	20	QPSK	1	0	23.20	0	0
	2636.5	41055	20	QPSK	1	50	23.37	0	0
	2636.5	41055	20	QPSK	1	99	22.96	0	0
	2636.5	41055	20	QPSK	50	0	22.34	0-1	1
	2636.5	41055	20	QPSK	50	25	22.26	0-1	1
	2636.5	41055	20	QPSK	50	50	22.20	0-1	1
	2636.5	41055	20	QPSK	100	0	22.10	0-1	1
	2636.5	41055	20	16-QAM	1	0	22.19	0-1	1
	2636.5	41055	20	16-QAM	1	50	22.31	0-1	1
	2636.5	41055	20	16-QAM	1	99	22.01	0-1	1
	2636.5	41055	20	16-QAM	50	0	21.29	0-2	2
	2636.5	41055	20	16-QAM	50	25	21.22	0-2	2
	2636.5	41055	20	16-QAM	50	50	20.85	0-2	2
	2636.5	41055	20	16-QAM	100	0	20.88	0-2	2
High	2680	41490	20	QPSK	1	0	23.39	0	0
	2680	41490	20	QPSK	1	50	23.46	0	0
	2680	41490	20	QPSK	1	99	23.37	0	0
	2680	41490	20	QPSK	50	0	22.41	0-1	1
	2680	41490	20	QPSK	50	25	22.40	0-1	1
	2680	41490	20	QPSK	50	50	22.39	0-1	1
	2680	41490	20	QPSK	100	0	22.37	0-1	1
	2680	41490	20	16-QAM	1	0	22.41	0-1	1
	2680	41490	20	16-QAM	1	50	22.39	0-1	1
	2680	41490	20	16-QAM	1	99	21.99	0-1	1
	2680	41490	20	16-QAM	50	0	21.31	0-2	2
	2680	41490	20	16-QAM	50	25	21.37	0-2	2
	2680	41490	20	16-QAM	50	50	20.90	0-2	2
	2680	41490	20	16-QAM	100	0	21.00	0-2	2

Table 9-8
LTE Band 41 Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	2503.5	39725	15	QPSK	1	0	23.31	0	0
	2503.5	39725	15	QPSK	1	36	23.32	0	0
	2503.5	39725	15	QPSK	1	74	23.12	0	0
	2503.5	39725	15	QPSK	36	0	22.21	0-1	1
	2503.5	39725	15	QPSK	36	18	22.40	0-1	1
	2503.5	39725	15	QPSK	36	37	22.05	0-1	1
	2503.5	39725	15	QPSK	75	0	22.21	0-1	1
	2503.5	39725	15	16QAM	1	0	22.06	0-1	1
	2503.5	39725	15	16QAM	1	36	22.47	0-1	1
	2503.5	39725	15	16QAM	1	74	22.12	0-1	1
	2503.5	39725	15	16QAM	36	0	21.38	0-2	2
	2503.5	39725	15	16QAM	36	18	21.05	0-2	2
	2503.5	39725	15	16QAM	36	37	21.01	0-2	2
	2503.5	39725	15	16QAM	75	0	20.96	0-2	2
Low Mid	2548.25	40173	15	QPSK	1	0	23.13	0	0
	2548.25	40173	15	QPSK	1	36	23.35	0	0
	2548.25	40173	15	QPSK	1	74	22.99	0	0
	2548.25	40173	15	QPSK	36	0	22.10	0-1	1
	2548.25	40173	15	QPSK	36	18	22.34	0-1	1
	2548.25	40173	15	QPSK	36	37	22.03	0-1	1
	2548.25	40173	15	QPSK	75	0	22.19	0-1	1
	2548.25	40173	15	16-QAM	1	0	22.30	0-1	1
	2548.25	40173	15	16-QAM	1	36	22.44	0-1	1
	2548.25	40173	15	16-QAM	1	74	22.24	0-1	1
	2548.25	40173	15	16-QAM	36	0	21.37	0-2	2
	2548.25	40173	15	16-QAM	36	18	21.20	0-2	2
	2548.25	40173	15	16-QAM	36	37	21.19	0-2	2
	2548.25	40173	15	16-QAM	75	0	21.15	0-2	2
Mid	2593	40620	15	QPSK	1	0	23.22	0	0
	2593	40620	15	QPSK	1	36	23.44	0	0
	2593	40620	15	QPSK	1	74	23.15	0	0
	2593	40620	15	QPSK	36	0	22.27	0-1	1
	2593	40620	15	QPSK	36	18	22.09	0-1	1
	2593	40620	15	QPSK	36	37	21.91	0-1	1
	2593	40620	15	QPSK	75	0	21.85	0-1	1
	2593	40620	15	16-QAM	1	0	22.01	0-1	1
	2593	40620	15	16-QAM	1	36	22.19	0-1	1
	2593	40620	15	16-QAM	1	74	21.57	0-1	1
	2593	40620	15	16-QAM	36	0	21.21	0-2	2
	2593	40620	15	16-QAM	36	18	21.08	0-2	2
	2593	40620	15	16-QAM	36	37	20.71	0-2	2
	2593	40620	15	16-QAM	75	0	20.78	0-2	2
Mid High	2637.75	41068	15	QPSK	1	0	23.39	0	0
	2637.75	41068	15	QPSK	1	36	23.36	0	0
	2637.75	41068	15	QPSK	1	74	23.13	0	0
	2637.75	41068	15	QPSK	36	0	22.39	0-1	1
	2637.75	41068	15	QPSK	36	18	22.49	0-1	1
	2637.75	41068	15	QPSK	36	37	22.01	0-1	1
	2637.75	41068	15	QPSK	75	0	21.87	0-1	1
	2637.75	41068	15	16-QAM	1	0	22.40	0-1	1
	2637.75	41068	15	16-QAM	1	36	22.15	0-1	1
	2637.75	41068	15	16-QAM	1	74	21.78	0-1	1
	2637.75	41068	15	16-QAM	36	0	21.25	0-2	2
	2637.75	41068	15	16-QAM	36	18	21.43	0-2	2
	2637.75	41068	15	16-QAM	36	37	20.55	0-2	2
	2637.75	41068	15	16-QAM	75	0	20.91	0-2	2
High	2682.5	41515	15	QPSK	1	0	23.17	0	0
	2682.5	41515	15	QPSK	1	36	23.16	0	0
	2682.5	41515	15	QPSK	1	74	23.33	0	0
	2682.5	41515	15	QPSK	36	0	22.25	0-1	1
	2682.5	41515	15	QPSK	36	18	22.19	0-1	1
	2682.5	41515	15	QPSK	36	37	22.09	0-1	1
	2682.5	41515	15	QPSK	75	0	22.40	0-1	1
	2682.5	41515	15	16-QAM	1	0	22.11	0-1	1
	2682.5	41515	15	16-QAM	1	36	22.47	0-1	1
	2682.5	41515	15	16-QAM	1	74	21.87	0-1	1
	2682.5	41515	15	16-QAM	36	0	21.23	0-2	2
	2682.5	41515	15	16-QAM	36	18	21.26	0-2	2
	2682.5	41515	15	16-QAM	36	37	20.60	0-2	2
	2682.5	41515	15	16-QAM	75	0	21.11	0-2	2

Table 9-9
LTE Band 41 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]
Low	2501	39700	10	QPSK	1	0	23.48	0	0
	2501	39700	10	QPSK	1	25	23.35	0	0
	2501	39700	10	QPSK	1	49	23.33	0	0
	2501	39700	10	QPSK	25	0	22.18	0-1	1
	2501	39700	10	QPSK	25	12	22.16	0-1	1
	2501	39700	10	QPSK	25	25	21.96	0-1	1
	2501	39700	10	QPSK	50	0	22.21	0-1	1
	2501	39700	10	16QAM	1	0	22.16	0-1	1
	2501	39700	10	16QAM	1	25	22.33	0-1	1
	2501	39700	10	16QAM	1	49	21.97	0-1	1
	2501	39700	10	16QAM	25	0	21.45	0-2	2
	2501	39700	10	16QAM	25	12	20.75	0-2	2
	2501	39700	10	16QAM	25	25	21.09	0-2	2
	2501	39700	10	16QAM	50	0	20.80	0-2	2
Low Mid	2547	40160	10	QPSK	1	0	22.89	0	0
	2547	40160	10	QPSK	1	25	23.50	0	0
	2547	40160	10	QPSK	1	49	23.16	0	0
	2547	40160	10	QPSK	25	0	22.27	0-1	1
	2547	40160	10	QPSK	25	12	22.37	0-1	1
	2547	40160	10	QPSK	25	25	21.90	0-1	1
	2547	40160	10	QPSK	50	0	21.98	0-1	1
	2547	40160	10	16-QAM	1	0	22.00	0-1	1
	2547	40160	10	16-QAM	1	25	22.47	0-1	1
	2547	40160	10	16-QAM	1	49	21.94	0-1	1
	2547	40160	10	16-QAM	25	0	21.10	0-2	2
	2547	40160	10	16-QAM	25	12	20.91	0-2	2
	2547	40160	10	16-QAM	25	25	21.01	0-2	2
	2547	40160	10	16-QAM	50	0	20.96	0-2	2
Mid	2593	40620	10	QPSK	1	0	23.40	0	0
	2593	40620	10	QPSK	1	25	23.35	0	0
	2593	40620	10	QPSK	1	49	23.01	0	0
	2593	40620	10	QPSK	25	0	22.44	0-1	1
	2593	40620	10	QPSK	25	12	21.87	0-1	1
	2593	40620	10	QPSK	25	25	22.15	0-1	1
	2593	40620	10	QPSK	50	0	21.77	0-1	1
	2593	40620	10	16-QAM	1	0	22.24	0-1	1
	2593	40620	10	16-QAM	1	25	22.10	0-1	1
	2593	40620	10	16-QAM	1	49	21.54	0-1	1
	2593	40620	10	16-QAM	25	0	21.19	0-2	2
	2593	40620	10	16-QAM	25	12	20.80	0-2	2
	2593	40620	10	16-QAM	25	25	20.80	0-2	2
	2593	40620	10	16-QAM	50	0	20.87	0-2	2
Mid High	2639	41080	10	QPSK	1	0	23.16	0	0
	2639	41080	10	QPSK	1	25	23.40	0	0
	2639	41080	10	QPSK	1	49	23.07	0	0
	2639	41080	10	QPSK	25	0	22.36	0-1	1
	2639	41080	10	QPSK	25	12	22.17	0-1	1
	2639	41080	10	QPSK	25	25	22.04	0-1	1
	2639	41080	10	QPSK	50	0	21.72	0-1	1
	2639	41080	10	16-QAM	1	0	22.40	0-1	1
	2639	41080	10	16-QAM	1	25	21.98	0-1	1
	2639	41080	10	16-QAM	1	49	21.86	0-1	1
	2639	41080	10	16-QAM	25	0	21.41	0-2	2
	2639	41080	10	16-QAM	25	12	21.20	0-2	2
	2639	41080	10	16-QAM	25	25	20.52	0-2	2
	2639	41080	10	16-QAM	50	0	20.65	0-2	2
High	2685	41540	10	QPSK	1	0	22.96	0	0
	2685	41540	10	QPSK	1	25	23.35	0	0
	2685	41540	10	QPSK	1	49	23.15	0	0
	2685	41540	10	QPSK	25	0	21.98	0-1	1
	2685	41540	10	QPSK	25	12	22.27	0-1	1
	2685	41540	10	QPSK	25	25	22.01	0-1	1
	2685	41540	10	QPSK	50	0	22.46	0-1	1
	2685	41540	10	16-QAM	1	0	22.11	0-1	1
	2685	41540	10	16-QAM	1	25	22.35	0-1	1
	2685	41540	10	16-QAM	1	49	21.65	0-1	1
	2685	41540	10	16-QAM	25	0	21.33	0-2	2
	2685	41540	10	16-QAM	25	12	21.21	0-2	2
	2685	41540	10	16-QAM	25	25	20.70	0-2	2
	2685	41540	10	16-QAM	50	0	21.11	0-2	2

Table 9-10
LTE Band 41 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	2498.5	39675	5	QPSK	1	0	23.18	0	0
	2498.5	39675	5	QPSK	1	12	23.36	0	0
	2498.5	39675	5	QPSK	1	24	23.35	0	0
	2498.5	39675	5	QPSK	12	0	22.15	0-1	1
	2498.5	39675	5	QPSK	12	6	22.48	0-1	1
	2498.5	39675	5	QPSK	12	13	21.96	0-1	1
	2498.5	39675	5	QPSK	25	0	22.14	0-1	1
	2498.5	39675	5	16-QAM	1	0	22.10	0-1	1
	2498.5	39675	5	16-QAM	1	12	22.05	0-1	1
	2498.5	39675	5	16-QAM	1	24	21.82	0-1	1
	2498.5	39675	5	16-QAM	12	0	21.41	0-2	2
	2498.5	39675	5	16-QAM	12	6	20.78	0-2	2
	2498.5	39675	5	16-QAM	12	13	20.97	0-2	2
	2498.5	39675	5	16-QAM	25	0	20.86	0-2	2
Low Mid	2545.75	40148	5	QPSK	1	0	22.88	0	0
	2545.75	40148	5	QPSK	1	12	23.39	0	0
	2545.75	40148	5	QPSK	1	24	23.07	0	0
	2545.75	40148	5	QPSK	12	0	22.12	0-1	1
	2545.75	40148	5	QPSK	12	6	22.31	0-1	1
	2545.75	40148	5	QPSK	12	13	21.99	0-1	1
	2545.75	40148	5	QPSK	25	0	22.20	0-1	1
	2545.75	40148	5	16-QAM	1	0	22.26	0-1	1
	2545.75	40148	5	16-QAM	1	12	22.29	0-1	1
	2545.75	40148	5	16-QAM	1	24	21.90	0-1	1
	2545.75	40148	5	16-QAM	12	0	20.86	0-2	2
	2545.75	40148	5	16-QAM	12	6	21.19	0-2	2
	2545.75	40148	5	16-QAM	12	13	21.09	0-2	2
	2545.75	40148	5	16-QAM	25	0	20.67	0-2	2
Mid	2593	40620	5	QPSK	1	0	23.30	0	0
	2593	40620	5	QPSK	1	12	23.46	0	0
	2593	40620	5	QPSK	1	24	23.03	0	0
	2593	40620	5	QPSK	12	0	22.29	0-1	1
	2593	40620	5	QPSK	12	6	21.73	0-1	1
	2593	40620	5	QPSK	12	13	21.91	0-1	1
	2593	40620	5	QPSK	25	0	21.76	0-1	1
	2593	40620	5	16-QAM	1	0	22.18	0-1	1
	2593	40620	5	16-QAM	1	12	22.05	0-1	1
	2593	40620	5	16-QAM	1	24	21.74	0-1	1
	2593	40620	5	16-QAM	12	0	21.32	0-2	2
	2593	40620	5	16-QAM	12	6	20.54	0-2	2
	2593	40620	5	16-QAM	12	13	20.84	0-2	2
	2593	40620	5	16-QAM	25	0	20.77	0-2	2
Mid High	2640.25	41093	5	QPSK	1	0	23.34	0	0
	2640.25	41093	5	QPSK	1	12	23.39	0	0
	2640.25	41093	5	QPSK	1	24	23.00	0	0
	2640.25	41093	5	QPSK	12	0	22.16	0-1	1
	2640.25	41093	5	QPSK	12	6	22.43	0-1	1
	2640.25	41093	5	QPSK	12	13	22.29	0-1	1
	2640.25	41093	5	QPSK	25	0	21.67	0-1	1
	2640.25	41093	5	16-QAM	1	0	22.12	0-1	1
	2640.25	41093	5	16-QAM	1	12	21.79	0-1	1
	2640.25	41093	5	16-QAM	1	24	21.72	0-1	1
	2640.25	41093	5	16-QAM	12	0	21.27	0-2	2
	2640.25	41093	5	16-QAM	12	6	21.23	0-2	2
	2640.25	41093	5	16-QAM	12	13	20.51	0-2	2
	2640.25	41093	5	16-QAM	25	0	20.63	0-2	2
High	2687.5	41565	5	QPSK	1	0	23.01	0	0
	2687.5	41565	5	QPSK	1	12	23.25	0	0
	2687.5	41565	5	QPSK	1	24	23.39	0	0
	2687.5	41565	5	QPSK	12	0	21.89	0-1	1
	2687.5	41565	5	QPSK	12	6	22.11	0-1	1
	2687.5	41565	5	QPSK	12	13	21.92	0-1	1
	2687.5	41565	5	QPSK	25	0	22.36	0-1	1
	2687.5	41565	5	16-QAM	1	0	22.06	0-1	1
	2687.5	41565	5	16-QAM	1	12	22.12	0-1	1
	2687.5	41565	5	16-QAM	1	24	21.63	0-1	1
	2687.5	41565	5	16-QAM	12	0	21.13	0-2	2
	2687.5	41565	5	16-QAM	12	6	21.20	0-2	2
	2687.5	41565	5	16-QAM	12	13	20.81	0-2	2
	2687.5	41565	5	16-QAM	25	0	21.08	0-2	2

9.3.3 LTE Carrier Aggregation Conducted Powers

Table 9-11
LTE Carrier Aggregation Conducted Powers – Band 41 (PCC) 10 MHz + Band 41 (SCC) 20 MHz BW

Band 41 (PCC) 10MHz + Band 41 (SCC) 20 MHz				
2547 MHz / ch.40160 + 2566.8 MHz / ch. 40358	PCC UL # RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	LTE Rel 8 Tx.Power (dBm)
	1	25	23.25	23.50

Notes:
1. The device does not support all Rel. 10 Carrier Aggregation features due to modem chipset limitation.
2. The device only supports downlink Carrier Aggregation. Uplink Carrier Aggregation is not supported. Power measurements were performed with two DL carriers for the Release 8 configuration that had the highest output power (across all bandwidths, channels and RB Configurations) for each band
3. This device only supports intra-band CA with 2 carriers (B41+B41).
4. All control and acknowledge data is sent on uplink channels that operate identical to release 8 specifications.

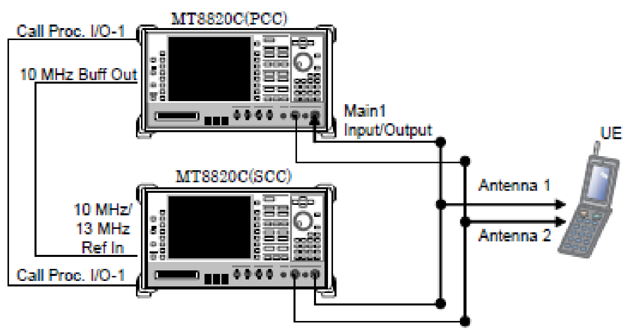


Figure 9-3
Power Measurement Setup

9.4 WLAN Conducted Powers

Table 9-5
2.4 GHz Average RF Power – Antenna 1

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]
		IEEE Transmission Mode
		802.11b
2412	1	**17.05**
2437	6	16.81
2462	11	16.71

Table 9-6
2.4 GHz Average RF Power – Antenna 2

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]
		IEEE Transmission Mode
		802.11b
2412	1	17.00
2437	6	**17.36**
2462	11	17.05

Table 9-7
5 GHz (40 MHz Bandwidth) Average RF Power – Antenna 1

Freq [MHz]	Channel	5GHz (40MHz) Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11n	802.11ac
5190	38	12.11	12.16
5230	46	12.08	12.01
5270	54	12.20	12.09
5310	62	**12.46**	12.44
5510	102	**12.28**	12.27
5550	110	12.15	12.22
5670	134	12.42	11.63
5710	142	11.90	11.72
5755	151	12.38	**12.47**
5795	159	12.36	12.35

Table 9-8
5 GHz (40 MHz Bandwidth) Average RF Power – Antenna 2

Freq [MHz]	Channel	5GHz (40MHz) Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11n	802.11ac
5190	38	12.32	12.14
5230	46	12.15	12.16
5270	54	12.40	12.40
5310	62	**12.47**	12.41
5510	102	12.15	**12.35**
5550	110	12.23	12.29
5670	134	12.34	**12.38**
5710	142	11.78	11.72
5755	151	11.96	12.01
5795	159	11.74	11.64

Justification for test configurations for WLAN per KDB Publication 248227 D01DR02-41929:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.
- The bolded data rate and channel above were tested for SAR.

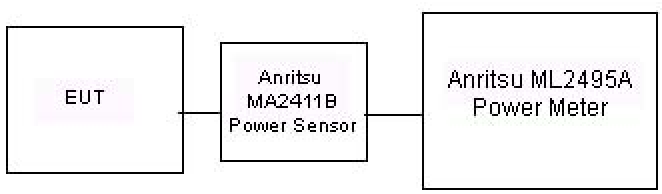


Figure 9-4
Power Measurement Setup for Bandwidths < 50 MHz

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
01/28/2015	835H	23.0	820	0.886	42.217	0.899	41.578	-1.45%	1.54%
			835	0.897	42.105	0.900	41.500	-0.33%	1.46%
			850	0.917	41.934	0.916	41.500	0.11%	1.05%
01/22/15	1750H	22.0	1710	1.305	38.634	1.348	40.142	-3.19%	-3.76%
			1750	1.344	38.466	1.371	40.079	-1.97%	-4.02%
			1790	1.385	38.286	1.394	40.016	-0.65%	-4.32%
01/26/2015	1900H	22.1	1850	1.361	38.362	1.400	40.000	-2.79%	-4.10%
			1880	1.391	38.258	1.400	40.000	-0.64%	-4.35%
			1910	1.421	38.116	1.400	40.000	1.50%	-4.71%
01/27/2015	2450-2600H	23.0	2401	1.758	38.812	1.756	39.287	0.11%	-1.21%
			2450	1.812	38.552	1.800	39.200	0.67%	-1.65%
			2499	1.866	38.434	1.853	39.138	0.70%	-1.80%
			2500	1.867	38.437	1.855	39.136	0.65%	-1.79%
			2550	1.920	38.178	1.909	39.073	0.58%	-2.29%
			2600	1.977	37.997	1.964	39.009	0.66%	-2.59%
			2650	2.031	37.749	2.018	38.945	0.64%	-3.07%
			2700	2.082	37.632	2.073	38.882	0.43%	-3.21%
02/02/2015	2450H	21.9	2401	1.745	38.159	1.756	39.287	-0.63%	-2.87%
			2450	1.797	37.953	1.800	39.200	-0.17%	-3.18%
			2499	1.853	37.796	1.853	39.138	0.00%	-3.43%
01/27/2015	5200H-5800H	22.8	5300	4.903	35.673	4.758	35.871	3.05%	-0.55%
			5320	4.920	35.637	4.778	35.849	2.97%	-0.59%
			5500	5.129	35.206	4.963	35.643	3.34%	-1.23%
			5520	5.158	35.161	4.983	35.620	3.51%	-1.29%
			5600	5.254	34.958	5.065	35.529	3.73%	-1.61%
			5660	5.333	34.821	5.127	35.460	4.02%	-1.80%
			5680	5.349	34.768	5.147	35.437	3.92%	-1.89%
			5745	5.430	34.635	5.214	35.363	4.14%	-2.06%
			5765	5.452	34.560	5.234	35.340	4.17%	-2.21%
			5800	5.496	34.471	5.270	35.300	4.29%	-2.35%
01/26/2015	835B	21.9	820	0.987	54.478	0.969	55.258	1.86%	-1.41%
			835	1.000	54.387	0.970	55.200	3.09%	-1.47%
			850	1.020	54.245	0.988	55.154	3.24%	-1.65%
01/26/2015	1750B	22.0	1710	1.436	52.692	1.463	53.537	-1.85%	-1.58%
			1750	1.479	52.543	1.488	53.432	-0.60%	-1.66%
			1790	1.522	52.413	1.514	53.326	0.53%	-1.71%
01/26/15	1900B	21.8	1850	1.523	52.183	1.520	53.300	0.20%	-2.10%
			1880	1.555	52.108	1.520	53.300	2.30%	-2.24%
			1910	1.590	52.007	1.520	53.300	4.61%	-2.43%
01/26/2015	2450-2600B	23.5	2401	1.931	51.976	1.903	52.765	1.47%	-1.50%
			2450	1.997	51.723	1.950	52.700	2.41%	-1.85%
			2499	2.062	51.582	2.019	52.638	2.13%	-2.01%
			2500	2.063	51.577	2.021	52.636	2.08%	-2.01%
			2550	2.134	51.310	2.092	52.573	2.01%	-2.40%
			2600	2.203	51.133	2.163	52.509	1.85%	-2.62%
			2650	2.269	50.847	2.234	52.445	1.57%	-3.05%
			2700	2.332	50.744	2.305	52.382	1.17%	-3.13%
02/02/2015	2450B	23.5	2401	1.886	52.813	1.903	52.765	-0.89%	0.09%
			2450	1.956	52.631	1.950	52.700	0.31%	-0.13%
			2499	2.017	52.443	2.019	52.638	-0.10%	-0.37%
01/26/2015	5200B-5800B	21.2	5300	5.489	47.474	5.416	48.879	1.35%	-2.87%
			5320	5.507	47.450	5.439	48.851	1.25%	-2.87%
			5500	5.748	47.138	5.650	48.607	1.73%	-3.02%
			5520	5.774	47.079	5.673	48.580	1.78%	-3.09%
			5600	5.880	46.988	5.766	48.471	1.98%	-3.06%
			5660	5.966	46.862	5.837	48.390	2.21%	-3.16%
			5680	6.002	46.836	5.860	48.363	2.42%	-3.16%
			5745	6.090	46.723	5.936	48.275	2.59%	-3.21%
			5765	6.110	46.679	5.959	48.248	2.53%	-3.25%
			5800	6.158	46.623	6.000	48.200	2.63%	-3.27%

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.

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)	$Deviation_{1g}$ (%)
G	835	HEAD	01/28/2015	24.4	23.0	0.100	4d133	3258	0.949	9.200	9.490	3.15%
D	1750	HEAD	01/22/2015	23.0	22.9	0.100	1008	3263	3.450	36.900	34.500	-6.50%
D	1900	HEAD	01/26/2015	23.5	22.1	0.100	5d149	3263	4.320	40.200	43.200	7.46%
G	2450	HEAD	01/27/2015	21.3	22.2	0.100	719	3258	5.340	52.100	53.400	2.50%
G	2450	HEAD	02/02/2015	24.1	23.0	0.100	719	3258	5.070	52.100	50.700	-2.69%
E	5300	HEAD	01/27/2015	24.3	21.8	0.100	1120	7308	7.910	83.400	79.100	-5.16%
E	5500	HEAD	01/27/2015	24.3	21.8	0.100	1120	7308	7.950	84.900	79.500	-6.36%
E	5600	HEAD	01/27/2015	24.4	21.8	0.100	1120	7308	8.150	82.200	81.500	-0.85%
E	5800	HEAD	01/27/2015	24.3	21.8	0.100	1120	7308	7.650	79.100	76.500	-3.29%
K	835	BODY	01/26/2015	23.5	22.0	0.100	4d133	3288	0.974	9.350	9.740	4.17%
K	1750	BODY	01/26/2015	23.9	22.1	0.100	1008	3288	3.720	37.600	37.200	-1.06%
G	1900	BODY	01/26/2015	23.9	22.0	0.100	5d149	3258	3.970	40.400	39.700	-1.73%
I	2450	BODY	01/26/2015	22.5	23.5	0.100	719	3209	5.470	51.800	54.700	5.60%
I	2450	BODY	02/02/2015	24.4	23.5	0.100	719	3209	5.420	51.800	54.200	4.63%
I	2600	BODY	01/26/2015	22.5	23.5	0.100	1071	3209	6.050	56.900	60.500	6.33%
E	5300	BODY	01/26/2015	21.8	21.2	0.100	1120	7308	7.200	75.800	72.000	-5.01%
E	5500	BODY	01/26/2015	21.8	21.2	0.100	1120	7308	7.230	79.200	72.300	-8.71%
E	5600	BODY	01/26/2015	21.7	21.3	0.100	1120	7308	7.790	79.400	77.900	-1.89%
E	5800	BODY	01/26/2015	21.7	21.3	0.100	1120	7308	6.790	74.400	67.900	-8.74%

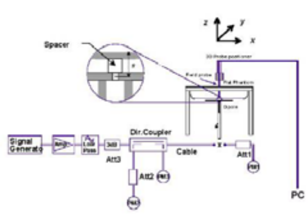


Figure 10-1
System Verification Setup Diagram

Figure 10-2
System Verification Setup Photo

11 SAR DATA SUMMARY

11.1 Standalone Head SAR Data

Table 11-1
GSM 850 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.0	31.96	0.13	Right	Cheek	085EA	1:8.3	0.143	1.271	0.182	A1
836.60	190	GSM 850	GSM	33.0	31.96	-0.01	Right	Tilt	085EA	1:8.3	0.089	1.271	0.113	
836.60	190	GSM 850	GSM	33.0	31.96	0.05	Left	Cheek	085EA	1:8.3	0.122	1.271	0.155	
836.60	190	GSM 850	GSM	33.0	31.96	-0.03	Left	Tilt	085EA	1:8.3	0.108	1.271	0.137	
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	23.5	23.46	0.03	Right	Cheek	085EA	1:1	0.179	1.009	0.181	A2
836.60	4183	UMTS 850	RMC	23.5	23.46	0.07	Right	Tilt	085EA	1:1	0.109	1.009	0.110	
836.60	4183	UMTS 850	RMC	23.5	23.46	0.04	Left	Cheek	085EA	1:1	0.158	1.009	0.159	
836.60	4183	UMTS 850	RMC	23.5	23.46	0.03	Left	Tilt	085EA	1:1	0.113	1.009	0.114	
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	30.0	29.27	0.20	Right	Cheek	085EA	1:8.3	0.029	1.183	0.034	
1880.00	661	GSM 1900	GSM	30.0	29.27	0.19	Right	Tilt	085EA	1:8.3	0.011	1.183	0.013	
1880.00	661	GSM 1900	GSM	30.0	29.27	0.18	Left	Cheek	085EA	1:8.3	0.040	1.183	0.047	A3
1880.00	661	GSM 1900	GSM	30.0	29.27	0.13	Left	Tilt	085EA	1:8.3	0.013	1.183	0.015	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 11-4
UMTS 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	23.5	23.41	-0.20	Right	Cheek	085EA	1:1	0.136	1.021	0.139	A4
1880.00	9400	UMTS 1900	RMC	23.5	23.41	0.20	Right	Tilt	085EA	1:1	0.032	1.021	0.033	
1880.00	9400	UMTS 1900	RMC	23.5	23.41	0.09	Left	Cheek	085EA	1:1	0.086	1.021	0.088	
1880.00	9400	UMTS 1900	RMC	23.5	23.41	0.03	Left	Tilt	085EA	1:1	0.033	1.021	0.034	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 11-5
LTE Band 4 (AWS) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.74	-0.11	0	Right	Cheek	QPSK	1	0	085EA	1:1	0.137	1.062	0.145	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	20.83	0.04	1	Right	Cheek	QPSK	50	0	085EA	1:1	0.106	1.309	0.139	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.74	0.12	0	Right	Tilt	QPSK	1	0	085EA	1:1	0.087	1.062	0.092	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	20.83	0.07	1	Right	Tilt	QPSK	50	0	085EA	1:1	0.050	1.309	0.065	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.74	-0.03	0	Left	Cheek	QPSK	1	0	085EA	1:1	0.175	1.062	0.186	A5
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	20.83	0.01	1	Left	Cheek	QPSK	50	0	085EA	1:1	0.122	1.309	0.160	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.74	-0.16	0	Left	Tilt	QPSK	1	0	085EA	1:1	0.071	1.062	0.075	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	20.83	0.05	1	Left	Tilt	QPSK	50	0	085EA	1:1	0.050	1.309	0.065	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

Table 11-6
LTE Band 41 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)	
2506.00	39750	Low	LTE Band 41	20	23.5	23.48	0.20	0	Right	Cheek	QPSK	1	0	085EA	1:1.58	0.167	1.005	0.168	A6
2506.00	39750	Low	LTE Band 41	20	22.5	22.42	0.01	1	Right	Cheek	QPSK	50	0	085EA	1:1.58	0.122	1.019	0.124	
2506.00	39750	Low	LTE Band 41	20	23.5	23.48	0.05	0	Right	Tilt	QPSK	1	0	085EA	1:1.58	0.023	1.005	0.023	
2506.00	39750	Low	LTE Band 41	20	22.5	22.42	0.04	1	Right	Tilt	QPSK	50	0	085EA	1:1.58	0.018	1.019	0.018	
2506.00	39750	Low	LTE Band 41	20	23.5	23.48	-0.09	0	Left	Cheek	QPSK	1	0	085EA	1:1.58	0.042	1.005	0.042	
2506.00	39750	Low	LTE Band 41	20	22.5	22.42	0.20	1	Left	Cheek	QPSK	50	0	085EA	1:1.58	0.032	1.019	0.033	
2506.00	39750	Low	LTE Band 41	20	23.5	23.48	0.04	0	Left	Tilt	QPSK	1	0	085EA	1:1.58	0.040	1.005	0.040	
2506.00	39750	Low	LTE Band 41	20	22.5	22.42	0.08	1	Left	Tilt	QPSK	50	0	085EA	1:1.58	0.032	1.019	0.033	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

Table 11-7
DTS Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
2412	1	802.11b	DSSS	22	17.5	17.05	-0.01	Right	Cheek	1	08602	1	99.99	0.555	0.455	1.109	1.000	0.505	
2412	1	802.11b	DSSS	22	17.5	17.05	0.13	Right	Tilt	1	08602	1	99.99	0.532	0.424	1.109	1.000	0.470	
2412	1	802.11b	DSSS	22	17.5	17.05	-	Left	Cheek	1	08602	1	99.99	0.452	-	1.109	1.000	-	
2412	1	802.11b	DSSS	22	17.5	17.05	-	Left	Tilt	1	08602	1	99.99	0.424	-	1.109	1.000	-	
2437	6	802.11b	DSSS	22	17.5	17.36	-0.15	Right	Cheek	2	08602	1	99.99	0.420	0.259	1.033	1.000	0.268	
2437	6	802.11b	DSSS	22	17.5	17.36	-	Right	Tilt	2	08602	1	99.99	0.156	-	1.033	1.000	-	
2437	6	802.11b	DSSS	22	17.5	17.36	-0.12	Left	Cheek	2	08602	1	99.99	1.052	0.848	1.033	1.000	0.876	A7
2462	11	802.11b	DSSS	22	17.5	17.05	0.20	Left	Cheek	2	08602	1	99.99	1.105	0.801	1.109	1.000	0.888	
2437	6	802.11b	DSSS	22	17.5	17.36	-	Left	Tilt	2	08602	1	99.99	0.416	-	1.033	1.000	-	
2437	6	802.11b	DSSS	22	17.5	17.36	-0.05	Left	Cheek	2	08602	1	99.99	1.033	0.812	1.033	1.000	0.839	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram											

Blue entry represents variability measurement.

Table 11-8
NII Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle %	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
5310	62	802.11n	OFDM	40	12.5	12.46	0.08	Right	Cheek	1	08602	13.5	94.78	1.237	0.518	1.009	1.055	0.552	
5310	62	802.11n	OFDM	40	12.5	12.46	0.20	Right	Tilt	1	08602	13.5	94.78	1.064	0.364	1.009	1.055	0.387	
5310	62	802.11n	OFDM	40	12.5	12.46	-	Left	Cheek	1	08602	13.5	94.78	0.635	-	1.009	1.055	-	
5310	62	802.11n	OFDM	40	12.5	12.46	-	Left	Tilt	1	08602	13.5	94.78	0.454	-	1.009	1.055	-	
5310	62	802.11n	OFDM	40	12.5	12.47	-	Right	Cheek	2	08602	13.5	92.26	0.258	-	1.007	1.084	-	
5310	62	802.11n	OFDM	40	12.5	12.47	-	Right	Tilt	2	08602	13.5	92.26	0.234	-	1.007	1.084	-	
5310	62	802.11n	OFDM	40	12.5	12.47	-	Left	Cheek	2	08602	13.5	92.26	0.339	-	1.007	1.084	-	
5310	62	802.11n	OFDM	40	12.5	12.47	0.02	Left	Tilt	2	08602	13.5	92.26	0.618	0.205	1.007	1.084	0.223	
5510	102	802.11n	OFDM	40	12.5	12.28	0.16	Right	Cheek	1	08602	13.5	94.78	1.306	0.580	1.052	1.055	0.644	A8
5510	102	802.11n	OFDM	40	12.5	12.28	0.03	Right	Tilt	1	08602	13.5	94.78	1.002	0.406	1.052	1.055	0.450	
5510	102	802.11n	OFDM	40	12.5	12.28	-	Left	Cheek	1	08602	13.5	94.78	0.587	-	1.052	1.055	-	
5510	102	802.11n	OFDM	40	12.5	12.28	-	Left	Tilt	1	08602	13.5	94.78	0.528	-	1.052	1.055	-	
5510	102	802.11ac	OFDM	40	12.5	12.35	-	Right	Cheek	2	08602	13.5	92.16	0.354	-	1.035	1.085	-	
5510	102	802.11ac	OFDM	40	12.5	12.35	-	Right	Tilt	2	08602	13.5	92.16	0.337	-	1.035	1.085	-	
5510	102	802.11ac	OFDM	40	12.5	12.35	0.06	Left	Cheek	2	08602	13.5	92.16	0.501	0.221	1.035	1.085	0.248	
5510	102	802.11ac	OFDM	40	12.5	12.35	-	Left	Tilt	2	08602	13.5	92.16	0.458	-	1.035	1.085	-	
5755	151	802.11ac	OFDM	40	12.5	12.47	0.20	Right	Cheek	1	08602	13.5	92.29	1.144	0.431	1.007	1.084	0.470	
5755	151	802.11ac	OFDM	40	12.5	12.47	0.03	Right	Tilt	1	08602	13.5	92.29	0.772	0.275	1.007	1.084	0.300	
5755	151	802.11ac	OFDM	40	12.5	12.47	-	Left	Cheek	1	08602	13.5	92.29	0.430	-	1.007	1.084	-	
5755	151	802.11ac	OFDM	40	12.5	12.47	-	Left	Tilt	1	08602	13.5	92.29	0.390	-	1.007	1.084	-	
5670	134	802.11ac	OFDM	40	12.5	12.38	-	Right	Cheek	2	08602	13.5	92.16	0.503	-	1.028	1.085	-	
5670	134	802.11ac	OFDM	40	12.5	12.38	-	Right	Tilt	2	08602	13.5	92.16	0.472	-	1.028	1.085	-	
5670	134	802.11ac	OFDM	40	12.5	12.38	0.20	Left	Cheek	2	08602	13.5	92.16	0.892	0.356	1.028	1.085	0.397	
5670	134	802.11ac	OFDM	40	12.5	12.38	-	Left	Tilt	2	08602	13.5	92.16	0.766	-	1.028	1.085	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram											

11.2 Standalone Body-Worn SAR Data

Table 11-9
GSM/UMTS Body-Worn SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of Time Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.0	31.96	-0.09	10 mm	085EA	1	1:8.3	back	0.340	1.271	0.432	A9
836.60	4183	UMTS 850	RMC	23.5	23.46	0.02	10 mm	085EA	N/A	1:1	back	0.334	1.009	0.337	A11
1880.00	661	GSM 1900	GSM	30.0	29.27	0.09	10 mm	085EA	1	1:8.3	back	0.290	1.183	0.343	A13
1880.00	9400	UMTS 1900	RMC	23.5	23.41	0.08	10 mm	085EA	N/A	1:1	back	0.634	1.021	0.647	A15
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
LTE Body-Worn SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.74	-0.03	0	085EA	QPSK	1	0	10 mm	back	1:1	0.752	1.062	0.799	A17
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	20.83	-0.08	1	085EA	QPSK	50	0	10 mm	back	1:1	0.559	1.309	0.732	
2506.00	39750	Low	LTE Band 41	20	23.5	23.48	0.00	0	085EA	QPSK	1	0	10 mm	back	1:1.58	0.778	1.005	0.782	A19
2549.50	40185	Low-Mid	LTE Band 41	20	23.5	23.35	0.02	0	085EA	QPSK	1	0	10 mm	back	1:1.58	0.732	1.035	0.758	
2593.00	40620	Mid	LTE Band 41	20	23.5	23.34	-0.01	0	085EA	QPSK	1	0	10 mm	back	1:1.58	0.674	1.038	0.700	
2636.50	41055	Mid-High	LTE Band 41	20	23.5	23.37	-0.09	0	085EA	QPSK	1	50	10 mm	back	1:1.58	0.586	1.030	0.604	
2680.00	41490	High	LTE Band 41	20	23.5	23.46	0.03	0	085EA	QPSK	1	50	10 mm	back	1:1.58	0.578	1.009	0.583	
2506.00	39750	Low	LTE Band 41	20	22.5	22.42	0.01	1	085EA	QPSK	50	0	10 mm	back	1:1.58	0.541	1.019	0.551	
2506.00	39750	Low	LTE Band 41	20	22.5	22.41	0.01	1	085EA	QPSK	100	0	10 mm	back	1:1.58	0.530	1.021	0.541	
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 11-11
DTS Body-Worn SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle %	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
2412	1	802.11b	DSSS	22	17.5	17.05	-0.03	10 mm	1	08602	1	back	99.99	0.133	0.110	1.109	1.000	0.122	A20
2437	6	802.11b	DSSS	22	17.5	17.36	0.14	10 mm	2	08602	1	back	99.99	0.105	0.083	1.033	1.000	0.086	
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 11-12
NII Body-Worn SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle %	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
5310	62	802.11n	OFDM	40	12.5	12.46	-0.09	10 mm	1	08602	13.5	back	94.78	0.061	0.026	1.009	1.055	0.027	
5310	62	802.11n	OFDM	40	12.5	12.47	0.05	10 mm	2	08602	13.5	back	92.26	0.055	0.027	1.007	1.084	0.029	
5510	102	802.11n	OFDM	40	12.5	12.28	0.03	10 mm	1	08602	13.5	back	94.78	0.059	0.028	1.052	1.055	0.031	
5510	102	802.11ac	OFDM	40	12.5	12.35	0.05	10 mm	2	08602	13.5	back	92.16	0.088	0.041	1.035	1.085	0.046	
5755	151	802.11ac	OFDM	40	12.5	12.47	0.09	10 mm	1	08602	13.5	back	92.29	0.029	0.013	1.007	1.084	0.014	
5670	134	802.11ac	OFDM	40	12.5	12.38	0.03	10 mm	2	08602	13.5	back	92.16	0.119	0.048	1.028	1.085	**0.053**	A22
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

11.3 Standalone Wireless Router SAR Data

Table 11-13
GPRS/UMTS Hotspot SAR Data

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of GPRS Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GPRS	29.0	28.89	-0.11	10 mm	085EA	4	1:2.076	back	0.593	1.026	0.608	
836.60	190	GSM 850	GPRS	29.0	28.89	-0.01	10 mm	085EA	4	1:2.076	front	0.499	1.026	0.512	
836.60	190	GSM 850	GPRS	29.0	28.89	-0.07	10 mm	085EA	4	1:2.076	bottom	0.283	1.026	0.290	
836.60	190	GSM 850	GPRS	29.0	28.89	0.02	10 mm	085EA	4	1:2.076	right	0.597	1.026	0.613	A10
836.60	190	GSM 850	GPRS	29.0	28.89	-0.04	10 mm	085EA	4	1:2.076	left	0.401	1.026	0.411	
836.60	4183	UMTS 850	RMC	23.5	23.46	0.02	10 mm	085EA	N/A	1:1	back	0.334	1.009	0.337	
836.60	4183	UMTS 850	RMC	23.5	23.46	0.02	10 mm	085EA	N/A	1:1	front	0.317	1.009	0.320	
836.60	4183	UMTS 850	RMC	23.5	23.46	0.00	10 mm	085EA	N/A	1:1	bottom	0.187	1.009	0.189	
836.60	4183	UMTS 850	RMC	23.5	23.46	0.04	10 mm	085EA	N/A	1:1	right	0.460	1.009	0.464	A12
836.60	4183	UMTS 850	RMC	23.5	23.46	0.05	10 mm	085EA	N/A	1:1	left	0.260	1.009	0.262	
1880.00	661	GSM 1900	GPRS	27.0	26.00	0.00	10 mm	085EA	3	1:2.76	back	0.308	1.259	0.388	
1880.00	661	GSM 1900	GPRS	27.0	26.00	-0.08	10 mm	085EA	3	1:2.76	front	0.374	1.259	0.471	
1880.00	661	GSM 1900	GPRS	27.0	26.00	-0.02	10 mm	085EA	3	1:2.76	bottom	0.611	1.259	0.769	A14
1880.00	661	GSM 1900	GPRS	27.0	26.00	0.20	10 mm	085EA	3	1:2.76	right	0.008	1.259	0.010	
1880.00	661	GSM 1900	GPRS	27.0	26.00	-0.04	10 mm	085EA	3	1:2.76	left	0.107	1.259	0.135	
1880.00	9400	UMTS 1900	RMC	23.5	23.41	0.08	10 mm	085EA	N/A	1:1	back	0.634	1.021	0.647	
1880.00	9400	UMTS 1900	RMC	23.5	23.41	-0.04	10 mm	085EA	N/A	1:1	front	0.728	1.021	0.743	
1852.40	9262	UMTS 1900	RMC	23.5	23.23	0.02	10 mm	085EA	N/A	1:1	bottom	0.880	1.064	0.936	
1880.00	9400	UMTS 1900	RMC	23.5	23.41	0.01	10 mm	085EA	N/A	1:1	bottom	0.942	1.021	0.962	
1907.60	9538	UMTS 1900	RMC	23.5	23.09	0.01	10 mm	085EA	N/A	1:1	bottom	0.970	1.099	**1.066**	A16
1880.00	9400	UMTS 1900	RMC	23.5	23.41	0.02	10 mm	085EA	N/A	1:1	right	0.039	1.021	0.040	
1880.00	9400	UMTS 1900	RMC	23.5	23.41	0.06	10 mm	085EA	N/A	1:1	left	0.183	1.021	0.187	
1907.60	9538	UMTS 1900	RMC	23.5	23.09	-0.01	10 mm	085EA	N/A	1:1	bottom	0.914	1.099	1.004	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

Blue entry represents variability measurement.

Table 11-14
LTE Band 4 (AWS) Hotspot SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.74	-0.03	0	085EA	QPSK	1	0	10 mm	back	1:1	0.752	1.062	0.799	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	20.83	-0.08	1	085EA	QPSK	50	0	10 mm	back	1:1	0.559	1.309	0.732	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.74	-0.04	0	085EA	QPSK	1	0	10 mm	front	1:1	0.956	1.062	1.015	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	20.83	0.04	1	085EA	QPSK	50	0	10 mm	front	1:1	0.718	1.309	0.940	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	20.76	0.02	1	085EA	QPSK	100	0	10 mm	front	1:1	0.703	1.330	0.935	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.74	-0.03	0	085EA	QPSK	1	0	10 mm	bottom	1:1	0.958	1.062	1.017	A18
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	20.83	-0.04	1	085EA	QPSK	50	0	10 mm	bottom	1:1	0.641	1.309	0.839	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	20.76	-0.15	1	085EA	QPSK	100	0	10 mm	bottom	1:1	0.627	1.330	0.834	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.74	0.19	0	085EA	QPSK	1	0	10 mm	right	1:1	0.054	1.062	0.057	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	20.83	-0.01	1	085EA	QPSK	50	0	10 mm	right	1:1	0.035	1.309	0.046	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.74	-0.16	0	085EA	QPSK	1	0	10 mm	left	1:1	0.352	1.062	0.374	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	20.83	0.00	1	085EA	QPSK	50	0	10 mm	left	1:1	0.256	1.309	0.335	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.74	0.03	0	085EA	QPSK	1	0	10 mm	bottom	1:1	0.937	1.062	0.995	
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 11-15
LTE Band 41 Hotspot SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
2506.00	39750	Low	LTE Band 41	20	23.5	23.48	0.00	0	085EA	QPSK	1	0	10 mm	back	1:1.58	0.778	1.005	0.782	A19
2549.50	40185	Low-Mid	LTE Band 41	20	23.5	23.35	0.02	0	085EA	QPSK	1	0	10 mm	back	1:1.58	0.732	1.035	0.758	
2593.00	40620	Mid	LTE Band 41	20	23.5	23.34	-0.01	0	085EA	QPSK	1	0	10 mm	back	1:1.58	0.674	1.038	0.700	
2636.50	41055	Mid-High	LTE Band 41	20	23.5	23.37	-0.09	0	085EA	QPSK	1	50	10 mm	back	1:1.58	0.586	1.030	0.604	
2680.00	41490	High	LTE Band 41	20	23.5	23.46	0.03	0	085EA	QPSK	1	50	10 mm	back	1:1.58	0.578	1.009	0.583	
2506.00	39750	Low	LTE Band 41	20	22.5	22.42	0.01	1	085EA	QPSK	50	0	10 mm	back	1:1.58	0.541	1.019	0.551	
2506.00	39750	Low	LTE Band 41	20	22.5	22.41	0.01	1	085EA	QPSK	100	0	10 mm	back	1:1.58	0.530	1.021	0.541	
2506.00	39750	Low	LTE Band 41	20	23.5	23.48	0.01	0	085EA	QPSK	1	0	10 mm	front	1:1.58	0.294	1.005	0.295	
2506.00	39750	Low	LTE Band 41	20	22.5	22.42	0.04	1	085EA	QPSK	50	0	10 mm	front	1:1.58	0.232	1.019	0.236	
2506.00	39750	Low	LTE Band 41	20	23.5	23.48	0.08	0	085EA	QPSK	1	0	10 mm	bottom	1:1.58	0.153	1.005	0.154	
2506.00	39750	Low	LTE Band 41	20	22.5	22.42	0.02	1	085EA	QPSK	50	0	10 mm	bottom	1:1.58	0.126	1.019	0.128	
2506.00	39750	Low	LTE Band 41	20	23.5	23.48	0.00	0	085EA	QPSK	1	0	10 mm	right	1:1.58	0.056	1.005	0.056	
2506.00	39750	Low	LTE Band 41	20	22.5	22.42	0.02	1	085EA	QPSK	50	0	10 mm	right	1:1.58	0.044	1.019	0.045	
2506.00	39750	Low	LTE Band 41	20	23.5	23.48	0.03	0	085EA	QPSK	1	0	10 mm	left	1:1.58	0.024	1.005	0.024	
2506.00	39750	Low	LTE Band 41	20	22.5	22.42	0.14	1	085EA	QPSK	50	0	10 mm	left	1:1.58	0.018	1.019	0.018	
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 11-16
WLAN Hotspot SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle %	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
2412	1	802.11b	DSSS	22	17.5	17.05	-	10 mm	1	08602	1	back	99.99	0.133	-	1.109	1.000	-	
2412	1	802.11b	DSSS	22	17.5	17.05	-	10 mm	1	08602	1	front	99.99	0.202	-	1.109	1.000	-	
2412	1	802.11b	DSSS	22	17.5	17.05	-0.20	10 mm	1	08602	1	top	99.99	0.267	0.221	1.109	1.000	**0.245**	A21
2412	1	802.11b	DSSS	22	17.5	17.05	-	10 mm	1	08602	1	left	99.99	0.051	-	1.109	1.000	-	
2437	6	802.11b	DSSS	22	17.5	17.36	-	10 mm	2	08602	1	back	99.99	0.105	-	1.033	1.000	-	
2437	6	802.11b	DSSS	22	17.5	17.36	0.04	10 mm	2	08602	1	front	99.99	0.220	0.135	1.033	1.000	0.139	
2437	6	802.11b	DSSS	22	17.5	17.36	-	10 mm	2	08602	1	top	99.99	0.048	-	1.033	1.000	-	
2437	6	802.11b	DSSS	22	17.5	17.36	-	10 mm	2	08602	1	right	99.99	0.024	-	1.033	1.000	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

11.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01, body-worn SAR was evaluated without a headset connected to the device. Since the standalone reported body-worn SAR was ≤ 1.2 W/kg, no additional body-worn SAR evaluations using a headset cable were required.
8. 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.
9. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v02, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.7 for more details).

GSM Test Notes:

1. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
2. Justification for reduced test configurations per KDB Publication 941225 D01v01 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 hotspot 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. 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 D01v03. 3G SAR test reduction procedure is applied to HSPA and DC-HSDPA with 12.2 kbps RMC as the primary mode.
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.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r03. The general test procedures used for testing can be found in Section 8.5.4.
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).
4. Per FCC KDB Publication 447498 D01v05r01, when the reported (scaled) for LTE Band 41 SAR measured at the highest output power channel in a given a test configuration was > 0.6 W/kg, testing at the other channels was required for such test configurations.
5. TDD LTE was tested per FCC KDB 941225 D05v02r03 and using the guidance provided in April 2013 TCB workshop notes. Testing was performed using UL-DL configuration 0 with 6 UL subframes and 2 S subframes using extended cyclic prefix only and special subframe configuration 6. SAR tests were performed at maximum output power and worst-case transmission duty factor in extended cyclic prefix. Per 3GPP 36.211 Section 4, the duty factor for special subframe configuration 6 using extended cyclic prefix is 0.633.
6. Per KDB Publication 941225 D05Av01r01, SAR for LTE CA operations was not needed since the maximum average output power in LTE CA mode was not >0.25 dB higher than the maximum output power when downlink carrier aggregation was inactive.

WLAN Notes:

1. For held-to-ear and hotspot operations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01DR02-41929 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 8.6.5 for more information.
3. Justification for test configurations for WLAN per KDB Publication 248227 D01DR02-41929 for 5 GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg. See Section 8.6.6 for more information.
4. Per KDB Publication 248227 D01DR02-41929, SAR for MIMO was evaluated by following the simultaneous SAR provisions from KDB Publication 447498. Please see Section 12 for complete analysis.

5. When the maximum reported 1g averaged SAR is ≤0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
6. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated EMC test reports.
7. Wireless Router operations are not allowed by the chipset firmware using 5GHz WIFI. Therefore, 5GHz WIFI was not tested for Hotspot SAR.

12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05r02 are applicable to devices with built-in unlicensed transmitters such as 802.11 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. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1-g or 10-g SAR.

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	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2480	9.50	10	0.189

Note:

Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

Since the sum of 1g single transmission chain SAR measurements is <1.6 W/kg, MIMO SAR is determined by the sum of 1g single transmission chain SAR values because the summation represents higher output power and yields more conservative result per KDB 248227 D01 DR02-41929.

The highest Reported SAR for each exposure condition is used for SAR summation purpose.

12.3 Head SAR Simultaneous Transmission Analysis

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.182	0.505	0.687
	UMTS 850	0.181	0.505	0.686
	GSM 1900	0.047	0.505	0.552
	UMTS 1900	0.139	0.505	0.644
	LTE Band 4 (AWS)	0.186	0.505	**0.691**
	LTE Band 41	0.168	0.505	0.673

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.182	0.888	1.070
	UMTS 850	0.181	0.888	1.069
	GSM 1900	0.047	0.888	0.935
	UMTS 1900	0.139	0.888	1.027
	LTE Band 4 (AWS)	0.186	0.888	**1.074**
	LTE Band 41	0.168	0.888	1.056

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.182	0.505	0.888	1.575
	UMTS 850	0.181	0.505	0.888	1.574
	GSM 1900	0.047	0.505	0.888	1.440
	UMTS 1900	0.139	0.505	0.888	1.532
	LTE Band 4 (AWS)	0.186	0.505	0.888	**1.579**
	LTE Band 41	0.168	0.505	0.888	1.561

Table 12-5
Simultaneous Transmission Scenario with 5 GHz WLAN - Ant 1 (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.182	0.644	0.826
	UMTS 850	0.181	0.644	0.825
	GSM 1900	0.047	0.644	0.691
	UMTS 1900	0.139	0.644	0.783
	LTE Band 4 (AWS)	0.186	0.644	**0.830**
	LTE Band 41	0.168	0.644	0.812

Table 12-6
Simultaneous Transmission Scenario with 5 GHz WLAN - Ant 2 (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.182	0.397	0.579
	UMTS 850	0.181	0.397	0.578
	GSM 1900	0.047	0.397	0.444
	UMTS 1900	0.139	0.397	0.536
	LTE Band 4 (AWS)	0.186	0.397	**0.583**
	LTE Band 41	0.168	0.397	0.565

Table 12-7
Simultaneous Transmission Scenario with 5 GHz WLAN MIMO (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.182	0.644	0.397	1.223
	UMTS 850	0.181	0.644	0.397	1.222
	GSM 1900	0.047	0.644	0.397	1.088
	UMTS 1900	0.139	0.644	0.397	1.180
	LTE Band 4 (AWS)	0.186	0.644	0.397	**1.227**
	LTE Band 41	0.168	0.644	0.397	1.209

12.4 Body-Worn Simultaneous Transmission Analysis

Table 12-8
Simultaneous Transmission Scenario with 2.4 GHz WLAN – Ant 1 (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.432	0.122	0.554
	UMTS 850	0.337	0.122	0.459
	GSM 1900	0.343	0.122	0.465
	UMTS 1900	0.647	0.122	0.769
	LTE Band 4 (AWS)	0.799	0.122	**0.921**
	LTE Band 41	0.782	0.122	0.904

Table 12-9
Simultaneous Transmission Scenario with 2.4 GHz WLAN - Ant 2 (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.432	0.086	0.518
	UMTS 850	0.337	0.086	0.423
	GSM 1900	0.343	0.086	0.429
	UMTS 1900	0.647	0.086	0.733
	LTE Band 4 (AWS)	0.799	0.086	**0.885**
	LTE Band 41	0.782	0.086	0.868

Table 12-10
Simultaneous Transmission Scenario with 2.4 GHz WLAN MIMO (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.432	0.122	0.086	0.640
	UMTS 850	0.337	0.122	0.086	0.545
	GSM 1900	0.343	0.122	0.086	0.551
	UMTS 1900	0.647	0.122	0.086	0.855
	LTE Band 4 (AWS)	0.799	0.122	0.086	**1.007**
	LTE Band 41	0.782	0.122	0.086	0.990

Table 12-11
Simultaneous Transmission Scenario with 5 GHz WLAN Ant 1 (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.432	0.031	0.463
	UMTS 850	0.337	0.031	0.368
	GSM 1900	0.343	0.031	0.374
	UMTS 1900	0.647	0.031	0.678
	LTE Band 4 (AWS)	0.799	0.031	**0.830**
	LTE Band 41	0.782	0.031	0.813

Table 12-12
Simultaneous Transmission Scenario with 5 GHz WLAN Ant 2 (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.432	0.053	0.485
	UMTS 850	0.337	0.053	0.390
	GSM 1900	0.343	0.053	0.396
	UMTS 1900	0.647	0.053	0.700
	LTE Band 4 (AWS)	0.799	0.053	**0.852**
	LTE Band 41	0.782	0.053	0.835

Table 12-13
Simultaneous Transmission Scenario with 5 GHz WLAN MIMO (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.432	0.031	0.053	0.516
	UMTS 850	0.337	0.031	0.053	0.421
	GSM 1900	0.343	0.031	0.053	0.427
	UMTS 1900	0.647	0.031	0.053	0.731
	LTE Band 4 (AWS)	0.799	0.031	0.053	**0.883**
	LTE Band 41	0.782	0.031	0.053	0.866

Table 12-14
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.432	0.189	0.621
	UMTS 850	0.337	0.189	0.526
	GSM 1900	0.343	0.189	0.532
	UMTS 1900	0.647	0.189	0.836
	LTE Band 4 (AWS)	0.799	0.189	**0.988**
	LTE Band 41	0.782	0.189	0.971

12.5 Hotspot SAR Simultaneous Transmission Analysis

Table 12-15
Simultaneous Transmission Scenario with 2.4 GHz – Ant 1 (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	GPRS 850	0.613	0.245	0.858
	UMTS 850	0.464	0.245	0.709
	GPRS 1900	0.769	0.245	1.014
	UMTS 1900	1.066	0.245	**1.311**
	LTE Band 4 (AWS)	1.017	0.245	1.262
	LTE Band 41	0.782	0.245	1.027

Table 12-16
Simultaneous Transmission Scenario with 2.4 GHz WLAN - Ant 2 (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	GPRS 850	0.613	0.139	0.752
	UMTS 850	0.464	0.139	0.603
	GPRS 1900	0.769	0.139	0.908
	UMTS 1900	1.066	0.139	**1.205**
	LTE Band 4 (AWS)	1.017	0.139	1.156
	LTE Band 41	0.782	0.139	0.921

Table 12-17
Simultaneous Transmission Scenario with 2.4 GHz WLAN MIMO (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	GPRS 850	0.613	0.245	0.139	0.997
	UMTS 850	0.464	0.245	0.139	0.848
	GPRS 1900	0.769	0.245	0.139	1.153
	UMTS 1900	1.066	0.245	0.139	**1.450**
	LTE Band 4 (AWS)	1.017	0.245	0.139	1.401
	LTE Band 41	0.782	0.245	0.139	1.166

12.6 Simultaneous Transmission Conclusion

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

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
Head SAR Measurement Variability Results

HEAD VARIABILITY RESULTS														
Band	FREQUENCY		Mode/Band	Service	Side	Test Position	Data Rate (Mbps)	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)	
2450	2437.00	6	802.11b 22 MHz Bandwidth	DSSS , ANT 2	Left	Cheek	1	0.848	0.812	1.04	N/A	N/A	N/A	N/A
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 13-2
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS														
Band	FREQUENCY		Mode	Service	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	bottom	10.0 mm	0.970	0.914	1.06	N/A	N/A	N/A	N/A
1750	1732.50	20175	LTE Band 4 (AWS)	QPSK, 1 RB, 0 RB Offset	bottom	10.0 mm	0.958	0.937	1.02	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.

14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/15/2014	Annual	4/15/2015	MY45470194
Agilent	8753E	(30kHz-6GHz) Network Analyzer	12/30/2014	Annual	12/30/2015	JP38020182
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8648D	(9kHz-4GHz) Signal Generator	4/15/2014	Annual	4/15/2015	3629U00687
Agilent	E4407B	ESA Spectrum Analyzer	4/16/2014	Annual	4/16/2015	US39210313
Agilent	E4438C	ESG Vector Signal Generator	4/25/2014	Annual	4/25/2015	MY42082385
Agilent	E4432B	ESG-D Series Signal Generator	4/15/2014	Annual	4/15/2015	US40053896
Agilent	N9020A	MXA Signal Analyzer	10/27/2014	Annual	10/27/2015	US46470561
Agilent	N5182A	MXG Vector Signal Generator	4/15/2014	Annual	4/15/2015	MY47420800
Agilent	N5182A	MXG Vector Signal Generator	4/15/2014	Annual	4/15/2015	MY47420651
Agilent	8753ES	S-Parameter Network Analyzer	5/22/2014	Annual	5/22/2015	US39170118
Agilent	E5515C	Wireless Communications Test Set	11/4/2014	Biennial	11/4/2016	GB43193563
Agilent	E5515C	Wireless Communications Test Set	11/20/2014	Biennial	11/20/2016	GB43163447
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433972
Anritsu	ML2469A	Power Meter	3/14/2014	Annual	3/14/2015	1306009
Anritsu	MA2411B	Pulse Power Sensor	3/25/2014	Annual	3/25/2015	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/13/2014	Annual	11/13/2015	1339018
Anritsu	MT8820C	Radio Communication Analyzer	5/6/2014	Annual	5/6/2015	6201144419
Anritsu	MT8820C	Radio Communication Analyzer	8/28/2014	Annual	8/28/2015	6201240328
Anritsu	MA24106A	USB Power Sensor	5/15/2014	Annual	5/15/2015	1244524
Anritsu	MA24106A	USB Power Sensor	5/15/2014	Annual	5/15/2015	1244512
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
Control Company	36934-158	Wall-Mounted Thermometer	4/29/2014	Biennial	4/29/2016	122014488
Fisher Scientific	15-077-960	Digital Thermometer	12/4/2013	Biennial	12/4/2015	130764551
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264162
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMW500	Radio Communication Tester	7/9/2014	Annual	7/9/2015	106578
Rohde & Schwarz	CMW500	Radio Communication Tester	7/22/2014	Annual	7/22/2015	116743
Rohde & Schwarz	CMW500	Radio Communication Tester	9/2/2014	Annual	9/2/2015	111427
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	22313
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/18/2014	Biennial	3/18/2016	N/A
SPEAG	D1765V2	1765 MHz SAR Dipole	5/7/2014	Annual	5/7/2015	1008
SPEAG	D2600V2	2600 MHz SAR Dipole	10/20/2014	Annual	10/20/2015	1071
SPEAG	D1900V2	1900 MHz SAR Dipole	7/23/2014	Annual	7/23/2015	5d149
SPEAG	D2450V2	2450 MHz SAR Dipole	8/11/2014	Annual	8/11/2015	719
SPEAG	D5GHzV2	5 GHz SAR Dipole	2/26/2014	Annual	2/26/2015	1120
SPEAG	D835V2	835 MHz SAR Dipole	7/24/2014	Annual	7/24/2015	4d133
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/26/2014	Annual	2/26/2015	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/17/2014	Annual	3/17/2015	1334
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/14/2014	Annual	5/14/2015	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/17/2014	Annual	9/17/2015	1323
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/18/2014	Annual	9/18/2015	1364
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/6/2014	Annual	5/6/2015	1070
SPEAG	ES3DV3	SAR Probe	2/25/2014	Annual	2/25/2015	3258
SPEAG	ES3DV3	SAR Probe	3/19/2014	Annual	3/19/2015	3209
SPEAG	ES3DV3	SAR Probe	5/15/2014	Annual	5/15/2015	3263
SPEAG	EX3DV4	SAR Probe	7/16/2014	Annual	7/16/2015	7308
SPEAG	ES3DV3	SAR Probe	9/24/2014	Annual	9/24/2015	3288
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/16/2014	Annual	4/16/2015	B010177
VWR	36934-158	Wall-Mounted Thermometer	8/8/2013	Biennial	8/8/2015	130477877

Note:

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

15 MEASUREMENT UNCERTAINTIES

Applicable for frequencies less than 3000 MHz.

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

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

Applicable for frequencies up to 6 GHz.

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

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

16 CONCLUSION

16.1 Measurement Conclusion

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

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

17 REFERENCES

[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, Aug. 1996.

[2] ANSI/IEEE C95.1-2005, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, 2006.

[3] ANSI/IEEE C95.1-1992, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, Sept. 1992.

[4] ANSI/IEEE C95.3-2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave, New York: IEEE, December 2002.

[5] IEEE Standards Coordinating Committee 39 –Standards Coordinating Committee 34 – IEEE Std. 1528-2003, Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head Due to Wireless Communications Devices: Measurement Techniques.

[6] NCRP, National Council on Radiation Protection and Measurements, Biological Effects and Exposure Criteria for RadioFrequency Electromagnetic Fields, NCRP Report No. 86, 1986. Reprinted Feb. 1995.

[7] T. Schmid, O. Egger, N. Kuster, Automated E-field scanning system for dosimetric assessments, IEEE Transaction on Microwave Theory and Techniques, vol. 44, Jan. 1996, pp. 105-113.

[8] K. Pokovic, T. Schmid, N. Kuster, Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies, ICECOM97, Oct. 1997, pp. -124.

[9] K. Pokovic, T. Schmid, and N. Kuster, E-field Probe with improved isotropy in brain simulating liquids, Proceedings of the ELMAR, Zadar, Croatia, June 23-25, 1996, pp. 172-175.

[10] Schmid & Partner Engineering AG, Application Note: Data Storage and Evaluation, June 1998, p2.

[11] V. Hombach, K. Meier, M. Burkhardt, E. Kuhn, N. Kuster, The Dependence of EM Energy Absorption upon Human Modeling at 900 MHz, IEEE Transaction on Microwave Theory and Techniques, vol. 44 no. 10, Oct. 1996, pp. 1865-1873.

[12] N. Kuster and Q. Balzano, Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz, IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.

[13] G. Hartsgrove, A. Kraszewski, A. Surowiec, Simulated Biological Materials for Electromagnetic Radiation Absorption Studies, University of Ottawa, Bioelectromagnetics, Canada: 1987, pp. 29-36.

[14] Q. Balzano, O. Garay, T. Manning Jr., Electromagnetic Energy Exposure of Simulated Users of Portable Cellular Telephones, IEEE Transactions on Vehicular Technology, vol. 44, no.3, Aug. 1995.

[15] W. Gander, Computermathematick, Birkhaeuser, Basel, 1992.

[16] W.H. Press, S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery, Numerical Recipes in C, The Art of Scientific Computing, Second edition, Cambridge University Press, 1992.

[17] N. Kuster, R. Kastle, T. Schmid, Dosimetric evaluation of mobile communications equipment with known precision, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.

[18] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10kHz-300GHz, Jan. 1995.

[19] Prof. Dr. Niels Kuster, ETH, Eidgenössische Technische Hoschschule Zürich, Dosimetric Evaluation of the Cellular Phone.

[20] IEC 62209-1, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz), Feb. 2005.

[21] Industry Canada RSS-102 Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) Issue 4, March 2010.

[22] Health Canada Safety Code 6 Limits of Human Exposure to Radio Frequency Electromagnetic Fields in the Frequency Range from 3 kHz – 300 GHz, 2009

[23] FCC SAR Test Procedures for 2G-3G Devices, Mobile Hotspot and UMPC Devices KDB Publications 941225, D01-D07

[24] SAR Measurement Guidance for IEEE 802.11 Transmitters, KDB Publication 248227 D01 DR02-41929

[25] FCC SAR Considerations for Handsets with Multiple Transmitters and Antennas, KDB Publications 648474 D03-D04

[26] FCC SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers, FCC KDB Publication 616217 D04

[27] FCC SAR Measurement and Reporting Requirements for 100MHz – 6 GHz, KDB Publications 865664 D01-D02

[28] FCC General RF Exposure Guidance and SAR Procedures for Dongles, KDB Publication 447498, D01-D02

[29] Anexo à Resolução No. 533, de 10 de Septembro de 2009.

[30] IEC 62209-2, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz), Mar. 2010.

APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

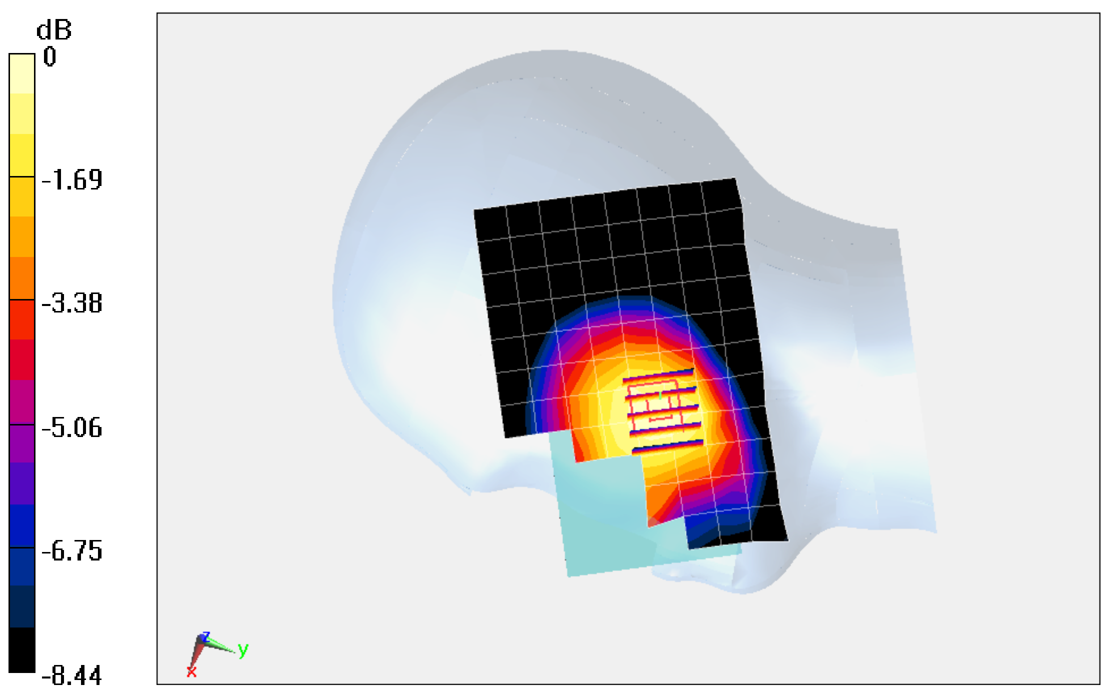
Communication System: UID 0, GSM; Frequency: 836.6 MHz;Duty Cycle: 1:8.3
Medium: 835 Head Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.899 S/m; ε_r = 42.087; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 01-28-2015; Ambient Temp: 24.4°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(6.27, 6.27, 6.27); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.57 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 0.174 W/kg
SAR(1 g) = 0.143 W/kg



0 dB = 0.153 W/kg = -8.15 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

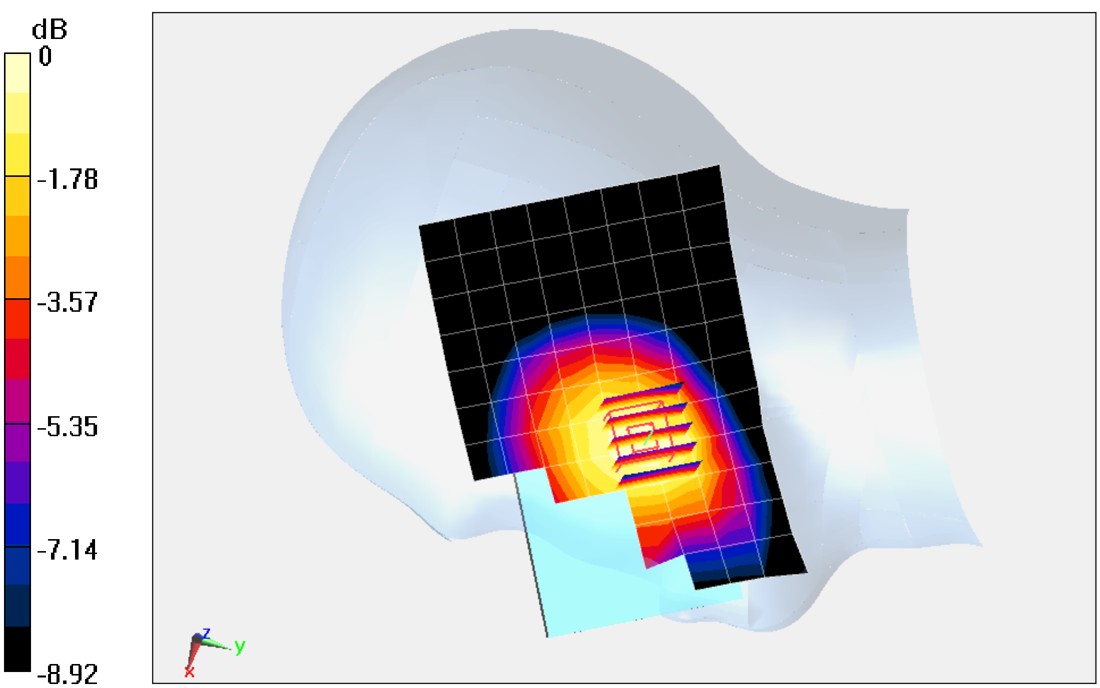
Communication System: UID 0, UMTS; Frequency: 836.6 MHz;Duty Cycle: 1:1
Medium: 835 Head Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.899 S/m; ε_r = 42.087; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 01-28-2015; Ambient Temp: 24.4°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(6.27, 6.27, 6.27); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: UMTS 850, Right Head, Cheek, 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 = 15.31 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.222 W/kg
SAR(1 g) = 0.179 W/kg



0 dB = 0.195 W/kg = -7.10 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

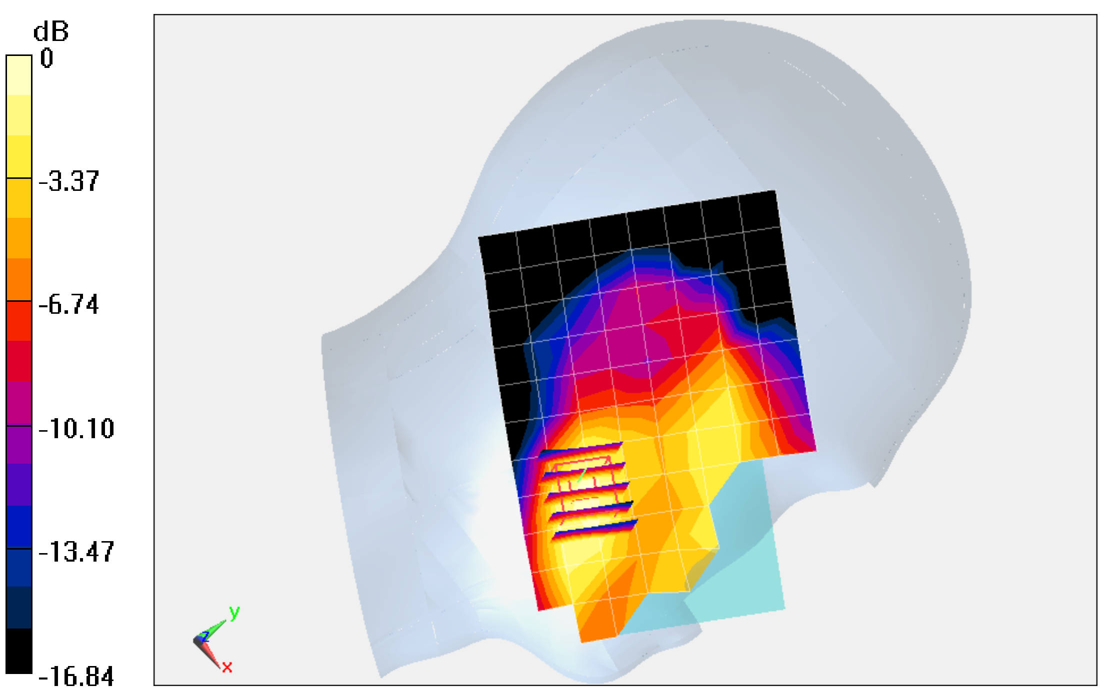
Communication System: UID 0, GSM1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.391 S/m; ε_r = 38.258; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 01-26-2015; Ambient Temp: 23.5°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3263; ConvF(5.08, 5.08, 5.08); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: GSM 1900, Left Head, Cheek, 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 = 5.469 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 0.0640 W/kg
SAR(1 g) = 0.040 W/kg



0 dB = 0.0478 W/kg = -13.21 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

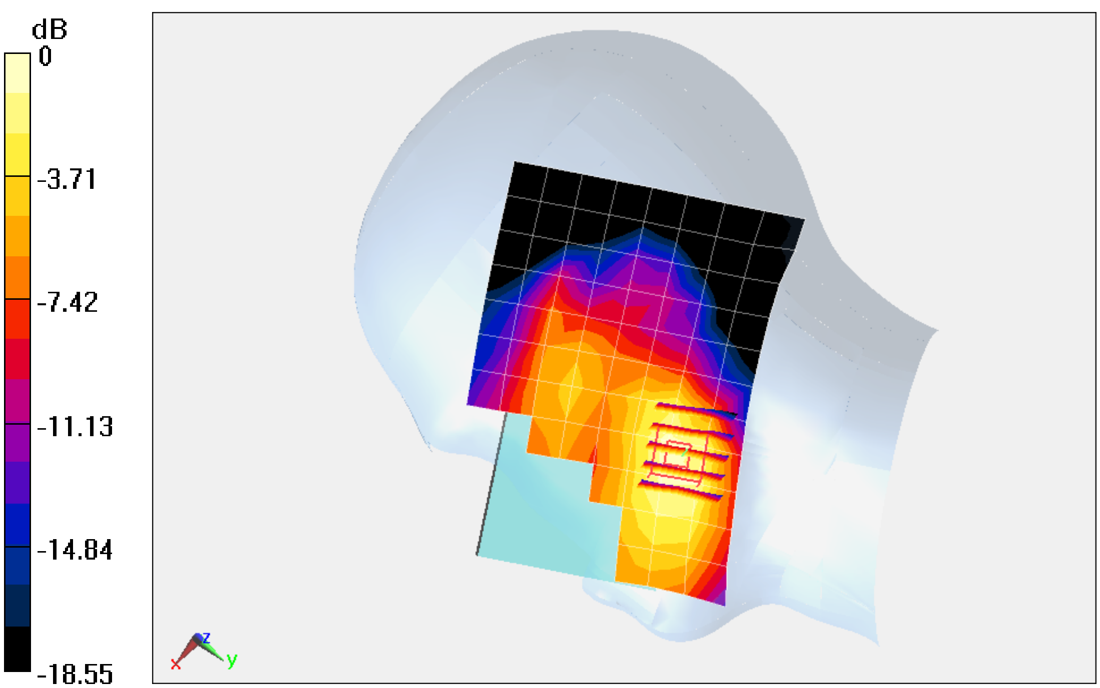
Communication System: UID 0, UMTS; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.391 S/m; ε_r = 38.258; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 01-26-2015; Ambient Temp: 23.5°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3263; ConvF(5.08, 5.08, 5.08); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: UMTS 1900, Right Head, Cheek, 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 = 10.47 V/m; Power Drift = -0.20 dB
Peak SAR (extrapolated) = 0.206 W/kg
SAR(1 g) = 0.136 W/kg



0 dB = 0.161 W/kg = -7.93 dBW/kg

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

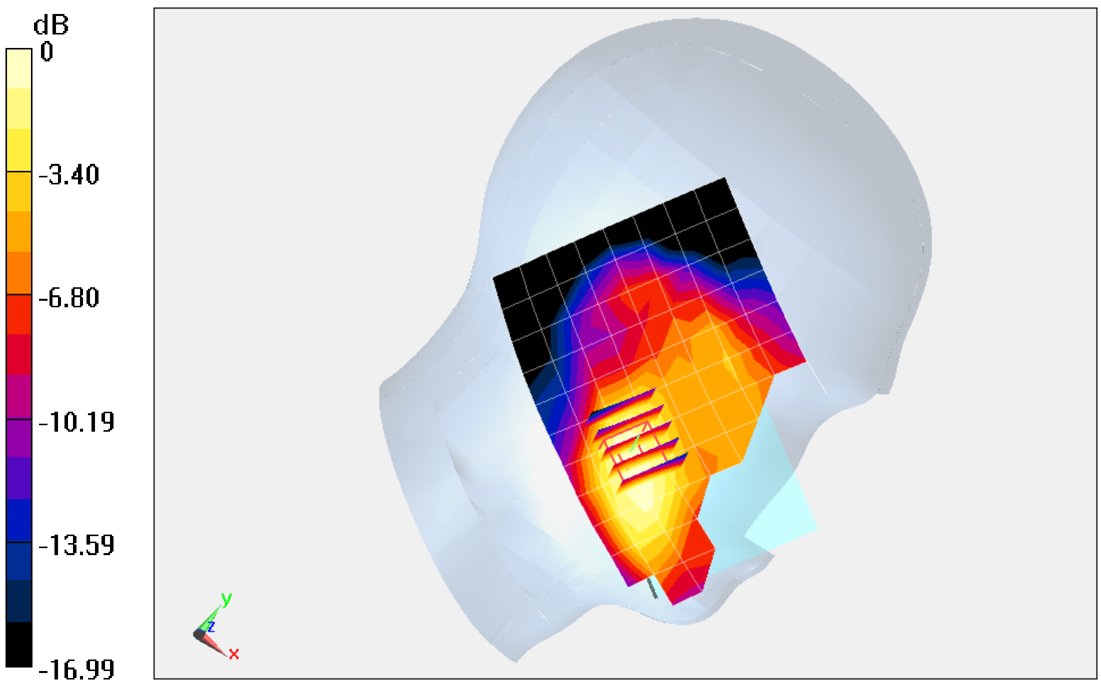
Communication System: UID 0, LTE RF Band 4 (AWS); Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium: 1750 Head Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.327 S/m; ε_r = 38.539; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 01-22-2015; Ambient Temp: 23.0°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3263; ConvF(5.41, 5.41, 5.41); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 4 (AWS), Left Head, Cheek, Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.68 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.259 W/kg
SAR(1 g) = 0.175 W/kg



0 dB = 0.201 W/kg = -6.97 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

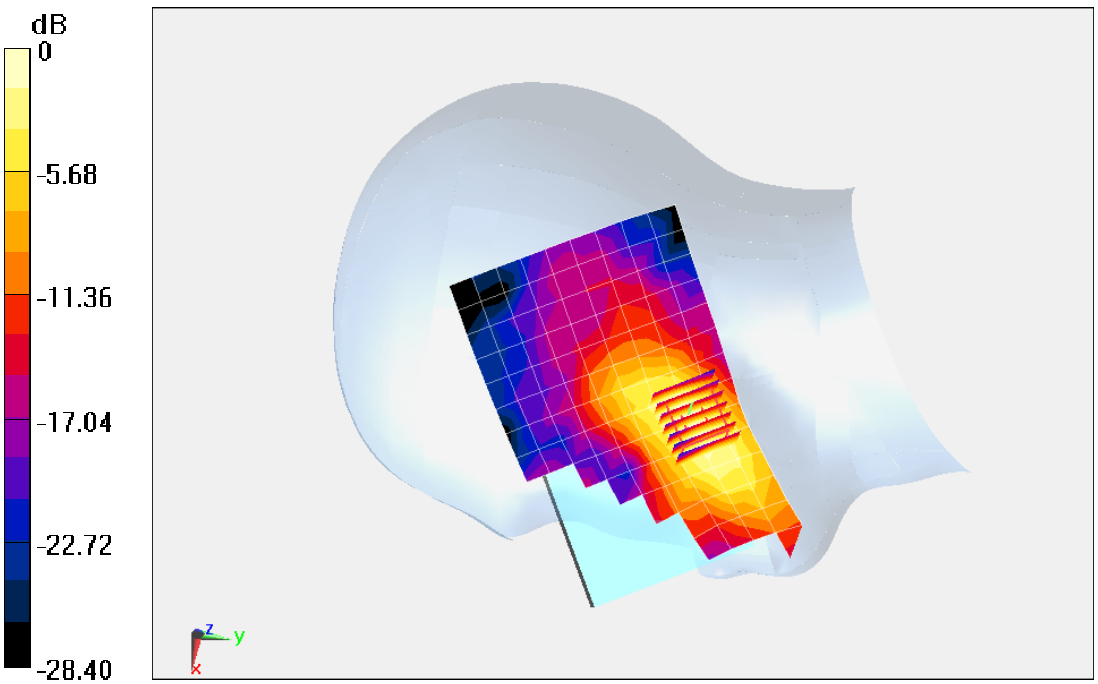
Communication System: UID 0, LTE Band 41; Frequency: 2506 MHz;Duty Cycle: 1:1.58
Medium: 2450 Head Medium parameters used (interpolated):
f = 2506 MHz; σ = 1.873 S/m; ε_r = 38.406; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 01-27-2015; Ambient Temp: 21.3°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3258; ConvF(4.52, 4.52, 4.52); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 41, Right Head, Cheek, Low.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 11.31 V/m; Power Drift = 0.20 dB
Peak SAR (extrapolated) = 0.309 W/kg
SAR(1 g) = 0.167 W/kg



0 dB = 0.212 W/kg = -6.74 dBW/kg

DUT: A3LSMG9200; Type: Portable Handset; Serial: 08602

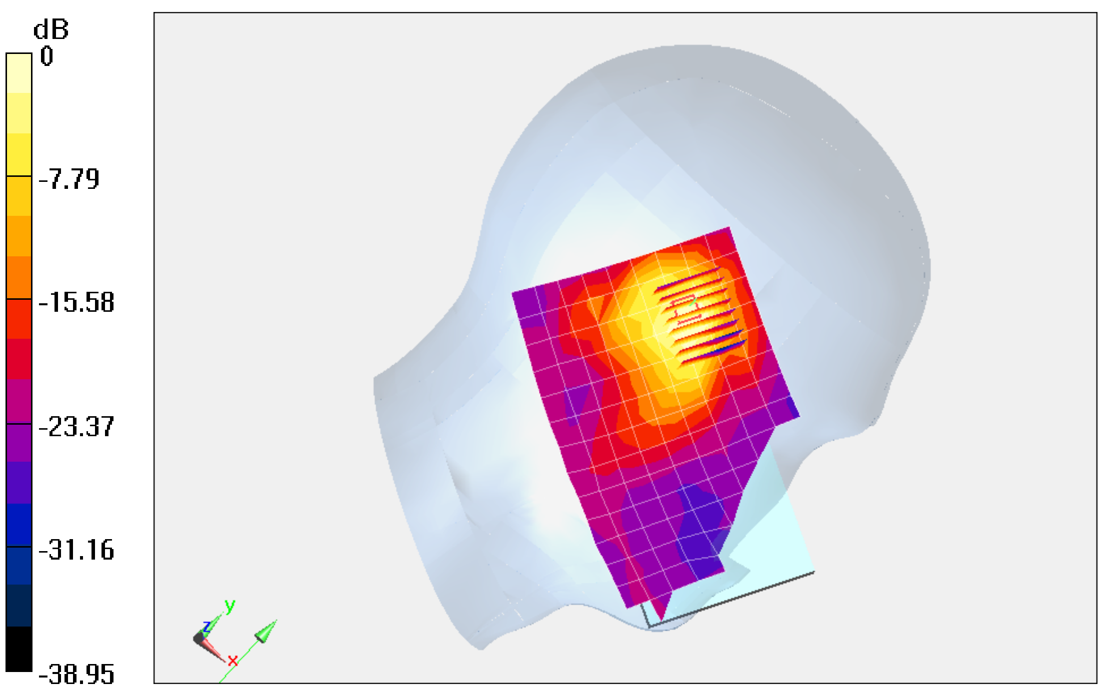
Communication System: UID 0, IEEE 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used (interpolated):
f = 2437 MHz; σ = 1.783 S/m; ε_r = 38.008; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 02-02-2015; Ambient Temp: 24.1°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(4.52, 4.52, 4.52); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11b, Left Head, Cheek, Ch 06, 1 Mbps, Antenna 2

Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.08 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 1.72 W/kg
SAR(1 g) = 0.848 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 08602

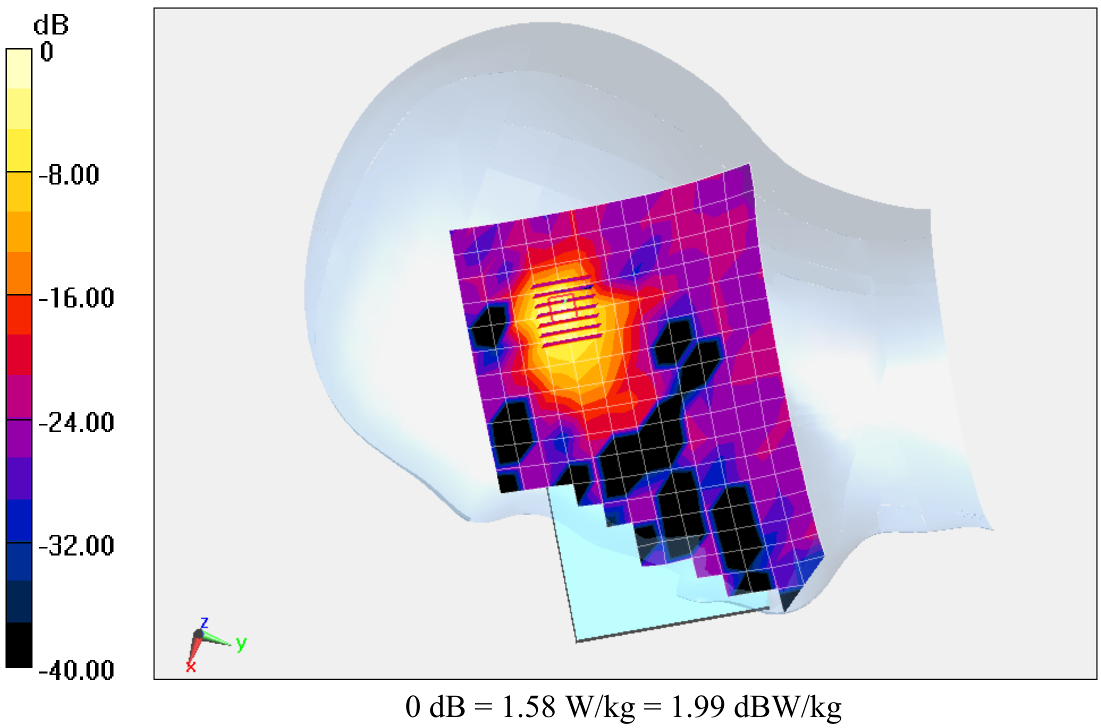
Communication System: UID 0, IEEE 802.11n; Frequency: 5510 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used (interpolated):
f = 5510 MHz; σ = 5.144 S/m; ε_r = 35.184; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 01-27-2015; Ambient Temp: 24.3°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN7308; ConvF(4.64, 4.64, 4.64); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11n, U-NII-2C, 40 MHz Bandwidth, Right Head, Cheek, Ch 102, 13.5 Mbps, Antenna 1

Area Scan (13x19x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio = 1.4
Reference Value = 10.52 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 3.07 W/kg
SAR(1 g) = 0.580 W/kg



0 dB = 1.58 W/kg = 1.99 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

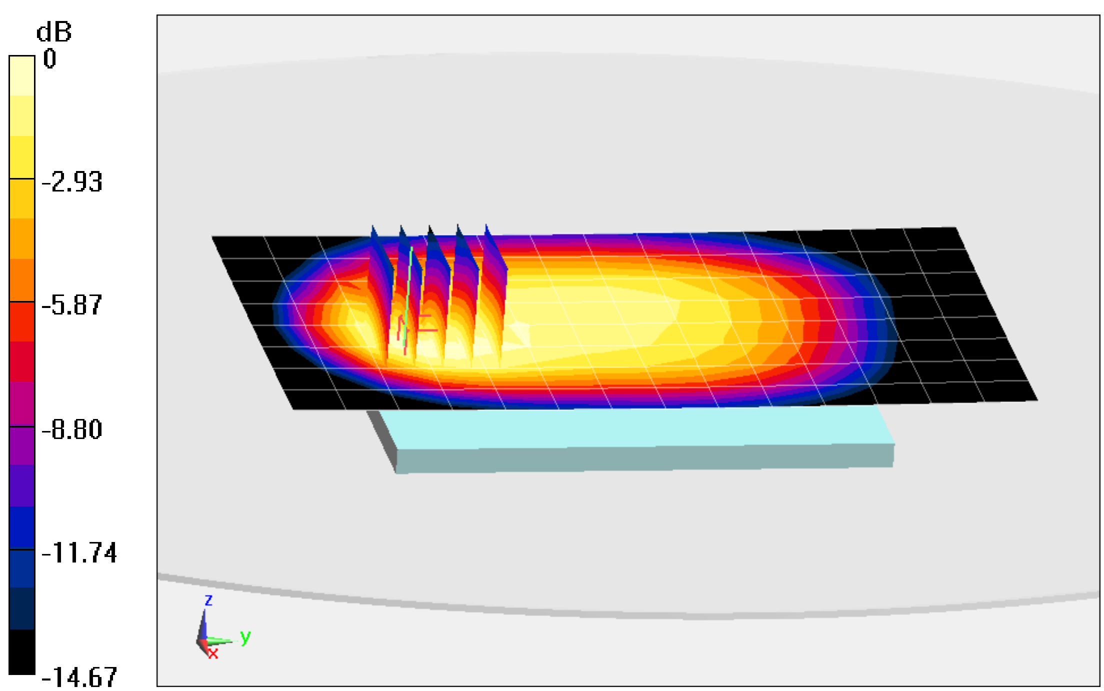
Communication System: UID 0, GSM; Frequency: 836.6 MHz;Duty Cycle: 1:8.3
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.002 S/m; ε_r = 54.372; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.5°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: GSM 850, Body SAR, Back side, 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 = 19.48 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 0.611 W/kg
SAR(1 g) = 0.340 W/kg



0 dB = 0.413 W/kg = -3.84 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

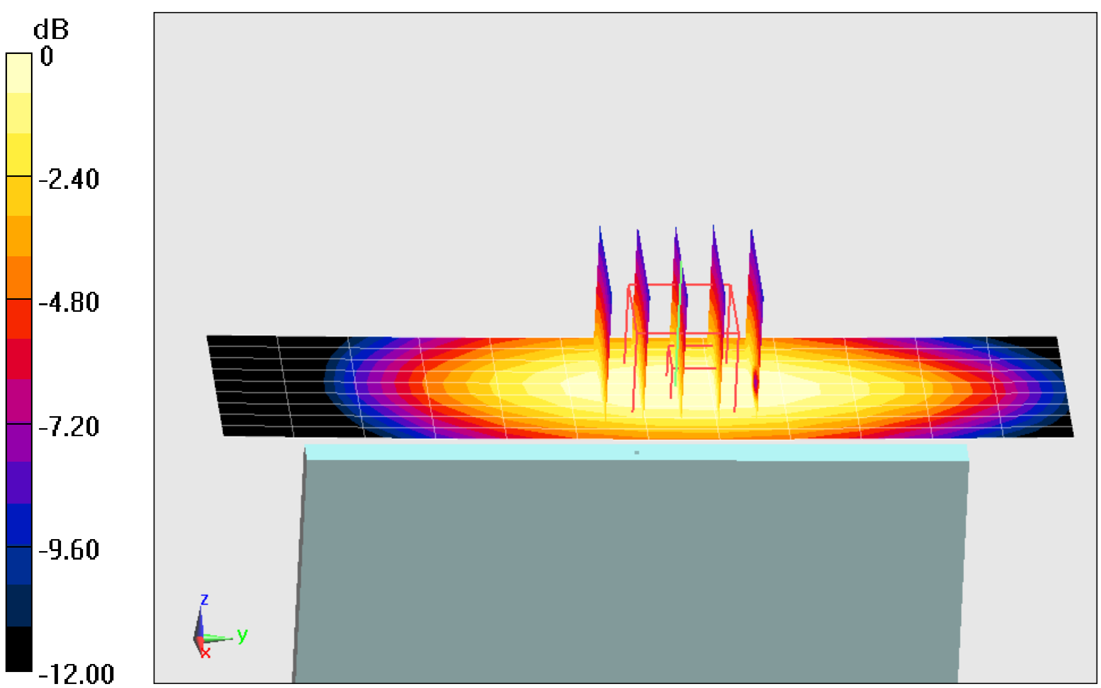
Communication System: UID 0, GSM850 GPRS; 4 Tx slots; Frequency: 836.6 MHz;Duty Cycle: 1:2.076
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.002 S/m; ε_r = 54.372; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.5°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: GPRS 850, Body SAR, Right Edge, Mid.ch, 4 Tx Slots

Area Scan (10x13x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.12 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 1.01 W/kg
SAR(1 g) = 0.597 W/kg



0 dB = 0.688 W/kg = -1.62 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

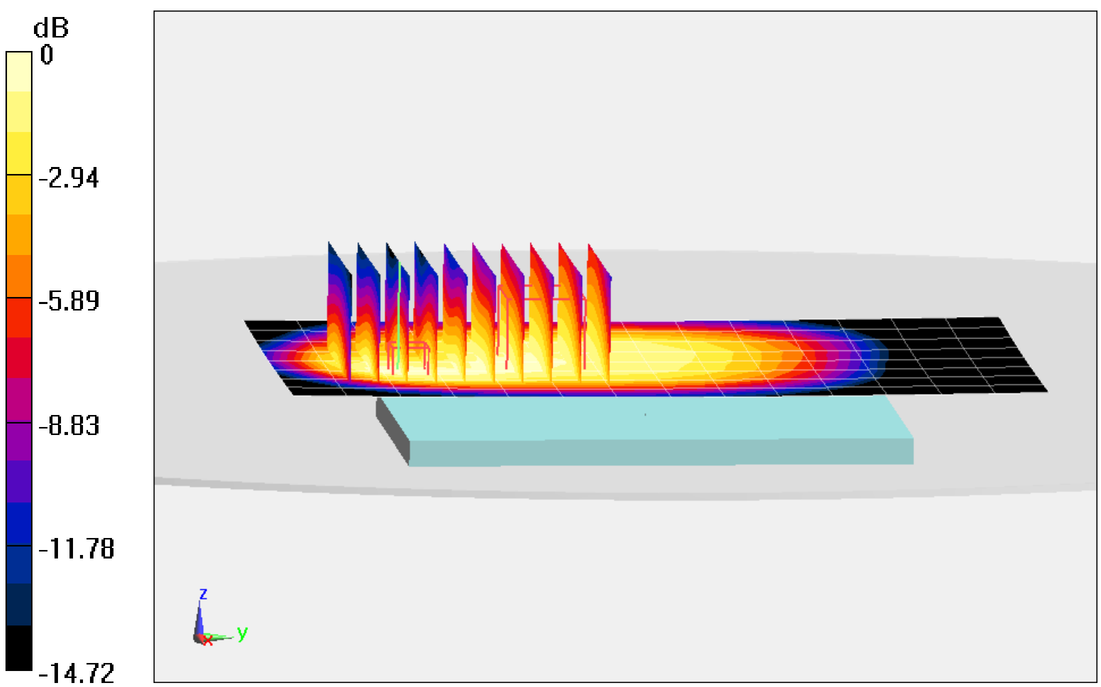
Communication System: UID 0, UMTS; Frequency: 836.6 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.002 S/m; ε_r = 54.372; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.5°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (8x10x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.89 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.586 W/kg
SAR(1 g) = 0.334 W/kg



0 dB = 0.410 W/kg = -3.87 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

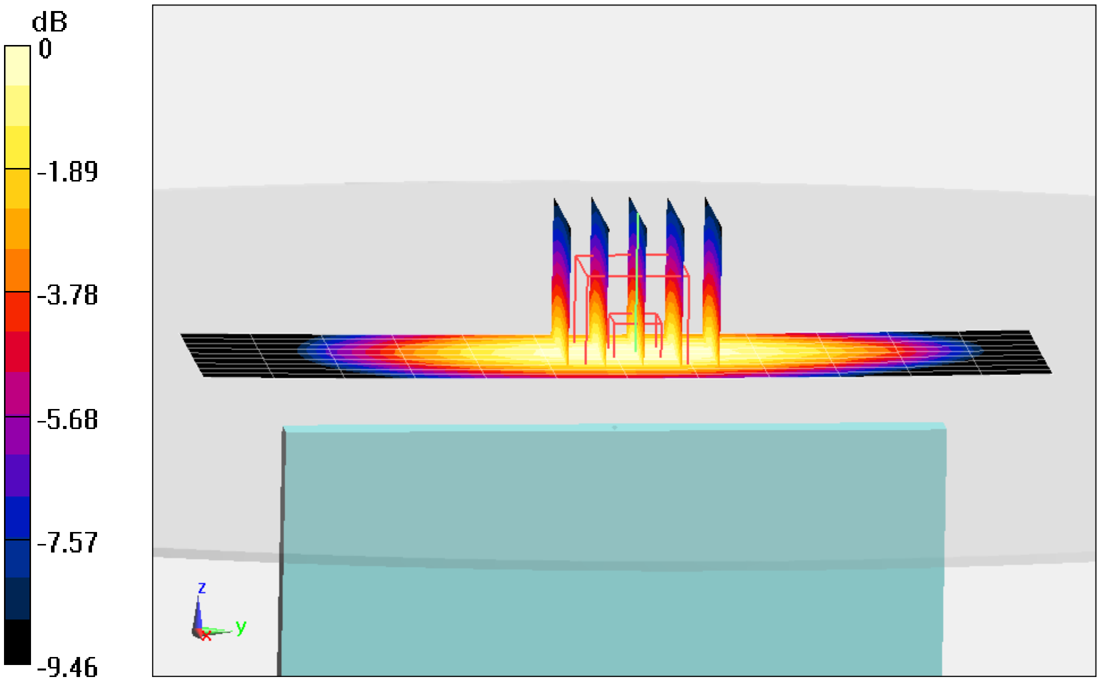
Communication System: UID 0, UMTS; Frequency: 836.6 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.002 S/m; ε_r = 54.372; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.5°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

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

Area Scan (10x13x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.29 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.654 W/kg
SAR(1 g) = 0.460 W/kg



0 dB = 0.528 W/kg = -2.77 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

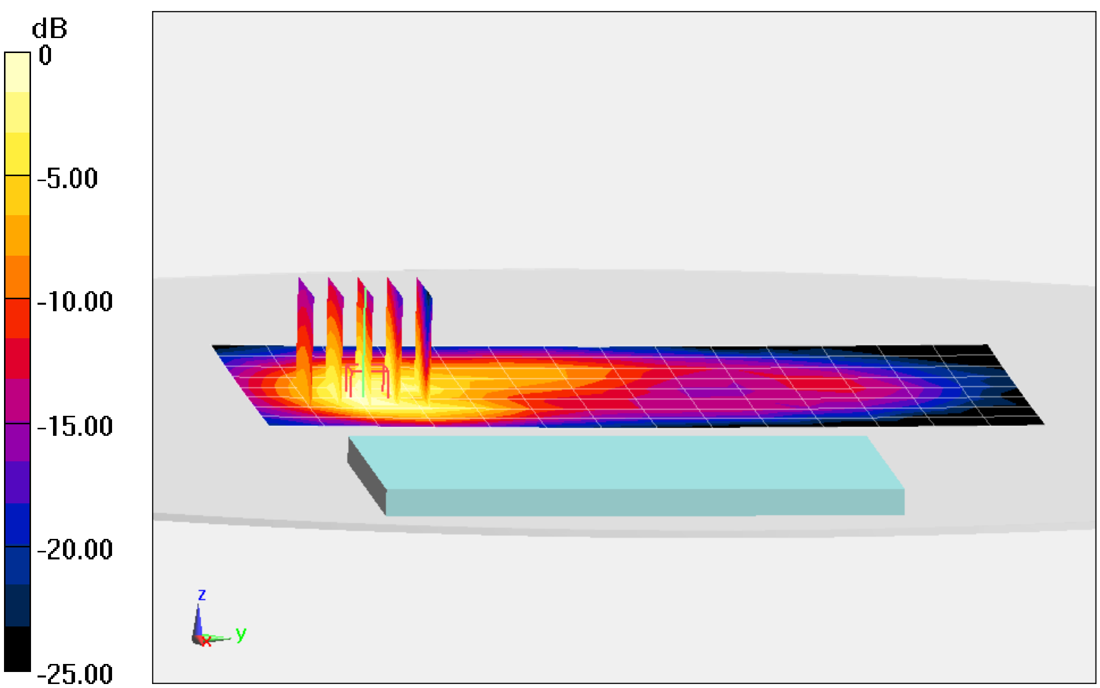
Communication System: UID 0, GSM; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.555 S/m; ε_r = 52.108; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); 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 (8);SEMCAD X Version 14.6.10 (7331)

Mode: GSM 1900, Body SAR, Back side, 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 = 14.13 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.508 W/kg
SAR(1 g) = 0.290 W/kg



0 dB = 0.350 W/kg = -4.56 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

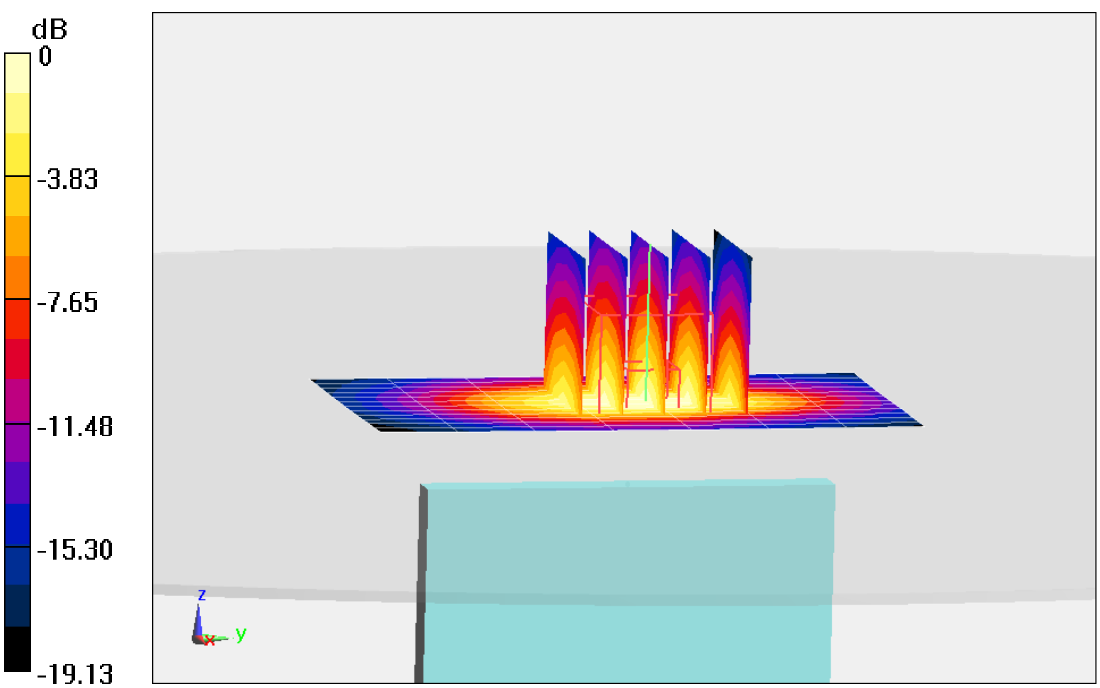
Communication System: UID 0, GSM GPRS; 3 Tx slots; Frequency: 1880 MHz;Duty Cycle: 1:2.76
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.555 S/m; ε_r = 52.108; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); 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 (8);SEMCAD X Version 14.6.10 (7331)

Mode: GPRS 1900, Body SAR, Bottom Edge, Mid.ch, 3 Tx Slots

Area Scan (13x8x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.50 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 1.02 W/kg
SAR(1 g) = 0.611 W/kg



0 dB = 0.755 W/kg = -1.22 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

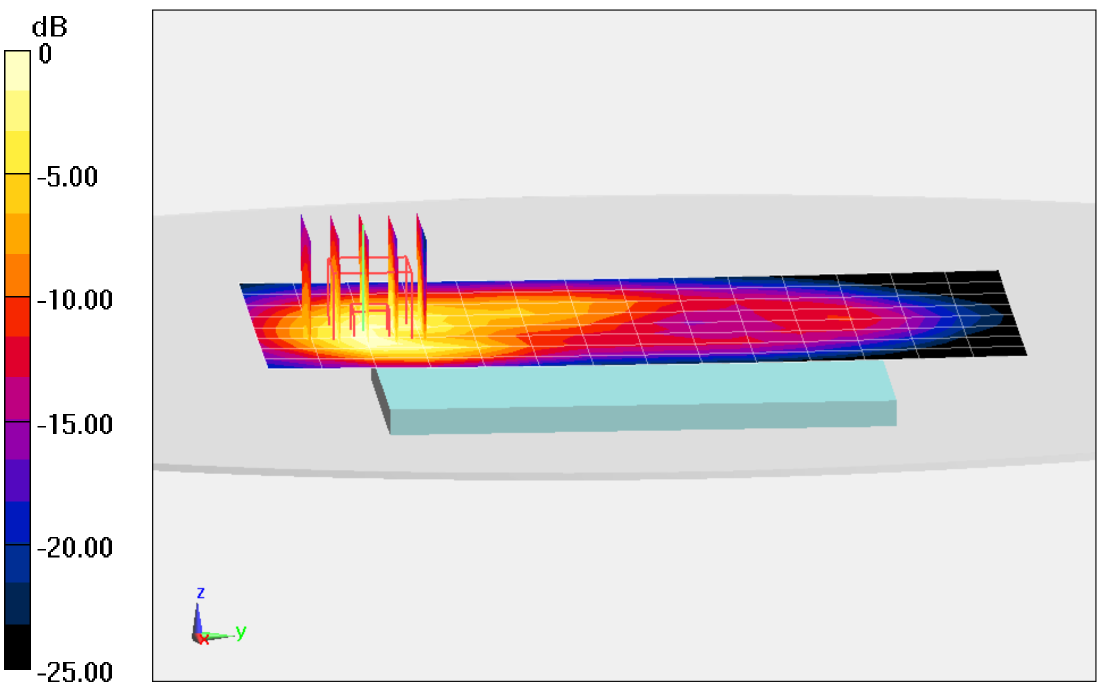
Communication System: UID 0, UMTS; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.555 S/m; ε_r = 52.108; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); 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 (8);SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.88 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 1.10 W/kg
SAR(1 g) = 0.634 W/kg



0 dB = 0.752 W/kg = -1.24 dBW/kg

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

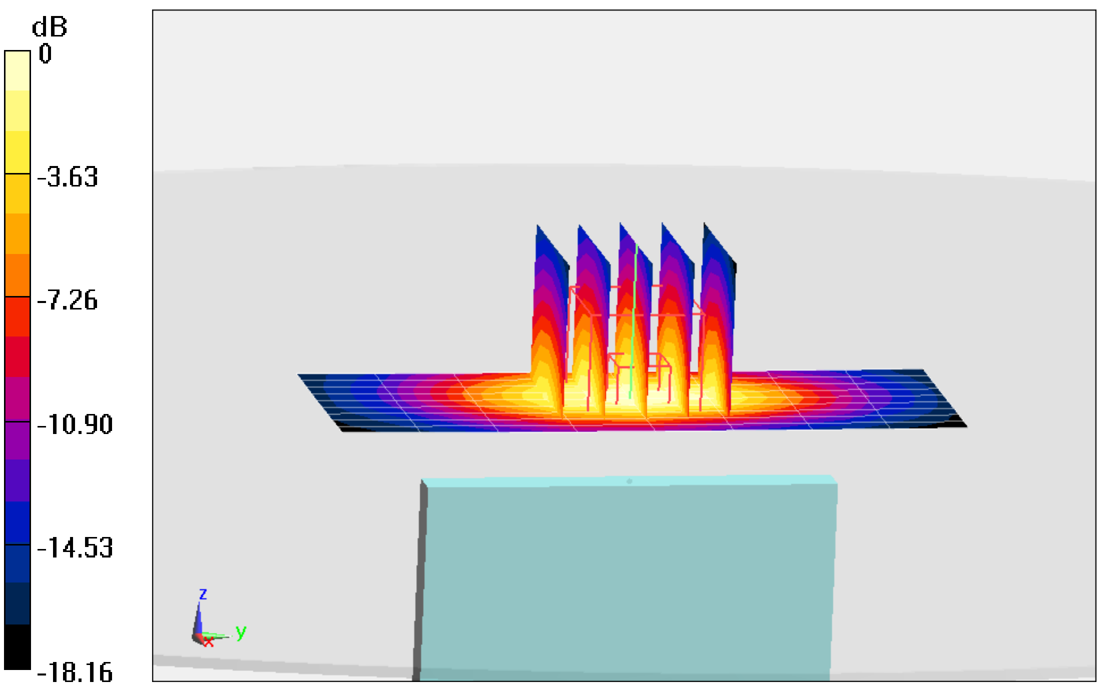
Communication System: UID 0, UMTS; Frequency: 1907.6 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1907.6 MHz; σ = 1.587 S/m; ε_r = 52.015; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); 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 (8);SEMCAD X Version 14.6.10 (7331)

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

Area Scan (10x9x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.46 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 1.63 W/kg
SAR(1 g) = 0.970 W/kg



0 dB = 1.17 W/kg = 0.68 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

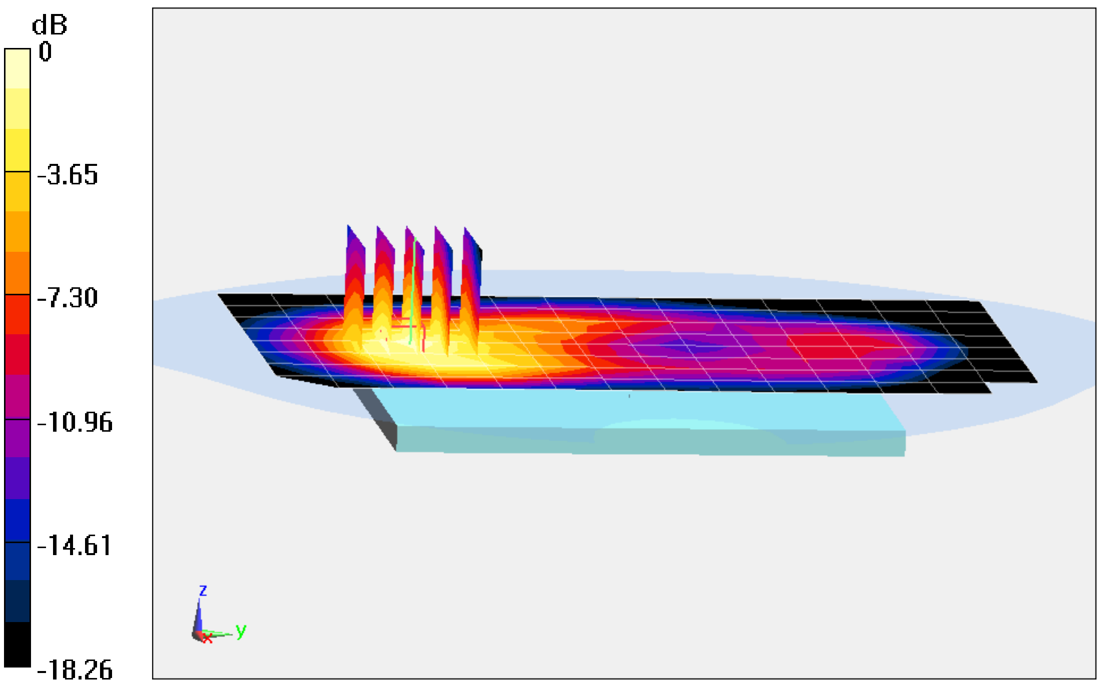
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.46 S/m; ε_r = 52.608; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3288; ConvF(5.03, 5.03, 5.03); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 4 (AWS), Body SAR, Back Side, Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.78 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.23 W/kg
SAR(1 g) = 0.752 W/kg



0 dB = 0.863 W/kg = -0.64 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

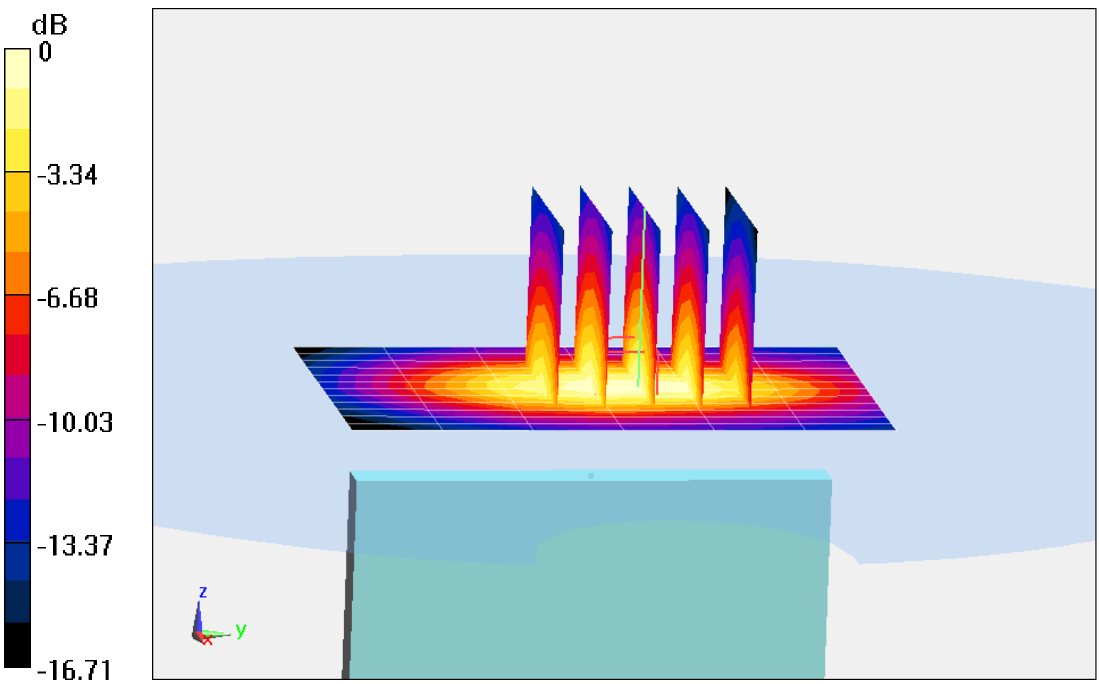
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.46 S/m; ε_r = 52.608; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3288; ConvF(5.03, 5.03, 5.03); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 4 (AWS), Body SAR, Bottom Edge, Mid.ch, 20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (13x7x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.21 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.59 W/kg
SAR(1 g) = 0.958 W/kg



0 dB = 1.18 W/kg = 0.72 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 085EA

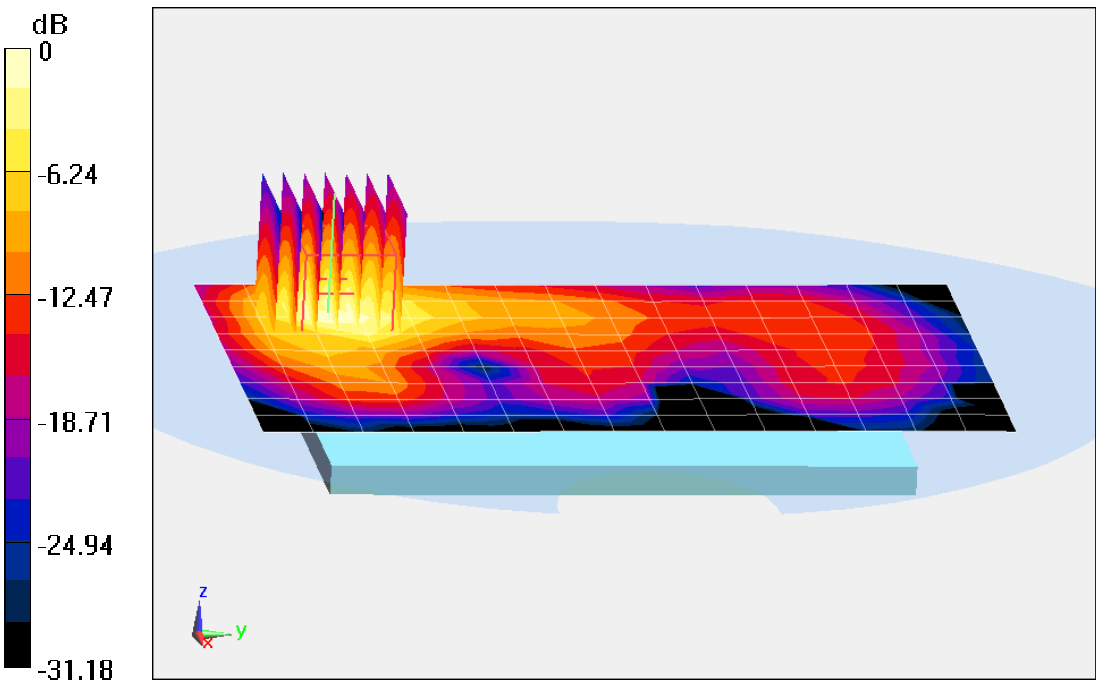
Communication System: UID 0, LTE Band 41; Frequency: 2506 MHz;Duty Cycle: 1:1.58
Medium: 2450 Body Medium parameters used (interpolated):
f = 2506 MHz; σ = 2.072 S/m; ε_r = 51.545; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 22.5°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3209; ConvF(4.2, 4.2, 4.2); Calibrated: 3/19/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/17/2014
Phantom: SAM left; Type: QD000P40CD; Serial: TP:1715
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 41, Body SAR, Back side, Low.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.05 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 1.74 W/kg
SAR(1 g) = 0.778 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 08602

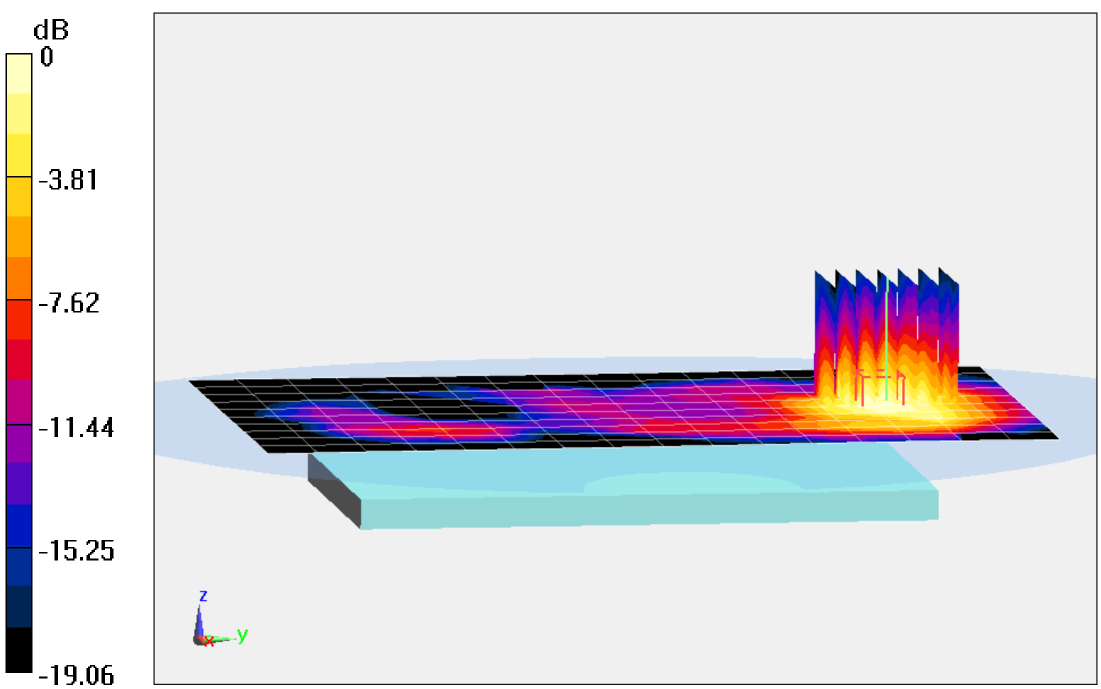
Communication System: UID 0, IEEE 802.11b; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2412 MHz; σ = 1.902 S/m; ε_r = 52.772; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-02-2015; Ambient Temp: 24.4°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3209; ConvF(4.2, 4.2, 4.2); Calibrated: 3/19/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/17/2014
Phantom: SAM left; Type: QD000P40CD; Serial: TP:1715
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11b, Body SAR, Ch 01, 1 Mbps, Back Side, Antenna 1

Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.994 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.216 W/kg
SAR(1 g) = 0.110 W/kg



0 dB = 0.137 W/kg = -8.63 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 08602

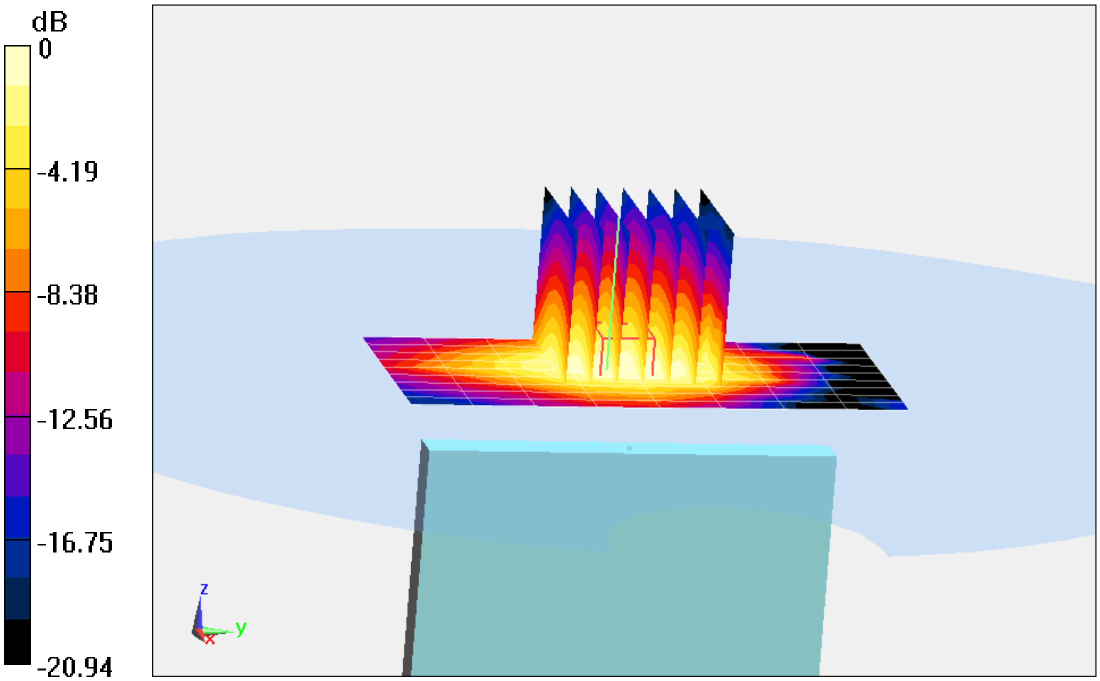
Communication System: UID 0, IEEE 802.11b; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2412 MHz; σ = 1.902 S/m; ε_r = 52.772; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-02-2015; Ambient Temp: 24.4°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3209; ConvF(4.2, 4.2, 4.2); Calibrated: 3/19/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/17/2014
Phantom: SAM left; Type: QD000P40CD; Serial: TP:1715
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11b, Body SAR, Ch 01, 1 Mbps, Top Edge, Antenna 1

Area Scan (10x9x1): Measurement grid: dx=5mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 11.55 V/m; Power Drift = -0.20 dB
Peak SAR (extrapolated) = 0.423 W/kg
SAR(1 g) = 0.221 W/kg



0 dB = 0.271 W/kg = -5.67 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG9200; Type: Portable Handset; Serial: 08602

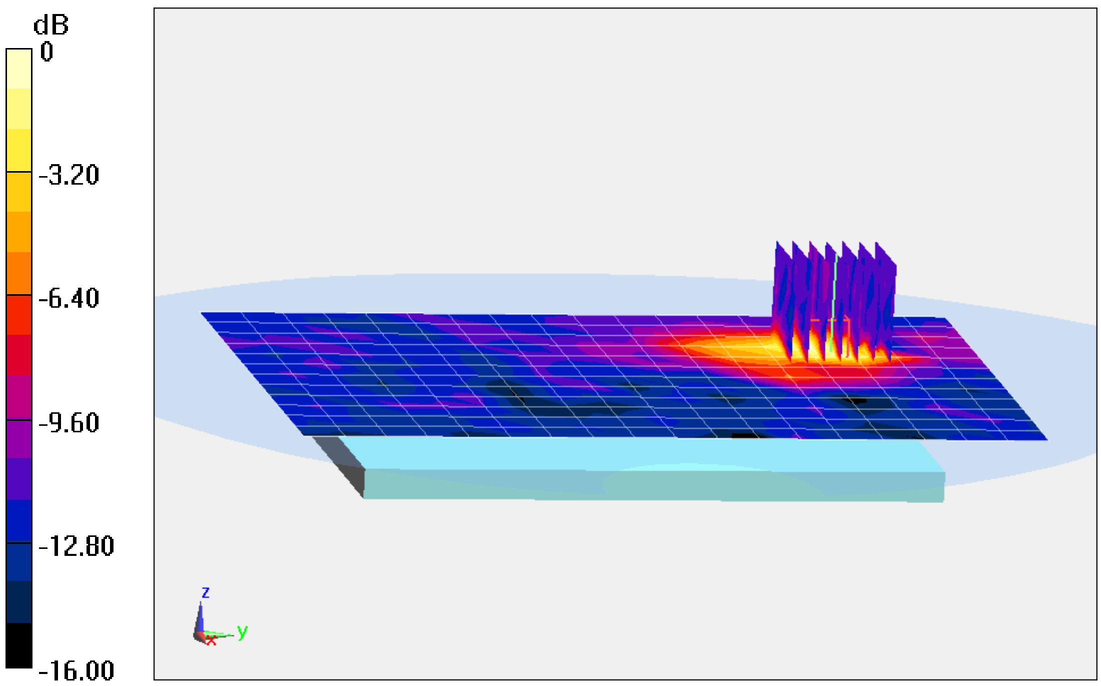
Communication System: UID 0, IEEE 802.11ac (0); Frequency: 5670 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used (interpolated):
f = 5670 MHz; σ = 5.984 S/m; ε_r = 46.849; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 21.7°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN7308; ConvF(4.22, 4.22, 4.22); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11ac, U-NII-2C, 40 MHz Bandwidth,
Body SAR, Ch 134, 13.5 Mbps, Back Side, Antenna 2

Area Scan (13x19x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio = 1.4
Reference Value = 3.028 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.269 W/kg
SAR(1 g) = 0.048 W/kg



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

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d133

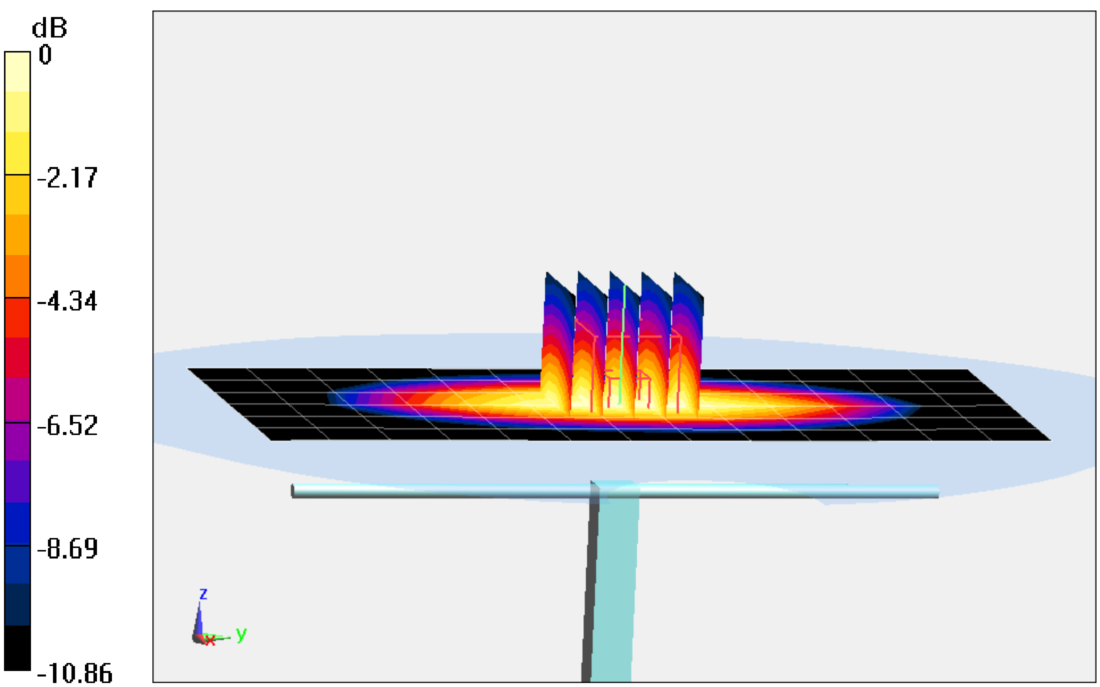
Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: 835 Head Medium parameters used:
f = 835 MHz; σ = 0.897 S/m; ε_r = 42.105; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-28-2015; Ambient Temp: 24.4°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(6.27, 6.27, 6.27); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

835 MHz System Validation

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 1.41 W/kg
SAR(1 g) = 0.949 W/kg
Deviation = 3.15%



0 dB = 1.09 W/kg = 0.37 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1765V2; Serial: 1008

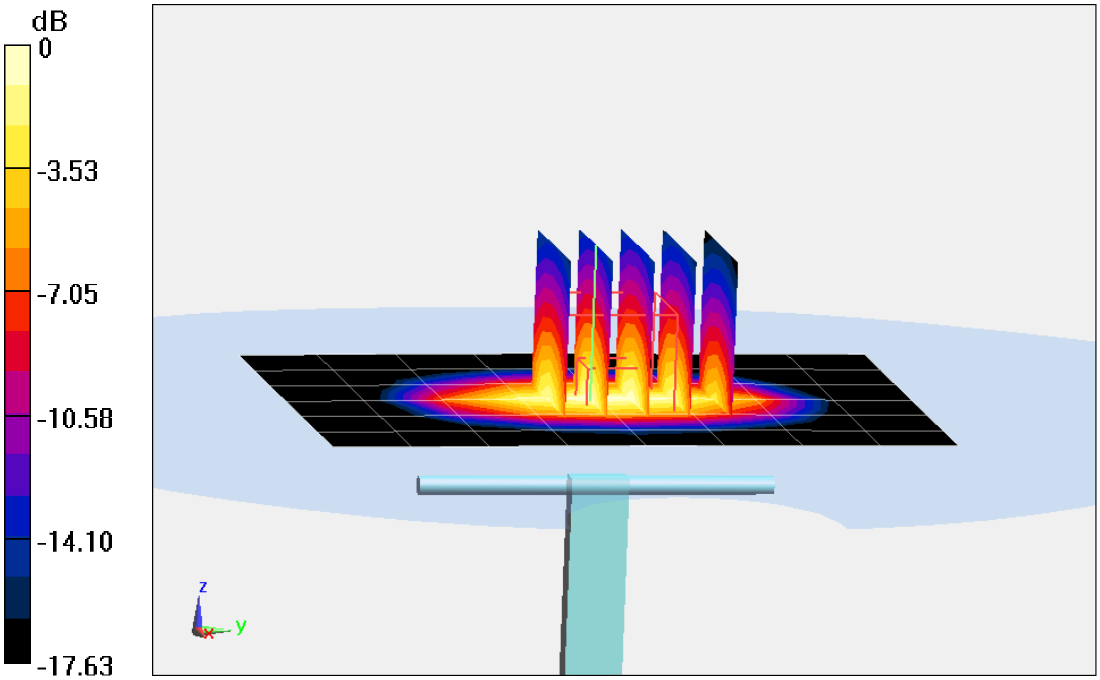
Communication System: UID 0, CW; Frequency: 1750 MHz;Duty Cycle: 1:1
Medium: 1750 Head Medium parameters used:
f = 1750 MHz; σ = 1.344 S/m; ε_r = 38.466; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-22-2015; Ambient Temp: 23.0°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3263; ConvF(5.41, 5.41, 5.41); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 6.16 W/kg
SAR(1 g) = 3.45 W/kg
Deviation = -6.50%



0 dB = 4.28 W/kg = 6.31 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

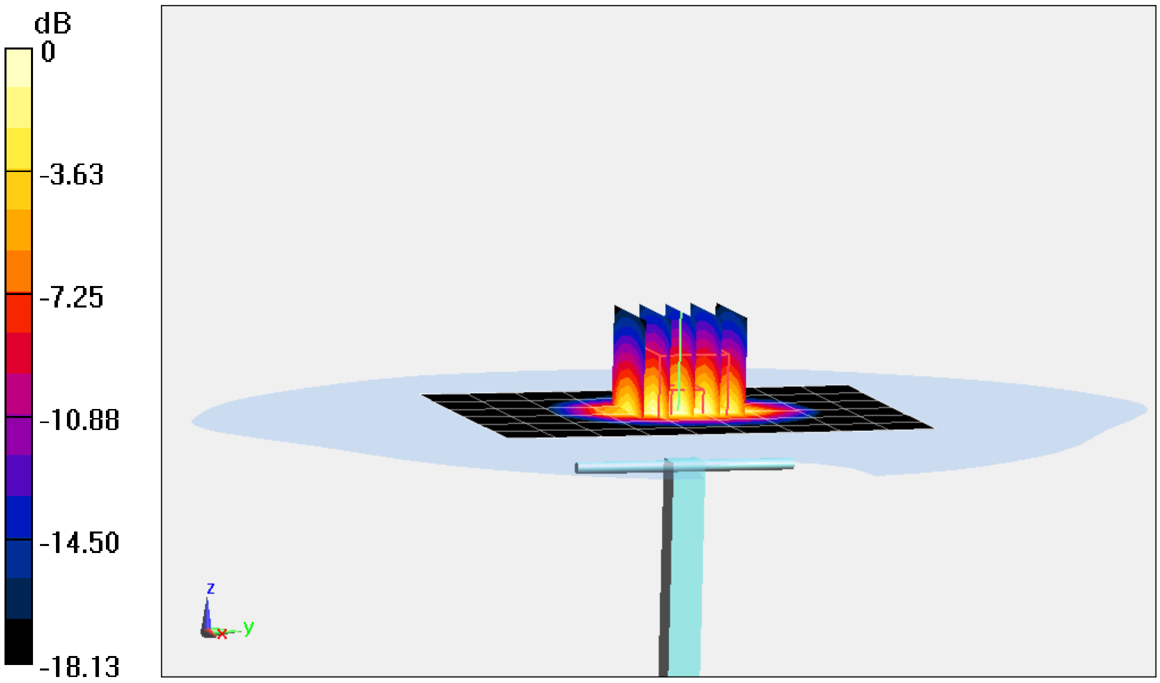
Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.411 S/m; ε_r = 38.163; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.5°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3263; ConvF(5.08, 5.08, 5.08); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

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) = 7.98 W/kg
SAR(1 g) = 4.32 W/kg
Deviation = 7.46%



0 dB = 5.48 W/kg = 7.39 dBW/kg

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

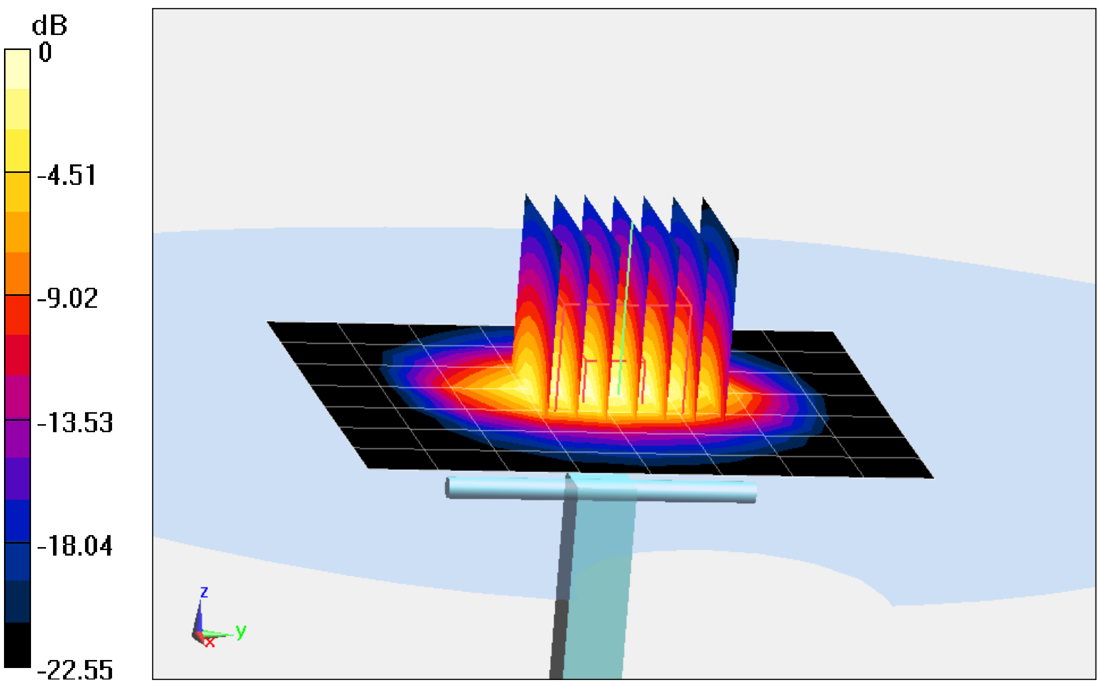
Communication System: UID 0, CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used:
f = 2450 MHz; σ = 1.797 S/m; ε_r = 37.953; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-02-2015; Ambient Temp: 24.1°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(4.52, 4.52, 4.52); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

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) = 10.5 W/kg
SAR(1 g) = 5.07 W/kg
Deviation = -2.69%



0 dB = 6.59 W/kg = 8.19 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

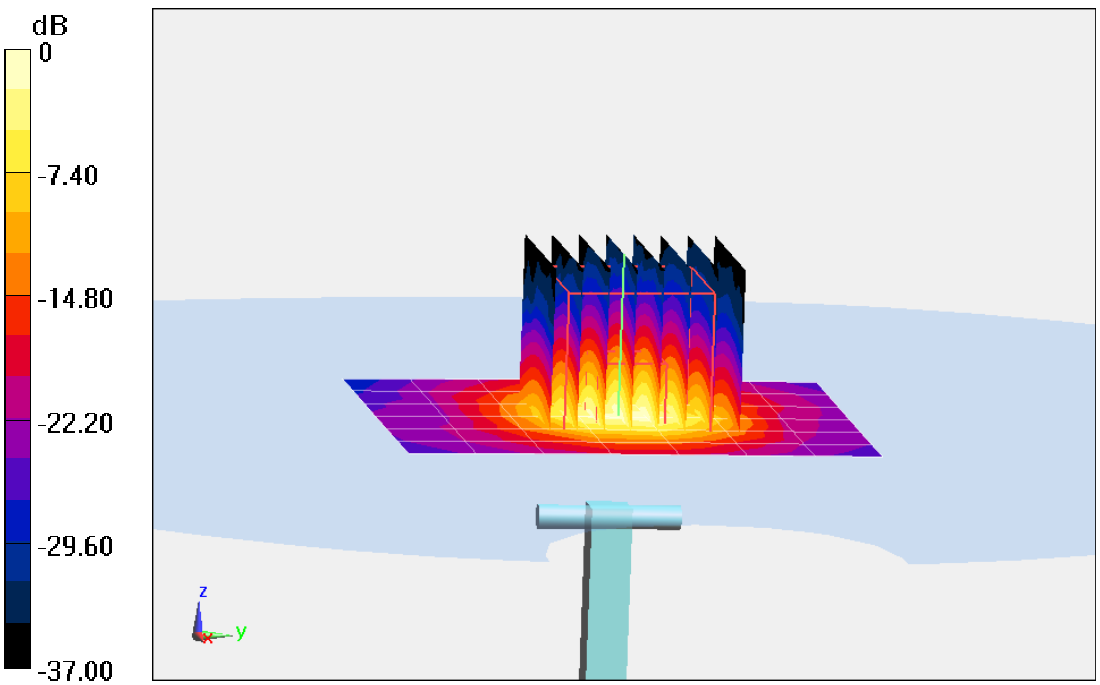
Communication System: UID 0, CW; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5300 MHz; σ = 4.903 S/m; ε_r = 35.673; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-27-2015; Ambient Temp: 24.3°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN7308; ConvF(5.37, 5.37, 5.37); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

5300 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio = 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 34.6 W/kg
SAR(1 g) = 7.91 W/kg
Deviation = -5.16%



0 dB = 20.4 W/kg = 13.10 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

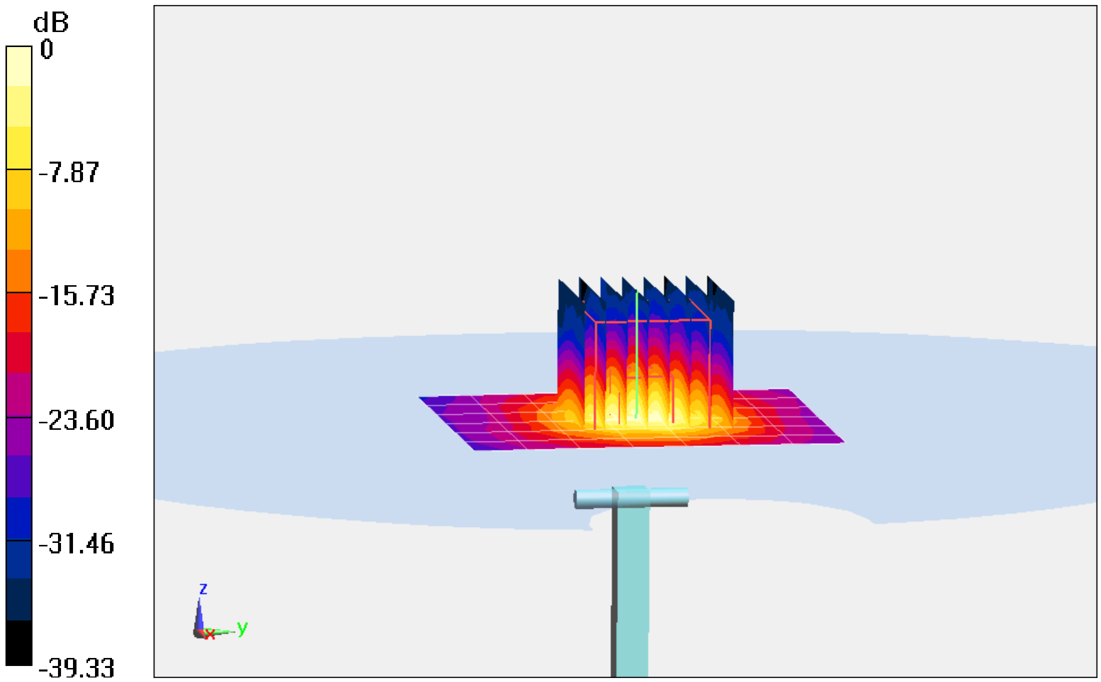
Communication System: UID 0, CW; Frequency: 5500 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5500 MHz; σ = 5.129 S/m; ε_r = 35.206; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-27-2015; Ambient Temp: 24.3°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN7308; ConvF(4.64, 4.64, 4.64); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

5500 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio = 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 35.7 W/kg
SAR(1 g) = 7.95 W/kg
Deviation = -6.36%



0 dB = 20.9 W/kg = 13.20 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1120

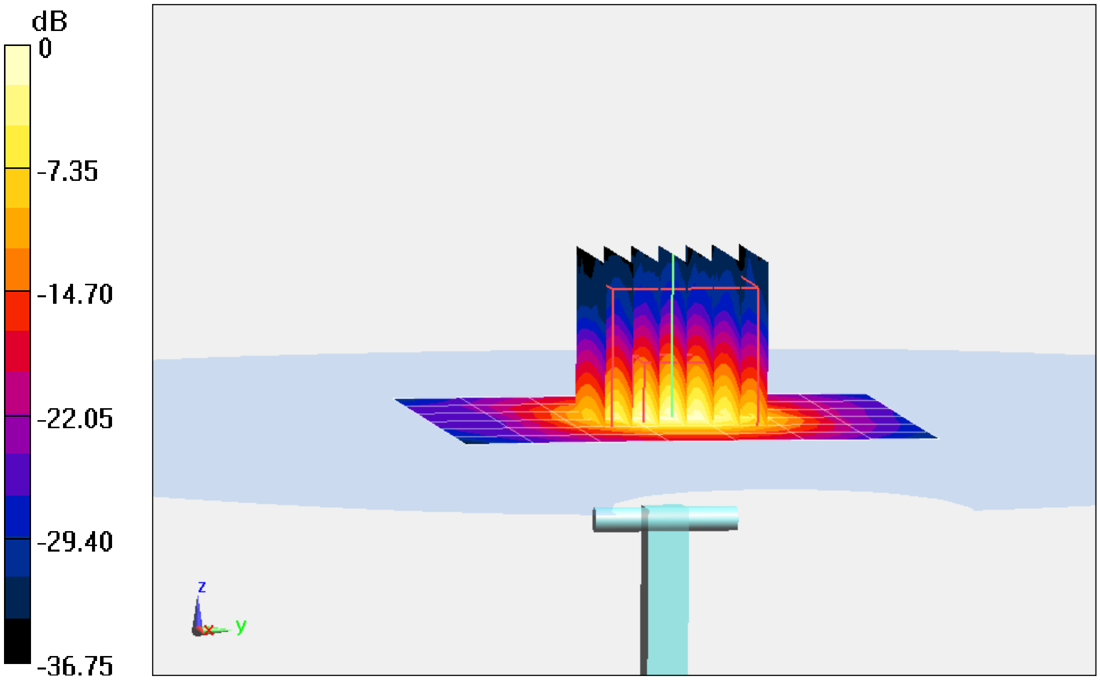
Communication System: UID 0, CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5600 MHz; σ = 5.254 S/m; ε_r = 34.958; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-27-2015; Ambient Temp: 24.4°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN7308; ConvF(4.64, 4.64, 4.64); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

5600 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio = 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 37.6 W/kg
SAR(1 g) = 8.15 W/kg
Deviation = -0.85%



0 dB = 21.7 W/kg = 13.36 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

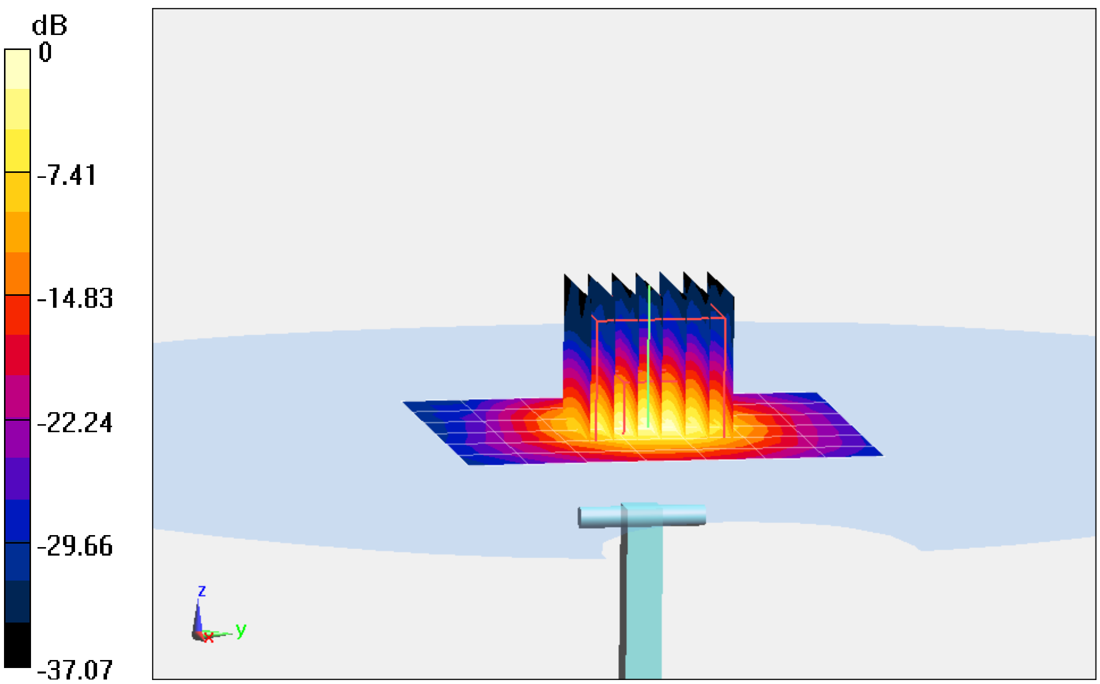
Communication System: UID 0, CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5800 MHz; σ = 5.496 S/m; ε_r = 34.471; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-27-2015; Ambient Temp: 24.3°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN7308; ConvF(4.81, 4.81, 4.81); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

5800 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio = 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 36.7 W/kg
SAR(1 g) = 7.65 W/kg
Deviation = -3.29%



0 dB = 20.6 W/kg = 13.14 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d133

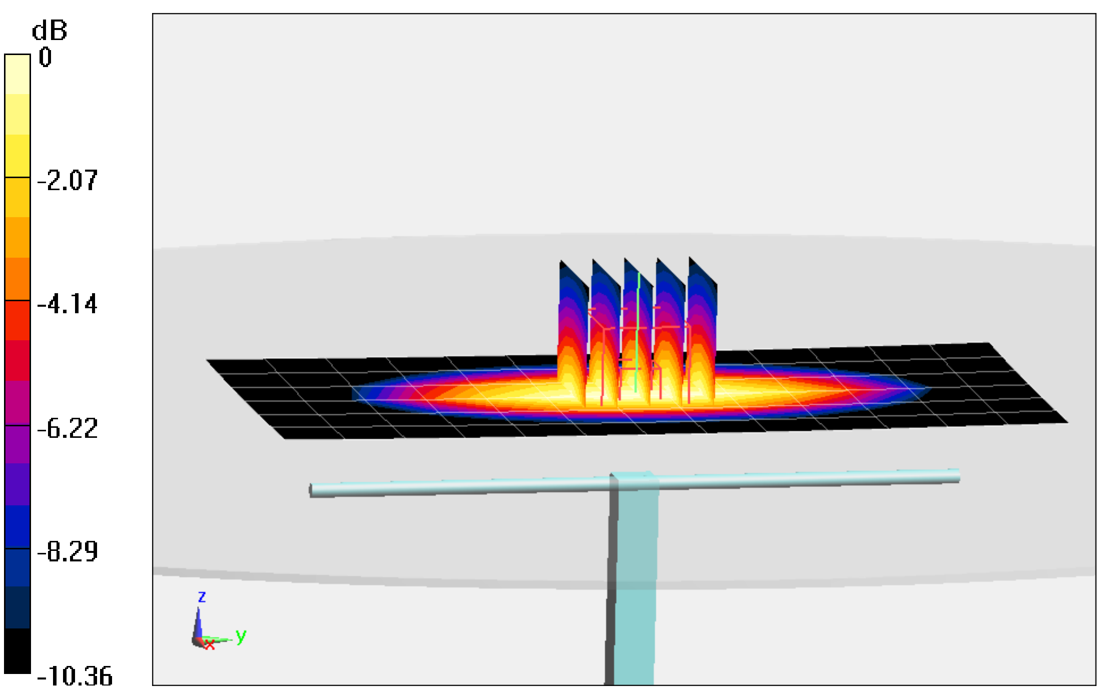
Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used:
f = 835 MHz; σ = 1 S/m; ε_r = 54.387; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-26-2015; Ambient Temp: 23.5°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

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) = 1.43 W/kg
SAR(1 g) = 0.974 W/kg
Deviation = 4.17%



0 dB = 1.14 W/kg = 0.57 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1765V2; Serial: 1008

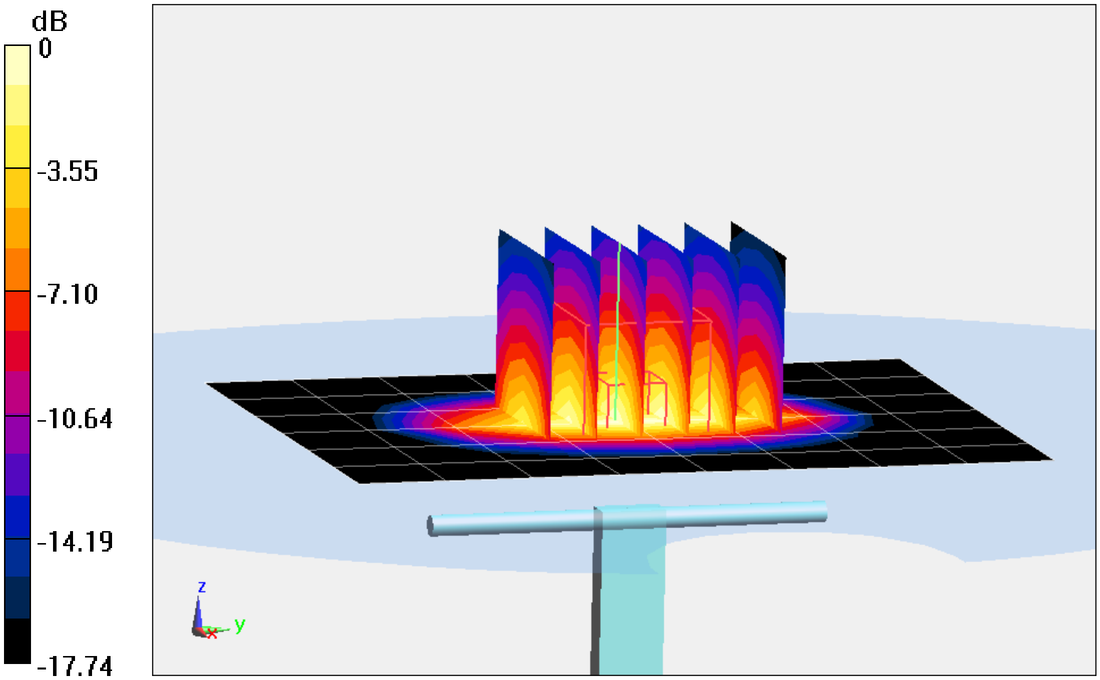
Communication System: UID 0, CW; Frequency: 1750 MHz;Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used:
f = 1750 MHz; σ = 1.479 S/m; ε_r = 52.543; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3288; ConvF(5.03, 5.03, 5.03); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 6.53 W/kg
SAR(1 g) = 3.72 W/kg
Deviation = -1.06%



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

PCTEST ENGINEERING LABORATORY, INC.

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

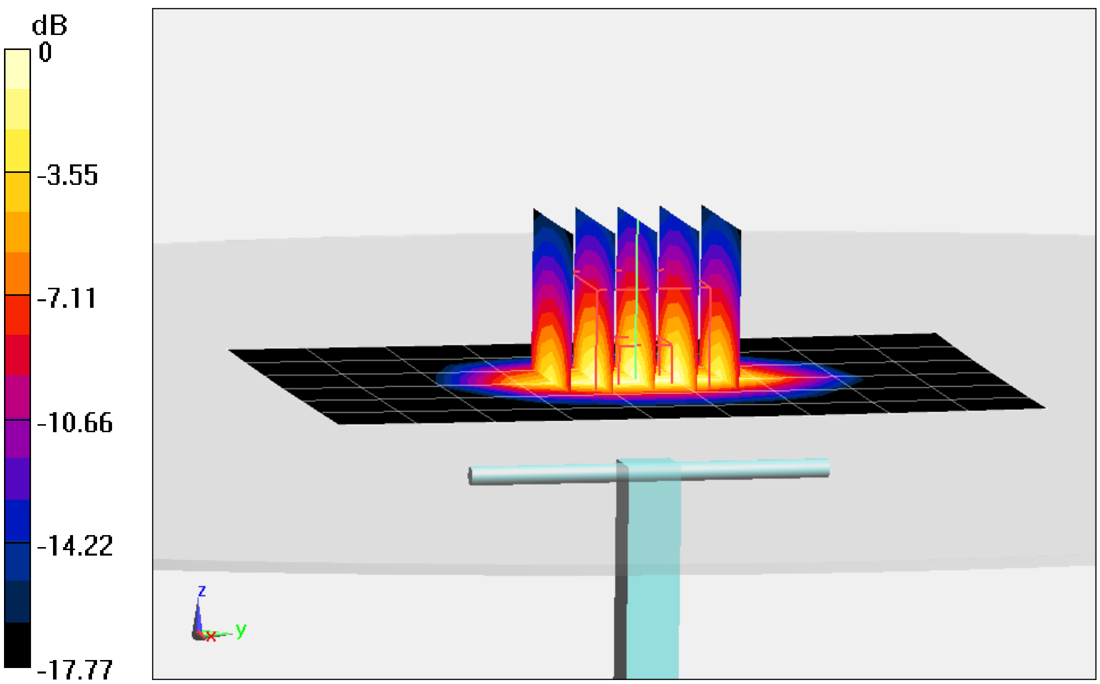
Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.578 S/m; ε_r = 52.041; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); 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 (8);SEMCAD X Version 14.6.10 (7331)

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) = 6.94 W/kg
SAR(1 g) = 3.97 W/kg
Deviation = -1.73%



0 dB = 5.02 W/kg = 7.01 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

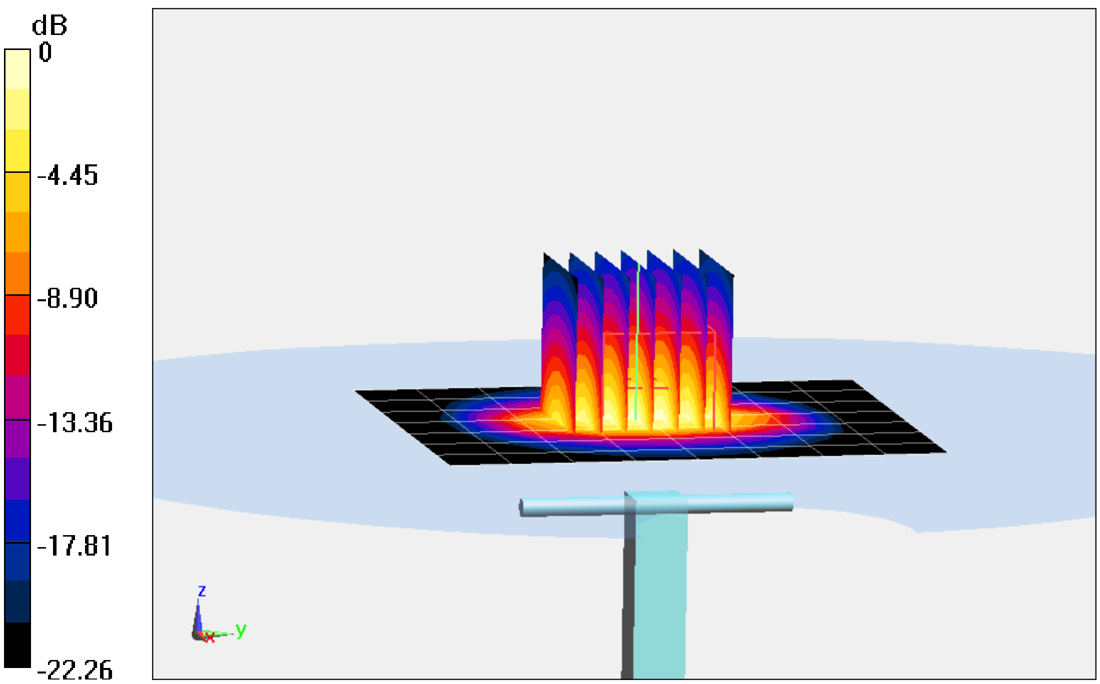
Communication System: UID 0, CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used:
f = 2450 MHz; σ = 1.997 S/m; ε_r = 51.723; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 22.5°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3209; ConvF(4.2, 4.2, 4.2); Calibrated: 3/19/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/17/2014
Phantom: SAM left; Type: QD000P40CD; Serial: TP:1715
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

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) = 11.9 W/kg
SAR(1 g) = 5.47 W/kg
Deviation = 5.60%



0 dB = 7.23 W/kg = 8.59 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1071

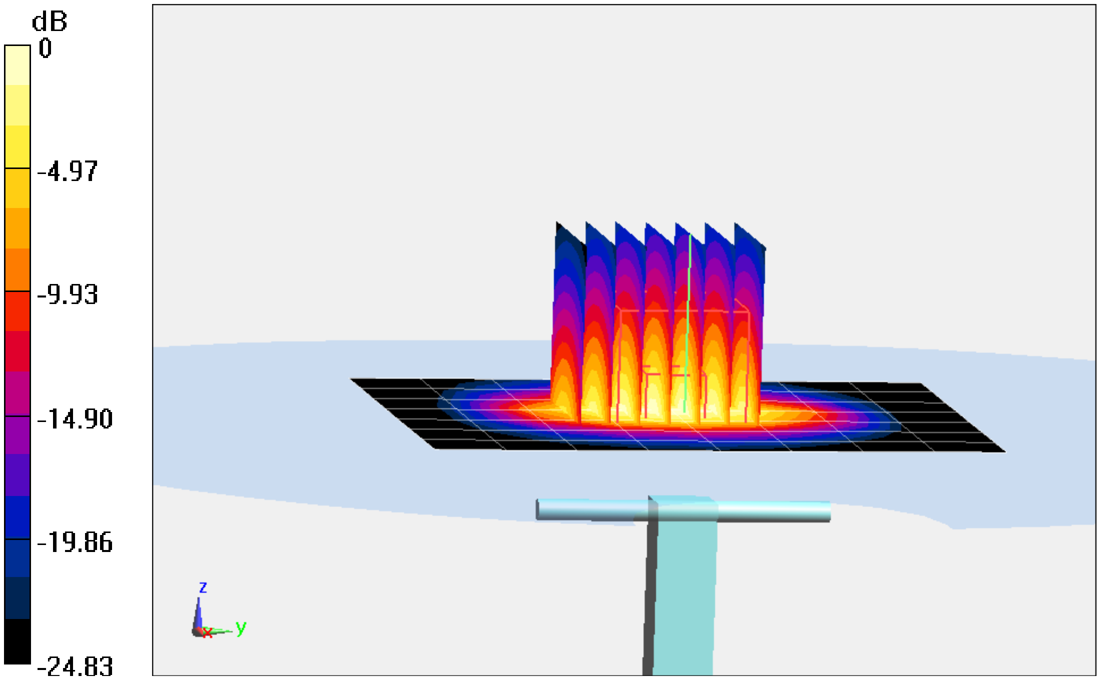
Communication System: UID 0, CW; Frequency: 2600 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used:
f = 2600 MHz; σ = 2.203 S/m; ε_r = 51.133; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 22.5°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3209; ConvF(4.04, 4.04, 4.04); Calibrated: 3/19/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/17/2014
Phantom: SAM left; Type: QD000P40CD; Serial: TP:1715
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

2600 MHz System Verification

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 14.0 W/kg
SAR(1 g) = 6.05 W/kg
Deviation = 6.33%



0 dB = 7.92 W/kg = 8.99 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

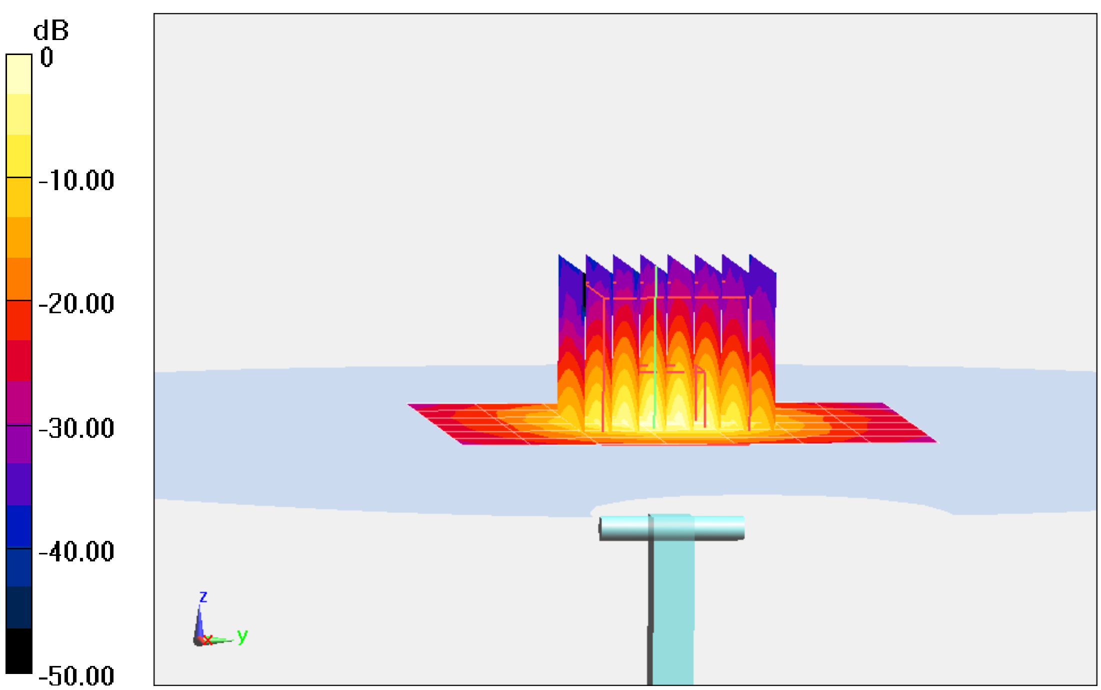
Communication System: UID 0, CW; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5300 MHz; σ = 5.489 S/m; ε_r = 47.474; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 21.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7308; ConvF(4.6, 4.6, 4.6); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

5300 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio = 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 31.8 W/kg
SAR(1 g) = 7.2 W/kg
Deviation = -5.01%



0 dB = 17.3 W/kg = 12.38 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

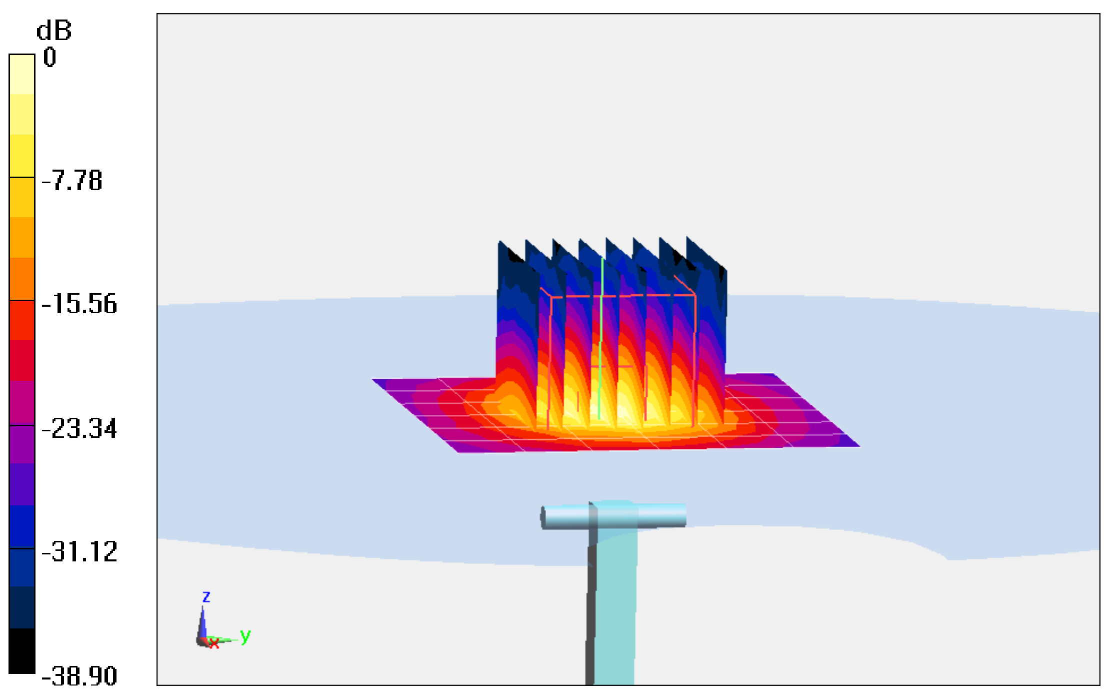
Communication System: UID 0, CW; Frequency: 5500 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5500 MHz; σ = 5.748 S/m; ε_r = 47.138; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 21.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7308; ConvF(4.09, 4.09, 4.09); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

5500 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio = 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 32.5 W/kg
SAR(1 g) = 7.23 W/kg
Deviation = -8.71%



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1120

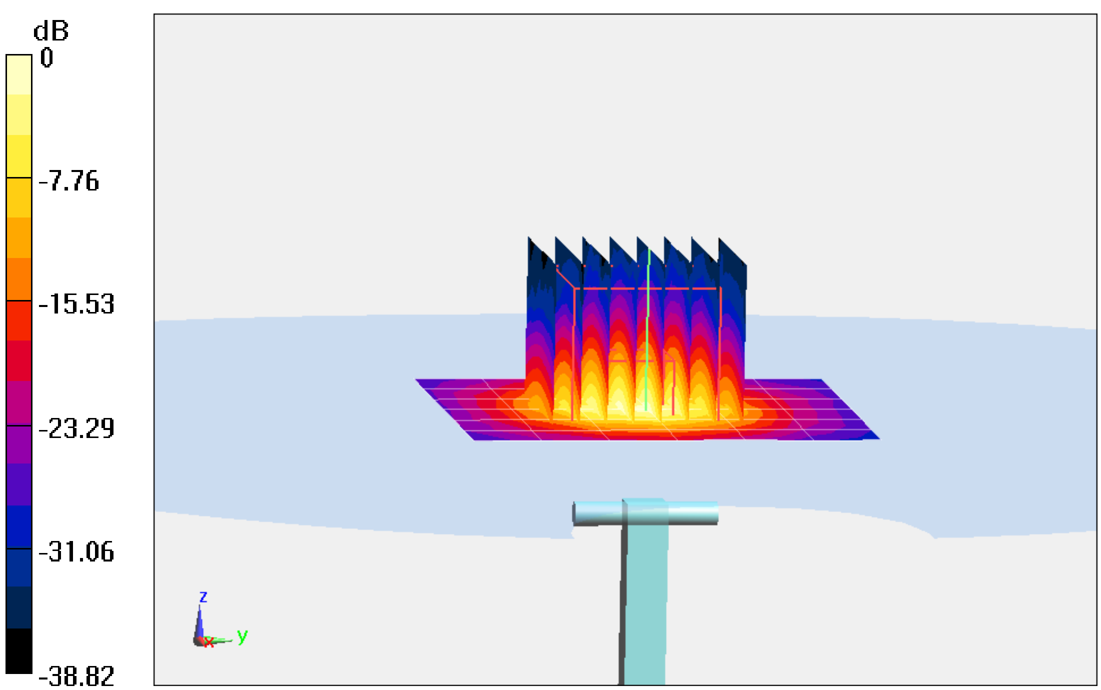
Communication System: UID 0, CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5600 MHz; σ = 5.88 S/m; ε_r = 46.988; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 21.7°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN7308; ConvF(4.09, 4.09, 4.09); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

5600 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio = 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 35.9 W/kg
SAR(1 g) = 7.79 W/kg
Deviation = -1.89%



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

PCTEST ENGINEERING LABORATORY, INC.

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

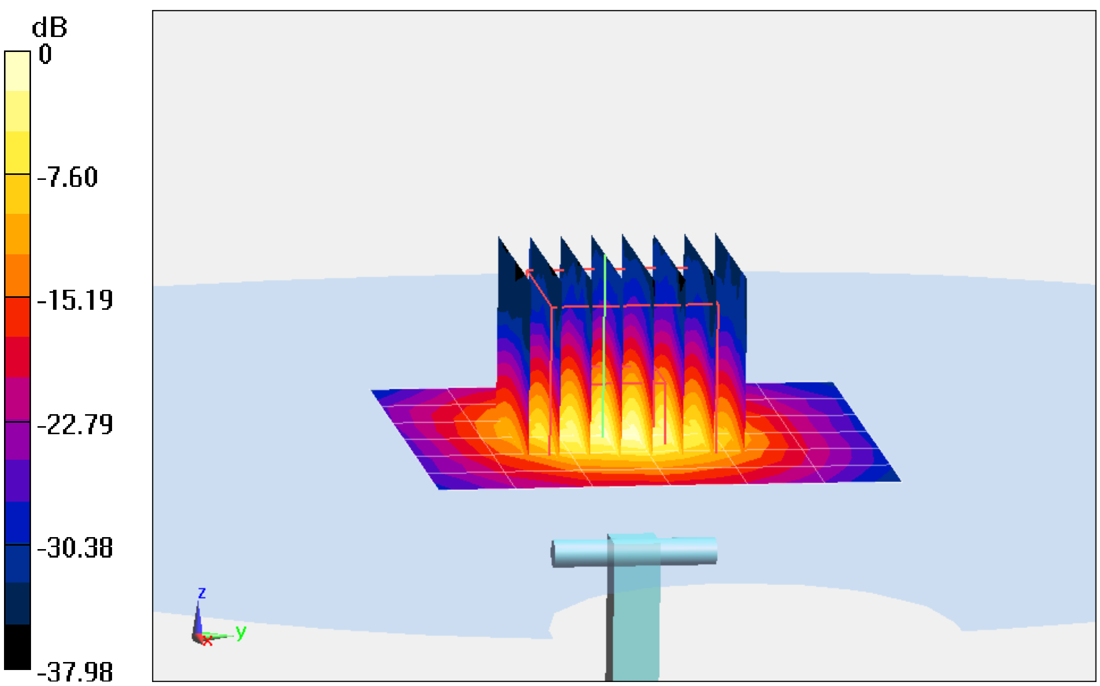
Communication System: UID 0, CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5800 MHz; σ = 6.158 S/m; ε_r = 46.623; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 21.7°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN7308; ConvF(4.22, 4.22, 4.22); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

5800 MHz System Verification

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm, Graded Ratio = 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 30.6 W/kg
SAR(1 g) = 6.79 W/kg
Deviation = -8.74%



0 dB = 16.5 W/kg = 12.17 dBW/kg

APPENDIX C: PROBE CALIBRATION

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

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

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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d133_Jul14**

CALIBRATION CERTIFICATE

Object: D835V2 - SN: 4d133

Calibration procedure(s): QA CAL-05.v9
Calibration procedure for dipole validation kits above 700 MHz

CC 11/6/14

Calibration date: July 24, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15

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: July 24, 2014

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

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.1 ± 6 %	0.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.38 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	1.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.96 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	53.8 ± 6 %	1.02 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	2.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.35 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.15 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.6 Ω - 1.0 jΩ
Return Loss	- 34.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.8 Ω - 3.3 jΩ
Return Loss	- 27.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.395 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: 24.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d133

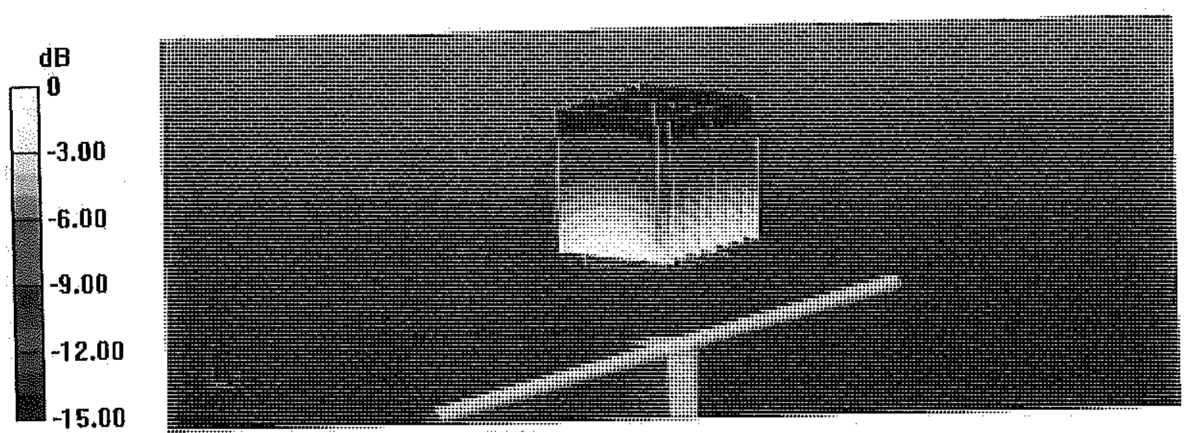
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 41.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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: 30.04.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

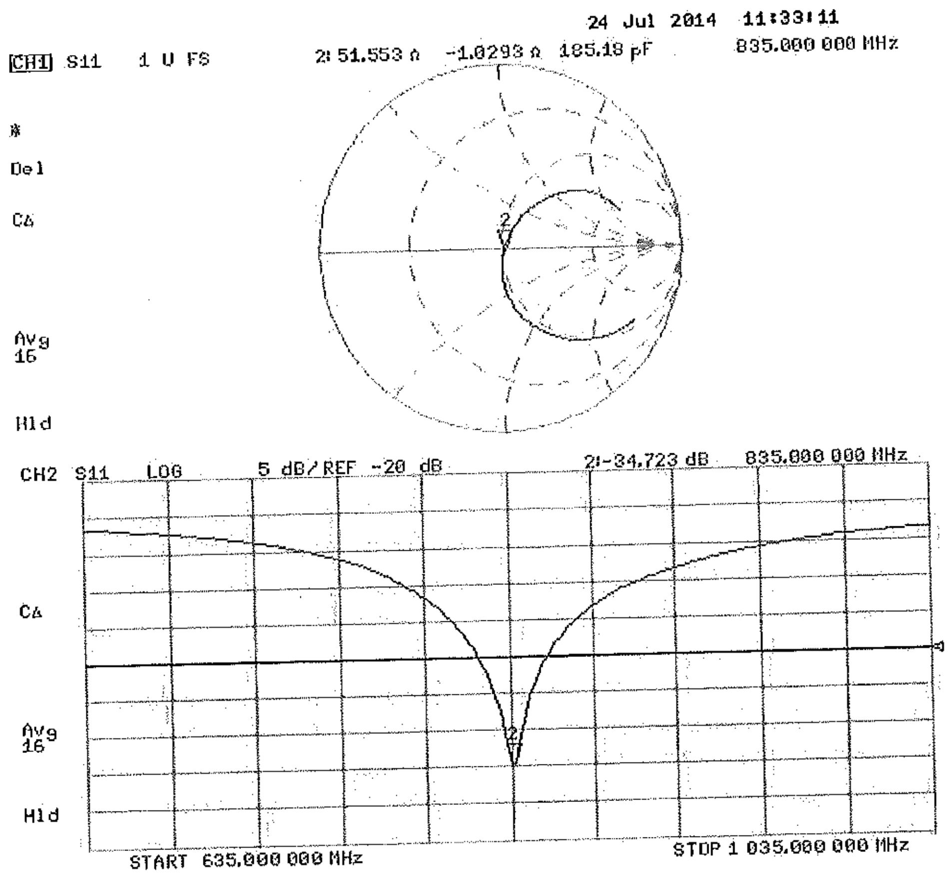
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.07 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 3.58 W/kg
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.53 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 Head TSL



DASY5 Validation Report for Body TSL

Date: 17.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d133

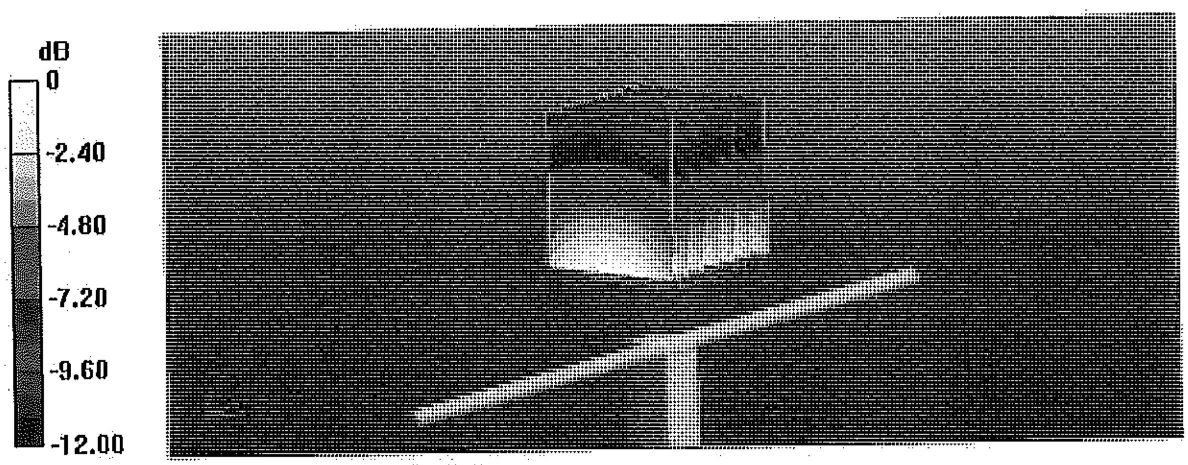
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.02 S/m; ε_r = 53.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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: 30.04.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

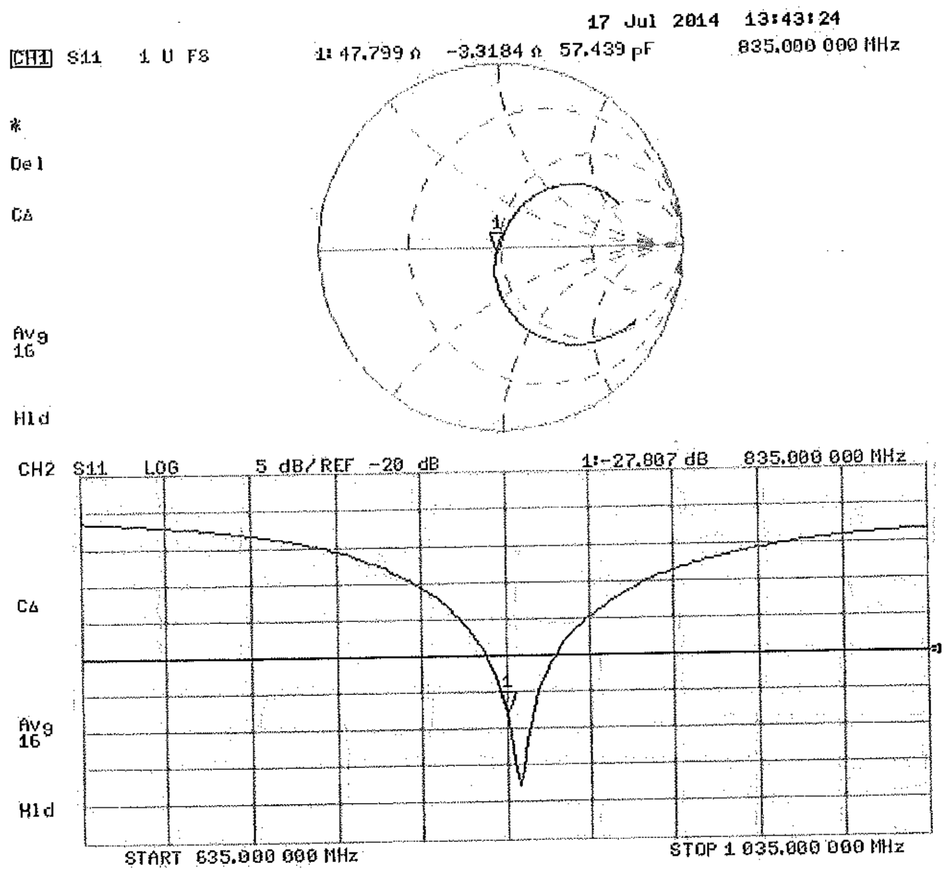
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.61 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.59 W/kg
SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.59 W/kg
Maximum value of SAR (measured) = 2.84 W/kg



0 dB = 2.84 W/kg = 4.53 dBW/kg

Impedance Measurement Plot for Body TSL



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

S **Schweizerischer Kalibrierdienst**
C **Service suisse d'étalonnage**
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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: D1765V2-1008_May14

CALIBRATION CERTIFICATE

Object	D1765V2 - SN: 1008
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 07, 2014

CCV 6/2/14

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)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15

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: May 12, 2014

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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.0 ± 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	9.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**36.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.5 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.2 ± 6 %	1.48 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**37.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.02 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.1 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.7 Ω - 6.1 jΩ
Return Loss	- 23.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.7 Ω - 6.4 jΩ
Return Loss	- 20.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.211 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 06, 2005

DASY5 Validation Report for Head TSL

Date: 07.05.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN: 1008

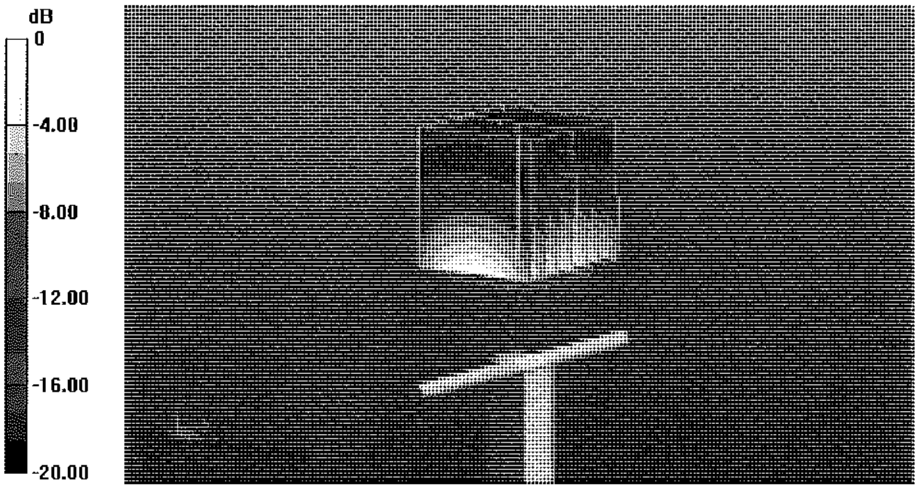
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.36 S/m; ε_r = 39; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.23, 5.23, 5.23); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

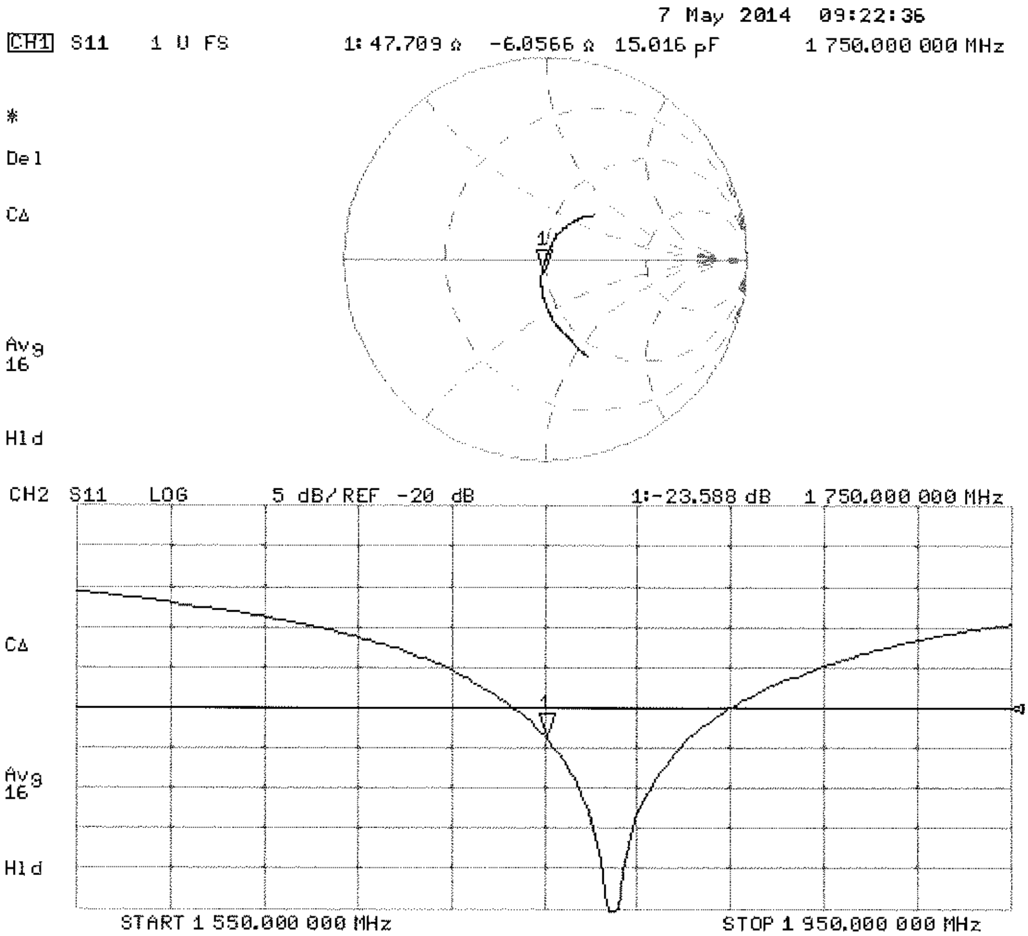
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.06 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 16.7 W/kg
SAR(1 g) = 9.23 W/kg; SAR(10 g) = 4.87 W/kg
Maximum value of SAR (measured) = 11.7 W/kg



0 dB = 11.7 W/kg = 10.68 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.05.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN: 1008

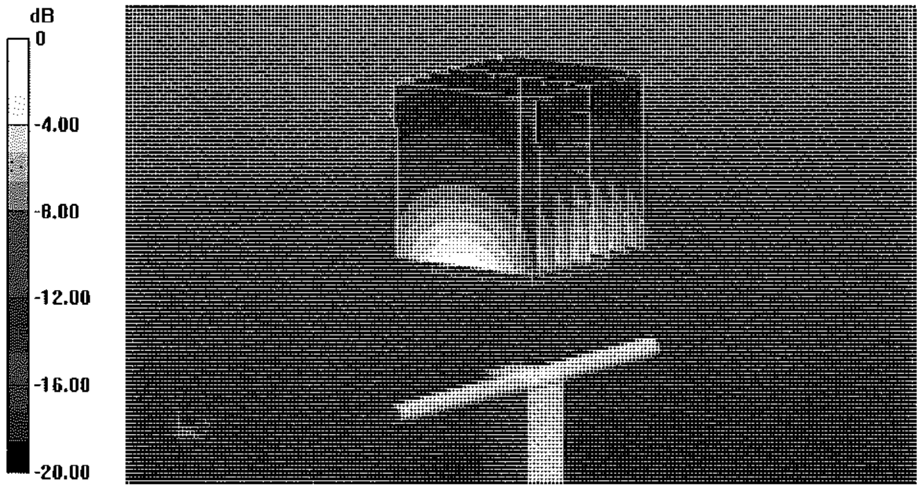
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.48 S/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.89, 4.89, 4.89); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

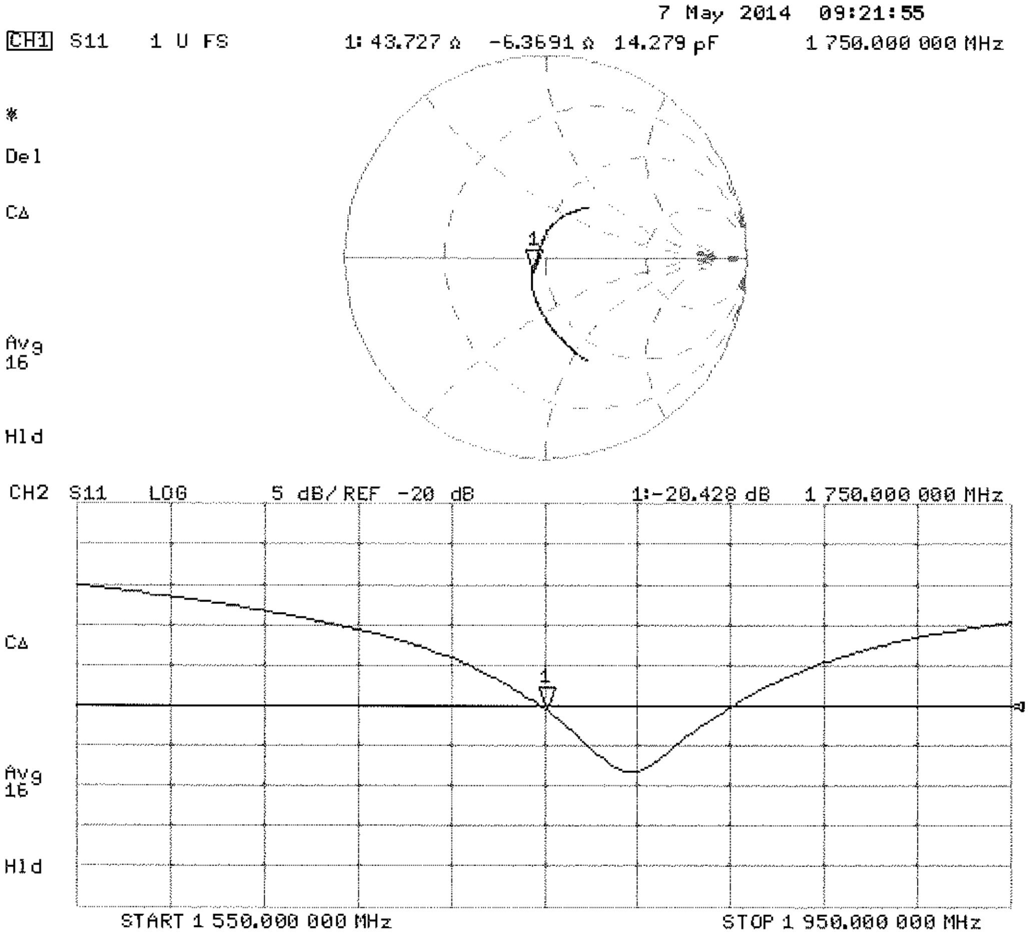
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.01 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 16.3 W/kg
SAR(1 g) = 9.41 W/kg; SAR(10 g) = 5.02 W/kg
Maximum value of SAR (measured) = 11.8 W/kg



0 dB = 11.8 W/kg = 10.72 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d149_Jul14**

CALIBRATION CERTIFICATE

Object: D1900V2 - SN: 5d149

Calibration procedure(s): QA CAL-05.v9
Calibration procedure for dipole validation kits above 700 MHz

CC 11/5/14

Calibration date: July 23, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15

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: July 23, 2014

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.5 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.0 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.5 ± 6 %	1.51 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**40.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.33 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.3 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.6 Ω + 5.5 jΩ
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.8 Ω + 6.1 jΩ
Return Loss	- 24.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 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: 23.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

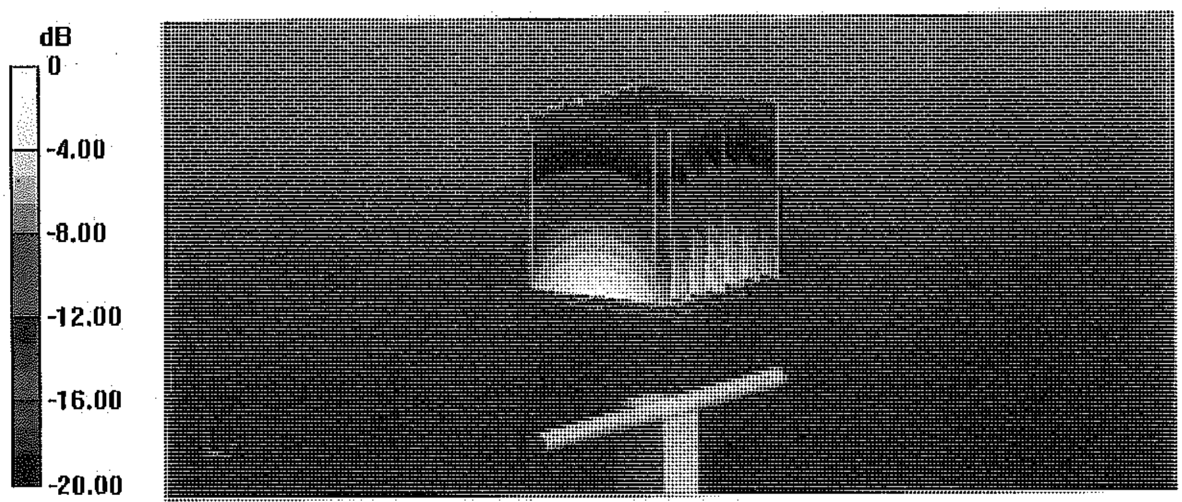
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 S/m; ε_r = 39.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

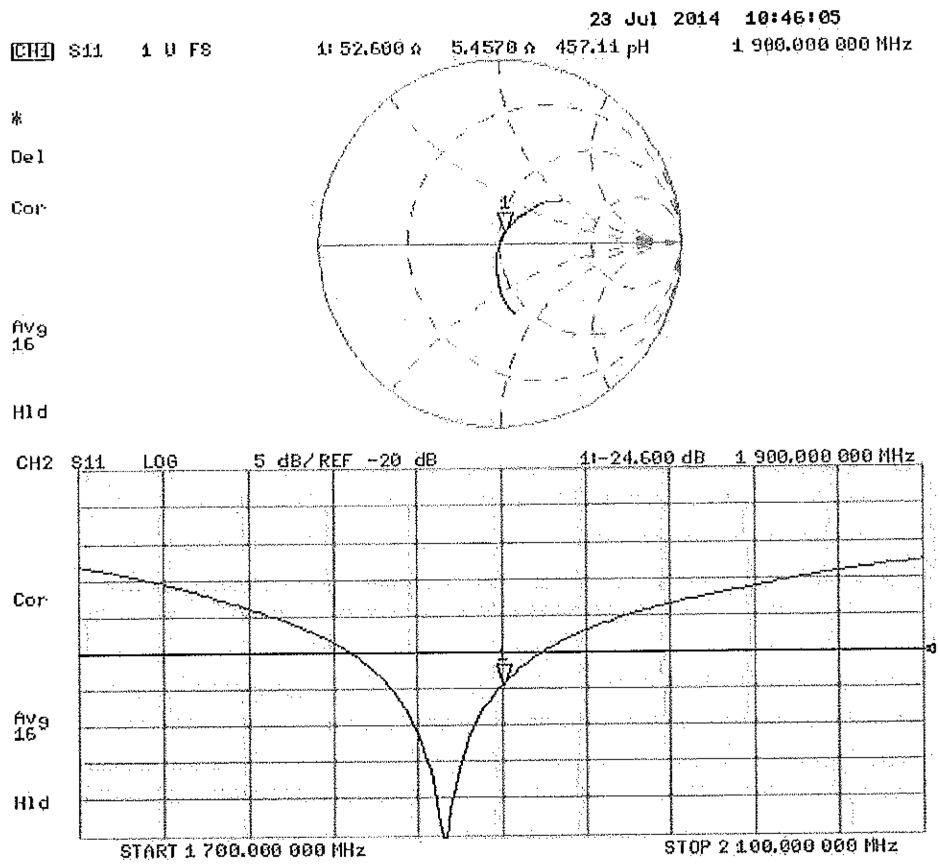
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.92 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 18.4 W/kg
SAR(1 g) = 10 W/kg; SAR(10 g) = 5.24 W/kg
Maximum value of SAR (measured) = 12.8 W/kg



0 dB = 12.8 W/kg = 11.07 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

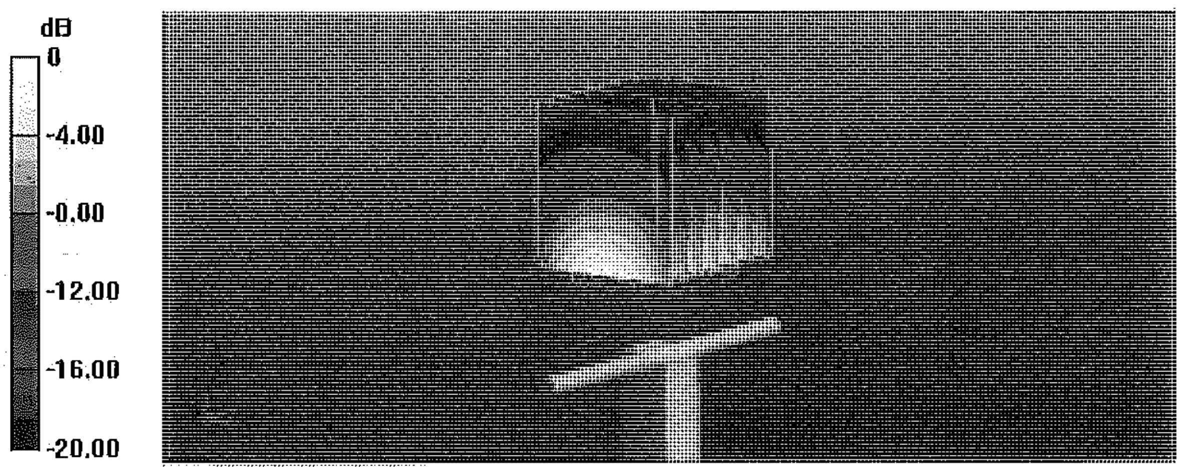
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.51 S/m; ε_r = 52.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

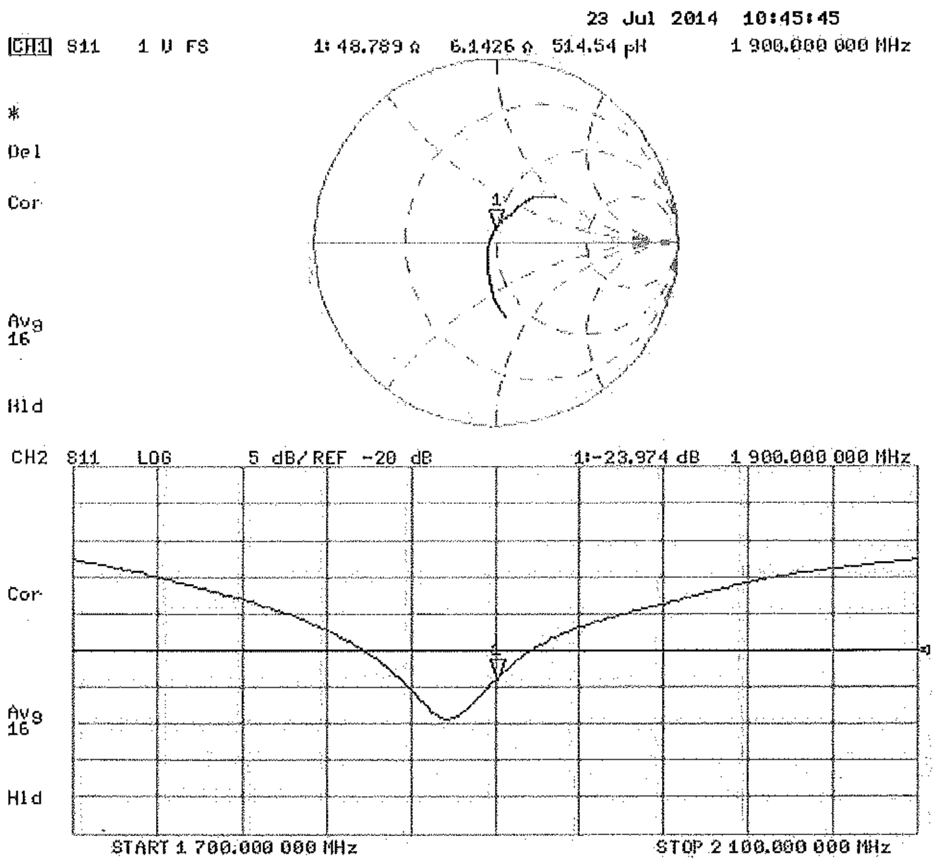
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.83 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 17.6 W/kg
SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.33 W/kg
Maximum value of SAR (measured) = 12.8 W/kg



0 dB = 12.8 W/kg = 11.07 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D2450V2-719_Aug14

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 719
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	August 11, 2014

✓ KOK 9/8/14

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)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15

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:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: August 12, 2014

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	V52.8.8
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	38.0 ± 6 %	1.82 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	**52.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.2 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.5 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.0 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.9 Ω + 3.0 jΩ
Return Loss	- 25.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.9 Ω + 5.8 jΩ
Return Loss	- 24.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 11.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

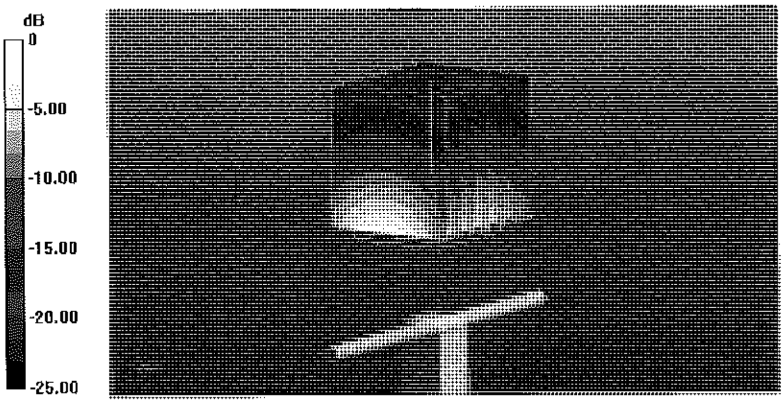
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.82 S/m; ε_r = 38; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

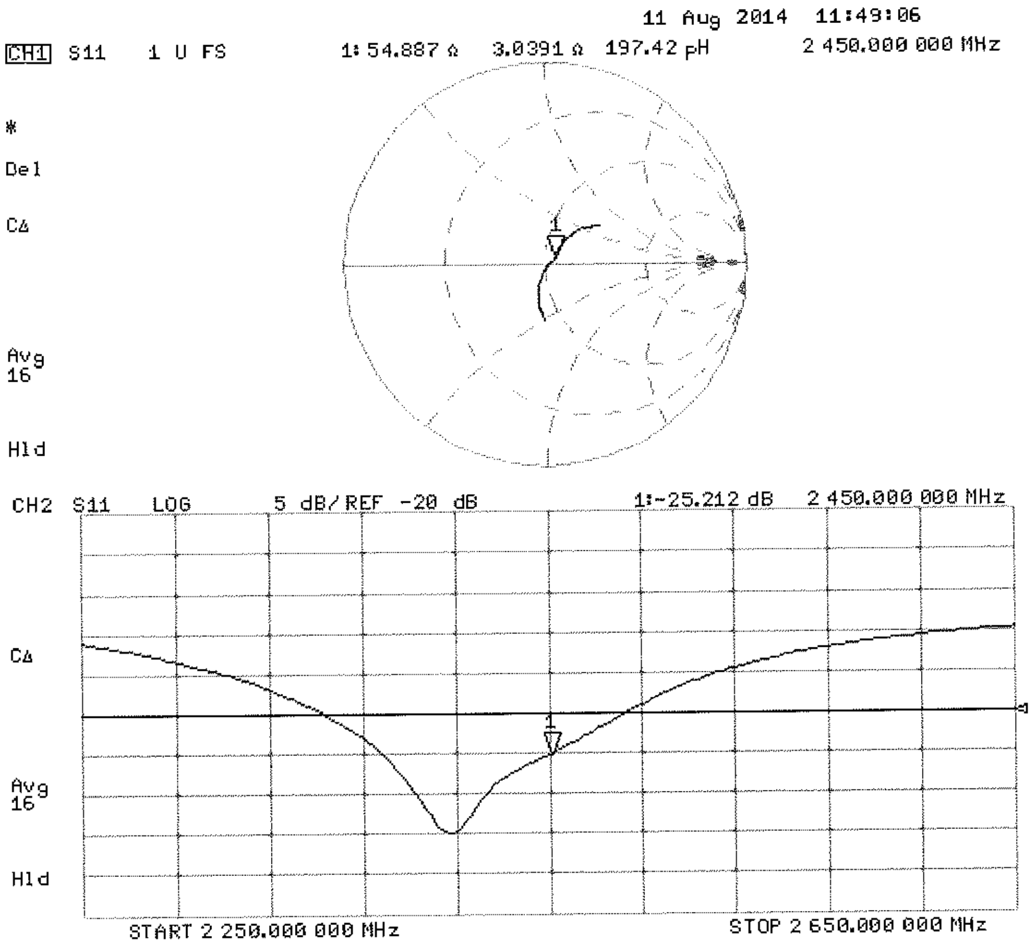
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.6 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 27.5 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.09 W/kg
Maximum value of SAR (measured) = 17.4 W/kg



0 dB = 17.4 W/kg = 12.41 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

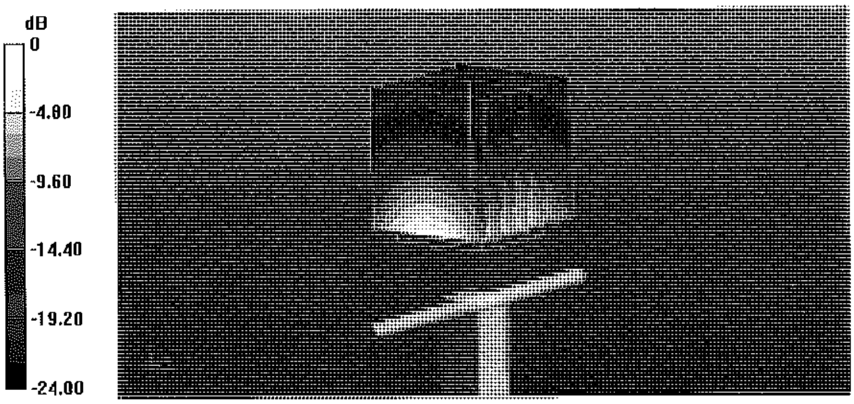
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 50.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

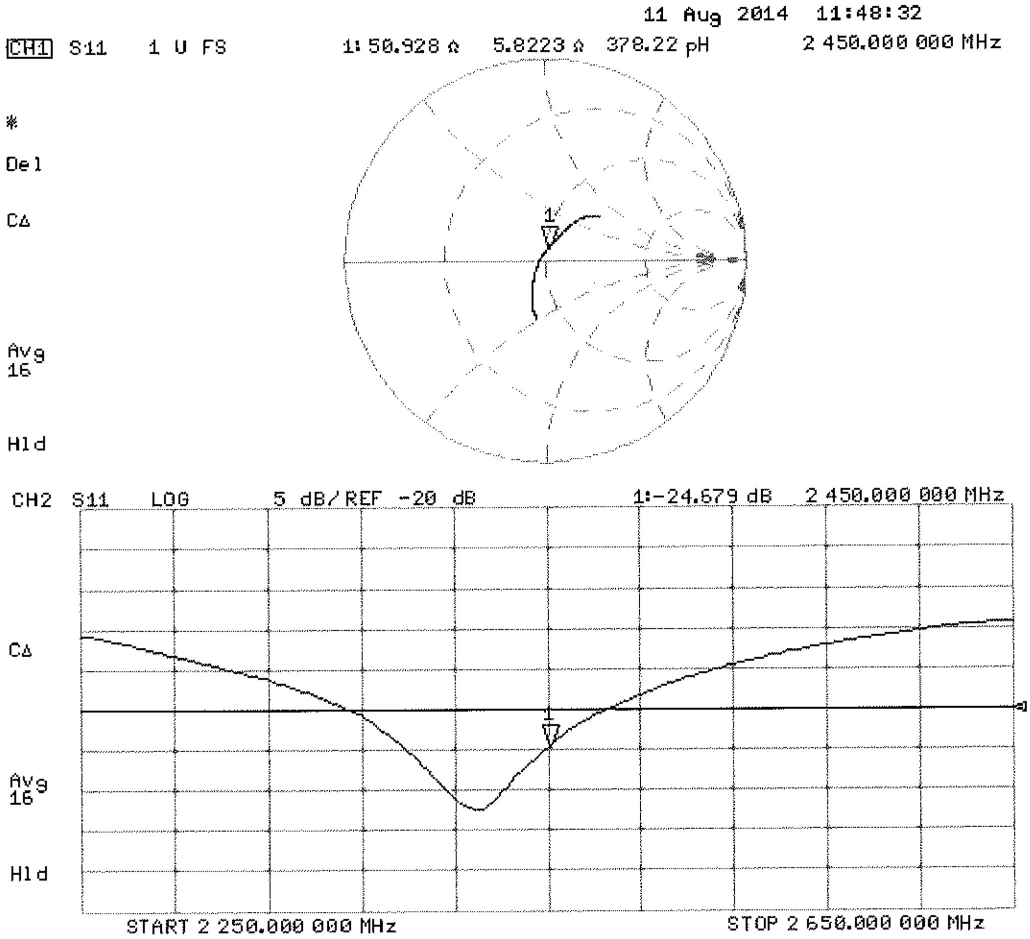
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.08 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.1 W/kg
Maximum value of SAR (measured) = 17.6 W/kg



0 dB = 17.6 W/kg = 12.46 dBW/kg

Impedance Measurement Plot for Body TSL



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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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: D5GHzV2-1120_Feb14

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1120
Calibration procedure(s)	QA CAL-22.v2 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	February 26, 2014

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

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

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

Issued: February 27, 2014

PCT# 80834

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

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

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.1 ± 6 %	4.52 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.9 ± 6 %	4.63 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**83.4 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.8 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.7 ± 6 %	4.84 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**84.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.1 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.6 ± 6 %	4.95 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**82.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.3 ± 6 %	5.16 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.4 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.8 ± 6 %	5.40 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.7 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.6 ± 6 %	5.53 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.3 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.3 ± 6 %	5.80 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.96 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**79.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.0 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.1 ± 6 %	5.94 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.98 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**79.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.0 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	6.21 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.47 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.6 W/kg ± 19.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	54.0 Ω - 5.6 jΩ
Return Loss	- 23.6 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	51.1 Ω + 1.6 jΩ
Return Loss	- 34.6 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.1 Ω - 2.3 jΩ
Return Loss	- 31.9 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	58.4 Ω - 0.2 jΩ
Return Loss	- 22.2 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	52.9 Ω + 2.8 jΩ
Return Loss	- 28.2 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	52.3 Ω - 5.9 jΩ
Return Loss	- 24.2 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	51.1 Ω + 1.2 jΩ
Return Loss	- 35.8 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	50.5 Ω - 2.6 jΩ
Return Loss	- 31.6 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	59.5 Ω - 2.9 jΩ
Return Loss	- 20.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	54.2 Ω + 1.1 jΩ
Return Loss	- 27.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.206 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 08, 2011

DASY5 Validation Report for Head TSL

Date: 26.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1120

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.52 S/m; ε_r = 37.1; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5300 MHz; σ = 4.63 S/m; ε_r = 36.9; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5500 MHz; σ = 4.84 S/m; ε_r = 36.7; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 4.95 S/m; ε_r = 36.6; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5800 MHz; σ = 5.16 S/m; ε_r = 36.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

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

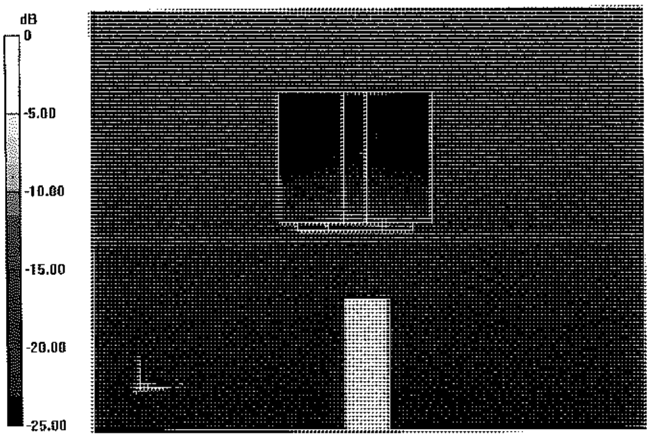
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.794 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 28.6 W/kg
SAR(1 g) = 7.87 W/kg; SAR(10 g) = 2.24 W/kg
Maximum value of SAR (measured) = 18.0 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.390 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 31.5 W/kg
SAR(1 g) = 8.3 W/kg; SAR(10 g) = 2.37 W/kg
Maximum value of SAR (measured) = 19.2 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.321 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 33.6 W/kg
SAR(1 g) = 8.45 W/kg; SAR(10 g) = 2.4 W/kg
Maximum value of SAR (measured) = 20.0 W/kg

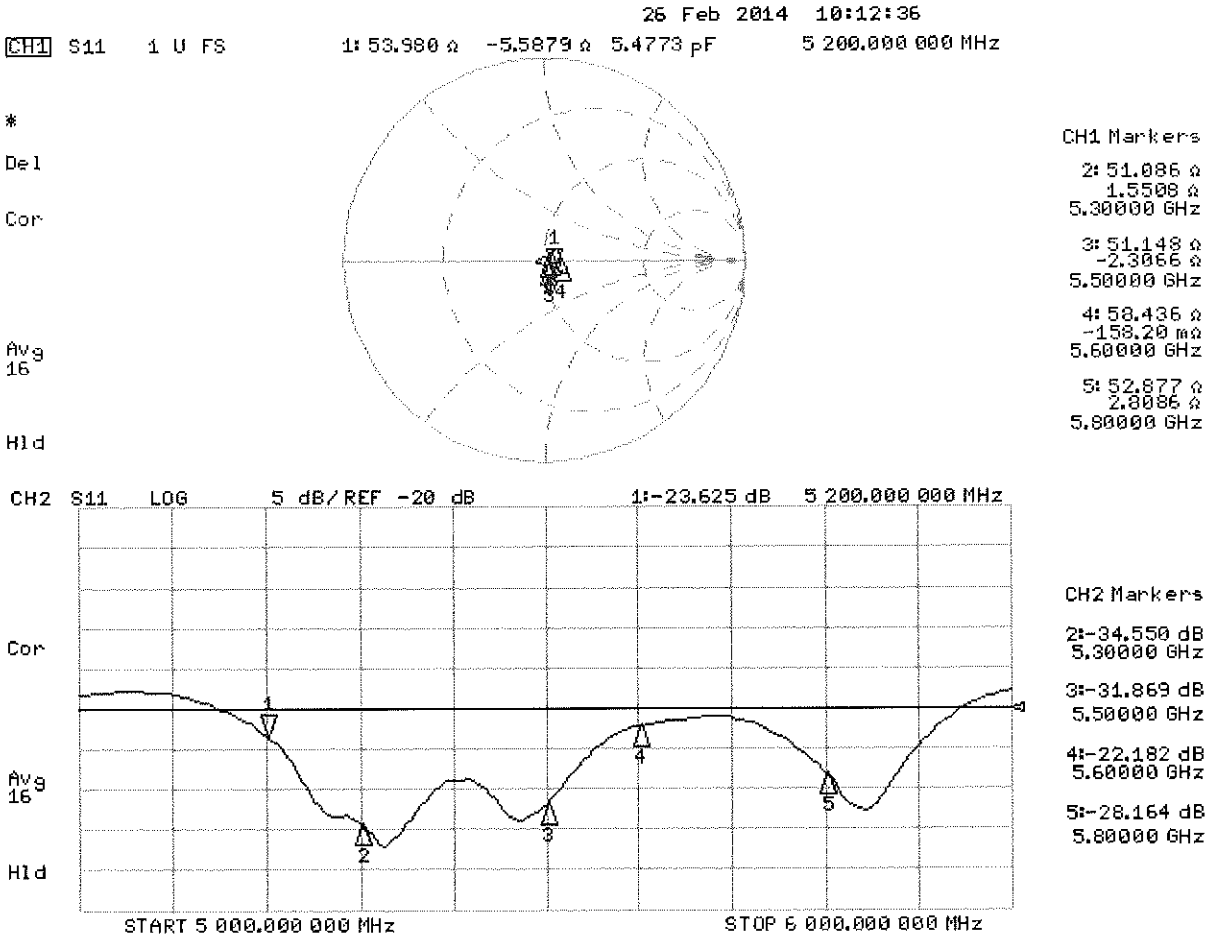
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.007 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 32.7 W/kg
SAR(1 g) = 8.18 W/kg; SAR(10 g) = 2.33 W/kg
Maximum value of SAR (measured) = 19.4 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 59.638 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 33.0 W/kg
SAR(1 g) = 7.87 W/kg; SAR(10 g) = 2.23 W/kg
Maximum value of SAR (measured) = 19.0 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 25.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1120

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.4 S/m; ε_r = 47.8; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5300 MHz; σ = 5.53 S/m; ε_r = 47.6; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5500 MHz; σ = 5.8 S/m; ε_r = 47.3; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 5.94 S/m; ε_r = 47.1; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5800 MHz; σ = 6.21 S/m; ε_r = 46.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

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

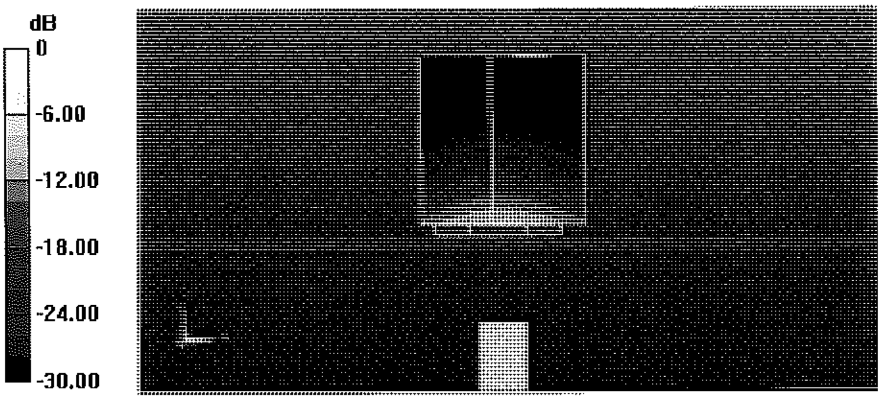
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 59.562 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 29.5 W/kg
SAR(1 g) = 7.43 W/kg; SAR(10 g) = 2.08 W/kg
Maximum value of SAR (measured) = 17.7 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.903 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 31.1 W/kg
SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.14 W/kg
Maximum value of SAR (measured) = 18.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 59.015 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 34.5 W/kg
SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.21 W/kg
Maximum value of SAR (measured) = 19.5 W/kg

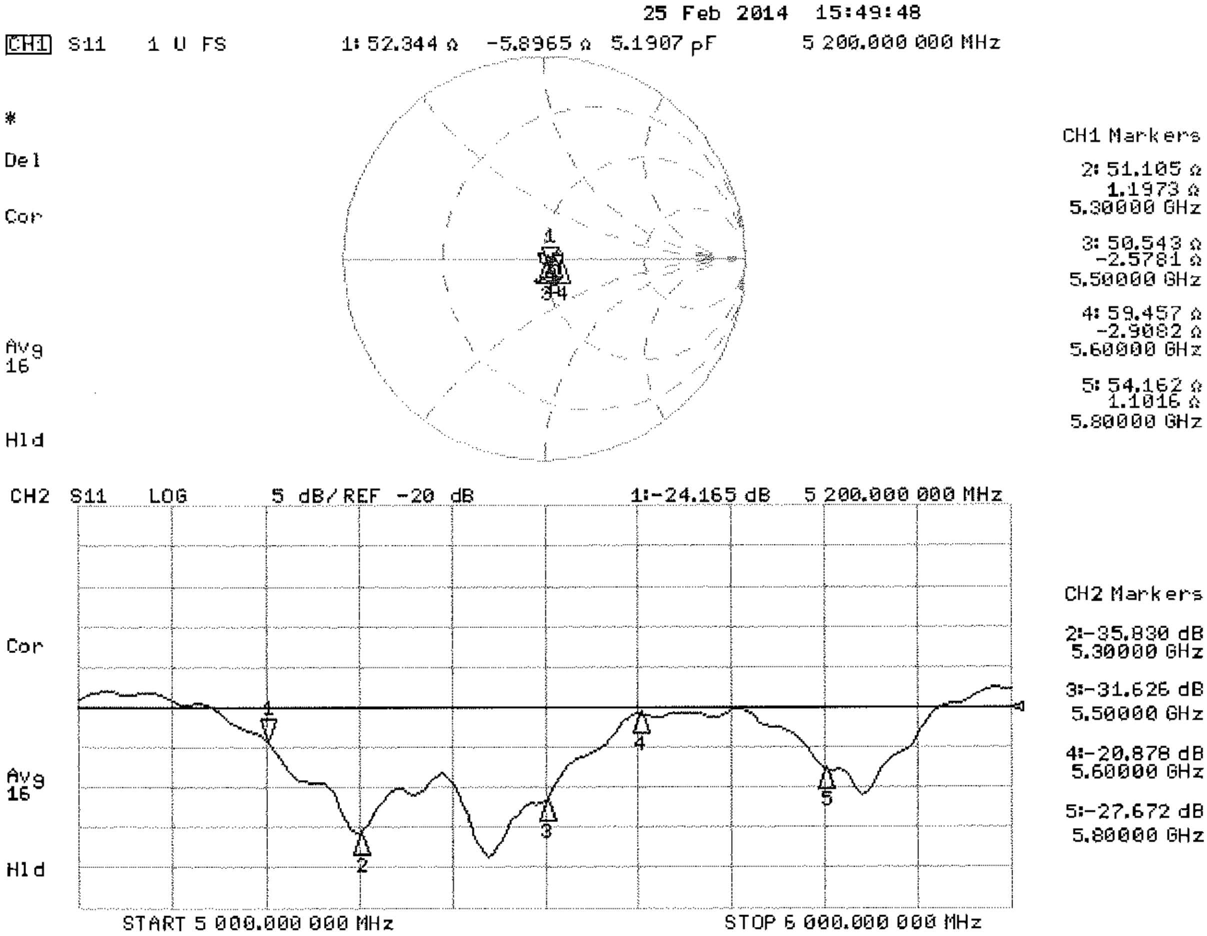
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.626 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 35.6 W/kg
SAR(1 g) = 7.98 W/kg; SAR(10 g) = 2.21 W/kg
Maximum value of SAR (measured) = 19.8 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.428 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 34.9 W/kg
SAR(1 g) = 7.47 W/kg; SAR(10 g) = 2.07 W/kg
Maximum value of SAR (measured) = 18.8 W/kg



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

Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D2600V2-1071_Oct14**

CALIBRATION CERTIFICATE

Object: D2600V2 - SN: 1071

Calibration procedure(s): QA CAL-05.v9
Calibration procedure for dipole validation kits above 700 MHz

CC
11/4/14

Calibration date: October 20, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

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-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: October 20, 2014

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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.8 ± 6 %	2.03 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**57.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.9 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.8 ± 6 %	2.22 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	14.5 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**56.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**25.4 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.7 Ω - 5.2 jΩ
Return Loss	- 25.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.9 Ω - 4.2 jΩ
Return Loss	- 24.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.153 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 17, 2013

DASY5 Validation Report for Head TSL

Date: 20.10.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1071

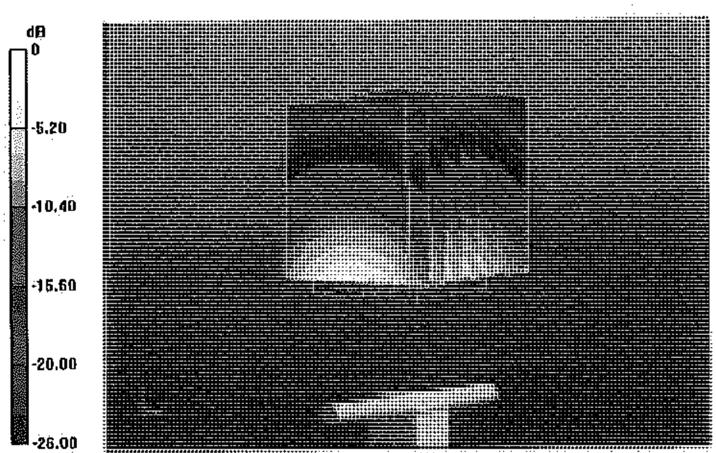
Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; σ = 2.03 S/m; ε_r = 37.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.46, 4.46, 4.46); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

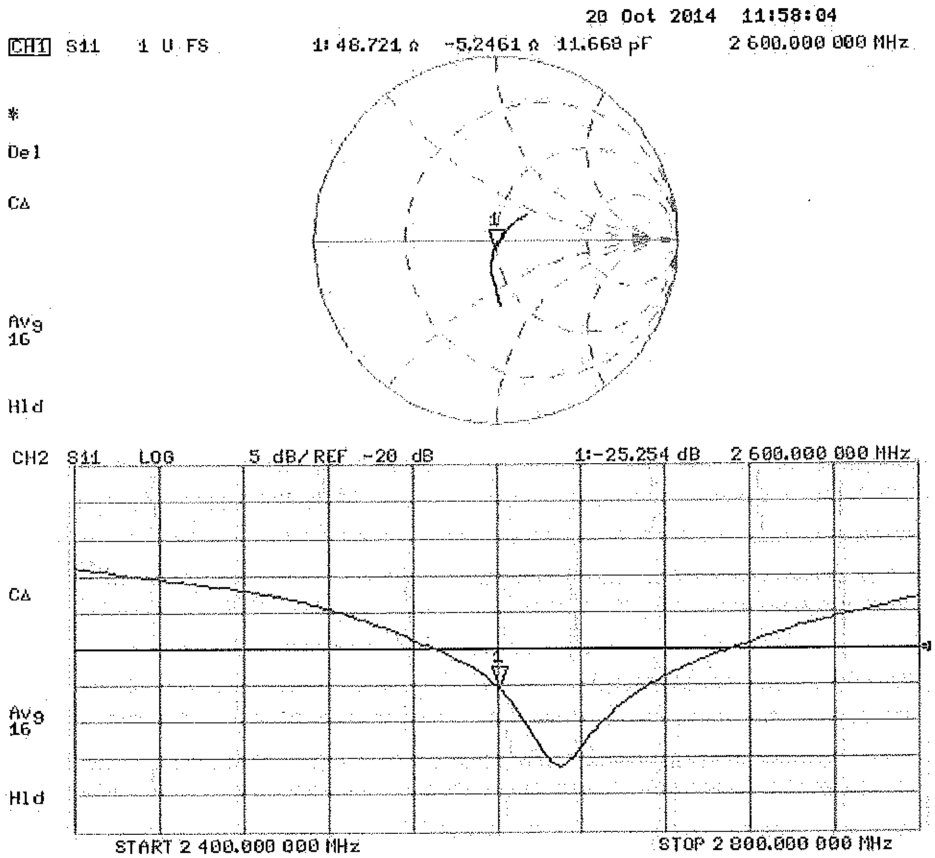
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 103.3 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 31.0 W/kg
SAR(1 g) = 14.7 W/kg; SAR(10 g) = 6.57 W/kg
Maximum value of SAR (measured) = 19.7 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 20.10.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1071

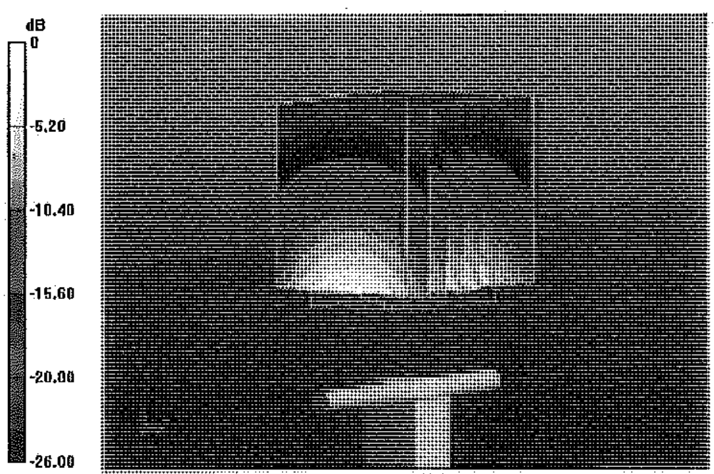
Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; σ = 2.22 S/m; ε_r = 50.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.24, 4.24, 4.24); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

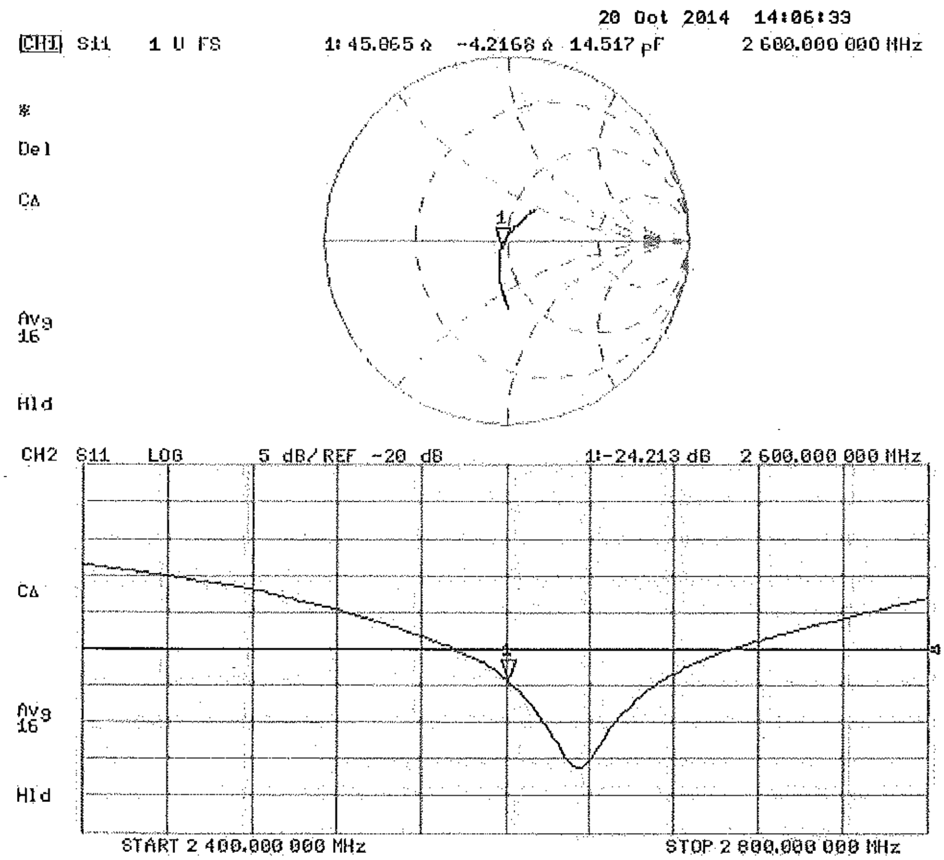
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 97.02 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 31.0 W/kg
SAR(1 g) = 14.5 W/kg; SAR(10 g) = 6.43 W/kg
Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 19.3 W/kg = 12.86 dBW/kg

Impedance Measurement Plot for Body TSL



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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

CC✓ 3/6/14

Calibration date: February 25, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: February 27, 2014

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PCT# 80615

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Accreditation No.: SCS 108

Glossary:

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

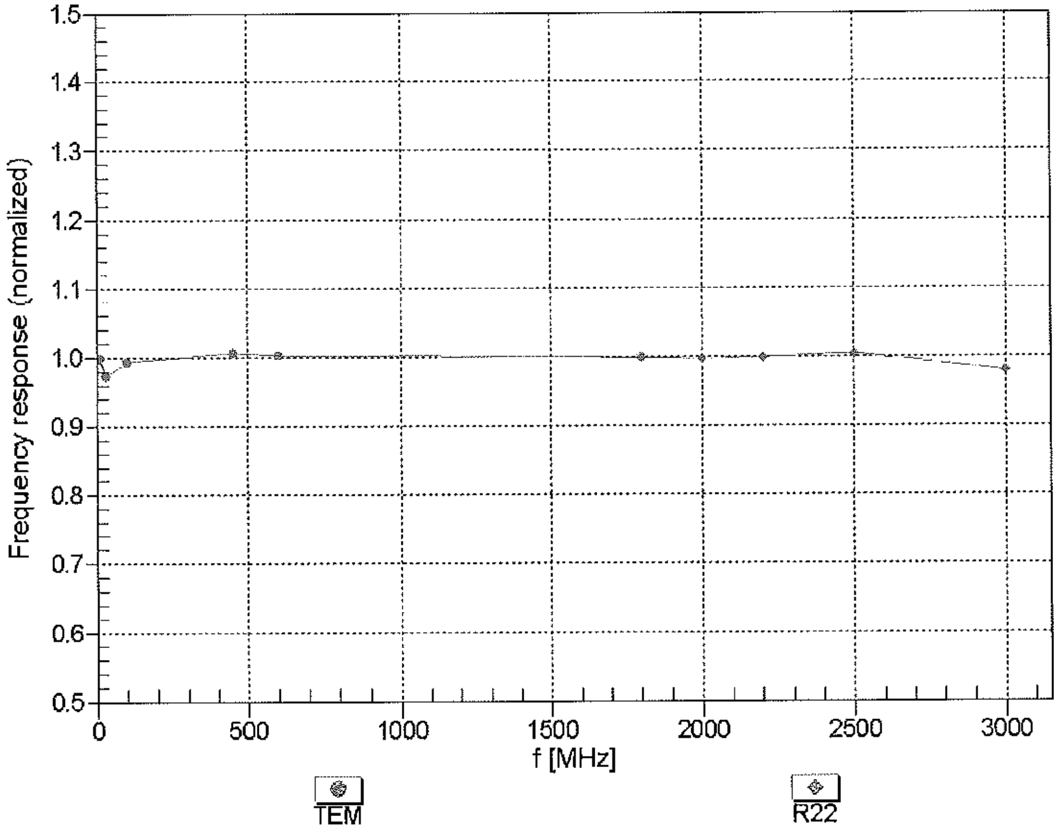
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

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.

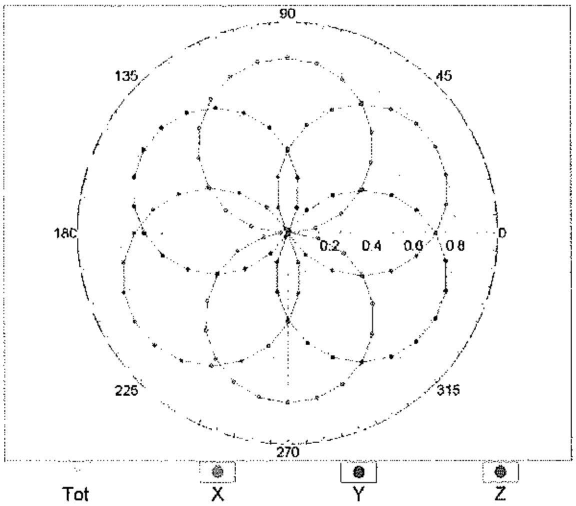
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



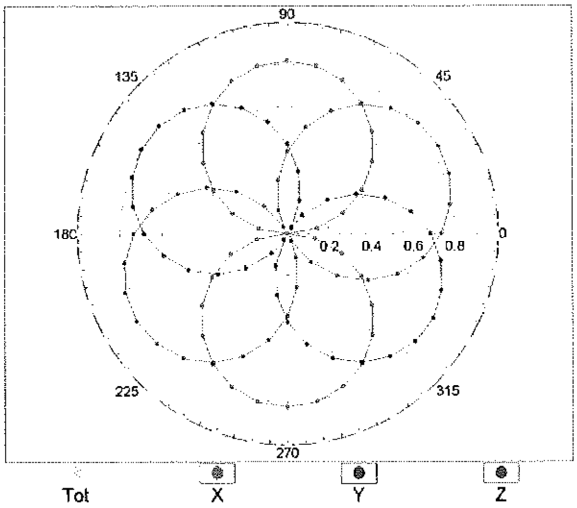
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

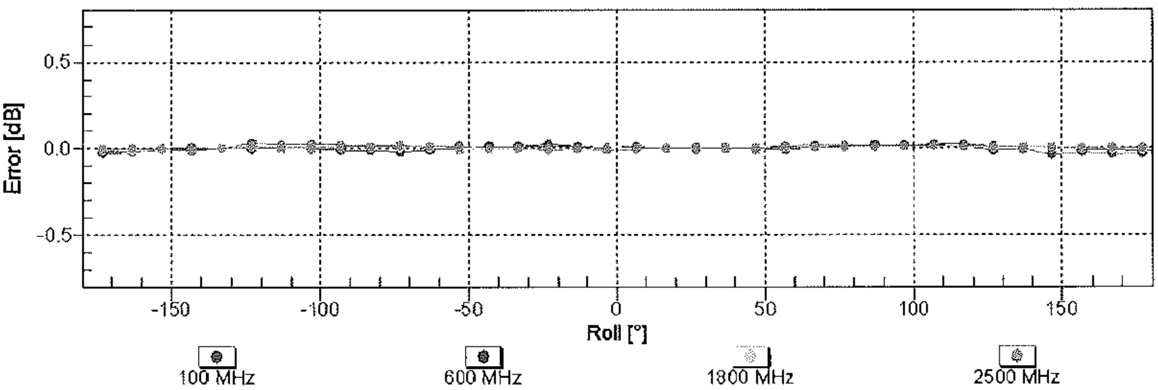
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



f=1800 MHz,R22

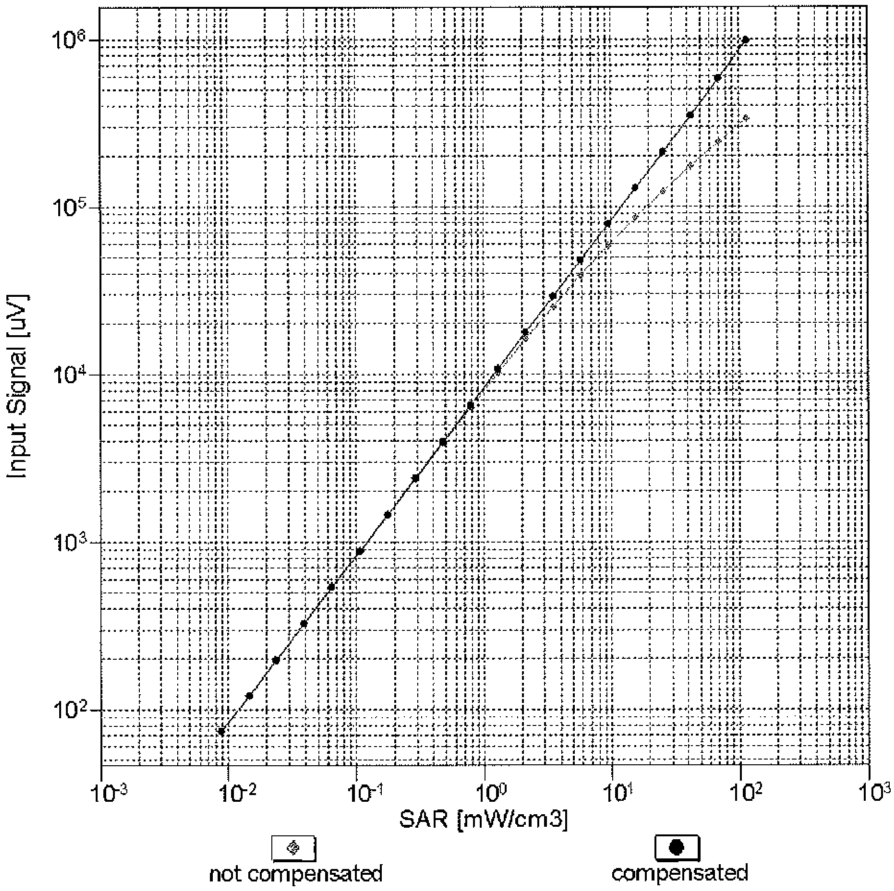


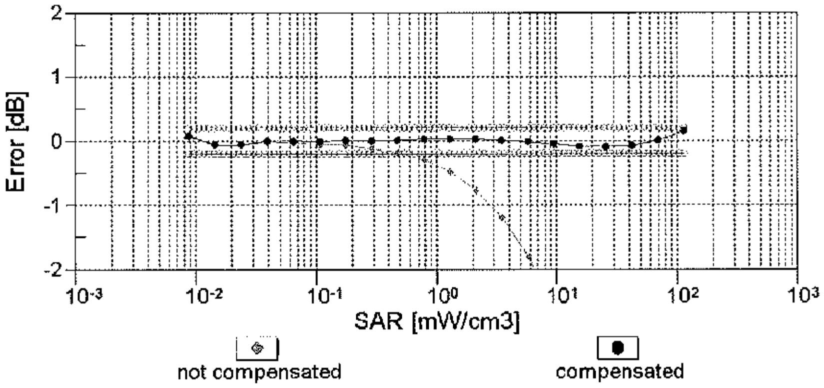


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR$_{head}$)

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

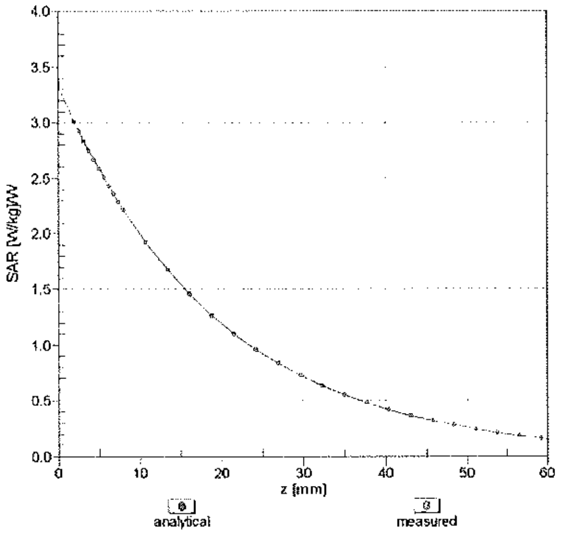




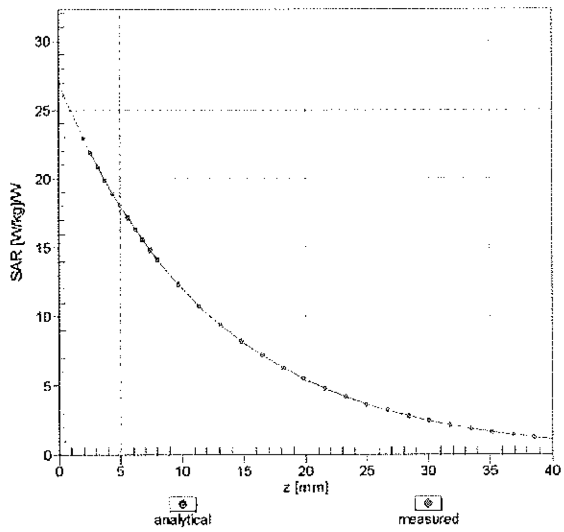
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

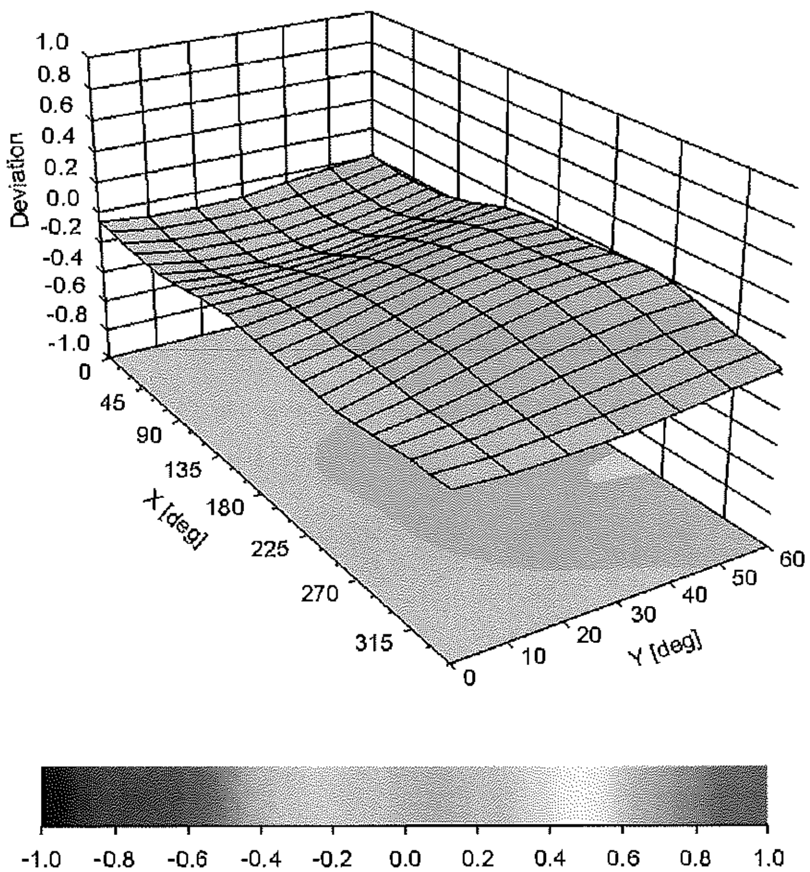


f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

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

Other Probe Parameters

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

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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: ES3-3263_May14

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3263
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	May 15, 2014

CC✓ 7/17/14

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	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 15, 2014

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

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Swiss Calibration Service

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

Accreditation No.: **SCS 108**

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:3263

Manufactured: January 25, 2010
Calibrated: May 15, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3263

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.21	1.24	1.13	± 10.1 %
DCP (mV)[B]	103.8	102.3	104.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	156.3	±3.5 %
		Y	0.0	0.0	1.0		203.1	
		Z	0.0	0.0	1.0		197.2	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	2.33	59.4	10.8	10.00	46.4	±1.4 %
		Y	4.39	63.4	13.6		50.8	
		Z	1.35	55.5	7.8		39.6	
10011-CAB	UMTS-FDD (WCDMA)	X	3.49	68.2	19.1	2.91	126.7	±0.7 %
		Y	3.28	66.9	18.5		120.7	
		Z	2.74	63.1	15.1		113.5	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.51	72.0	20.3	1.87	127.9	±0.7 %
		Y	3.21	69.4	18.8		124.1	
		Z	1.93	60.6	12.6		113.3	
10013-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.30	70.8	23.3	9.46	125.2	±2.5 %
		Y	12.42	72.7	24.4		129.4	
		Z	10.03	67.8	21.1		105.5	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	24.45	99.1	27.6	9.39	141.4	±1.4 %
		Y	29.93	99.5	29.0		124.5	
		Z	4.53	73.0	18.1		111.6	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	25.10	99.7	27.9	9.57	134.2	±1.9 %
		Y	24.85	96.1	28.0		120.2	
		Z	5.99	76.5	19.1		142.5	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	24.34	93.0	23.0	6.56	117.1	±1.4 %
		Y	26.49	92.6	24.2		148.7	
		Z	4.00	69.6	13.8		136.6	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	51.24	99.9	23.5	4.80	131.1	±1.9 %
		Y	56.83	99.5	24.3		101.8	
		Z	1.70	61.4	9.1		107.7	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	60.12	99.6	22.2	3.55	138.7	±1.9 %
		Y	64.73	99.9	23.4		105.5	
		Z	1.13	58.4	6.0		116.0	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	77.27	99.6	19.6	1.16	149.5	±2.5 %
		Y	60.44	99.7	21.0		109.4	
		Z	0.34	55.9	2.9		131.4	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.79	66.8	19.0	4.57	124.5	±0.9 %
		Y	4.85	66.4	18.8		125.6	
		Z	4.06	63.4	16.1		108.1	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.93	66.1	18.5	3.97	119.8	±0.7 %
		Y	3.90	65.5	18.2		120.1	
		Z	3.29	62.4	15.3		108.5	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.68	66.9	18.7	3.98	131.2	±0.7 %
		Y	4.64	66.6	18.6		130.5	
		Z	4.15	64.5	16.5		118.8	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.61	68.1	20.0	5.67	137.5	±1.7 %
		Y	6.70	68.4	20.2		137.7	
		Z	5.90	65.6	17.9		124.0	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.44	67.5	19.8	5.80	135.1	±1.7 %
		Y	6.60	68.0	20.1		135.4	
		Z	5.75	64.9	17.6		121.8	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.14	67.1	19.7	5.75	131.6	±1.2 %
		Y	6.28	67.4	19.9		132.7	
		Z	5.62	65.5	18.2		118.4	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.18	68.8	21.2	8.10	124.3	±1.9 %
		Y	10.60	69.7	21.8		126.2	
		Z	9.38	67.0	19.8		108.4	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.23	68.9	21.3	8.07	125.0	±1.9 %
		Y	10.56	69.6	21.7		127.1	
		Z	9.37	67.1	19.8		109.1	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	10.23	75.7	26.0	9.28	125.0	±2.7 %
		Y	14.60	83.3	29.5		147.3	
		Z	8.05	69.7	22.3		106.3	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.12	67.0	19.6	5.75	131.6	±1.4 %
		Y	6.28	67.4	19.9		132.4	
		Z	5.49	64.7	17.4		117.9	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.57	67.5	19.8	5.82	136.0	±1.4 %
		Y	6.71	67.9	20.1		137.1	
		Z	5.89	65.2	17.8		122.4	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.82	66.0	19.3	5.73	113.5	±1.4 %
		Y	5.12	66.3	19.4		116.6	
		Z	4.75	65.9	18.3		142.7	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	9.53	80.6	28.6	9.21	136.5	±2.2 %
		Y	11.32	81.6	28.8		109.2	
		Z	6.84	72.0	23.8		117.3	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.86	66.2	19.4	5.72	112.9	±1.2 %
		Y	5.10	66.2	19.4		115.9	
		Z	4.55	64.9	17.8		137.7	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.81	66.0	19.2	5.72	111.6	±1.2 %
		Y	5.13	66.4	19.5		116.1	
		Z	4.70	65.7	18.3		137.1	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.80	68.3	21.0	8.09	117.2	±2.2 %
		Y	10.23	69.1	21.6		121.5	
		Z	9.85	68.9	20.8		148.4	

10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.81	68.4	21.1	8.10	117.7	±2.2 %
		Y	10.23	69.2	21.6		121.7	
		Z	9.87	69.0	20.9		149.9	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.71	68.3	21.0	8.03	117.8	±2.2 %
		Y	10.12	69.1	21.6		121.0	
		Z	8.90	66.6	19.6		104.1	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.14	68.7	21.2	8.06	122.3	±1.9 %
		Y	10.52	69.5	21.7		125.4	
		Z	9.28	66.8	19.6		108.5	
10225-CAB	UMTS-FDD (HSPA+)	X	7.25	67.8	19.9	5.97	146.3	±1.7 %
		Y	7.32	67.5	19.8		149.3	
		Z	6.52	65.7	18.0		130.7	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	9.55	80.7	28.7	9.21	137.2	±2.5 %
		Y	11.34	81.7	28.9		109.9	
		Z	6.98	72.5	24.0		119.5	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	9.26	74.1	25.3	9.24	115.6	±3.3 %
		Y	13.72	82.5	29.3		137.9	
		Z	8.83	73.3	24.4		144.1	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	10.06	75.2	25.8	9.30	122.9	±2.7 %
		Y	14.69	83.4	29.6		147.6	
		Z	8.02	69.6	22.3		103.4	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.08	67.2	19.0	4.87	140.2	±1.2 %
		Y	6.23	67.5	19.2		143.5	
		Z	5.52	65.4	17.4		125.1	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.44	66.7	18.7	3.96	122.1	±0.7 %
		Y	4.39	66.3	18.5		124.4	
		Z	3.83	63.7	16.0		114.0	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.64	66.7	18.6	3.46	115.7	±0.7 %
		Y	3.60	66.0	18.2		118.0	
		Z	3.17	64.2	16.3		108.4	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.62	67.0	18.8	3.39	116.9	±0.9 %
		Y	3.54	66.1	18.2		119.1	
		Z	3.24	64.2	15.8		145.6	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.43	67.5	19.8	5.81	132.0	±1.4 %
		Y	6.60	68.0	20.1		134.9	
		Z	5.81	65.4	18.0		115.0	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.04	68.1	20.2	6.06	137.5	±1.4 %
		Y	7.19	68.6	20.5		140.3	
		Z	6.26	65.7	18.2		119.6	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	3.05	70.0	19.4	1.71	121.7	±0.7 %
		Y	2.91	68.7	18.7		123.4	
		Z	1.83	60.2	12.3		108.4	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.05	68.7	21.4	8.36	117.3	±1.9 %
		Y	10.57	69.7	22.0		122.8	
		Z	9.11	66.5	19.7		103.1	

10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.81	68.3	18.8	3.76	125.8	±0.7 %
		Y	4.65	66.5	18.1		130.8	
		Z	3.98	64.7	16.0		114.7	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.91	69.1	19.2	3.77	123.3	±0.7 %
		Y	4.60	66.6	18.1		128.5	
		Z	3.73	64.0	15.4		112.0	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.78	69.0	19.0	1.54	121.9	±0.7 %
		Y	2.46	66.8	17.9		122.5	
		Z	1.83	60.9	13.0		112.4	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.88	68.4	21.2	8.23	116.6	±1.7 %
		Y	10.29	69.2	21.7		121.5	
		Z	9.25	67.3	20.2		103.4	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 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:3263

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	6.42	6.42	6.42	0.72	1.18	± 12.0 %
835	41.5	0.90	6.23	6.23	6.23	0.27	2.02	± 12.0 %
1750	40.1	1.37	5.41	5.41	5.41	0.74	1.23	± 12.0 %
1900	40.0	1.40	5.08	5.08	5.08	0.80	1.16	± 12.0 %
2450	39.2	1.80	4.47	4.47	4.47	0.80	1.22	± 12.0 %
2600	39.0	1.96	4.33	4.33	4.33	0.66	1.41	± 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.

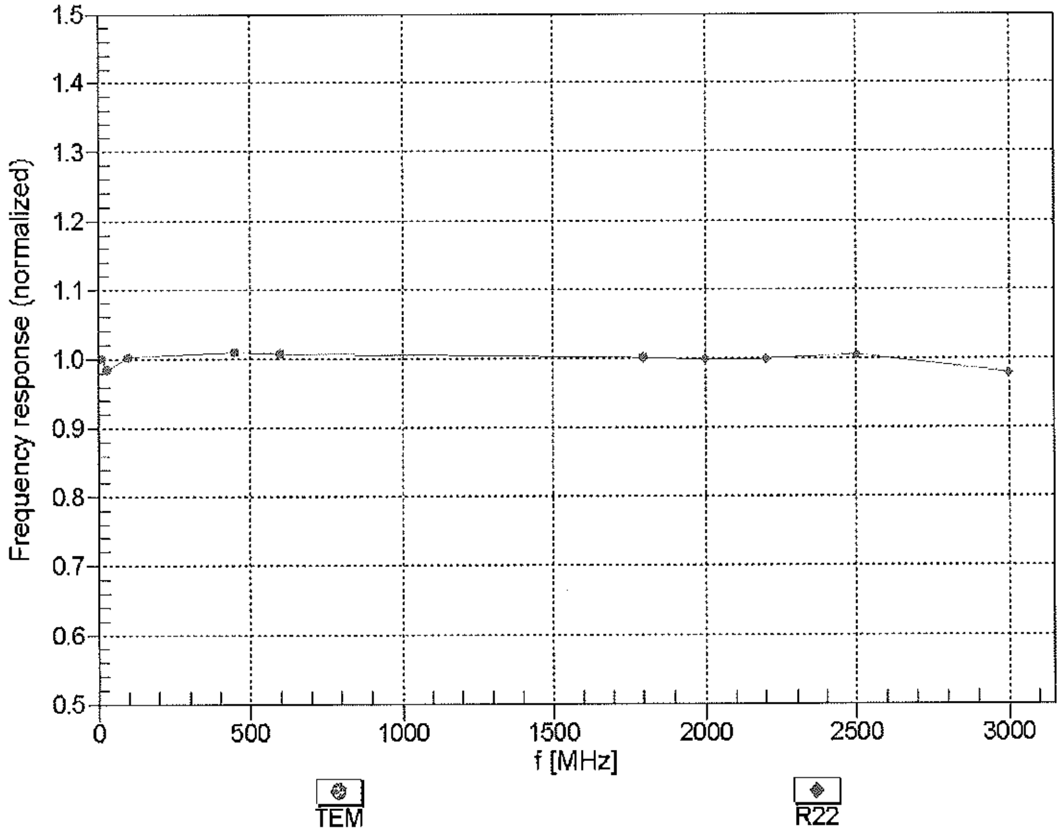
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3263

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	6.19	6.19	6.19	0.52	1.41	± 12.0 %
835	55.2	0.97	6.16	6.16	6.16	0.68	1.28	± 12.0 %
1750	53.4	1.49	4.98	4.98	4.98	0.38	1.91	± 12.0 %
1900	53.3	1.52	4.78	4.78	4.78	0.66	1.35	± 12.0 %
2450	52.7	1.95	4.27	4.27	4.27	0.72	1.13	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.74	1.07	± 12.0 %

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

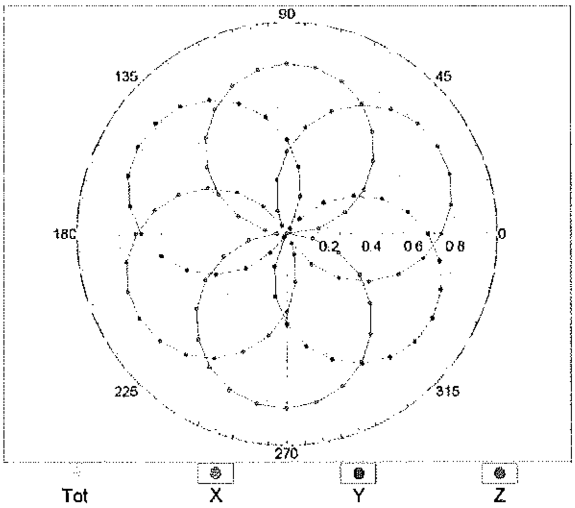
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



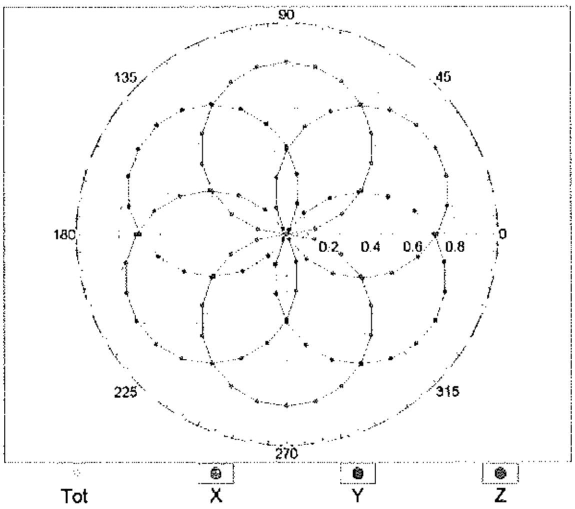
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

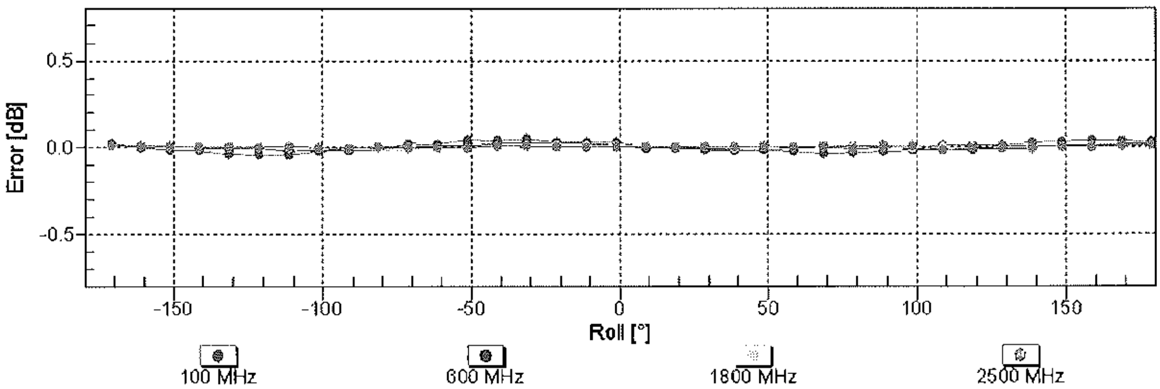
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

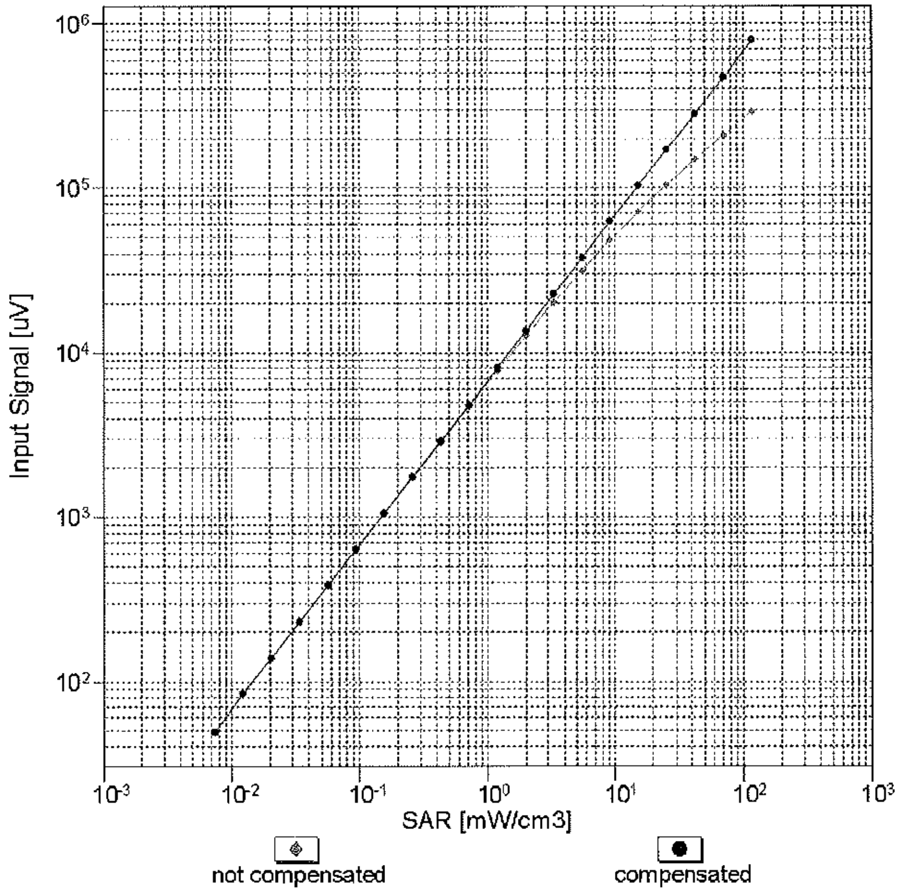


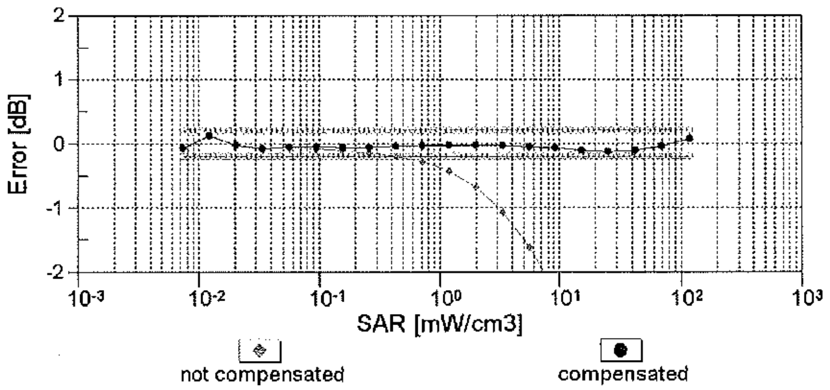


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

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

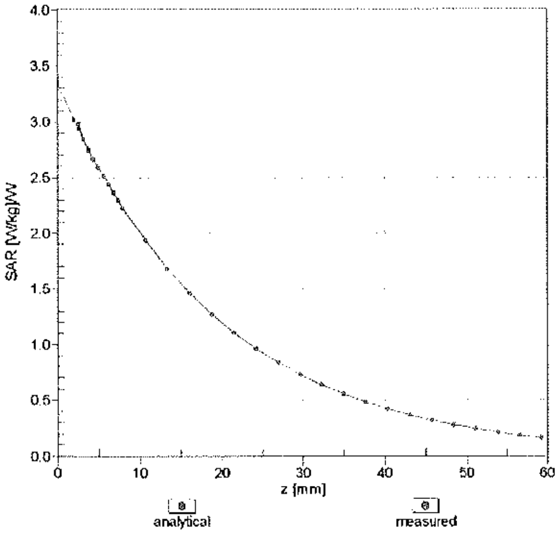




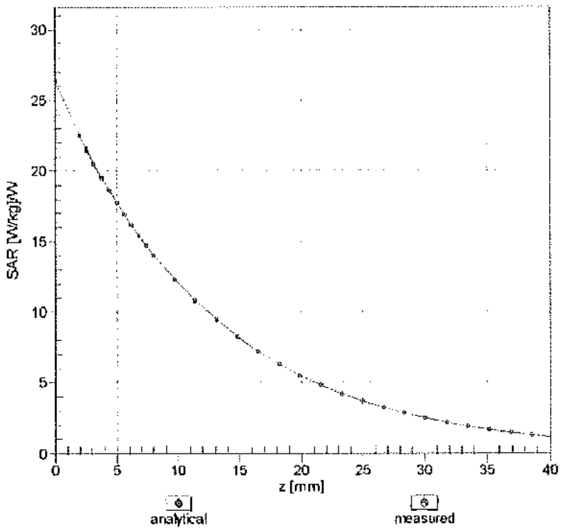
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

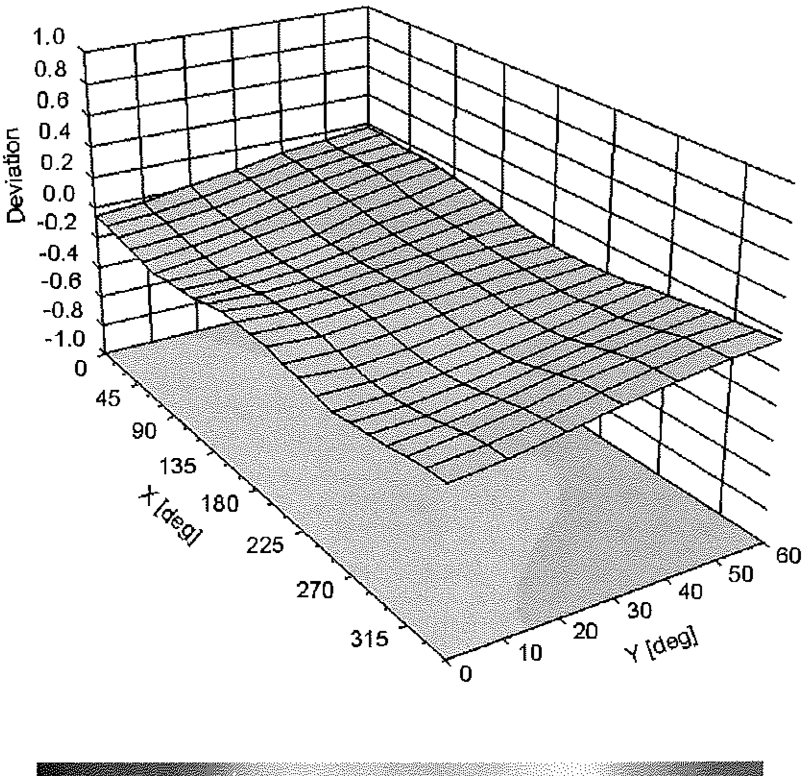


f = 1750 MHz,WGLS R22 (H_convF)



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:3263

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-111.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
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: **EX3-7308_Jul14**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:7308
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:	July 16, 2014

CC 11/4/14

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	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 21, 2014

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:7308

Manufactured: March 11, 2014
Calibrated: July 16, 2014

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7308

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	0.50	0.60	0.45	± 10.1 %
DCP (mV)[B]	100.8	98.6	99.9	

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	160.9	±2.5 %
		Y	0.0	0.0	1.0		132.5	
		Z	0.0	0.0	1.0		154.1	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.79	68.0	18.3	1.87	125.2	±0.5 %
		Y	2.74	67.3	17.9		142.6	
		Z	2.74	67.2	17.7		119.7	
10062-CAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.26	68.8	21.6	8.68	124.2	±2.5 %
		Y	10.73	69.7	22.0		144.6	
		Z	9.98	68.3	21.3		116.1	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.24	68.6	21.0	8.10	125.1	±2.2 %
		Y	9.68	67.1	20.1		99.7	
		Z	10.17	68.5	21.0		122.8	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.27	68.7	21.0	8.07	126.1	±2.2 %
		Y	9.67	67.0	20.1		100.6	
		Z	10.12	68.4	20.9		123.9	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.83	68.2	20.9	8.09	120.3	±2.5 %
		Y	10.37	69.4	21.5		147.5	
		Z	9.71	68.2	20.9		116.9	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.80	68.2	20.9	8.10	120.4	±1.9 %
		Y	9.54	67.2	20.3		102.9	
		Z	9.65	68.0	20.8		116.5	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.67	68.0	20.8	8.03	119.1	±1.9 %
		Y	9.41	67.1	20.2		102.5	
		Z	9.54	68.0	20.8		116.0	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.21	68.6	21.0	8.06	125.9	±2.2 %
		Y	9.84	67.5	20.4		106.4	
		Z	10.09	68.4	20.9		122.3	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.92	69.3	18.9	1.71	123.4	±0.5 %
		Y	2.80	68.0	18.2		107.9	
		Z	2.85	68.3	18.3		122.3	
10317-AAA	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	9.98	68.4	21.2	8.36	119.4	±1.9 %
		Y	9.66	67.3	20.5		101.7	
		Z	9.79	68.1	21.0		115.6	

10400-AAA	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.10	68.5	21.2	8.37	121.3	±2.2 %
		Y	9.82	67.5	20.6		103.5	
		Z	9.90	68.2	21.1		116.6	
10402-AAA	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	11.17	69.7	21.7	8.53	131.0	±2.2 %
		Y	10.57	68.2	20.8		110.9	
		Z	11.01	69.4	21.5		128.1	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 6 and 7).
[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:7308

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)
5250	35.9	4.71	5.37	5.37	5.37	0.30	1.80	± 13.1 %
5600	35.5	5.07	4.64	4.64	4.64	0.35	1.80	± 13.1 %
5750	35.4	5.22	4.81	4.81	4.81	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[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.

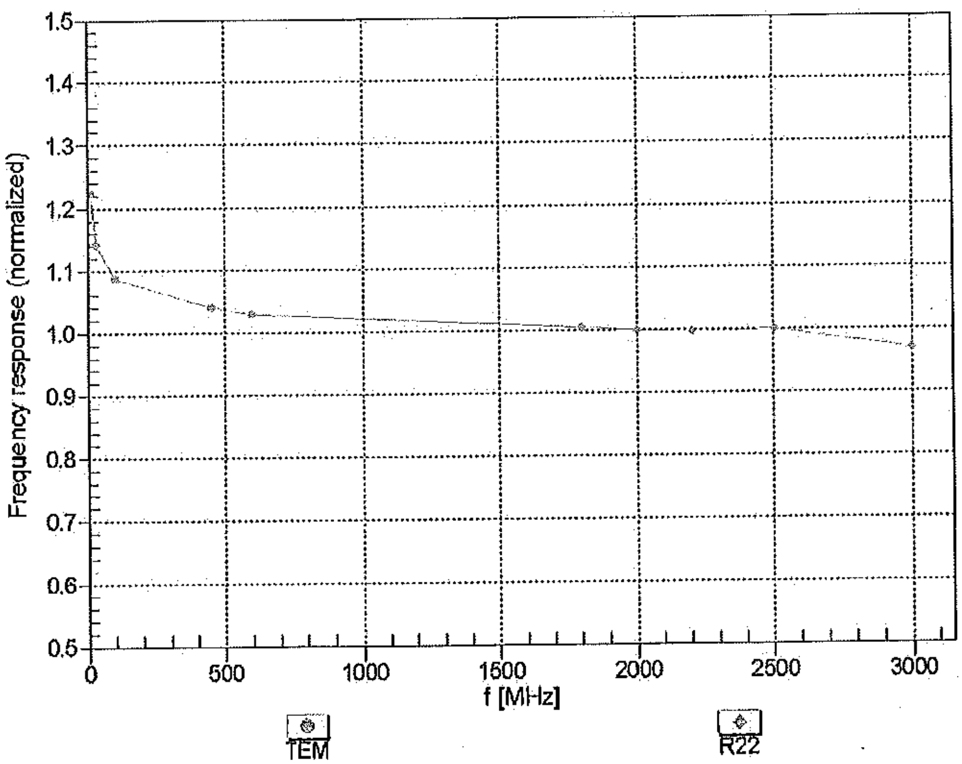
DASY/EASY - Parameters of Probe: EX3DV4 - SN:7308

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)
5250	48.9	5.36	4.60	4.60	4.60	0.35	1.90	± 13.1 %
5600	48.5	5.77	4.09	4.09	4.09	0.40	1.90	± 13.1 %
5750	48.3	5.94	4.22	4.22	4.22	0.50	1.90	± 13.1 %

[C] Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[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.

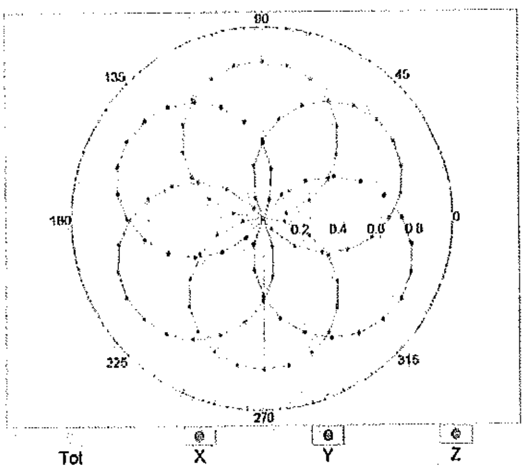
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



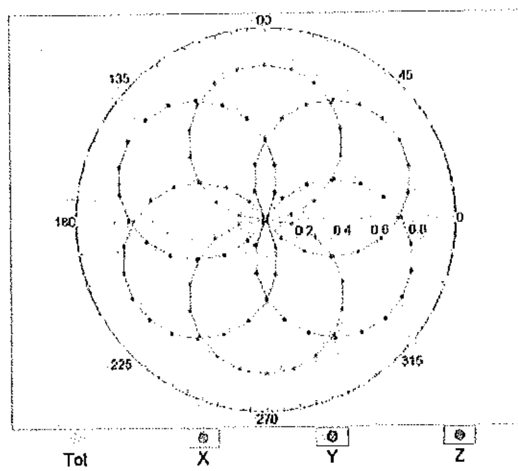
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

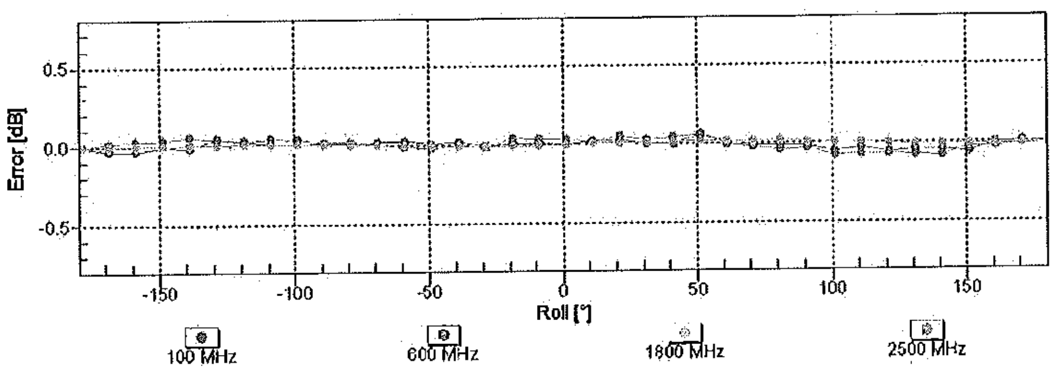
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



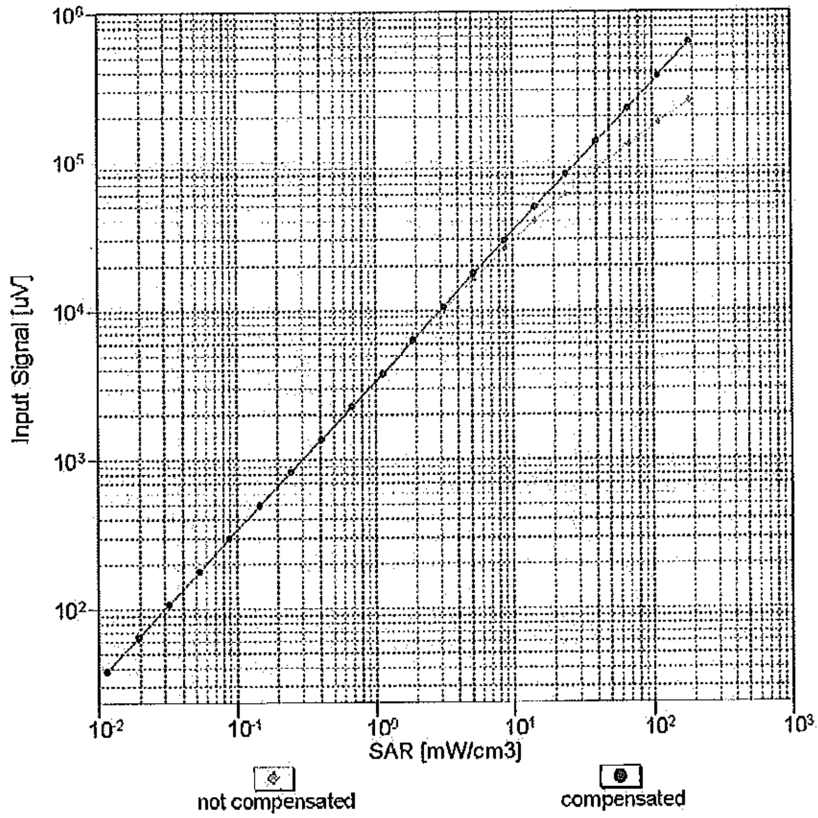
f=1800 MHz,R22

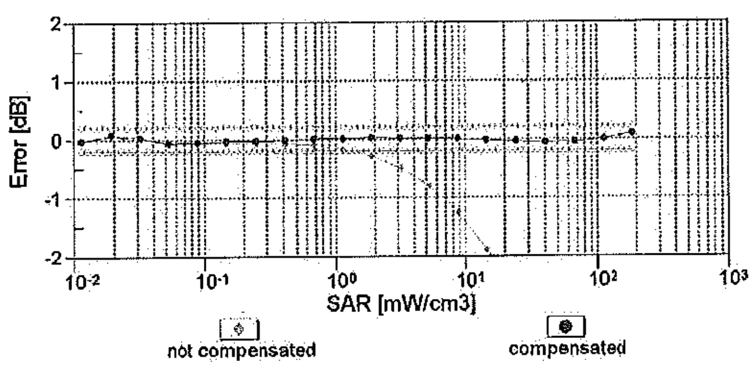




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

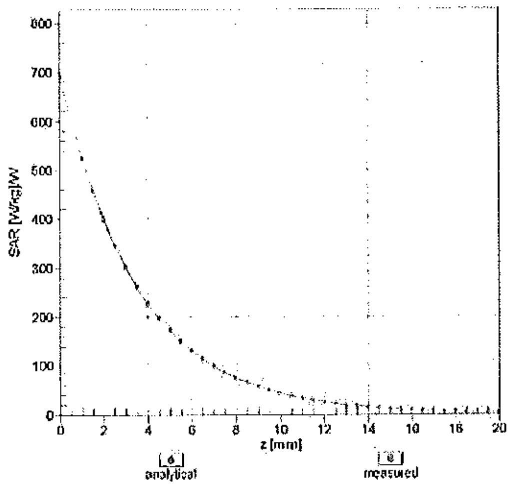




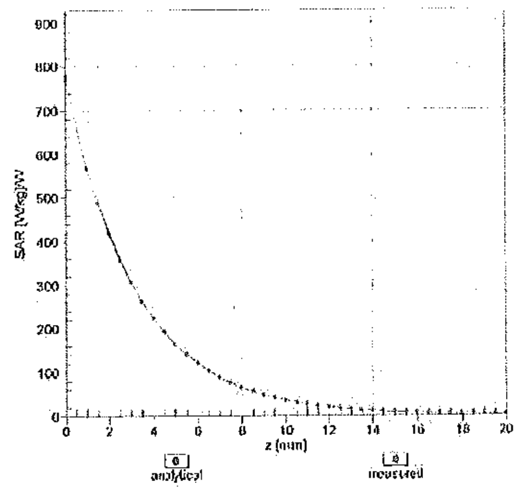
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 5250 MHz,WGLS R58 (H_convF)-SCS

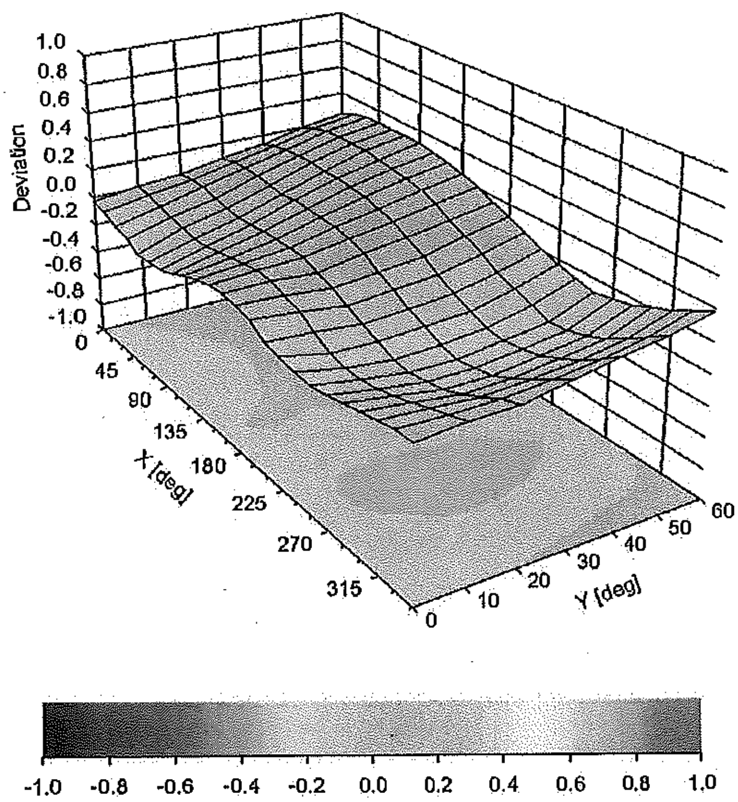


f = 5750 MHz,WGLS R58 (H_convF)-SCS



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:7308

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-68.9
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	1.4 mm

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

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

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

Accreditation No.: SCS 108

Client PC Test

Certificate No: ES3-3288_Sep14/2

CALIBRATION CERTIFICATE (Replacement of No:ES3-3288_Sep14)

Object	ES3DV3 - SN:3288
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	September 24, 2014

CC
12/12/14

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	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
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:	Leif Klysner	Laboratory Technician	Leif Klysner
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: November 3, 2014

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:3288

Manufactured: July 6, 2010
Repaired: September 18, 2014
Calibrated: September 24, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)^A	1.05	1.16	0.92	± 10.1 %
DCP (mV)^B	105.1	104.6	106.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√µV	C	D dB	VR mV	Unc^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	195.8	±3.5 %
		Y	0.0	0.0	1.0		175.9	
		Z	0.0	0.0	1.0		177.1	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	2.71	61.9	11.4	10.00	40.3	±2.2 %
		Y	2.37	60.2	11.2		42.6	
		Z	1.54	56.6	8.9		41.2	
10011-CAB	UMTS-FDD (WCDMA)	X	3.29	67.1	18.4	2.91	133.8	±0.5 %
		Y	3.43	67.9	18.9		139.5	
		Z	3.45	68.1	18.9		141.3	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.99	68.9	18.6	1.87	135.1	±0.7 %
		Y	3.59	72.4	20.4		140.7	
		Z	3.54	72.4	20.3		143.0	
10013-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.15	70.8	23.3	9.46	132.3	±3.5 %
		Y	11.29	70.8	23.2		141.1	
		Z	11.07	70.7	23.2		139.2	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	14.71	90.5	24.5	9.39	149.0	±1.9 %
		Y	16.40	92.8	26.0		131.3	
		Z	11.34	87.2	23.6		126.1	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	15.91	92.2	25.3	9.57	138.9	±2.5 %
		Y	21.25	96.9	27.2		142.0	
		Z	11.68	87.2	23.5		145.9	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	38.62	99.8	24.7	6.56	123.8	±2.2 %
		Y	36.71	99.7	25.2		128.1	
		Z	36.56	99.4	24.5		129.5	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	56.60	99.6	22.6	4.80	138.8	±1.9 %
		Y	46.94	99.9	23.7		149.9	
		Z	51.17	99.8	22.9		144.9	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	70.88	100.0	21.6	3.55	147.5	±1.9 %
		Y	52.58	99.8	22.6		129.4	
		Z	76.98	99.8	21.2		128.7	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	98.89	99.5	18.9	1.16	135.8	±1.4 %
		Y	78.39	99.6	19.5		141.7	
		Z	95.21	95.5	17.1		143.4	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.72	66.7	18.9	4.57	133.7	±0.9 %
		Y	4.85	67.1	19.1		137.7	
		Z	4.81	67.4	19.2		141.9	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.91	66.3	18.6	3.97	129.5	±0.7 %
		Y	4.00	66.6	18.7		133.7	
		Z	3.99	66.8	18.8		137.5	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.63	66.9	18.7	3.98	141.4	±0.7 %
		Y	4.78	67.5	19.0		147.7	
		Z	4.57	66.8	18.6		127.8	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.59	68.2	20.1	5.67	149.2	±1.4 %
		Y	6.36	67.3	19.6		130.7	
		Z	6.36	67.5	19.6		133.6	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.44	67.8	20.0	5.80	146.6	±1.4 %
		Y	6.23	66.8	19.4		128.8	
		Z	6.24	67.1	19.6		131.4	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.08	67.1	19.6	5.75	143.2	±1.4 %
		Y	6.20	67.4	19.8		148.0	
		Z	5.92	66.6	19.3		128.5	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.32	69.3	21.5	8.10	137.0	±2.2 %
		Y	10.31	69.1	21.4		143.5	
		Z	10.37	69.5	21.6		146.1	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.35	69.4	21.6	8.07	138.3	±2.2 %
		Y	10.36	69.3	21.4		146.4	
		Z	10.42	69.6	21.6		149.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.95	75.7	26.2	9.28	134.9	±3.3 %
		Y	10.37	76.0	26.1		146.6	
		Z	9.77	75.4	26.0		142.5	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.12	67.2	19.7	5.75	144.9	±1.4 %
		Y	6.21	67.4	19.8		148.8	
		Z	5.91	66.5	19.3		128.7	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.28	66.7	19.4	5.82	125.5	±1.2 %
		Y	6.37	66.8	19.4		129.7	
		Z	6.36	67.1	19.6		132.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.08	67.6	20.2	5.73	147.0	±1.2 %
		Y	4.95	66.6	19.6		128.6	
		Z	4.91	66.9	19.8		131.2	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	8.18	77.2	27.2	9.21	123.4	±2.7 %
		Y	8.37	76.6	26.6		129.5	
		Z	7.97	76.7	26.9		128.7	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.05	67.4	20.1	5.72	146.2	±1.4 %
		Y	5.10	67.3	20.0		142.8	
		Z	4.87	66.7	19.6		129.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.04	67.4	20.0	5.72	145.5	±1.2 %
		Y	5.12	67.4	20.0		143.4	
		Z	4.87	66.7	19.6		129.9	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.92	68.9	21.4	8.09	131.0	±2.2 %
		Y	9.84	68.5	21.1		130.0	
		Z	9.94	69.0	21.4		138.6	

10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.90	68.9	21.4	8.10	130.8	±2.2 %
		Y	9.81	68.4	21.0		131.4	
		Z	9.95	69.1	21.5		140.5	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.81	68.8	21.3	8.03	130.0	±2.2 %
		Y	9.89	68.9	21.3		138.1	
		Z	9.89	69.1	21.5		140.5	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.25	69.2	21.4	8.06	137.1	±2.2 %
		Y	10.30	69.2	21.4		144.4	
		Z	10.38	69.6	21.6		148.4	
10225-CAB	UMTS-FDD (HSPA+)	X	6.90	66.8	19.3	5.97	132.8	±1.4 %
		Y	7.09	67.3	19.6		142.0	
		Z	7.04	67.4	19.6		143.5	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	9.61	81.9	29.6	9.21	149.3	±2.7 %
		Y	8.66	77.6	27.1		133.7	
		Z	8.20	77.5	27.3		132.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	9.16	74.5	25.8	9.24	126.3	±3.0 %
		Y	9.62	75.0	25.8		137.4	
		Z	9.16	74.8	25.9		135.2	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.97	75.7	26.3	9.30	133.7	±3.3 %
		Y	10.38	75.9	26.1		146.1	
		Z	9.91	75.7	26.3		143.8	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.86	66.6	18.7	4.87	129.9	±0.9 %
		Y	6.01	67.1	19.0		135.7	
		Z	5.95	67.1	19.0		139.4	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.40	66.7	18.6	3.96	136.4	±0.7 %
		Y	4.55	67.3	19.0		138.3	
		Z	4.56	67.6	19.1		144.3	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.64	66.9	18.7	3.46	127.4	±0.5 %
		Y	3.77	67.6	19.1		130.2	
		Z	3.72	67.5	19.0		134.4	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.58	67.0	18.7	3.39	128.4	±0.5 %
		Y	3.73	67.7	19.1		132.7	
		Z	3.69	67.8	19.1		136.1	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.43	67.7	19.9	5.81	145.5	±1.4 %
		Y	6.49	67.7	19.9		149.5	
		Z	6.23	67.0	19.6		129.5	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.74	67.3	19.8	6.06	126.7	±1.4 %
		Y	6.83	67.5	19.8		132.9	
		Z	6.81	67.6	19.9		135.8	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	3.00	69.9	19.4	1.71	133.9	±0.5 %
		Y	3.30	71.5	20.1		141.0	
		Z	3.22	71.4	20.0		142.9	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.17	69.2	21.8	8.36	130.5	±2.5 %
		Y	10.20	69.1	21.6		138.4	
		Z	10.20	69.4	21.8		140.7	

10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.75	68.3	18.8	3.76	138.5	±0.7 %
		Y	5.00	69.1	19.2		146.7	
		Z	4.92	69.2	19.1		148.5	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.73	68.6	18.9	3.77	136.3	±0.7 %
		Y	4.97	69.4	19.4		143.7	
		Z	4.91	69.6	19.3		146.0	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.65	68.1	18.5	1.54	135.2	±0.5 %
		Y	3.05	70.8	19.9		140.7	
		Z	2.87	69.8	19.3		144.8	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.00	69.0	21.5	8.23	130.8	±2.2 %
		Y	10.06	68.9	21.4		138.6	
		Z	10.08	69.3	21.7		141.6	

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:3288

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	6.81	6.81	6.81	0.37	1.70	± 12.0 %
835	41.5	0.90	6.51	6.51	6.51	0.45	1.52	± 12.0 %
1750	40.1	1.37	5.38	5.38	5.38	0.44	1.58	± 12.0 %
1900	40.0	1.40	5.17	5.17	5.17	0.80	1.18	± 12.0 %
2450	39.2	1.80	4.56	4.56	4.56	0.80	1.21	± 12.0 %
2600	39.0	1.96	4.44	4.44	4.44	0.80	1.22	± 12.0 %

[C] Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[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:3288

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	6.38	6.38	6.38	0.31	1.89	± 12.0 %
835	55.2	0.97	6.32	6.32	6.32	0.55	1.39	± 12.0 %
1750	53.4	1.49	5.03	5.03	5.03	0.57	1.44	± 12.0 %
1900	53.3	1.52	4.82	4.82	4.82	0.51	1.54	± 12.0 %
2450	52.7	1.95	4.36	4.36	4.36	0.71	1.07	± 12.0 %
2600	52.5	2.16	4.22	4.22	4.22	0.80	1.07	± 12.0 %

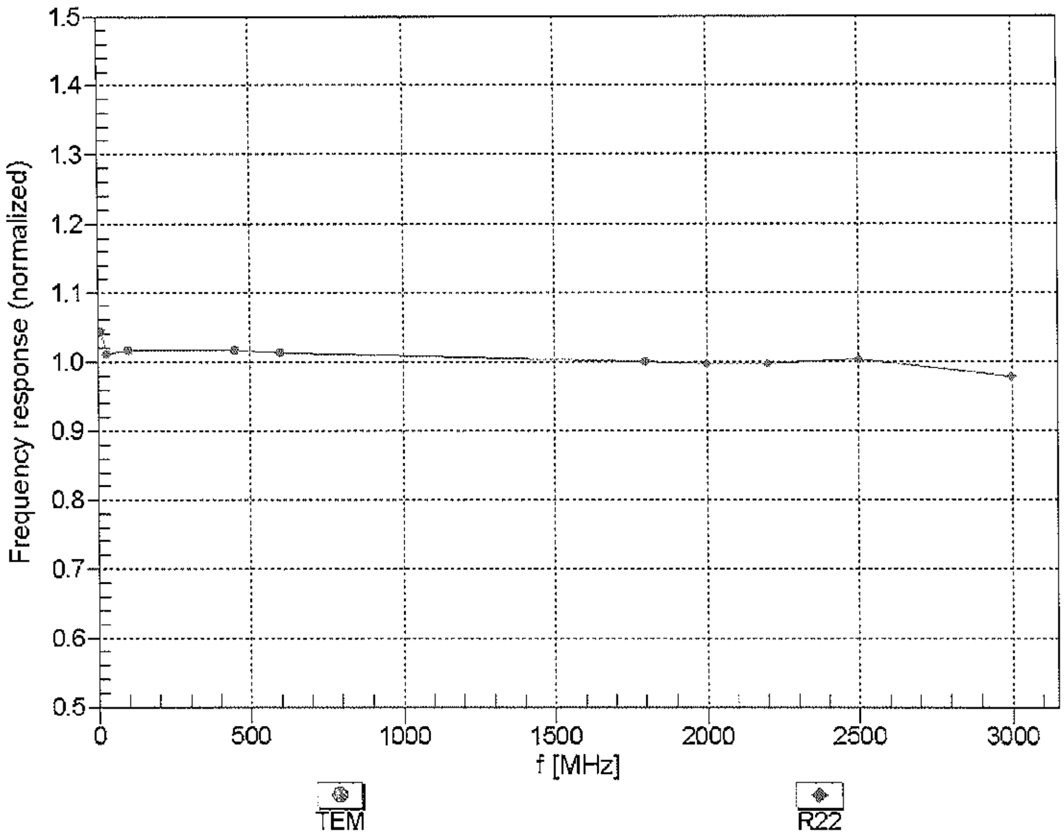
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[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

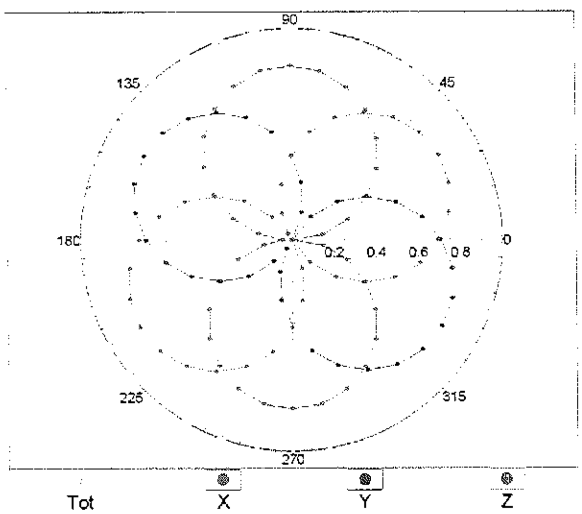
(TEM-Cell:ifi110 EXX, Waveguide: R22)



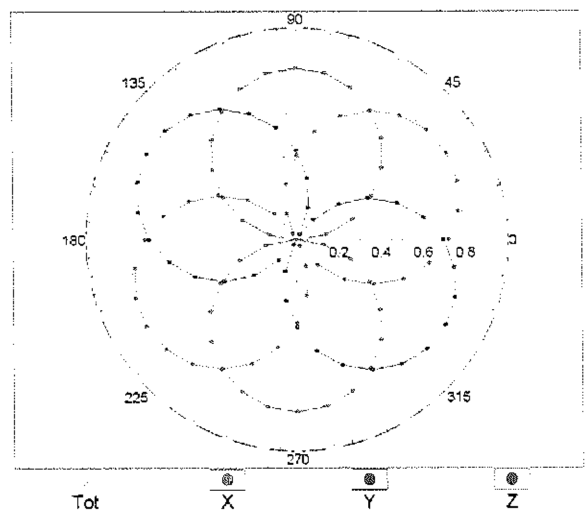
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

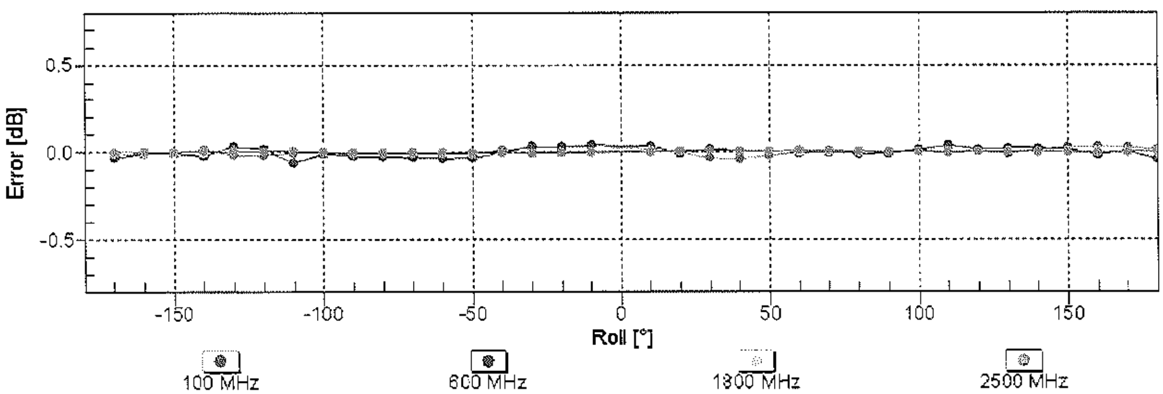
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

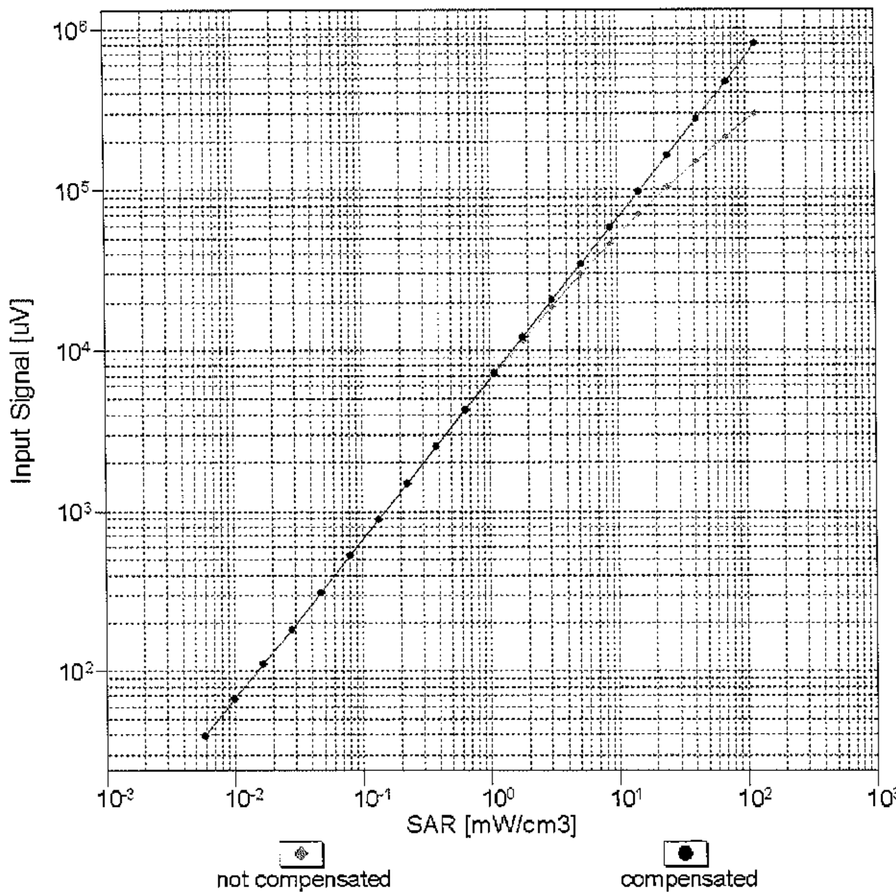


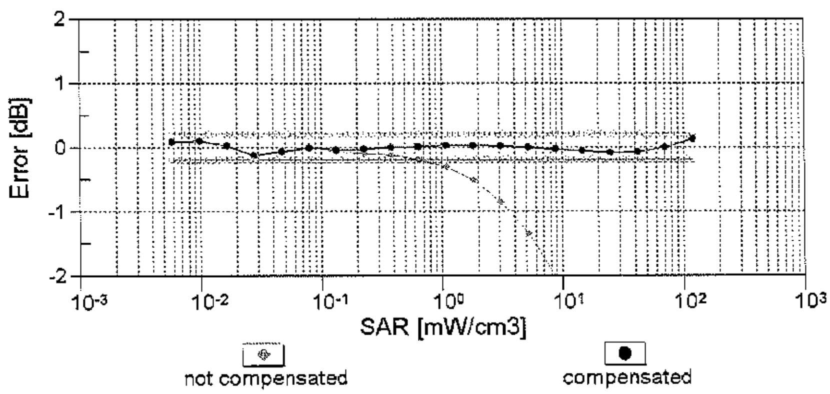


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

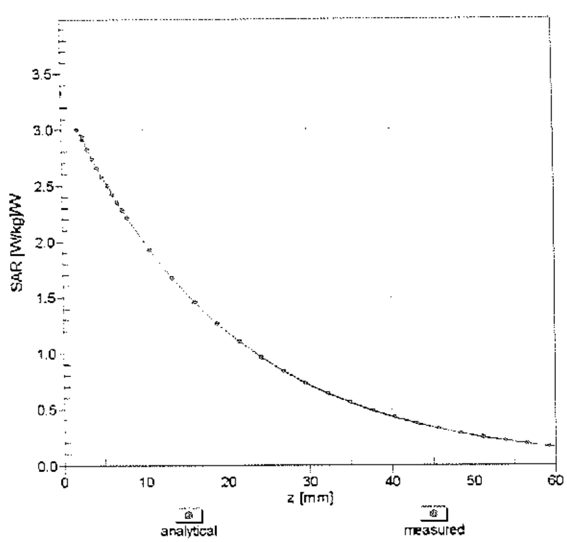
(TEM cell , f_{eval}= 1900 MHz)

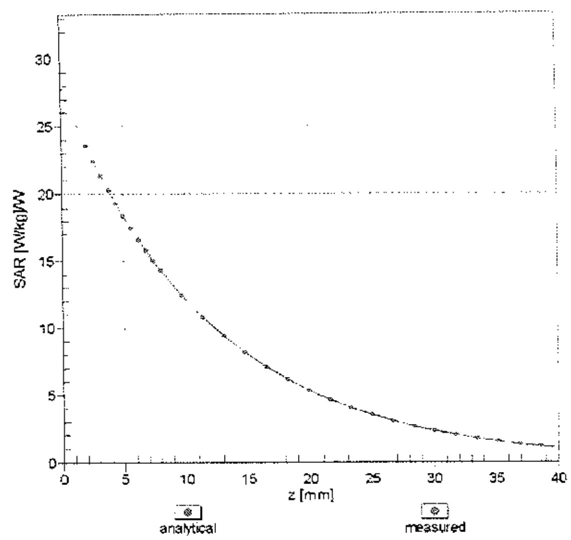




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

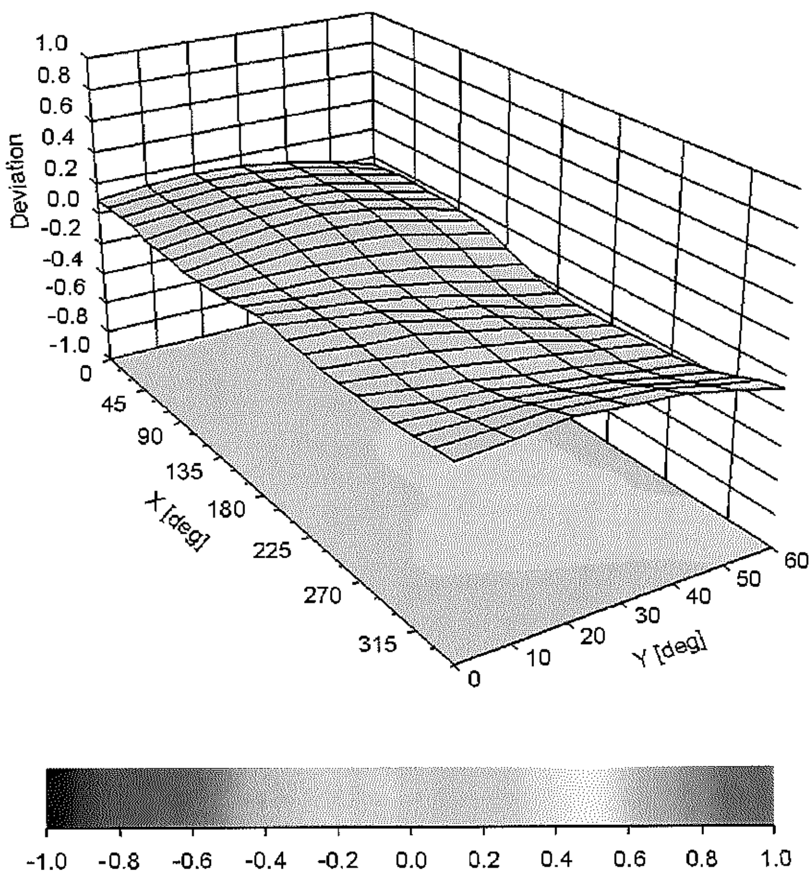
Conversion Factor Assessment





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:3288

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-110
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: **ES3-3209_Mar14**

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3209

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

CC✓ 3/27/14

Calibration date: March 19, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: March 20, 2014

PCT # 80244

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

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

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

Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
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:3209

Manufactured: October 14, 2008
Calibrated: March 19, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.35	1.32	1.13	± 10.1 %
DCP (mV)[B]	101.5	101.0	102.5	

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	188.4	±3.8 %
		Y	0.0	0.0	1.0		180.7	
		Z	0.0	0.0	1.0		200.1	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	2.80	64.7	12.3	10.00	43.2	±1.4 %
		Y	3.12	65.6	13.1		41.9	
		Z	2.67	64.0	11.7		39.4	
10011-CAB	UMTS-FDD (WCDMA)	X	3.39	67.7	19.0	2.91	149.2	±0.5 %
		Y	3.38	67.7	19.0		146.1	
		Z	3.35	67.6	18.7		136.1	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.01	69.8	19.4	1.87	149.4	±0.7 %
		Y	3.06	70.1	19.6		147.1	
		Z	2.98	69.7	19.2		136.4	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	5.47	79.6	20.4	9.39	146.9	±1.7 %
		Y	7.76	84.9	22.9		134.2	
		Z	4.34	75.3	18.5		134.2	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	6.66	82.9	21.6	9.57	139.8	±2.5 %
		Y	9.36	88.2	24.2		131.5	
		Z	4.67	76.1	18.8		144.8	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	5.89	79.1	17.9	6.56	141.2	±1.9 %
		Y	27.58	99.6	24.8		145.8	
		Z	5.42	77.8	17.4		129.3	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	9.68	85.3	19.0	4.80	136.9	±2.2 %
		Y	36.47	100.0	23.3		139.2	
		Z	31.63	96.5	21.4		149.2	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	40.09	99.7	21.7	3.55	125.9	±1.9 %
		Y	47.92	99.6	21.7		127.6	
		Z	61.98	99.9	20.8		136.2	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	99.32	95.7	16.5	1.16	145.1	±1.7 %
		Y	55.30	99.5	19.3		145.6	
		Z	0.54	60.4	5.7		132.7	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.77	67.1	19.2	4.57	145.6	±0.9 %
		Y	4.85	67.5	19.5		147.8	
		Z	4.67	66.7	18.9		133.4	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.93	66.4	18.8	3.97	140.9	±0.7 %
		Y	4.02	66.9	19.1		146.0	
		Z	3.86	66.1	18.5		129.1	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.56	66.6	18.6	3.98	132.8	±0.7 %
		Y	4.58	66.7	18.7		135.9	
		Z	4.63	67.0	18.7		143.0	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.42	67.5	19.8	5.67	139.3	±1.4 %
		Y	6.49	67.9	20.1		143.0	
		Z	6.18	66.7	19.3		126.9	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.28	67.1	19.7	5.80	136.9	±1.4 %
		Y	6.35	67.5	20.0		140.4	
		Z	6.36	67.5	19.8		147.1	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.94	66.5	19.4	5.75	134.0	±1.4 %
		Y	6.01	66.9	19.8		136.4	
		Z	5.99	66.8	19.5		143.6	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.02	68.5	21.1	8.10	127.2	±2.2 %
		Y	10.31	69.3	21.8		130.2	
		Z	10.12	68.8	21.2		139.0	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.03	68.5	21.1	8.07	129.2	±2.2 %
		Y	10.31	69.3	21.7		131.2	
		Z	10.15	68.9	21.3		141.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	8.54	72.4	24.8	9.28	139.6	±3.0 %
		Y	9.29	75.2	26.7		144.1	
		Z	8.55	72.5	24.7		149.7	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.94	66.5	19.4	5.75	134.7	±1.4 %
		Y	6.00	66.9	19.7		136.7	
		Z	6.01	66.9	19.5		143.3	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.40	67.1	19.7	5.82	139.9	±1.7 %
		Y	6.48	67.5	20.0		142.9	
		Z	6.43	67.3	19.7		148.7	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.90	66.8	19.8	5.73	136.1	±1.4 %
		Y	5.03	67.2	20.2		141.1	
		Z	5.08	67.3	20.0		148.1	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	6.56	72.5	25.2	9.21	125.7	±2.5 %
		Y	7.28	75.4	27.1		128.8	
		Z	6.78	73.0	25.2		138.3	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.86	66.6	19.7	5.72	133.7	±1.4 %
		Y	4.97	66.9	20.0		136.3	
		Z	5.04	67.2	19.9		145.7	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.88	66.7	19.7	5.72	133.3	±1.4 %
		Y	4.99	67.0	20.0		136.5	
		Z	5.06	67.3	19.9		145.7	

10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	10.05	69.2	21.7	8.09	146.7	±2.5 %
		Y	10.20	69.8	22.1		146.9	
		Z	9.76	68.5	21.1		132.1	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.05	69.2	21.7	8.10	148.5	±2.2 %
		Y	10.21	69.9	22.2		148.0	
		Z	9.75	68.5	21.2		133.6	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.96	69.2	21.6	8.03	148.9	±2.5 %
		Y	10.09	69.7	22.1		147.4	
		Z	9.67	68.5	21.1		133.4	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.00	68.5	21.1	8.06	127.8	±2.2 %
		Y	10.21	69.1	21.6		127.3	
		Z	10.11	68.9	21.2		140.4	
10225-CAB	UMTS-FDD (HSPA+)	X	6.81	66.5	19.3	5.97	125.8	±1.4 %
		Y	7.07	67.5	19.9		149.0	
		Z	6.92	67.0	19.4		136.8	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	6.62	72.8	25.3	9.21	128.5	±2.2 %
		Y	7.33	75.7	27.2		129.5	
		Z	6.87	73.4	25.5		141.8	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	7.92	71.5	24.4	9.24	131.3	±3.0 %
		Y	8.35	73.3	25.7		131.3	
		Z	7.94	71.6	24.3		140.2	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	8.52	72.3	24.8	9.30	138.8	±3.0 %
		Y	9.10	74.5	26.3		139.5	
		Z	8.53	72.3	24.6		149.4	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.98	67.1	19.1	4.87	144.4	±0.9 %
		Y	5.99	67.3	19.2		144.0	
		Z	5.80	66.6	18.7		131.0	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.51	67.2	19.0	3.96	148.6	±0.7 %
		Y	4.30	66.3	18.6		127.3	
		Z	4.40	66.9	18.7		135.9	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.61	66.9	18.8	3.46	138.3	±0.7 %
		Y	3.67	67.2	19.0		140.5	
		Z	3.62	67.0	18.7		128.8	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.59	67.1	18.9	3.39	141.5	±0.7 %
		Y	3.59	67.1	18.9		142.0	
		Z	3.59	67.2	18.8		130.8	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.27	67.0	19.7	5.81	135.3	±1.7 %
		Y	6.31	67.3	19.9		136.0	
		Z	6.36	67.4	19.8		147.2	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.91	67.9	20.2	6.06	141.9	±1.7 %
		Y	6.94	68.1	20.4		142.7	
		Z	6.68	67.1	19.7		130.3	

10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.94	69.9	19.6	1.71	148.6	±0.5 %
		Y	2.81	68.8	19.0		148.8	
		Z	2.92	69.7	19.2		138.1	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.76	68.7	19.1	3.76	128.0	±0.5 %
		Y	4.71	68.2	18.9		129.2	
		Z	4.85	68.8	19.0		141.9	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.64	68.5	19.0	3.77	126.3	±0.7 %
		Y	4.60	68.2	18.9		127.9	
		Z	4.74	68.8	19.0		140.6	

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:3209

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	6.43	6.43	6.43	0.29	2.01	± 12.0 %
835	41.5	0.90	6.23	6.23	6.23	0.34	1.70	± 12.0 %
1750	40.1	1.37	5.24	5.24	5.24	0.80	1.13	± 12.0 %
1900	40.0	1.40	5.13	5.13	5.13	0.46	1.49	± 12.0 %
2450	39.2	1.80	4.54	4.54	4.54	0.63	1.38	± 12.0 %
2600	39.0	1.96	4.38	4.38	4.38	0.76	1.28	± 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.

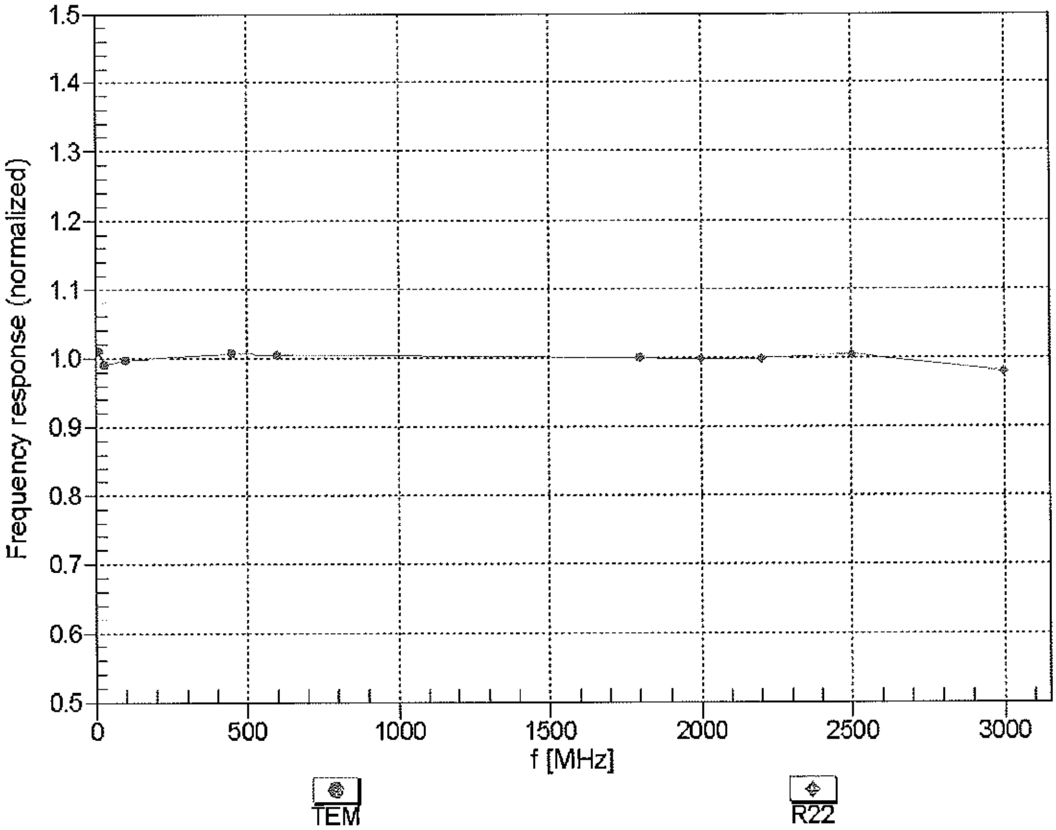
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	6.16	6.16	6.16	0.26	2.23	± 12.0 %
835	55.2	0.97	6.14	6.14	6.14	0.80	1.13	± 12.0 %
1750	53.4	1.49	4.85	4.85	4.85	0.59	1.42	± 12.0 %
1900	53.3	1.52	4.68	4.68	4.68	0.52	1.59	± 12.0 %
2450	52.7	1.95	4.20	4.20	4.20	0.73	1.08	± 12.0 %
2600	52.5	2.16	4.04	4.04	4.04	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.

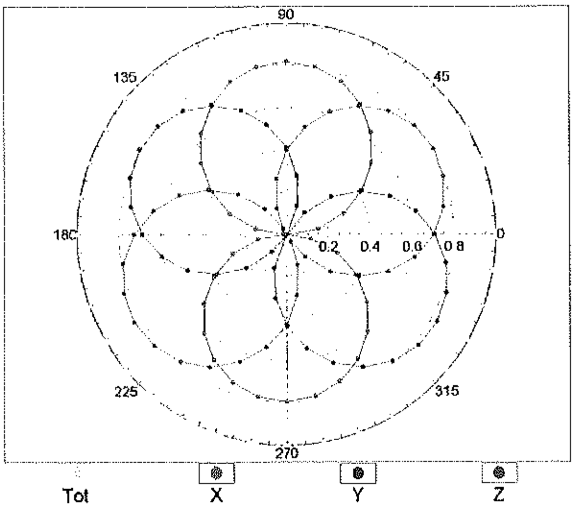
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



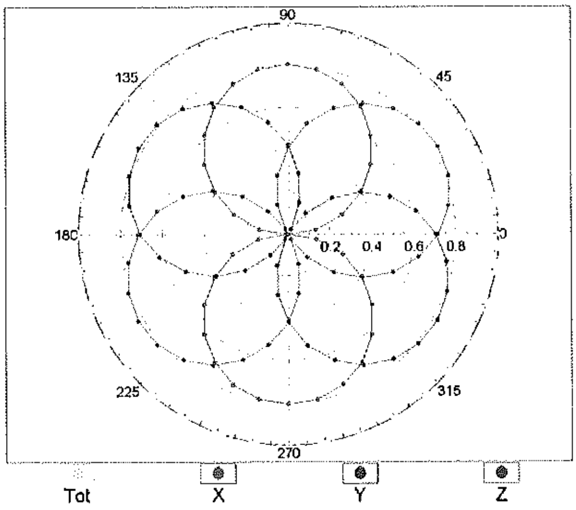
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

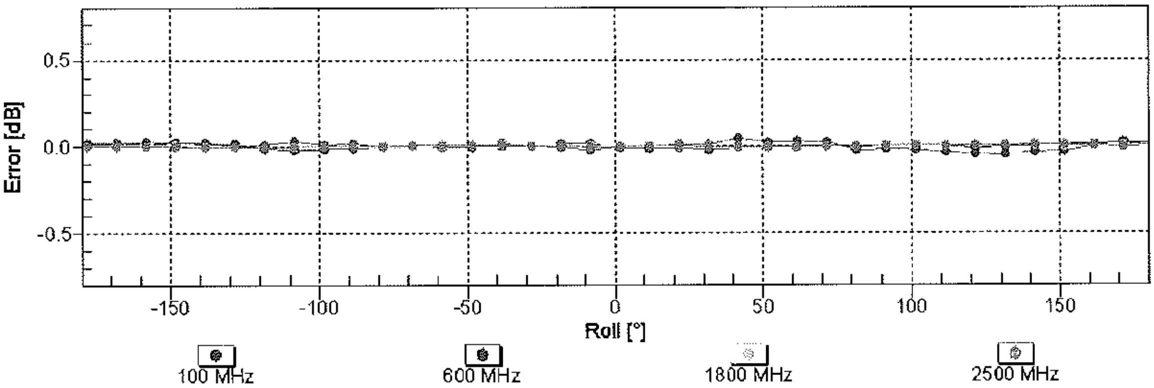
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



f=1800 MHz,R22

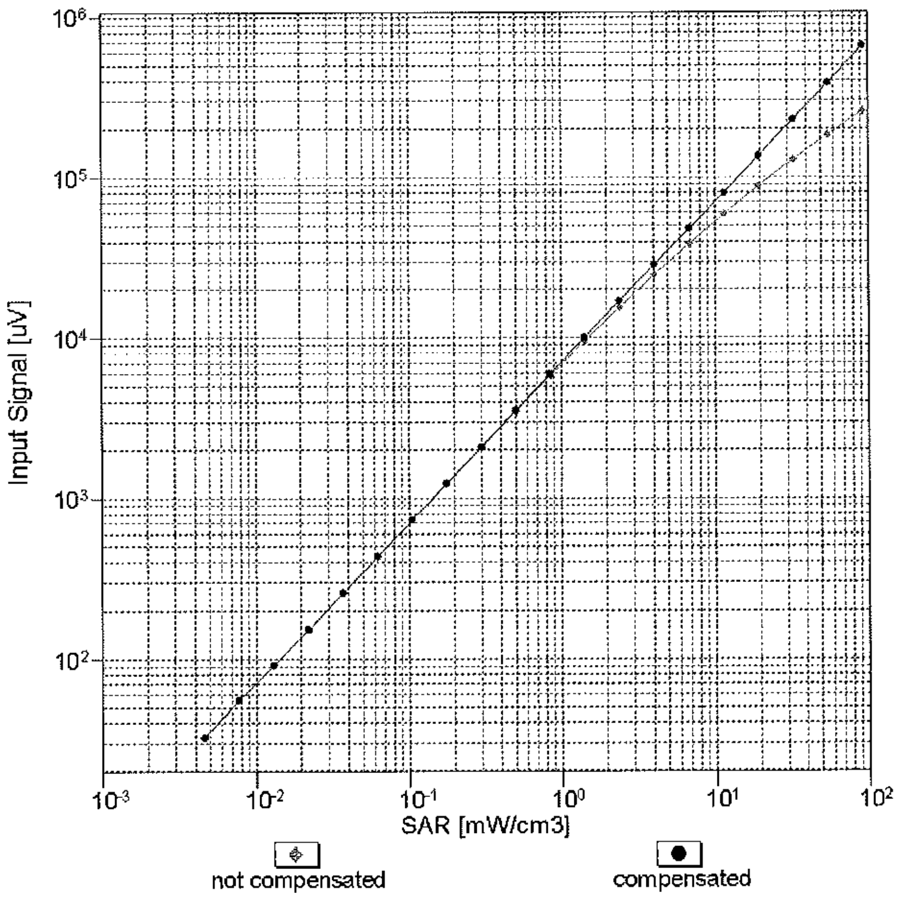


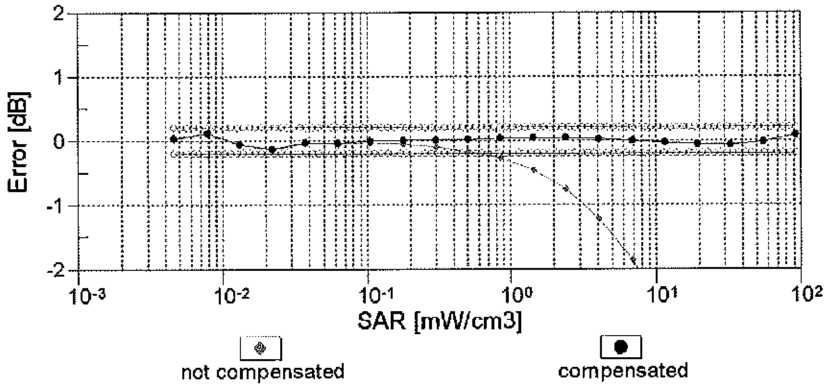


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

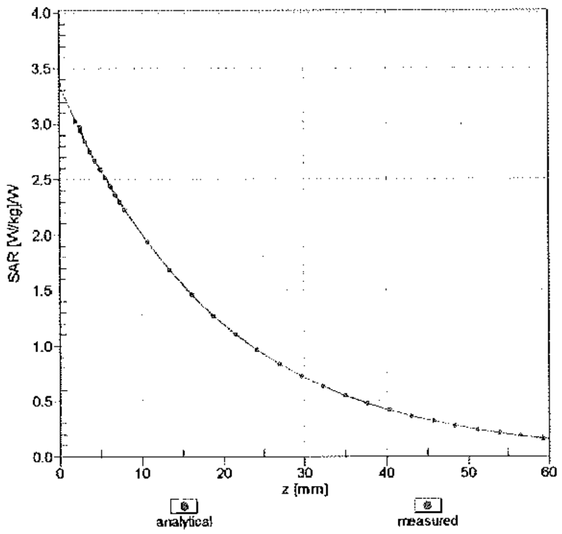
(TEM cell , f_{eval}= 1900 MHz)

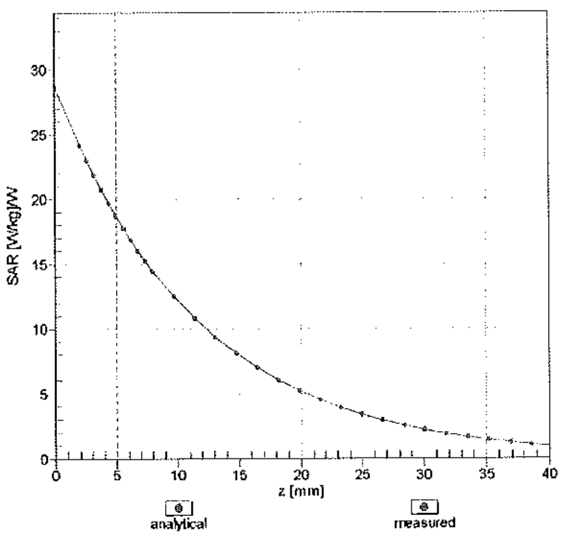




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

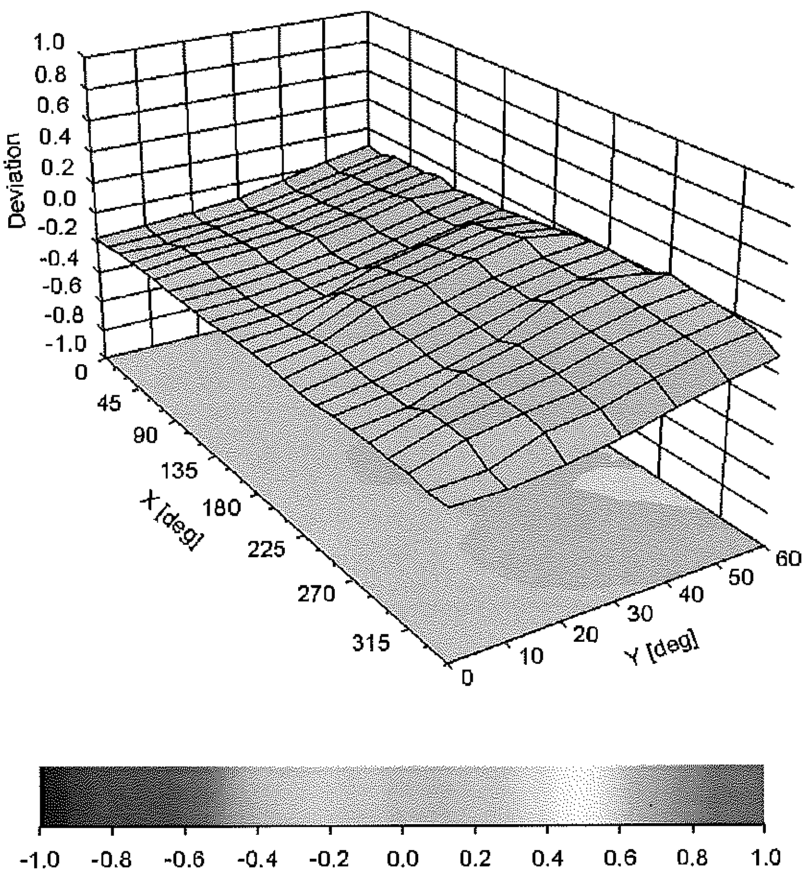
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-38.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

APPENDIX D: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue verification:

3) The network analyzer and probe system was configured and calibrated.
4) 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.
5) The complex admittance with respect to the probe aperture was measured
6) The complex relative permittivity $\varepsilon^{'}$ 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	1750	1750	1900	1900	2450-2600	2450-2600	5200-5800	5200-5800
Tissue	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Ingredients (% by weight)										
Bactericide	0.1	0.1					See page 2		See page 3	
DGBE			47	31	44.92	29.44		26.7		
HEC	1	1								
NaCl	1.45	0.94	0.4	0.2	0.18	0.39		0.1		
Sucrose	57	44.9								
Polysorbate (Tween) 80										20
Water	40.45	53.06	52.6	68.8	54.9	70.17		73.2		80

2 Composition / Information on ingredients

The Item is composed of the following ingredients:

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: 130926-1)
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.

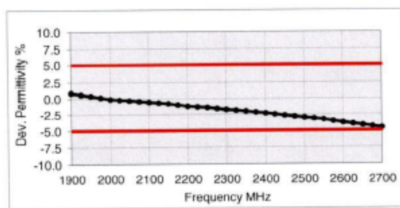
Test Condition

Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	23°C
Test Date	2-Oct-13
Operator	CL

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	40.3	11.88	1.26	40.0	1.40	0.9	-10.3
1925	40.3	11.98	1.28	40.0	1.40	0.6	-8.3
1950	40.2	12.08	1.31	40.0	1.40	0.4	-6.4
1975	40.1	12.15	1.34	40.0	1.40	0.2	-4.6
2000	40.0	12.23	1.36	40.0	1.40	-0.1	-2.8
2025	39.9	12.34	1.39	40.0	1.42	-0.2	-2.3
2050	39.8	12.45	1.42	39.9	1.44	-0.3	-1.7
2075	39.7	12.54	1.45	39.9	1.47	-0.4	-1.3
2100	39.6	12.64	1.48	39.8	1.49	-0.5	-0.8
2125	39.5	12.69	1.50	39.8	1.51	-0.7	-0.7
2150	39.4	12.75	1.52	39.7	1.53	-0.8	-0.6
2175	39.3	12.84	1.55	39.7	1.56	-1.0	-0.1
2200	39.2	12.94	1.58	39.6	1.58	-1.2	0.4
2225	39.1	13.00	1.61	39.6	1.60	-1.3	0.6
2250	39.0	13.07	1.64	39.6	1.62	-1.4	0.8
2275	38.9	13.15	1.66	39.5	1.64	-1.5	1.2
2300	**38.8**	**13.22**	**1.69**	**39.5**	**1.67**	**-1.7**	**1.5**
2325	38.7	13.32	1.72	39.4	1.69	-1.9	2.0
2350	38.6	13.42	1.75	39.4	1.71	-2.0	2.5
2375	38.5	13.49	1.78	39.3	1.73	-2.1	2.8
2400	38.4	13.56	1.81	39.3	1.76	-2.3	3.1
2425	38.3	13.63	1.84	39.2	1.78	-2.5	3.5
2450	**38.2**	**13.71**	**1.87**	**39.2**	**1.80**	**-2.6**	**3.8**
2475	38.1	13.79	1.90	39.2	1.83	-2.8	3.9
2500	38.0	13.87	1.93	39.1	1.85	-3.0	4.0
2525	37.9	13.96	1.96	39.1	1.88	-3.1	4.2
2550	37.8	14.05	1.99	39.1	1.91	-3.3	4.4
2575	37.7	14.11	2.02	39.0	1.94	-3.5	4.4
2600	**37.5**	**14.17**	**2.05**	**39.0**	**1.96**	**-3.8**	**4.4**
2625	37.4	14.23	2.08	39.0	1.99	-4.0	4.4
2650	37.3	14.30	2.11	38.9	2.02	-4.2	4.5
2675	37.2	14.37	2.14	38.9	2.05	-4.4	4.6
2700	37.1	14.45	2.17	38.9	2.07	-4.6	4.7



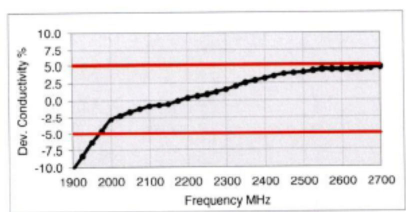


Figure D-2
2.4 GHz Head Tissue Equivalent Matter

2 Composition / Information on ingredients

The Item is composed of the following ingredients:

Water	50 – 65%
Mineral oil	10 – 30%
Emulsifiers	8 – 25%
Sodium salt	0 – 1.5%

Figure D-3
Composition of 5 GHz Head Tissue Equivalent Matter

Note: 5GHz head liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

Item Name	**Head Tissue Simulating Liquid (HBBL3500-5800V5)**
Product No.	SL AAH 502 AC (Charge: 130903-1)
Manufacturer	SPEAG

Measurement Method
TSL dielectric parameters measured using calibrated OCP probe.

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

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

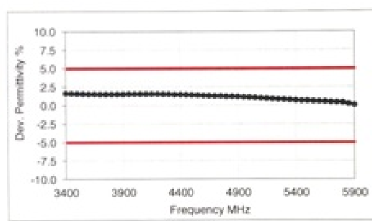
Test Condition

Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	4-Sep-13
Operator	IEN

Additional Information

TSL Density	0.985 g/cm^3
TSL Heat-capacity	3.383 kJ/(kg*K)

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e"	sigma	eps	sigma	Δ-eps	Δ-sigma
3400	38.7	15.01	2.84	38.0	2.81	1.7	1.1
3500	38.5	14.98	2.92	37.9	2.91	1.5	0.3
3600	38.4	14.98	3.00	37.8	3.02	1.5	-0.5
3700	38.3	14.97	3.08	37.7	3.12	1.6	-1.2
3800	38.2	14.95	3.16	37.6	3.22	1.6	-1.9
3900	38.1	14.96	3.25	37.5	3.32	1.7	-2.2
4000	37.9	14.98	3.33	37.4	3.43	1.5	-2.8
4100	37.8	15.00	3.42	37.2	3.53	1.5	-3.0
4200	37.7	15.04	3.51	37.1	3.63	1.5	-3.3
4300	37.6	15.10	3.61	37.0	3.73	1.6	-3.3
4400	37.4	15.16	3.71	36.9	3.84	1.4	-3.3
4500	37.3	15.22	3.81	36.8	3.94	1.4	-3.2
4600	37.2	15.29	3.91	36.7	4.04	1.4	-3.2
4700	37.0	15.34	4.01	36.6	4.14	1.2	-3.2
4800	36.9	15.41	4.11	36.4	4.25	1.3	-3.2
4850	36.8	15.43	4.16	36.4	4.30	1.1	-3.2
4900	36.8	15.47	4.22	36.3	4.35	1.3	-2.9
4950	36.7	15.49	4.26	36.3	4.40	1.2	-3.2
5000	36.6	15.52	4.32	36.2	4.45	1.1	-2.9
5050	36.5	15.55	4.37	36.2	4.50	0.9	-2.9
5100	36.5	15.59	4.42	36.1	4.55	1.1	-2.9
5150	36.4	15.62	4.47	36.0	4.60	1.0	-2.9
5200	36.3	15.65	4.53	36.0	4.66	0.9	-2.7
5250	36.2	15.67	4.58	35.9	4.71	0.8	-2.7
5300	36.2	15.71	4.63	35.9	4.76	0.9	-2.7
5350	36.1	15.73	4.68	35.8	4.81	0.8	-2.7
5400	36.0	15.75	4.73	35.8	4.86	0.7	-2.7
5450	35.9	15.78	4.78	35.7	4.91	0.6	-2.7
5500	35.9	15.79	4.83	35.6	4.96	0.7	-2.7
5550	35.8	15.83	4.89	35.6	5.01	0.6	-2.5
5600	35.7	15.86	4.94	35.5	5.07	0.5	-2.5
5650	35.7	15.89	5.00	35.5	5.12	0.6	-2.3
5700	35.6	15.92	5.05	35.4	5.17	0.5	-2.3
5750	35.5	15.96	5.11	35.4	5.22	0.4	-2.1
5800	35.5	15.97	5.15	35.3	5.27	0.6	-2.3
5850	35.4	16.02	5.21	35.3	5.34	0.3	-2.3
5900	35.3	16.03	5.26	35.3	5.40	0.0	-2.6



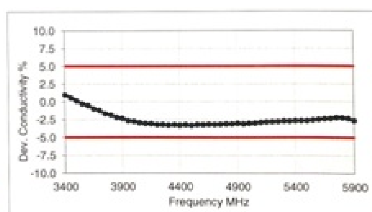


Figure D-4
5GHz Head Tissue Equivalent Matter

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
G	835	6/30/2014	3258	ES3DV3	835	Head	0.907	40.95	PASS	PASS	PASS	GMSK	PASS	N/A
D	1750	7/31/2014	3263	ES3DV3	1750	Head	1.360	39.45	PASS	PASS	PASS	N/A	N/A	N/A
D	1900	9/30/2014	3263	ES3DV3	1900	Head	1.421	39.44	PASS	PASS	PASS	GMSK	PASS	N/A
G	2450	3/6/2014	3258	ES3DV3	2450	Head	1.736	38.36	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
E	5300	10/28/2014	7308	EX3DV4	5250	Head	4.617	36.20	PASS	PASS	PASS	OFDM	N/A	PASS
E	5500	10/28/2014	7308	EX3DV4	5600	Head	4.828	35.97	PASS	PASS	PASS	OFDM	N/A	PASS
E	5600	10/28/2014	7308	EX3DV4	5600	Head	4.914	35.82	PASS	PASS	PASS	OFDM	N/A	PASS
E	5800	10/28/2014	7308	EX3DV4	5750	Head	5.113	35.53	PASS	PASS	PASS	OFDM	N/A	PASS
K	835	10/13/2014	3288	ES3DV3	835	Body	0.998	52.95	PASS	PASS	PASS	GMSK	PASS	N/A
K	1750	10/10/2014	3288	ES3DV3	1750	Body	1.480	50.89	PASS	PASS	PASS	N/A	N/A	N/A
G	1900	6/25/2014	3258	ES3DV3	1900	Body	1.534	51.23	PASS	PASS	PASS	GMSK	PASS	N/A
I	2450	7/14/2014	3209	ES3DV3	2450	Body	1.928	51.04	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
I	2600	7/14/2014	3209	ES3DV3	2600	Body	2.133	50.50	PASS	PASS	PASS	TDD	PASS	N/A
E	5300	10/30/2014	7308	EX3DV4	5250	Body	5.508	48.17	PASS	PASS	PASS	OFDM	N/A	PASS
E	5500	10/30/2014	7308	EX3DV4	5600	Body	5.811	47.64	PASS	PASS	PASS	OFDM	N/A	PASS
E	5600	10/30/2014	7308	EX3DV4	5600	Body	5.969	47.41	PASS	PASS	PASS	OFDM	N/A	PASS
E	5800	10/30/2014	7308	EX3DV4	5750	Body	6.276	46.92	PASS	PASS	PASS	OFDM	N/A	PASS

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