



SAR EVALUATION REPORT

Applicant Name:

 LG Electronics MobileComm U.S.A., Inc.
 1000 Sylvan Avenue
 Englewood Cliffs, NJ 07632
 United States

Date of Testing:

11/21/16 - 11/28/16

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

0Y1612011858-R1.ZNF

FCC ID:
ZNFL63BL
APPLICANT:
LG ELECTRONICS MOBILECOMM U.S.A., INC.
DUT Type:

Portable Handset

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model:

LGL63BL

Additional Model(s):

LG-L63BL, L63BL, LG-M327, LGM327, M327

Equipment Class	Band & Mode	Tx Frequency	SAR			
			1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Hotspot (W/kg)	10 gm Phablet (W/kg)
PCE	GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	0.44	0.62	0.58	N/A
PCE	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	0.42	0.56	0.56	N/A
PCE	UMTS 850	826.40 - 846.60 MHz	0.42	0.51	0.51	N/A
PCE	UMTS 1750	1712.4 - 1752.6 MHz	0.32	0.78	0.78	N/A
PCE	UMTS 1900	1852.4 - 1907.6 MHz	0.42	0.49	0.49	N/A
PCE	LTE Band 12	699.7 - 715.3 MHz	0.38	0.45	0.49	N/A
PCE	LTE Band 5 (Cell)	824.7 - 848.3 MHz	0.54	0.59	0.59	N/A
PCE	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	0.31	0.60	0.60	N/A
PCE	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	0.44	0.50	0.54	N/A
DTS	2.4 GHz WLAN	2412 - 2462 MHz	1.09	0.70	0.70	N/A
DSS/DTS	Bluetooth	2402 - 2480 MHz	N/A			
Simultaneous SAR per KDB 690783 D01v01r03:			1.53	1.48	1.48	N/A

Note: This revised Test Report (S/N: 0Y1612011858-R1.ZNF) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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

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


 Randy Ortanez
 President


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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE 850	Voice/Data	824.20 - 848.80 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
UMTS 1750	Voice/Data	1712.4 - 1752.6 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
LTE Band 12	Voice/Data	699.7 - 715.3 MHz
LTE Band 5 (Cell)	Voice/Data	824.7 - 848.3 MHz
LTE Band 4 (AWS)	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Voice/Data	1850.7 - 1909.3 MHz
2.4 GHz WLAN	Voice/Data	2412 - 2462 MHz
Bluetooth	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

This device uses a fixed level power reduction mechanism for WLAN operations during voice or VoIP held to ear scenarios. Per FCC Guidance, the held-to-ear exposure conditions were evaluated at reduced power according to the head SAR positions described in IEEE 1528-2013. Detailed descriptions of the power reduction mechanism are included in the operational description. Additional test procedure information and data verifying the WLAN power reduction mechanism is included in Appendix G.

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 D01v06.

A. Maximum Output Powers

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	33.2	33.2	31.7	30.2	28.2	26.7	26.7	25.2	24.7		
	Nominal	32.7	32.7	31.2	29.7	27.7	26.2	26.2	24.7	24.2		
GSM/GPRS/EDGE 1900	Maximum	30.2	30.2	28.7	27.2	25.2	25.2	25.2	24.2	23.2		
	Nominal	29.7	29.7	28.2	26.7	24.7	24.7	24.7	23.7	22.7		

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Mode / Band		Modulated Average (dBm)		
		3GPP WCDMA	3GPP HSDPA	3GPP HSUPA
UMTS Band 5 (850 MHz)	Maximum	23.7	23.7	23.7
	Nominal	23.2	23.2	23.2
UMTS Band 4 (1750 MHz)	Maximum	23.7	23.7	23.7
	Nominal	23.2	23.2	23.2
UMTS Band 2 (1900 MHz)	Maximum	23.7	23.7	23.7
	Nominal	23.2	23.2	23.2

Mode / Band		Modulated Average (dBm)	
LTE Band 12	Maximum	24.2	
	Nominal	23.7	
LTE Band 5 (Cell)	Maximum	24.2	
	Nominal	23.7	
LTE Band 4 (AWS)	Maximum	23.7	
	Nominal	23.2	
LTE Band 2 (PCS)	Maximum	23.7	
	Nominal	23.2	

Mode / Band		Modulated Average (dBm)		
		Ch. 1	Ch. 2-10	Ch. 11
IEEE 802.11b (2.4 GHz)	Maximum	18.0	19.0	18.0
	Nominal	17.0	18.0	17.0
IEEE 802.11g (2.4 GHz)	Maximum	15.5	16.5	15.5
	Nominal	14.5	15.5	14.5
IEEE 802.11n (2.4 GHz)	Maximum	14.5	15.5	14.5
	Nominal	13.5	14.5	13.5

Mode / Band		Modulated Average (dBm)	
Bluetooth (1 Mbps)	Maximum	9.5	
	Nominal	8.5	
Bluetooth (2 Mbps)	Maximum	9.0	
	Nominal	8.0	
Bluetooth (3 Mbps)	Maximum	8.0	
	Nominal	7.0	
Bluetooth LE	Maximum	1.0	
	Nominal	0.0	

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B. Reduced Output Powers

Mode / Band		Modulated Average (dBm)		
		Ch. 1	Ch. 2-10	Ch. 11
IEEE 802.11b (2.4 GHz)	Maximum	14.5	15.5	14.5
	Nominal	13.5	14.5	13.5
IEEE 802.11g (2.4 GHz)	Maximum	14.5	15.5	14.5
	Nominal	13.5	14.5	13.5

1.4 DUT Antenna Locations

The overall dimensions of this device are $> 9 \times 5$ cm. A diagram showing the location of the device antennas can be found in Appendix F. Since the diagonal dimension of this device is > 160 mm and < 200 mm, it is considered a “phablet.”.

Table 1-1
Device Edges/Sides for SAR Testing

Mode	Back	Front	Top	Bottom	Right	Left
GPRS 850	Yes	Yes	No	Yes	Yes	Yes
GPRS 1900	Yes	Yes	No	Yes	No	Yes
UMTS 850	Yes	Yes	No	Yes	Yes	Yes
UMTS 1750	Yes	Yes	No	Yes	No	Yes
UMTS 1900	Yes	Yes	No	Yes	No	Yes
LTE Band 12	Yes	Yes	No	Yes	Yes	Yes
LTE Band 5 (Cell)	Yes	Yes	No	Yes	Yes	Yes
LTE Band 4 (AWS)	Yes	Yes	No	Yes	No	Yes
LTE Band 2 (PCS)	Yes	Yes	No	Yes	No	Yes
2.4 GHz WLAN	Yes	Yes	Yes	No	Yes	No

Note: Particular DUT edges were not required to be evaluated for wireless router SAR or phablet SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v02r01 Section III and FCC KDB Publication 648474 D04v01r03. The distances between the transmit antennas and the edges of the device are included in the filing.

1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, 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.



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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 D01v06 4.3.2 procedures.

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body-Worn Accessory	Wireless Router	Phablet	Notes
1	GSM voice + 2.4 GHz WI-FI	Yes	Yes	N/A	Yes	
2	GSM voice + 2.4 GHz Bluetooth	N/A	Yes	N/A	Yes	
3	UMTS + 2.4 GHz WI-FI	Yes	Yes	Yes	Yes	
4	UMTS + 2.4 GHz Bluetooth	N/A	Yes	N/A	Yes	
5	LTE + 2.4 GHz WI-FI	Yes	Yes	Yes	Yes	
6	LTE + 2.4 GHz Bluetooth	N/A	Yes	N/A	Yes	
7	GPRS/EDGE + 2.4 GHz WI-FI	Yes*	Yes*	Yes	Yes	*-Pre-installed VOIP applications are considered.
8	GPRS/EDGE + 2.4 GHz Bluetooth	N/A	Yes*	N/A	Yes	*-Pre-installed VOIP applications are considered.

1. 2.4 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 expected to be used in conjunction with a held-to-ear or body-worn accessory voice call. Simultaneous transmission scenarios involving WIFI direct are included in the above table.
5. This device supports VOLTE.
6. This device supports VOWIFI.

1.6 Miscellaneous SAR Test Considerations

(A) WIFI/BT

Per FCC KDB 447498 D01v06, the 1g SAR exclusion threshold for distances <50mm is defined by the following equation:

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

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, body-worn Bluetooth SAR was not required; $[(9/10)^* \sqrt{2.480}] = 1.4 < 3.0$. Per KDB Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

Per FCC KDB 447498 D01v06, the 10g SAR exclusion threshold for distances <50mm is defined by the following equation:

$$\frac{\text{Max Power of Channel (mW)}}{\text{Test Separation Dist (mm)}} * \sqrt{\text{Frequency(GHz)}} \leq 7.5$$

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, phablet Bluetooth SAR was not required; $[(9/ 5)^* \sqrt{2.480}] = 2.8 < 7.5$. Per KDB

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Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

Per FCC KDB Publication 648474 D04v01r03, this device is considered a "phablet" since the diagonal dimension is greater than 160mm and less than 200mm. Phablet SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg. Phablet SAR was not evaluated for 2.4 GHz WLAN operations since wireless router 1g SAR was < 1.2 W/kg.

(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 D01v03r01.

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 D05v02r04.

Per FCC KDB Publication 648474 D04v01r03, this device is considered a "phablet" since the diagonal dimension is greater than 160mm and less than 200mm. Therefore, phablet SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg. Phablet SAR was not evaluated for licensed technologies since wireless router 1g SAR was < 1.2 W/kg for these modes.

1.7 Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D01v03r01, D05v02r04, D06v02r01 (2G/3G/4G and Hotspot)
- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 648474 D04v01r03 (Phablet Procedures)
- October 2013 TCB Workshop Notes (GPRS Testing Considerations)

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1.8 Device Serial Numbers

Several samples with identical hardware were used 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	08161	08211	08211
GSM/GPRS/EDGE 1900	08211	08161	08161
UMTS 850	08211	08161	08161
UMTS 1750	08161	08211	08211
UMTS 1900	08161	08161	08161
LTE Band 12	08187	08187	08187
LTE Band 5 (Cell)	08138	08187	08187
LTE Band 4 (AWS)	08138	08138	08138
LTE Band 2 (PCS)	08138	08187	08187
2.4 GHz WLAN	10407	10407	10407

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2 LTE INFORMATION

LTE Information			
FCC ID	ZNFL63BL		
Form Factor	Portable Handset		
Frequency Range of each LTE transmission band	LTE Band 12 (699.7 - 715.3 MHz) LTE Band 5 (Cell) (824.7 - 848.3 MHz) LTE Band 4 (AWS) (1710.7 - 1754.3 MHz) LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)		
Channel Bandwidths	LTE Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 12: 1.4 MHz	699.7 (23017)	707.5 (23095)	715.3 (23173)
LTE Band 12: 3 MHz	700.5 (23025)	707.5 (23095)	714.5 (23165)
LTE Band 12: 5 MHz	701.5 (23035)	707.5 (23095)	713.5 (23155)
LTE Band 12: 10 MHz	704 (23060)	707.5 (23095)	711 (23130)
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)	836.5 (20525)	848.3 (20643)
LTE Band 5 (Cell): 3 MHz	825.5 (20415)	836.5 (20525)	847.5 (20635)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
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 2 (PCS): 1.4 MHz	1850.7 (18607)	1880 (18900)	1909.3 (19193)
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	1880 (18900)	1908.5 (19185)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	1880 (18900)	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855 (18650)	1880 (18900)	1905 (19150)
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	1880 (18900)	1902.5 (19125)
LTE Band 2 (PCS): 20 MHz	1860 (18700)	1880 (18900)	1900 (19100)
UE Category	4		
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 Release 10 Additional Information	This device does not support full CA features on 3GPP Release 10. All uplink communications are identical to the Release 8 Specifications. The following LTE Release 10 Features are not supported: Carrier Aggregation, Relay, HetNet, Enhanced MIMO, eICIC, WIFI Offloading, MDH, eMBMS, Cross-Carrier Scheduling, Enhanced SC-FDMA.		

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3 INTRODUCTION

The FCC and Innovation, Science, and Economic Development 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/m³)
- E = Total RMS electric field strength (V/m)

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

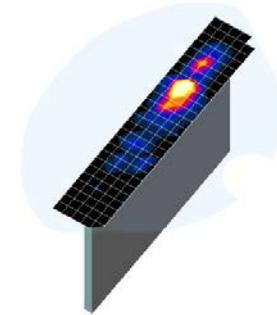
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4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (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 D01v01r04 (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 ($10 \times 10 \times 10$) were obtained through interpolation, in order to calculate the averaged SAR.
 - c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.



**Figure 4-1
Sample SAR Area Scan**

**Table 4-1
Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04***

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

*Also compliant to IEEE 1528-2013 Table 6

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5 DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

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

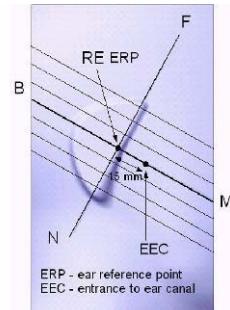


Figure 5-1
Close-Up Side view
of ERP

5.2 HANDSET REFERENCE POINTS

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



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

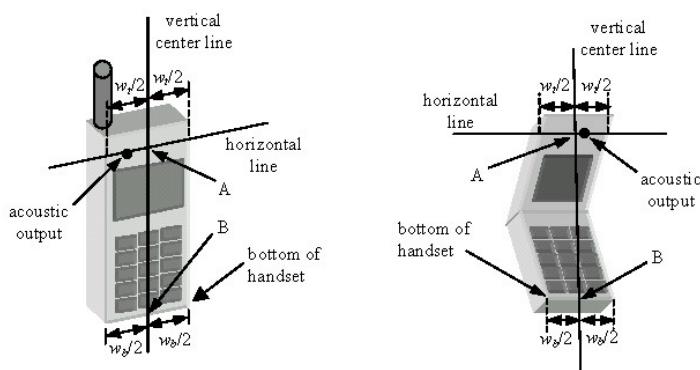


Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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6 TEST CONFIGURATION POSITIONS

6.1 Device Holder

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

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.

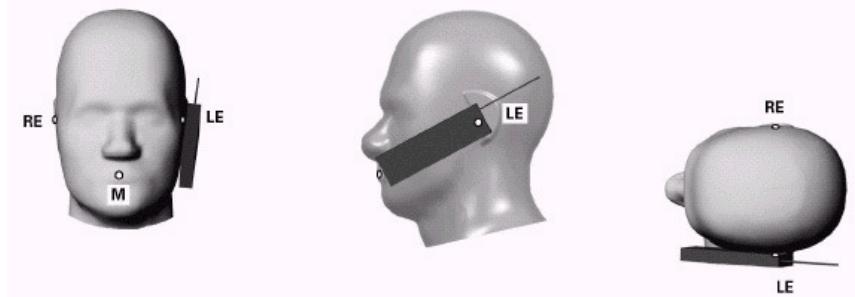


Figure 6-1 Front, Side and Top View of Cheek Position

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 with respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the device contact with the ear, the device was rotated about the NF line until any point on the handset made contact with a phantom point below the ear (cheek) (See Figure 6-2).

6.3 Positioning for Ear / 15° Tilt

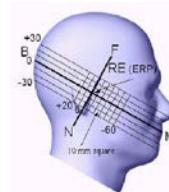
With the test device aligned in the “Cheek Position”:

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

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



**Figure 6-3
Side view w/ relevant markings**

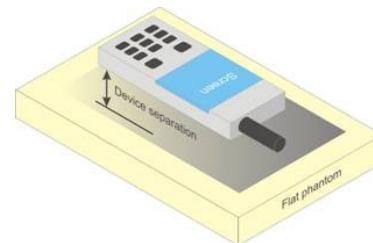
6.4 SAR Evaluations near the Mouth/Jaw Regions of the SAM Phantom

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 D04v01r03. 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 D04v01r03, 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 D01v06 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.

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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 447498 D01v06 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D01v06, 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 D06v02r01 where SAR test considerations for handsets ($L \times W \geq 9 \text{ cm} \times 5 \text{ cm}$) 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 D01v06 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.

6.8 Phablet Configurations

For smart phones with a display diagonal dimension $> 150 \text{ mm}$ or an overall diagonal dimension $> 160 \text{ mm}$ that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that support voice calls next to the ear, the phablets procedures outlined in KDB Publication 648474 D04v01r03 should be applied to evaluate SAR compliance. A device marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance. In addition to the normally required head and body-worn accessory SAR test procedures required for handsets, the UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna $\leq 25 \text{ mm}$ from that surface or edge, in direct contact with the phantom, for 10-g SAR. The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g SAR $> 1.2 \text{ W/kg}$.

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7 RF EXPOSURE LIMITS

7.1 Uncontrolled Environment

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

7.2 Controlled Environment

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

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

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

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

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8 FCC MEASUREMENT PROCEDURES

Power measurements 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 D01v06, 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 D01v01r03.

8.2 3G SAR Test Reduction Procedure

In FCC KDB Publication 941225 D01v03r01, 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 D01v03r01 “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.

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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.

8.5 SAR Measurement Conditions for LTE

LTE modes are tested according to FCC KDB 941225 D05v02r04 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.

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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 D05v02r04:

- 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 $\frac{1}{2}$ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is < 1.45 W/kg.

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 D01v02r02 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.

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8.6.2 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. When 10-g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

8.6.3 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. When 10-g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

8.6.4 OFDM Transmission Mode and SAR Test Channel Selection

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, 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 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.

8.6.5 Initial Test Configuration Procedure

For OFDM, 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, lowest data rate and lowest order IEEE 802.11 mode. 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

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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 8.6.4). When 10-g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

8.6.6 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 $\leq 1.2 \text{ W/kg}$, no additional SAR tests for the subsequent test configurations are required. When 10-g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

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9 RF CONDUCTED POWERS

9.1 GSM Conducted Powers

Maximum Burst-Averaged Output Power											
Band	Channel	Voice	GPRS/EDGE Data (GMSK)					EDGE Data (8-PSK)			
			GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	33.18	33.18	31.64	29.76	28.18	26.50	26.49	25.03	24.35	
	190	33.17	33.05	31.60	29.71	28.20	26.58	26.31	25.15	24.21	
	251	33.10	33.12	31.59	29.75	28.13	26.58	26.37	25.10	24.29	
GSM 1900	512	30.12	30.20	28.67	27.00	25.16	24.97	24.83	24.16	23.03	
	661	30.19	30.19	28.70	26.90	25.20	24.99	24.86	24.11	22.99	
	810	30.20	30.17	28.63	26.99	25.03	25.01	24.94	24.20	22.94	

Calculated Maximum Frame-Averaged Output Power											
Band	Channel	Voice	GPRS/EDGE Data (GMSK)					EDGE Data (8-PSK)			
			GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	24.15	24.15	25.62	25.50	25.17	17.47	20.47	20.77	21.34	
	190	24.14	24.02	25.58	25.45	25.19	17.55	20.29	20.89	21.20	
	251	24.07	24.09	25.57	25.49	25.12	17.55	20.35	20.84	21.28	
GSM 1900	512	21.09	21.17	22.65	22.74	22.15	15.94	18.81	19.90	20.02	
	661	21.16	21.16	22.68	22.64	22.19	15.96	18.84	19.85	19.98	
	810	21.17	21.14	22.61	22.73	22.02	15.98	18.92	19.94	19.93	

GSM 850	Frame	23.67	23.67	25.18	25.44	24.69	17.17	20.18	20.44	21.19
GSM 1900	Avg.Targets:	20.67	20.67	22.18	22.44	21.69	15.67	18.68	19.44	19.69

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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: 12 (Max 4 Tx uplink slots)

EDGE Multislot class: 12 (Max 4 Tx uplink slots)

DTM Multislot Class: N/A

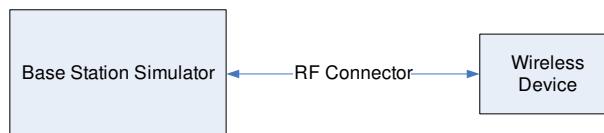


Figure 9-1
Power Measurement Setup

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9.2 UMTS Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			AWS Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	1312	1412	1513	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	23.60	23.66	23.68	23.70	23.68	23.67	23.63	23.68	23.68	-
99		12.2 kbps AMR	23.61	23.58	23.68	23.57	23.60	23.69	23.64	23.67	23.63	-
6	HSDPA	Subtest 1	23.51	23.48	23.55	23.55	23.48	23.44	23.46	23.54	23.58	0
6		Subtest 2	23.50	23.45	23.49	23.55	23.50	23.53	23.55	23.50	23.49	0
6		Subtest 3	23.10	22.97	22.98	22.92	22.98	23.01	23.15	23.05	23.08	0.5
6		Subtest 4	23.12	23.05	22.97	22.99	22.87	23.05	23.04	23.00	23.05	0.5
6	HSUPA	Subtest 1	23.15	23.68	22.97	22.78	23.00	22.89	23.26	22.70	22.85	0
6		Subtest 2	21.85	22.14	22.19	21.90	22.17	22.12	21.85	22.04	21.96	2
6		Subtest 3	22.65	22.91	22.61	21.90	23.00	23.04	22.33	22.85	21.94	1
6		Subtest 4	21.99	22.18	22.10	21.87	22.08	22.19	22.18	22.06	21.90	2
6		Subtest 5	23.64	23.70	23.65	23.61	23.68	23.70	23.70	23.64	23.66	0

This device does not support DC-HSDPA.

It is expected by the manufacturer that MPR for some HSPA subtests may be up to 1 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model.



Figure 9-2
Power Measurement Setup

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9.3 LTE Conducted Powers

9.3.1 LTE Band 12

Table 9-1
LTE Band 12 Conducted Powers - 10 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 12 10 MHz Bandwidth		MPR Allowed per 3GPP [dB]	MPR [dB]		
			Mid Channel					
			23095 (707.5 MHz)	Conducted Power [dBm]				
QPSK	1	0	24.18	0	0	0		
	1	25	24.05		0	0		
	1	49	24.10		0	0		
	25	0	23.11		1	1		
	25	12	23.06	0-1	1	1		
	25	25	23.05		1	1		
	50	0	23.06		1	1		
	1	0	23.10	0-1	1	1		
16QAM	1	25	23.09		1	1		
	1	49	23.00		1	1		
	25	0	22.20		2	2		
	25	12	22.05	0-2	2	2		
	25	25	22.08		2	2		
	50	0	22.11		2	2		

Note: LTE Band 12 at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Table 9-2
LTE Band 12 Conducted Powers - 5 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 12 5 MHz Bandwidth			MPR Allowed per 3GPP [dB]	MPR [dB]
			Low Channel	Mid Channel	High Channel		
			23035 (701.5 MHz)	23095 (707.5 MHz)	23155 (713.5 MHz)		
QPSK	1	0	24.04	24.06	24.01	0	0
	1	12	24.02	24.08	24.00		0
	1	24	23.98	24.06	24.03		0
	12	0	22.96	23.04	23.06		1
	12	6	22.91	23.07	23.08	0-1	1
	12	13	22.94	23.00	23.03		1
	25	0	23.14	23.01	23.12		1
16QAM	1	0	22.96	23.00	23.06	0-1	1
	1	12	23.02	23.01	23.08		1
	1	24	23.06	23.12	23.04		1
	12	0	22.12	22.11	22.12	0-2	2
	12	6	22.13	22.12	22.16		2
	12	13	22.11	22.12	22.08		2
	25	0	22.01	22.15	22.12		2

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Table 9-3
LTE Band 12 Conducted Powers - 3 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 12 3 MHz Bandwidth			MPR Allowed per 3GPP [dB]	MPR [dB]
			Low Channel	Mid Channel	High Channel		
			23025 (700.5 MHz)	23095 (707.5 MHz)	23165 (714.5 MHz)		
Conducted Power [dBm]							
QPSK	1	0	24.01	24.05	24.15	0	0
	1	7	23.95	24.01	24.15		0
	1	14	24.06	24.08	24.14		0
16QAM	8	0	23.04	22.99	23.11	0-1	1
	8	4	23.02	22.97	23.15		1
	8	7	22.89	22.89	23.12		1
	15	0	23.02	23.03	23.12		1
	1	0	23.12	23.09	23.01	0-1	1
	1	7	23.12	22.90	23.06		1
	1	14	23.12	23.04	23.14		1
16QAM	8	0	22.09	22.12	22.01	0-2	2
	8	4	22.07	22.13	22.03		2
	8	7	22.17	22.19	22.13		2
	15	0	22.12	22.11	21.94		2

Table 9-4
LTE Band 12 Conducted Powers - 1.4 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 12 1.4 MHz Bandwidth			MPR Allowed per 3GPP [dB]	MPR [dB]
			Low Channel	Mid Channel	High Channel		
			23017 (699.7 MHz)	23095 (707.5 MHz)	23173 (715.3 MHz)		
Conducted Power [dBm]							
QPSK	1	0	23.91	24.06	23.94	0	0
	1	2	24.02	24.03	23.93		0
	1	5	24.06	23.99	23.99		0
16QAM	3	0	24.02	23.98	23.97	0-1	0
	3	2	23.94	23.94	23.91		0
	3	3	23.92	23.95	23.99		0
	6	0	22.76	23.03	22.93	0-1	1
	1	0	22.93	23.04	22.92		1
	1	2	23.14	22.92	22.99		1
	1	5	23.20	22.99	22.98		1
	3	0	23.06	23.11	22.98	0-2	1
	3	2	23.17	22.91	22.97		1
	3	3	22.94	22.90	23.01		1
	6	0	21.95	22.11	22.03		2

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9.3.2 LTE Band 5 (Cell)

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

Modulation	RB Size	RB Offset	LTE Band 5 (Cell) 10 MHz Bandwidth		
			Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20525 (836.5 MHz)		
QPSK	1	0	24.19	0	0
	1	25	23.99		0
	1	49	23.94		0
	25	0	23.05		1
	25	12	22.89	0-1	1
	25	25	22.99		1
	50	0	22.97		1
	1	0	22.89	0-1	1
16QAM	1	25	22.96		1
	1	49	23.00		1
	25	0	22.15		2
	25	12	22.06	0-2	2
	25	25	22.13		2
	50	0	22.06		2

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

Table 9-6
LTE Band 5 (Cell) Conducted Powers - 5 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 5 (Cell) 5 MHz Bandwidth			MPR Allowed per 3GPP [dB]	MPR [dB]
			Low Channel	Mid Channel	High Channel		
			20425 (826.5 MHz)	20525 (836.5 MHz)	20625 (846.5 MHz)		
QPSK	1	0	24.04	24.14	23.94	0	0
	1	12	24.06	24.03	23.95		0
	1	24	24.02	23.96	24.01		0
	12	0	23.05	22.99	22.99	0-1	1
	12	6	23.15	23.14	23.02		1
	12	13	23.11	22.99	23.12		1
	25	0	23.05	23.06	23.11		1
16QAM	1	0	23.09	23.17	22.92	0-1	1
	1	12	23.02	23.14	23.12		1
	1	24	22.92	23.02	23.03		1
	12	0	22.14	22.01	21.96	0-2	2
	12	6	22.16	22.05	22.12		2
	12	13	21.91	22.06	22.05		2
	25	0	22.02	21.94	22.06		2

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Table 9-7
LTE Band 5 (Cell) Conducted Powers - 3 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 5 (Cell) 3 MHz Bandwidth			MPR Allowed per 3GPP [dB]	MPR [dB]
			Low Channel 20415 (825.5 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20635 (847.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.91	23.94	24.03	0	0
	1	7	23.81	23.98	24.12		0
	1	14	24.04	23.91	24.05		0
	8	0	23.06	23.05	23.10	0-1	1
	8	4	23.04	23.14	23.00		1
	8	7	23.15	23.15	23.12		1
	15	0	22.94	23.14	23.03		1
16QAM	1	0	23.05	23.06	23.04	0-1	1
	1	7	22.96	22.92	23.15		1
	1	14	22.92	22.90	22.91		1
	8	0	22.15	22.10	22.02	0-2	2
	8	4	22.12	22.15	22.01		2
	8	7	22.11	22.12	21.96		2
	15	0	22.19	22.05	22.11		2

Table 9-8
LTE Band 5 (Cell) Conducted Powers - 1.4 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 5 (Cell) 1.4 MHz Bandwidth			MPR Allowed per 3GPP [dB]	MPR [dB]
			Low Channel 20407 (824.7 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20643 (848.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	24.05	23.89	23.90	0	0
	1	2	23.90	23.87	23.93		0
	1	5	24.09	23.90	24.05		0
	3	0	24.07	23.96	24.11		0
	3	2	23.94	24.01	23.82	0-1	0
	3	3	23.99	23.88	23.90		0
	6	0	23.07	23.01	23.06		1
16QAM	1	0	23.06	23.12	23.11	0-1	1
	1	2	23.10	23.10	23.02		1
	1	5	23.08	23.18	23.00		1
	3	0	23.00	23.17	23.09		1
	3	2	23.05	23.17	23.04	0-2	1
	3	3	23.11	23.02	22.92		1
	6	0	22.11	22.11	22.11		2

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9.3.3 LTE Band 4 (AWS)

Table 9-9
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 4 (AWS) 20 MHz Bandwidth		
			Mid Channel	20175 (1732.5 MHz)	MPR Allowed per 3GPP [dB]
			Conducted Power [dBm]		
QPSK	50	1	23.63	0	0
		1	23.61		0
		1	23.56		0
		50	22.58		1
		50	22.55		1
		50	22.51		1
		100	22.38		1
16QAM	100	1	22.44	0-1	1
		1	22.40		1
		1	22.49		1
		50	21.44	0-2	2
		50	21.70		2
		50	21.66		2
		100	21.63		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 9-10
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 4 (AWS) 15 MHz Bandwidth				
			Low Channel	Mid Channel	High Channel		
			20025 (1717.5 MHz)	20175 (1732.5 MHz)	20325 (1747.5 MHz)		
QPSK	36	1	23.42	23.47	23.59	0	0
		1	23.57	23.46	23.55		0
		1	23.55	23.60	23.54		0
		36	22.47	22.44	22.45	0-1	1
		36	22.52	22.50	22.46		1
		36	22.54	22.55	22.51		1
		75	22.66	22.45	22.58		1
16QAM	75	1	22.69	22.46	22.68	0-1	1
		1	22.63	22.48	22.65		1
		1	22.49	22.44	22.44		1
		36	21.38	21.57	21.55	0-2	2
		36	21.68	21.52	21.50		2
		36	21.62	21.57	21.44		2
		75	21.57	21.55	21.44		2

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Table 9-11
LTE Band 4 (AWS) Conducted Powers - 10 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20000 (1715.0 MHz)	20175 (1732.5 MHz)	20350 (1750.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.57	23.60	23.44	0	0
	1	25	23.48	23.48	23.49		0
	1	49	23.64	23.45	23.49		0
	25	0	22.70	22.42	22.51	0-1	1
	25	12	22.58	22.48	22.52		1
	25	25	22.55	22.55	22.65		1
	50	0	22.65	22.64	22.64		1
16QAM	1	0	22.60	22.65	22.63	0-1	1
	1	25	22.62	22.45	22.64		1
	1	49	22.65	22.47	22.45		1
	25	0	21.51	21.44	21.49	0-2	2
	25	12	21.69	21.65	21.48		2
	25	25	21.60	21.64	21.45		2
	50	0	21.68	21.58	21.44		2

Table 9-12
LTE Band 4 (AWS) Conducted Powers - 5 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			19975 (1712.5 MHz)	20175 (1732.5 MHz)	20375 (1752.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.48	23.44	23.57	0	0
	1	12	23.56	23.57	23.65		0
	1	24	23.56	23.44	23.54		0
	12	0	22.43	22.55	22.56	0-1	1
	12	6	22.66	22.54	22.45		1
	12	13	22.65	22.44	22.67		1
	25	0	22.44	22.46	22.66		1
16QAM	1	0	22.46	22.58	22.47	0-1	1
	1	12	22.56	22.59	22.66		1
	1	24	22.48	22.67	22.60		1
	12	0	21.66	21.65	21.50	0-2	2
	12	6	21.55	21.65	21.55		2
	12	13	21.69	21.67	21.40		2
	25	0	21.50	21.59	21.56		2

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Table 9-13
LTE Band 4 (AWS) Conducted Powers - 3 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			19965 (1711.5 MHz)	20175 (1732.5 MHz)	20385 (1753.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.47	23.37	23.34	0	0
	1	7	23.48	23.39	23.38		0
	1	14	23.46	23.38	23.40		0
	8	0	22.52	22.42	22.48	0-1	1
	8	4	22.55	22.40	22.59		1
	8	7	22.51	22.49	22.52		1
	15	0	22.61	22.52	22.51		1
16QAM	1	0	22.57	22.57	22.49	0-1	1
	1	7	22.57	22.67	22.53		1
	1	14	22.49	22.63	22.51		1
	8	0	21.63	21.60	21.68	0-2	2
	8	4	21.62	21.57	21.48		2
	8	7	21.60	21.59	21.63		2
	15	0	21.67	21.62	21.60		2

Table 9-14
LTE Band 4 (AWS) Conducted Powers -1.4 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			19957 (1710.7 MHz)	20175 (1732.5 MHz)	20393 (1754.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.38	23.40	23.37	0	0
	1	2	23.32	23.35	23.42		0
	1	5	23.38	23.39	23.51		0
	3	0	23.34	23.37	23.44		0
	3	2	23.38	23.42	23.46	0-1	0
	3	3	23.34	23.44	23.39		0
	6	0	22.39	22.52	22.62		1
16QAM	1	0	22.62	22.50	22.60	0-1	1
	1	2	22.51	22.54	22.64		1
	1	5	22.54	22.57	22.68		1
	3	0	22.49	22.46	22.57		1
	3	2	22.38	22.49	22.49	0-2	1
	3	3	22.38	22.54	22.50		1
	6	0	21.49	21.62	21.60		2

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9.3.4 LTE Band 2 (PCS)

Table 9-15
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 2 (PCS) 20 MHz Bandwidth			MPR Allowed per 3GPP [dB]	MPR [dB]
			Low Channel	Mid Channel	High Channel		
			18700 (1860.0 MHz)	18900 (1880.0 MHz)	19100 (1900.0 MHz)		
Conducted Power [dBm]							
QPSK	1	0	23.44	23.70	23.55	0	0
	1	50	23.39	23.55	23.61		0
	1	99	23.38	23.65	23.66		0
	50	0	22.61	22.30	22.26	0-1	1
	50	25	22.68	22.69	22.58		1
	50	50	22.50	22.59	22.68		1
	100	0	22.41	22.56	22.51		1
16QAM	1	0	22.29	22.35	22.68	0-1	1
	1	50	22.38	22.54	22.61		1
	1	99	22.24	22.58	22.34		1
	50	0	21.65	21.64	21.64	0-2	2
	50	25	21.59	21.68	21.25		2
	50	50	21.50	21.25	21.33		2
	100	0	21.30	21.29	21.40		2

Table 9-16
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 2 (PCS) 15 MHz Bandwidth			MPR Allowed per 3GPP [dB]	MPR [dB]
			Low Channel	Mid Channel	High Channel		
			18675 (1857.5 MHz)	18900 (1880.0 MHz)	19125 (1902.5 MHz)		
Conducted Power [dBm]							
QPSK	1	0	23.47	23.38	23.57	0	0
	1	36	23.65	23.49	23.42		0
	1	74	23.54	23.44	23.39		0
	36	0	22.68	22.62	22.48	0-1	1
	36	18	22.66	22.63	22.54		1
	36	37	22.65	22.54	22.62		1
	75	0	22.57	22.51	22.63		1
16QAM	1	0	22.54	22.45	22.58	0-1	1
	1	36	22.66	22.34	22.64		1
	1	74	22.57	22.49	22.54		1
	36	0	21.66	21.43	21.38	0-2	2
	36	18	21.69	21.40	21.42		2
	36	37	21.64	21.42	21.40		2
	75	0	21.62	21.61	21.43		2

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Table 9-17
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 2 (PCS) 10 MHz Bandwidth			MPR Allowed per 3GPP [dB]	MPR [dB]
			Low Channel	Mid Channel	High Channel		
			18650 (1855.0 MHz)	18900 (1880.0 MHz)	19150 (1905.0 MHz)		
Conducted Power [dBm]							
QPSK	1	0	23.52	23.49	23.54	0	0
	1	25	23.49	23.48	23.68		0
	1	49	23.42	23.39	23.64		0
	25	0	22.54	22.66	22.68	0-1	1
	25	12	22.65	22.67	22.68		1
	25	25	22.60	22.58	22.62		1
	50	0	22.48	22.54	22.68		1
16QAM	1	0	22.51	22.57	22.57	0-1	1
	1	25	22.45	22.54	22.59		1
	1	49	22.66	22.65	22.48		1
	25	0	21.65	21.68	21.49	0-2	2
	25	12	21.66	21.57	21.48		2
	25	25	21.69	21.66	21.69		2
	50	0	21.62	21.62	21.57		2

Table 9-18
LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 2 (PCS) 5 MHz Bandwidth			MPR Allowed per 3GPP [dB]	MPR [dB]
			Low Channel	Mid Channel	High Channel		
			18625 (1852.5 MHz)	18900 (1880.0 MHz)	19175 (1907.5 MHz)		
Conducted Power [dBm]							
QPSK	1	0	23.48	23.65	23.54	0	0
	1	12	23.49	23.57	23.52		0
	1	24	23.38	23.54	23.62		0
	12	0	22.52	22.62	22.51	0-1	1
	12	6	22.68	22.65	22.40		1
	12	13	22.62	22.68	22.42		1
	25	0	22.67	22.48	22.45		1
16QAM	1	0	22.58	22.56	22.53	0-1	1
	1	12	22.66	22.50	22.54		1
	1	24	22.68	22.55	22.41		1
	12	0	21.59	21.53	21.51	0-2	2
	12	6	21.57	21.54	21.43		2
	12	13	21.65	21.62	21.44		2
	25	0	21.51	21.60	21.34		2

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Table 9-19
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 2 (PCS) 3 MHz Bandwidth			MPR Allowed per 3GPP [dB]	MPR [dB]
			Low Channel	Mid Channel	High Channel		
			18615 (1851.5 MHz)	18900 (1880.0 MHz)	19185 (1908.5 MHz)		
Conducted Power [dBm]							
QPSK	1	0	23.67	23.65	23.61	0	0
	1	7	23.68	23.69	23.62		0
	1	14	23.69	23.52	23.68		0
	8	0	22.61	22.64	22.62		1
	8	4	22.60	22.64	22.58		1
	8	7	22.60	22.68	22.54		1
	15	0	22.61	22.65	22.65		1
	1	0	22.67	22.68	22.69		1
16QAM	1	7	22.61	22.65	22.57	0-1	1
	1	14	22.69	22.64	22.61		1
	8	0	21.54	21.62	21.68		2
	8	4	21.62	21.58	21.65		2
	8	7	21.65	21.55	21.58	0-2	2
	15	0	21.67	21.66	21.54		2

Table 9-20
LTE Band 2 (PCS) Conducted Powers - 1.4 MHz Bandwidth

Modulation	RB Size	RB Offset	LTE Band 2 (PCS) 1.4 MHz Bandwidth			MPR Allowed per 3GPP [dB]	MPR [dB]
			Low Channel	Mid Channel	High Channel		
			18607 (1850.7 MHz)	18900 (1880.0 MHz)	19193 (1909.3 MHz)		
Conducted Power [dBm]							
QPSK	1	0	23.67	23.63	23.66	0	0
	1	2	23.58	23.44	23.62		0
	1	5	23.67	23.50	23.67		0
	3	0	23.56	23.60	23.69		0
	3	2	23.65	23.65	23.28		0
	3	3	23.67	23.61	23.64		0
	6	0	22.60	22.62	22.62		0-1
	1	0	22.67	22.69	22.61		1
16QAM	1	2	22.64	22.63	22.64	0-1	1
	1	5	22.60	22.69	22.63		1
	3	0	22.63	22.69	22.54		1
	3	2	22.67	22.57	22.61		1
	3	3	22.61	22.63	22.68	0-2	1
	6	0	21.69	21.57	21.62		2

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9.4 WLAN Conducted Powers

Table 9-21
2.4 GHz WLAN Maximum Average RF Power

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11b	802.11g
2412	1	17.99	15.34
2417	2	18.99	16.25
2437	6	18.96	16.03
2457	10	18.98	16.22
2462	11	17.98	15.25

Table 9-22
2.4 GHz WLAN Reduced Average RF Power

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11b	802.11g	802.11n
2412	1	14.15	14.22	14.29
2417	2	15.16	15.16	15.13
2437	6	15.06	15.13	15.17
2457	10	15.11	15.19	15.22
2462	11	14.05	14.07	14.15

Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02:

- 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.

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10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (°C)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ϵ	% dev σ	% dev ϵ
11/23/2016	750H	21.5	700	0.864	42.228	0.889	42.201	-2.81%	0.06%
			710	0.873	42.099	0.890	42.149	-1.91%	-0.12%
			740	0.901	41.671	0.893	41.994	0.90%	-0.77%
			755	0.915	41.454	0.894	41.916	2.35%	-1.10%
11/22/2016	835H	21.1	820	0.882	40.809	0.899	41.578	-1.89%	-1.85%
			835	0.896	40.608	0.900	41.500	-0.44%	-2.15%
			850	0.911	40.427	0.916	41.500	-0.55%	-2.59%
11/22/2016	1750H	22.0	1710	1.343	38.691	1.348	40.142	-0.37%	-3.61%
			1750	1.386	38.491	1.371	40.079	1.09%	-3.96%
			1790	1.421	38.287	1.394	40.016	1.94%	-4.32%
11/21/2016	1900H	20.9	1850	1.393	38.904	1.400	40.000	-0.50%	-2.74%
			1880	1.424	38.773	1.400	40.000	1.71%	-3.07%
			1910	1.455	38.643	1.400	40.000	3.93%	-3.39%
11/28/2016	2450H	23.0	2400	1.799	38.806	1.756	39.289	2.45%	-1.23%
			2450	1.851	38.646	1.800	39.200	2.83%	-1.41%
			2500	1.905	38.431	1.855	39.136	2.70%	-1.80%
11/21/2016	750B	20.5	700	0.912	55.848	0.959	55.726	-4.90%	0.22%
			710	0.921	55.774	0.960	55.687	-4.06%	0.16%
			740	0.948	55.499	0.963	55.570	-1.56%	-0.13%
			755	0.963	55.320	0.964	55.512	-0.10%	-0.35%
11/21/2016	835B	20.4	820	0.964	53.879	0.969	55.258	-0.52%	-2.50%
			835	0.978	53.718	0.970	55.200	0.82%	-2.68%
			850	0.992	53.545	0.988	55.154	0.40%	-2.92%
11/28/2016	835B	20.8	820	0.974	53.490	0.969	55.258	0.52%	-3.20%
			835	0.988	53.327	0.970	55.200	1.86%	-3.39%
			850	1.003	53.162	0.988	55.154	1.52%	-3.61%
11/22/2016	1750B	21.7	1710	1.480	51.378	1.463	53.537	1.16%	-4.03%
			1750	1.525	51.240	1.488	53.432	2.49%	-4.10%
			1790	1.563	51.045	1.514	53.326	3.24%	-4.28%
11/21/2016	1900B	20.0	1850	1.461	53.722	1.520	53.300	-3.88%	0.79%
			1880	1.495	53.634	1.520	53.300	-1.64%	0.63%
			1910	1.530	53.512	1.520	53.300	0.66%	0.40%
11/21/2016	2450B	23.0	2400	1.923	51.632	1.902	52.767	1.10%	-2.15%
			2450	1.988	51.444	1.950	52.700	1.95%	-2.38%
			2500	2.054	51.246	2.021	52.636	1.63%	-2.64%

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 D01v01r04 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

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10.2 Test System Verification

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

Table 10-2
System Verification Results

SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	System Verification								
				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} (%)
K	750	HEAD	11/23/2016	22.9	21.6	0.200	1054	7409	1.540	8.220	7.700	-6.33%
D	835	HEAD	11/22/2016	22.2	21.1	0.200	4d047	3213	1.910	9.130	9.550	4.60%
A	1750	HEAD	11/22/2016	22.1	22.0	0.100	1150	3022	3.490	36.100	34.900	-3.32%
I	1900	HEAD	11/21/2016	20.2	20.4	0.100	5d149	3288	4.120	40.100	41.200	2.74%
D	2450	HEAD	11/28/2016	21.8	22.7	0.100	981	3213	5.230	52.800	52.300	-0.95%
K	750	BODY	11/21/2016	22.1	21.0	0.200	1054	7409	1.750	8.560	8.750	2.22%
H	835	BODY	11/21/2016	20.8	20.4	0.200	4d047	3319	2.010	9.570	10.050	5.02%
H	835	BODY	11/28/2016	23.1	21.5	0.200	4d047	3319	1.950	9.570	9.750	1.88%
C	1750	BODY	11/22/2016	23.3	21.7	0.100	1150	7410	3.840	36.500	38.400	5.21%
G	1900	BODY	11/21/2016	21.3	20.1	0.100	5d149	3287	3.710	39.900	37.100	-7.02%
E	2450	BODY	11/21/2016	22.9	22.1	0.100	797	7406	4.830	50.700	48.300	-4.73%

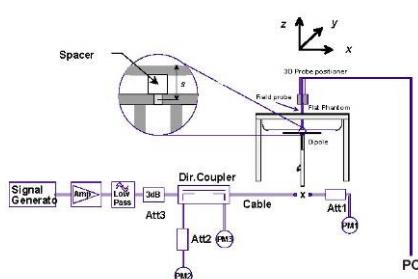


Figure 10-1
System Verification Setup Diagram



Figure 10-2
System Verification Setup Photo

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11 SAR DATA SUMMARY

11.1 Standalone Head SAR Data

Table 11-1
GSM 850 Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	# of Time Slots	Duty Cycle	SAR (1g) (W/kg)	Scaling Factor	Reported SAR (1g) (W/kg)	Plot #
MHz	Ch.														
836.60	190	GSM 850	GSM	33.2	33.17	-0.01	Right	Cheek	08161	1	1:8.3	0.334	1.007	0.336	
836.60	190	GSM 850	GSM	33.2	33.17	-0.04	Right	Tilt	08161	1	1:8.3	0.203	1.007	0.204	
836.60	190	GSM 850	GSM	33.2	33.17	-0.04	Left	Cheek	08161	1	1:8.3	0.312	1.007	0.314	
836.60	190	GSM 850	GSM	33.2	33.17	0.00	Left	Tilt	08161	1	1:8.3	0.194	1.007	0.195	
836.60	190	GSM 850	GRPS	30.2	29.71	-0.05	Right	Cheek	08161	3	1:2.76	0.390	1.119	0.436	A1
836.60	190	GSM 850	GRPS	30.2	29.71	-0.02	Right	Tilt	08161	3	1:2.76	0.221	1.119	0.247	
836.60	190	GSM 850	GRPS	30.2	29.71	0.04	Left	Cheek	08161	3	1:2.76	0.361	1.119	0.404	
836.60	190	GSM 850	GRPS	30.2	29.71	-0.05	Left	Tilt	08161	3	1:2.76	0.225	1.119	0.252	
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
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	# of Time Slots	Duty Cycle	SAR (1g) (W/kg)	Scaling Factor	Reported SAR (1g) (W/kg)	Plot #
MHz	Ch.														
1880.00	661	GSM 1900	GSM	30.2	30.19	0.11	Right	Cheek	08211	1	1:8.3	0.257	1.002	0.258	
1880.00	661	GSM 1900	GSM	30.2	30.19	0.00	Right	Tilt	08211	1	1:8.3	0.162	1.002	0.162	
1880.00	661	GSM 1900	GSM	30.2	30.19	0.06	Left	Cheek	08211	1	1:8.3	0.352	1.002	0.353	
1880.00	661	GSM 1900	GSM	30.2	30.19	0.05	Left	Tilt	08211	1	1:8.3	0.188	1.002	0.188	
1880.00	661	GSM 1900	GRPS	27.2	26.90	-0.03	Right	Cheek	08211	3	1:2.76	0.282	1.072	0.302	
1880.00	661	GSM 1900	GRPS	27.2	26.90	0.11	Right	Tilt	08211	3	1:2.76	0.180	1.072	0.193	
1880.00	661	GSM 1900	GRPS	27.2	26.90	-0.10	Left	Cheek	08211	3	1:2.76	0.392	1.072	0.420	A2
1880.00	661	GSM 1900	GRPS	27.2	26.90	0.12	Left	Tilt	08211	3	1:2.76	0.187	1.072	0.200	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram							

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Table 11-3
UMTS 850 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	23.7	23.66	0.01	Right	Cheek	08211	1:1	0.416	1.009	0.420	A3
836.60	4183	UMTS 850	RMC	23.7	23.66	0.03	Right	Tilt	08211	1:1	0.280	1.009	0.283	
836.60	4183	UMTS 850	RMC	23.7	23.66	-0.02	Left	Cheek	08211	1:1	0.329	1.009	0.332	
836.60	4183	UMTS 850	RMC	23.7	23.66	0.08	Left	Tilt	08211	1:1	0.231	1.009	0.233	
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 1750 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	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1732.40	1412	UMTS 1750	RMC	23.7	23.68	0.01	Right	Cheek	08161	1:1	0.172	1.005	0.173	
1732.40	1412	UMTS 1750	RMC	23.7	23.68	0.08	Right	Tilt	08161	1:1	0.110	1.005	0.111	
1732.40	1412	UMTS 1750	RMC	23.7	23.68	-0.03	Left	Cheek	08161	1:1	0.320	1.005	0.322	A4
1732.40	1412	UMTS 1750	RMC	23.7	23.68	0.11	Left	Tilt	08161	1:1	0.169	1.005	0.170	
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
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	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	23.7	23.68	0.14	Right	Cheek	08161	1:1	0.273	1.005	0.274	
1880.00	9400	UMTS 1900	RMC	23.7	23.68	0.00	Right	Tilt	08161	1:1	0.154	1.005	0.155	
1880.00	9400	UMTS 1900	RMC	23.7	23.68	0.04	Left	Cheek	08161	1:1	0.413	1.005	0.415	A5
1880.00	9400	UMTS 1900	RMC	23.7	23.68	0.03	Left	Tilt	08161	1:1	0.172	1.005	0.173	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

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Table 11-6
LTE Band 12 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	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)	(W/kg)			
707.50	23095	Md	LTE Band 12	10	24.2	24.18	0.01	0	Right	Cheek	QPSK	1	0	08187	1:1	0.375	1.005	0.377	A6
707.50	23095	Md	LTE Band 12	10	23.2	23.11	0.00	1	Right	Cheek	QPSK	25	0	08187	1:1	0.296	1.021	0.302	
707.50	23095	Md	LTE Band 12	10	24.2	24.18	-0.21	0	Right	Tilt	QPSK	1	0	08187	1:1	0.203	1.005	0.204	
707.50	23095	Md	LTE Band 12	10	23.2	23.11	-0.19	1	Right	Tilt	QPSK	25	0	08187	1:1	0.177	1.021	0.181	
707.50	23095	Md	LTE Band 12	10	24.2	24.18	0.17	0	Left	Cheek	QPSK	1	0	08187	1:1	0.285	1.005	0.286	
707.50	23095	Md	LTE Band 12	10	23.2	23.11	0.08	1	Left	Cheek	QPSK	25	0	08187	1:1	0.234	1.021	0.239	
707.50	23095	Md	LTE Band 12	10	24.2	24.18	-0.13	0	Left	Tilt	QPSK	1	0	08187	1:1	0.184	1.005	0.185	
707.50	23095	Md	LTE Band 12	10	23.2	23.11	0.04	1	Left	Tilt	QPSK	25	0	08187	1:1	0.153	1.021	0.156	
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
LTE Band 5 (Cell) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR(1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)	(W/kg)			
836.50	20525	Md	LTE Band 5 (Cell)	10	24.2	24.19	0.00	0	Right	Cheek	QPSK	1	0	08188	1:1	0.538	1.002	0.539	A7
836.50	20525	Md	LTE Band 5 (Cell)	10	23.2	23.05	0.05	1	Right	Cheek	QPSK	25	0	08188	1:1	0.459	1.035	0.475	
836.50	20525	Md	LTE Band 5 (Cell)	10	24.2	24.19	-0.12	0	Right	Tilt	QPSK	1	0	08188	1:1	0.335	1.002	0.336	
836.50	20525	Md	LTE Band 5 (Cell)	10	23.2	23.05	-0.05	1	Right	Tilt	QPSK	25	0	08188	1:1	0.284	1.035	0.294	
836.50	20525	Md	LTE Band 5 (Cell)	10	24.2	24.19	0.00	0	Left	Cheek	QPSK	1	0	08188	1:1	0.432	1.002	0.433	
836.50	20525	Md	LTE Band 5 (Cell)	10	23.2	23.05	-0.08	1	Left	Cheek	QPSK	25	0	08188	1:1	0.383	1.035	0.396	
836.50	20525	Md	LTE Band 5 (Cell)	10	24.2	24.19	0.11	0	Left	Tilt	QPSK	1	0	08188	1:1	0.276	1.002	0.277	
836.50	20525	Md	LTE Band 5 (Cell)	10	23.2	23.05	0.03	1	Left	Tilt	QPSK	25	0	08188	1:1	0.246	1.035	0.255	
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 11-8
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	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)	(W/kg)			
1732.50	20175	Md	LTE Band 4 (AWS)	20	23.7	23.63	0.04	0	Right	Cheek	QPSK	1	0	08188	1:1	0.208	1.016	0.211	
1732.50	20175	Md	LTE Band 4 (AWS)	20	22.7	22.58	-0.01	1	Right	Cheek	QPSK	50	0	08188	1:1	0.161	1.028	0.166	
1732.50	20175	Md	LTE Band 4 (AWS)	20	23.7	23.63	-0.16	0	Right	Tilt	QPSK	1	0	08188	1:1	0.185	1.016	0.188	
1732.50	20175	Md	LTE Band 4 (AWS)	20	22.7	22.58	-0.08	1	Right	Tilt	QPSK	50	0	08188	1:1	0.139	1.028	0.143	
1732.50	20175	Md	LTE Band 4 (AWS)	20	23.7	23.63	-0.01	0	Left	Cheek	QPSK	1	0	08188	1:1	0.307	1.016	0.312	A8
1732.50	20175	Md	LTE Band 4 (AWS)	20	22.7	22.58	0.02	1	Left	Cheek	QPSK	50	0	08188	1:1	0.242	1.028	0.249	
1732.50	20175	Md	LTE Band 4 (AWS)	20	23.7	23.63	0.02	0	Left	Tilt	QPSK	1	0	08188	1:1	0.185	1.016	0.188	
1732.50	20175	Md	LTE Band 4 (AWS)	20	22.7	22.58	-0.09	1	Left	Tilt	QPSK	50	0	08188	1:1	0.149	1.028	0.153	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram									

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Table 11-9
LTE Band 2 (PCS) 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	Reported SAR (1g)	Plot #
MHz	Ch.														(W/kg)	(W/kg)		
1880.00	18900	Md	LTE Band 2 (PCS)	20	23.7	23.70	0.07	0	Right	Cheek	QPSK	1	0	08138	1:1	0.298	1.000	0.298
1880.00	18900	Md	LTE Band 2 (PCS)	20	22.7	22.69	-0.03	1	Right	Cheek	QPSK	50	25	08138	1:1	0.232	1.002	0.232
1880.00	18900	Md	LTE Band 2 (PCS)	20	23.7	23.70	0.06	0	Right	Tilt	QPSK	1	0	08138	1:1	0.192	1.000	0.192
1880.00	18900	Md	LTE Band 2 (PCS)	20	22.7	22.69	0.09	1	Right	Tilt	QPSK	50	25	08138	1:1	0.137	1.002	0.137
1880.00	18900	Md	LTE Band 2 (PCS)	20	23.7	23.70	0.08	0	Left	Cheek	QPSK	1	0	08138	1:1	0.436	1.000	0.436
1880.00	18900	Md	LTE Band 2 (PCS)	20	22.7	22.69	0.00	1	Left	Cheek	QPSK	50	25	08138	1:1	0.362	1.002	0.363
1880.00	18900	Md	LTE Band 2 (PCS)	20	23.7	23.70	0.05	0	Left	Tilt	QPSK	1	0	08138	1:1	0.206	1.000	0.206
1880.00	18900	Md	LTE Band 2 (PCS)	20	22.7	22.69	-0.03	1	Left	Tilt	QPSK	50	25	08138	1:1	0.175	1.002	0.175
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 11-10
DTS Head SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR(1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.													(W/kg)	(W/kg)			
2417	2	802.11b	DSSS	22	15.5	15.16	0.03	Right	Cheek	10407	1	99.9	0.500	0.435	1.081	1.001	0.471	
2417	2	802.11b	DSSS	22	15.5	15.16	0.05	Right	Tilt	10407	1	99.9	0.444	-	1.081	1.001	-	
2417	2	802.11b	DSSS	22	15.5	15.16	0.01	Left	Cheek	10407	1	99.9	1.343	1.010	1.081	1.001	1.093	
2457	10	802.11b	DSSS	22	15.5	15.11	0.11	Left	Cheek	10407	1	99.9	1.207	0.950	1.094	1.001	1.040	
2417	2	802.11b	DSSS	22	15.5	15.16	0.07	Left	Tilt	10407	1	99.9	1.026	0.822	1.081	1.001	0.889	
2457	10	802.11b	DSSS	22	15.5	15.11	0.01	Left	Tilt	10407	1	99.9	0.925	0.742	1.094	1.001	0.813	
2417	2	802.11b	DSSS	22	15.5	15.16	0.02	Left	Cheek	10407	1	99.9	1.136	1.000	1.081	1.001	1.082	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram								

Note: Blue entry represents variability measurement

11.2 Standalone Body-Worn SAR Data

Table 11-11
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	Reported SAR (1g)	(W/kg)	(W/kg)	Plot #
MHz	Ch.											(W/kg)		(W/kg)			
836.60	190	GSM 850	GSM	33.2	33.17	-0.07	10 mm	08211	1	1:8.3	back	0.615	1.007	0.619	1.001	0.619	A11
836.60	190	GSM 850	GPRS	30.2	29.71	-0.02	10 mm	08211	3	1:2.76	back	0.514	1.119	0.575	1.001	0.575	
1880.00	661	GSM 1900	GSM	30.2	30.19	-0.06	10 mm	08161	1	1:8.3	back	0.346	1.002	0.347	1.001	0.347	
1880.00	661	GSM 1900	GPRS	27.2	26.90	-0.02	10 mm	08161	3	1:2.76	back	0.518	1.072	0.555	1.001	0.555	A13
836.60	4183	UMTS 850	RMC	23.7	23.66	0.00	10 mm	08161	N/A	1:1	back	0.507	1.009	0.512	1.001	0.512	A14
1732.40	1412	UMTS 1750	RMC	23.7	23.68	0.07	10 mm	08211	N/A	1:1	back	0.776	1.005	0.780	1.001	0.780	A15
1880.00	9400	UMTS 1900	RMC	23.7	23.68	0.01	10 mm	08161	N/A	1:1	back	0.489	1.005	0.491	1.001	0.491	A16
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Body 1.6 W/kg (mW/g) averaged over 1 gram							

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Table 11-12
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	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)	(W/kg)			
707.50	23095	Mid	LTE Band 12	10	24.2	24.18	0.19	0	08187	QPSK	1	0	10 mm	back	1:1	0.446	1.005	0.448	A17
707.50	23095	Mid	LTE Band 12	10	23.2	23.11	-0.07	1	08187	QPSK	25	0	10 mm	back	1:1	0.349	1.021	0.356	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.19	-0.05	0	08187	QPSK	1	0	10 mm	back	1:1	0.588	1.002	0.589	A19
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	23.05	-0.04	1	08187	QPSK	25	0	10 mm	back	1:1	0.456	1.035	0.472	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.7	23.63	0.03	0	08138	QPSK	1	0	10 mm	back	1:1	0.591	1.016	0.600	A20
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.7	22.58	-0.12	1	08138	QPSK	50	0	10 mm	back	1:1	0.449	1.028	0.462	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.70	0.20	0	08187	QPSK	1	0	10 mm	back	1:1	0.502	1.000	0.502	A21
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.7	22.69	-0.03	1	08187	QPSK	50	25	10 mm	back	1:1	0.421	1.002	0.422	
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 11-13
DTS Body-Worn SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #	
MHz	Ch.																	
2417	2	802.11b	DSSS	22	19.0	18.99	0.01	10 mm	10407	1	back	99.9	0.999	0.695	1.002	1.001	0.697	A23
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Body 1.6 W/kg (mW/g) averaged over 1 gram								

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11.3 Standalone Hotspot SAR Data

Table 11-14
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	Reported SAR (1g)	Plot #	
MHz	Ch.											(W/kg)		(W/kg)		
836.60	190	GSM 850	GPRS	30.2	29.71	-0.02	10 mm	08211	3	12.76	back	0.514	1.119	0.575	A12	
836.60	190	GSM 850	GPRS	30.2	29.71	0.00	10 mm	08211	3	12.76	front	0.337	1.119	0.377		
836.60	190	GSM 850	GPRS	30.2	29.71	-0.20	10 mm	08211	3	12.76	bottom	0.368	1.119	0.412		
836.60	190	GSM 850	GPRS	30.2	29.71	0.00	10 mm	08211	3	12.76	right	0.394	1.119	0.441		
836.60	190	GSM 850	GPRS	30.2	29.71	-0.13	10 mm	08211	3	12.76	left	0.215	1.119	0.241		
1880.00	661	GSM 1900	GPRS	27.2	26.90	-0.02	10 mm	08161	3	12.76	back	0.518	1.072	0.555	A13	
1880.00	661	GSM 1900	GPRS	27.2	26.90	0.04	10 mm	08161	3	12.76	front	0.437	1.072	0.468		
1880.00	661	GSM 1900	GPRS	27.2	26.90	0.02	10 mm	08161	3	12.76	bottom	0.195	1.072	0.209		
1880.00	661	GSM 1900	GPRS	27.2	26.90	0.10	10 mm	08161	3	12.76	left	0.501	1.072	0.537		
836.60	4183	UMTS 850	RMC	23.7	23.66	0.00	10 mm	08161	N/A	1:1	back	0.507	1.009	0.512	A14	
836.60	4183	UMTS 850	RMC	23.7	23.66	-0.14	10 mm	08161	N/A	1:1	front	0.403	1.009	0.407		
836.60	4183	UMTS 850	RMC	23.7	23.66	-0.08	10 mm	08161	N/A	1:1	bottom	0.407	1.009	0.411		
836.60	4183	UMTS 850	RMC	23.7	23.66	-0.01	10 mm	08161	N/A	1:1	right	0.468	1.009	0.472		
836.60	4183	UMTS 850	RMC	23.7	23.66	-0.01	10 mm	08161	N/A	1:1	left	0.317	1.009	0.320		
1732.40	1412	UMTS 1750	RMC	23.7	23.68	0.07	10 mm	08211	N/A	1:1	back	0.776	1.005	0.780	A15	
1732.40	1412	UMTS 1750	RMC	23.7	23.68	0.07	10 mm	08211	N/A	1:1	front	0.517	1.005	0.520		
1732.40	1412	UMTS 1750	RMC	23.7	23.68	-0.09	10 mm	08211	N/A	1:1	bottom	0.386	1.005	0.388		
1732.40	1412	UMTS 1750	RMC	23.7	23.68	0.03	10 mm	08211	N/A	1:1	left	0.461	1.005	0.463		
1880.00	9400	UMTS 1900	RMC	23.7	23.68	0.01	10 mm	08161	N/A	1:1	back	0.489	1.005	0.491	A16	
1880.00	9400	UMTS 1900	RMC	23.7	23.68	0.02	10 mm	08161	N/A	1:1	front	0.465	1.005	0.467		
1880.00	9400	UMTS 1900	RMC	23.7	23.68	-0.13	10 mm	08161	N/A	1:1	bottom	0.180	1.005	0.181		
1880.00	9400	UMTS 1900	RMC	23.7	23.68	-0.02	10 mm	08161	N/A	1:1	left	0.462	1.005	0.464		
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 11-15
LTE Band 12 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	Reported SAR (1g)	Plot #
MHz	Ch.																	
707.50	23095	Mid	LTE Band 12	10	24.2	24.18	0.19	0	08187	QPSK	1	0	10 mm	back	1:1	0.446	1.005	0.448
707.50	23095	Mid	LTE Band 12	10	23.2	23.11	-0.07	1	08187	QPSK	25	0	10 mm	back	1:1	0.349	1.021	0.356
707.50	23095	Mid	LTE Band 12	10	24.2	24.18	-0.05	0	08187	QPSK	1	0	10 mm	front	1:1	0.387	1.005	0.389
707.50	23095	Mid	LTE Band 12	10	23.2	23.11	0.05	1	08187	QPSK	25	0	10 mm	front	1:1	0.301	1.021	0.307
707.50	23095	Mid	LTE Band 12	10	24.2	24.18	0.05	0	08187	QPSK	1	0	10 mm	bottom	1:1	0.224	1.005	0.225
707.50	23095	Mid	LTE Band 12	10	23.2	23.11	-0.07	1	08187	QPSK	25	0	10 mm	bottom	1:1	0.189	1.021	0.193
707.50	23095	Mid	LTE Band 12	10	24.2	24.18	-0.10	0	08187	QPSK	1	0	10 mm	right	1:1	0.492	1.005	0.494
707.50	23095	Mid	LTE Band 12	10	23.2	23.11	-0.09	1	08187	QPSK	25	0	10 mm	right	1:1	0.392	1.021	0.400
707.50	23095	Mid	LTE Band 12	10	24.2	24.18	-0.21	0	08187	QPSK	1	0	10 mm	left	1:1	0.289	1.005	0.290
707.50	23095	Mid	LTE Band 12	10	23.2	23.11	0.09	1	08187	QPSK	25	0	10 mm	left	1:1	0.239	1.021	0.244
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population											Body 1.6 W/kg (mW/g) averaged over 1 gram							

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Table 11-16
LTE Band 5 (Cell) 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	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)				
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.19	-0.05	0	08187	QPSK	1	0	10 mm	back	1:1	0.588	1.002	0.589	A19
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	23.05	-0.04	1	08187	QPSK	25	0	10 mm	back	1:1	0.456	1.035	0.472	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.19	-0.01	0	08187	QPSK	1	0	10 mm	front	1:1	0.443	1.002	0.444	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	23.05	-0.09	1	08187	QPSK	25	0	10 mm	front	1:1	0.333	1.035	0.345	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.19	0.00	0	08187	QPSK	1	0	10 mm	bottom	1:1	0.453	1.002	0.454	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	23.05	0.02	1	08187	QPSK	25	0	10 mm	bottom	1:1	0.359	1.035	0.372	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.19	0.10	0	08187	QPSK	1	0	10 mm	right	1:1	0.515	1.002	0.516	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	23.05	0.01	1	08187	QPSK	25	0	10 mm	right	1:1	0.413	1.035	0.427	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.19	0.02	0	08187	QPSK	1	0	10 mm	left	1:1	0.318	1.002	0.319	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	23.05	0.00	1	08187	QPSK	25	0	10 mm	left	1:1	0.258	1.035	0.267	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT										Body									
Spatial Peak										1.6 W/kg (mW/g)									
Uncontrolled Exposure/General Population										averaged over 1 gram									

Table 11-17
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	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)				
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.7	23.63	0.03	0	08138	QPSK	1	0	10 mm	back	1:1	0.591	1.016	0.600	A20
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.7	22.58	-0.12	1	08138	QPSK	50	0	10 mm	back	1:1	0.449	1.028	0.462	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.7	23.63	-0.01	0	08138	QPSK	1	0	10 mm	front	1:1	0.451	1.016	0.458	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.7	22.58	-0.07	1	08138	QPSK	50	0	10 mm	front	1:1	0.334	1.028	0.343	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.7	23.63	-0.16	0	08138	QPSK	1	0	10 mm	bottom	1:1	0.285	1.016	0.290	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.7	22.58	0.14	1	08138	QPSK	50	0	10 mm	bottom	1:1	0.219	1.028	0.225	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.7	23.63	-0.17	0	08138	QPSK	1	0	10 mm	left	1:1	0.294	1.016	0.299	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.7	22.58	0.09	1	08138	QPSK	50	0	10 mm	left	1:1	0.247	1.028	0.254	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT										Body									
Spatial Peak										1.6 W/kg (mW/g)									
Uncontrolled Exposure/General Population										averaged over 1 gram									

Table 11-18
LTE Band 2 (PCS) 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	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)				
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.70	0.20	0	08187	QPSK	1	0	10 mm	back	1:1	0.502	1.000	0.502	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.7	22.69	-0.03	1	08187	QPSK	50	25	10 mm	back	1:1	0.421	1.002	0.422	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.70	0.14	0	08187	QPSK	1	0	10 mm	front	1:1	0.435	1.000	0.435	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.7	22.69	-0.16	1	08187	QPSK	50	25	10 mm	front	1:1	0.361	1.002	0.362	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.70	0.05	0	08187	QPSK	1	0	10 mm	bottom	1:1	0.172	1.000	0.172	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.7	22.69	0.01	1	08187	QPSK	50	25	10 mm	bottom	1:1	0.135	1.002	0.135	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.70	-0.04	0	08187	QPSK	1	0	10 mm	left	1:1	0.539	1.000	0.539	A22
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.7	22.69	-0.15	1	08187	QPSK	50	25	10 mm	left	1:1	0.416	1.002	0.417	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT										Body									
Spatial Peak										1.6 W/kg (mW/g)									
Uncontrolled Exposure/General Population										averaged over 1 gram									

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Table 11-19
WLAN Hotspot SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan W/kg	SAR (1g) W/kg	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g) (W/kg)	Plot #
MHz	Ch.																	
2417	2	802.11b	DSSS	22	19.0	18.99	0.01	10 mm	10407	1	back	99.9	0.999	0.695	1.002	1.001	0.697	A23
2417	2	802.11b	DSSS	22	19.0	18.99	0.20	10 mm	10407	1	front	99.9	0.750	-	1.002	1.001	-	
2417	2	802.11b	DSSS	22	19.0	18.99	0.14	10 mm	10407	1	top	99.9	0.830	0.570	1.002	1.001	0.572	
2417	2	802.11b	DSSS	22	19.0	18.99	0.06	10 mm	10407	1	right	99.9	0.537	-	1.002	1.001	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT									Body									
Spatial Peak									1.6 W/kg (mW/g) averaged over 1 gram									
Uncontrolled Exposure/General Population																		

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 1528-2013, and FCC KDB Publication 447498 D01v06.
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 D01v06.
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 D04v01r03, 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 D01v01r04, variability SAR tests were performed when the measured SAR results for a frequency band were greater than or equal to 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 D06v02r01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.7 for more details).
10. Per FCC KDB Publication 648474 D04v01r03, this device is considered a "phablet" since the diagonal dimension is > 160 mm and < 200 mm. Therefore, phablet SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg.

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 D01v03r01 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 D01v06, 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 $> 1/2$ dB, instead of the middle channel, the highest output power channel was used.

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4. GPRS was additionally evaluated for head and body-worm exposure conditions to address possible VoIP scenarios.

UMTS Notes:

1. UMTS mode in was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03r01. AMR and HSPA SAR was not required per the 3G Test Reduction Procedure in KDB Publication 941225 D01v03r01.
2. Per FCC KDB Publication 447498 D01v06, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel was used.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r04. 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).

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 D01v02r02 for 2.4 GHz WIFI 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 8.6.3 for more information. 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.
3. When 10-g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.
4. 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.

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12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 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 Publication 447498 D01v06 4.3.2 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 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 SAR.

When standalone SAR is not required to be measured, per FCC KDB 447498 D01v06 4.3.2 b), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

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

Table 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 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

SAR testing was not required for phablet exposure conditions per FCC KDB 648474 D04v01r03. Therefore, no further analysis was required to determine that possible simultaneous scenarios would not exceed the SAR limit.

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12.3 Head SAR Simultaneous Transmission Analysis

(*) For test positions that were not required to be evaluated for WLAN SAR per FCC KDB Publication 248227, the worst case WLAN SAR result for the applicable exposure condition was used for simultaneous transmission analysis.

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

Simult Tx	Configuration	GSM 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	GPRS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
Head SAR	Right Cheek	0.336	0.471	0.807	Head SAR	Right Cheek	0.436	0.471	0.907	
	Right Tilt	0.204	1.093*	1.297		Right Tilt	0.247	1.093*	1.340	
	Left Cheek	0.314	1.093	1.407		Left Cheek	0.404	1.093	1.497	
	Left Tilt	0.195	0.889	1.084		Left Tilt	0.252	0.889	1.141	
Simult Tx	Configuration	GSM 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
Head SAR	Right Cheek	0.258	0.471	0.729	Head SAR	Right Cheek	0.302	0.471	0.773	
	Right Tilt	0.162	1.093*	1.255		Right Tilt	0.193	1.093*	1.286	
	Left Cheek	0.353	1.093	1.446		Left Cheek	0.420	1.093	1.513	
	Left Tilt	0.188	0.889	1.077		Left Tilt	0.200	0.889	1.089	
Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 1750 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
Head SAR	Right Cheek	0.420	0.471	0.891	Head SAR	Right Cheek	0.173	0.471	0.644	
	Right Tilt	0.283	1.093*	1.376		Right Tilt	0.111	1.093*	1.204	
	Left Cheek	0.332	1.093	1.425		Left Cheek	0.322	1.093	1.415	
	Left Tilt	0.233	0.889	1.122		Left Tilt	0.170	0.889	1.059	
Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
Head SAR	Right Cheek	0.274	0.471	0.745	Head SAR	Right Cheek	0.377	0.471	0.848	
	Right Tilt	0.155	1.093*	1.248		Right Tilt	0.204	1.093*	1.297	
	Left Cheek	0.415	1.093	1.508		Left Cheek	0.286	1.093	1.379	
	Left Tilt	0.173	0.889	1.062		Left Tilt	0.185	0.889	1.074	
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
Head SAR	Right Cheek	0.539	0.471	1.010	Head SAR	Right Cheek	0.211	0.471	0.682	
	Right Tilt	0.336	1.093*	1.429		Right Tilt	0.188	1.093*	1.281	
	Left Cheek	0.433	1.093	1.526		Left Cheek	0.312	1.093	1.405	
	Left Tilt	0.277	0.889	1.166		Left Tilt	0.188	0.889	1.077	
		Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)				
		Head SAR	Right Cheek	0.298	0.471	0.769				
			Right Tilt	0.192	1.093*	1.285				
			Left Cheek	0.436	1.093	1.529				
			Left Tilt	0.206	0.889	1.095				

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12.4 Body-Worn Simultaneous Transmission Analysis

Table 12-3
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM/GPRS 850	0.619	0.697	1.316
	GSM/GPRS 1900	0.555	0.697	1.252
	UMTS 850	0.512	0.697	1.209
	UMTS 1750	0.780	0.697	1.477
	UMTS 1900	0.491	0.697	1.188
	LTE Band 12	0.448	0.697	1.145
	LTE Band 5 (Cell)	0.589	0.697	1.286
	LTE Band 4 (AWS)	0.600	0.697	1.297
	LTE Band 2 (PCS)	0.502	0.697	1.199

Table 12-4
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/GPRS 850	0.619	0.189	0.808
	GSM/GPRS 1900	0.555	0.189	0.744
	UMTS 850	0.512	0.189	0.701
	UMTS 1750	0.780	0.189	0.969
	UMTS 1900	0.491	0.189	0.680
	LTE Band 12	0.448	0.189	0.637
	LTE Band 5 (Cell)	0.589	0.189	0.778
	LTE Band 4 (AWS)	0.600	0.189	0.789
	LTE Band 2 (PCS)	0.502	0.189	0.691

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12.5 Hotspot SAR Simultaneous Transmission Analysis

Table 12-5
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	GPRS 850	0.575	0.697	1.272
	GPRS 1900	0.555	0.697	1.252
	UMTS 850	0.512	0.697	1.209
	UMTS 1750	0.780	0.697	1.477
	UMTS 1900	0.491	0.697	1.188
	LTE Band 12	0.494	0.697	1.191
	LTE Band 5 (Cell)	0.589	0.697	1.286
	LTE Band 4 (AWS)	0.600	0.697	1.297
	LTE Band 2 (PCS)	0.539	0.697	1.236

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 D01v06 and IEEE 1528-2013 Section 6.3.4.1.2.

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13 SAR MEASUREMENT VARIABILITY

13.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, 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 ($\sim 10\%$ 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
- 5) When 10-g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

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) (W/kg)	1st Repeated SAR (1g) (W/kg)	Ratio	2nd Repeated SAR (1g) (W/kg)	Ratio	3rd Repeated SAR (1g) (W/kg)	Ratio	
	MHz	Ch.													
2450	2417.00	2	802.11b, 22 MHz Bandwidth	DSSS	Left	Cheek	1	1.010	1.000	1.01	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							

13.2 Measurement Uncertainty

The measured SAR was < 1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

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14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8753E	(30kHz-6GHz) Network Analyzer	3/2/2016	Annual	3/2/2017	JP38020182
Agilent	8753ES	S-Parameter Network Analyzer	3/3/2016	Annual	3/3/2017	US39170122
Agilent	8753ES	S-Parameter Vector Network Analyzer	8/19/2016	Annual	8/19/2017	MY40003841
Agilent	8753ES	S-Parameter Network Analyzer	10/26/2016	Annual	10/26/2017	US39170118
Agilent	E4438C	ESG Vector Signal Generator	3/2/2016	Annual	3/2/2017	MY47270002
Agilent	E5515C	Wireless Communications Test Set	12/24/2014	Biennial	12/24/2016	GB44400860
Agilent	E5515C	8960 Series 10 Wireless Communications Test Set	10/5/2016	Annual	10/5/2017	GB42230325
Agilent	E8257D	(250kHz-20GHz) Signal Generator	3/2/2016	Annual	3/2/2017	MY45470194
Agilent	N5182A	MXG Vector Signal Generator	2/27/2016	Annual	2/27/2017	MY47420651
Agilent	N9020A	MXA Signal Analyzer	10/28/2016	Annual	10/28/2017	US46470561
Amplifier Research	15S166	Amplifier	CBT	N/A	CBT	433971
Anritsu	MA24106A	USB Power Sensor	10/27/2016	Annual	10/27/2017	1349503
Anritsu	MA24106A	USB Power Sensor	10/27/2016	Annual	10/27/2017	1349509
Anritsu	MA2411B	Pulse Power Sensor	12/7/2015	Annual	12/7/2016	1207364
Anritsu	MA2411B	Pulse Power Sensor	12/7/2015	Annual	12/7/2016	1339018
Anritsu	ML2495A	Power Meter	10/16/2015	Biennial	10/16/2017	941001
Anritsu	ML2496A	Power Meter	3/5/2016	Annual	3/5/2017	1351001
Anritsu	MT8820C	Radio Communication Analyzer	12/4/2015	Annual	12/4/2016	6201300731
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
Control Company	4040	Digital Thermometer	3/15/2015	Biennial	3/15/2017	150194929
Control Company	4352	Ultra Long Stem Thermometer	3/8/2016	Biennial	3/8/2018	160261728
Control Company	4353	Long Stem Thermometer	1/22/2015	Biennial	1/22/2017	150053081
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-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
Mitutoyo	CD-6"CSX	Digital Caliper	3/2/2016	Biennial	3/2/2018	13264162
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	NC-100	Torque Wrench	5/21/2015	Biennial	5/21/2017	N/A
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	N/A	CBT	N/A	N/A
Rohde & Schwarz	CMW500	Radio Communication Tester	3/25/2016	Annual	3/25/2017	128633
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/2/2016	Biennial	3/2/2018	N/A
Seekonk	NC-100	Torque Wrench (8' lb)	9/1/2016	Biennial	9/1/2018	21053
SPEAG	D1750V2	1750 MHz SAR Dipole	7/14/2016	Annual	7/14/2017	1150
SPEAG	D1900V2	1900 MHz SAR Dipole	7/15/2016	Annual	7/15/2017	5d149
SPEAG	D2450V2	2450 MHz SAR Dipole	7/25/2016	Annual	7/25/2017	981
SPEAG	D2450V2	2450 MHz SAR Dipole	9/13/2016	Annual	9/13/2017	797
SPEAG	D750V3	750 MHz Dipole	3/16/2016	Annual	3/16/2017	1054
SPEAG	D835V2	835 MHz SAR Dipole	7/13/2016	Annual	7/13/2017	4d047
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/15/2016	Annual	1/15/2017	1466
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/18/2016	Annual	2/18/2017	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/14/2016	Annual	3/14/2017	1368
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/14/2016	Annual	4/14/2017	1407
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/11/2016	Annual	5/11/2017	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/12/2016	Annual	7/12/2017	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/22/2016	Annual	8/22/2017	1364
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/14/2016	Annual	9/14/2017	1408
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/13/2016	Annual	9/13/2017	1091
SPEAG	ES3DV2	SAR Probe	7/19/2016	Annual	7/19/2017	3022
SPEAG	ES3DV3	SAR Probe	2/19/2016	Annual	2/19/2017	3213
SPEAG	ES3DV3	SAR Probe	3/18/2016	Annual	3/18/2017	3319
SPEAG	ES3DV3	SAR Probe	8/24/2016	Annual	8/24/2017	3288
SPEAG	ES3DV3	SAR Probe	9/19/2016	Annual	9/19/2017	3287
SPEAG	EX3DV4	SAR Probe	4/19/2016	Annual	4/19/2017	7406
SPEAG	EX3DV4	SAR Probe	5/17/2016	Annual	5/17/2017	7409
SPEAG	EX3DV4	SAR Probe	7/25/2016	Annual	7/25/2017	7410

Note:

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

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15 MEASUREMENT UNCERTAINTIES

a	c	d	e = f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	Tol. (± %)	Prob. Dist.	Div.	c _i 1gm	c _i 10 gms	1gm u _i (± %)	10gms u _i (± %)	v _i
Measurement System								
Probe Calibration	6.55	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemispherical Isotropy	1.3	N	1	0.7	0.7	0.9	0.9	∞
Boundary Effect	2.0	R	1.73	1.0	1.0	1.2	1.2	∞
Linearity	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	0.25	R	1.73	1.0	1.0	0.1	0.1	∞
Readout Electronics	0.3	N	1	1.0	1.0	0.3	0.3	∞
Response Time	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions - Noise	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
RF Ambient Conditions - Reflections	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	6.7	R	1.73	1.0	1.0	3.9	3.9	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Test Sample Related								
Test Sample Positioning	2.7	N	1	1.0	1.0	2.7	2.7	35
Device Holder Uncertainty	1.67	N	1	1.0	1.0	1.7	1.7	5
Output Power Variation - SAR drift measurement	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
SAR Scaling	0.0	R	1.73	1.0	1.0	0.0	0.0	∞
Phantom & Tissue Parameters								
Phantom Uncertainty (Shape & Thickness tolerances)	7.6	R	1.73	1.0	1.0	4.4	4.4	∞
Liquid Conductivity - measurement uncertainty	4.2	N	1	0.78	0.71	3.3	3.0	10
Liquid Permittivity - measurement uncertainty	4.1	N	1	0.23	0.26	1.0	1.1	10
Liquid Conductivity - Temperature Uncertainty	3.4	R	1.73	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Uncertainty	0.6	R	1.73	0.23	0.26	0.1	0.1	∞
Liquid Conductivity - deviation from target values	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Permittivity - deviation from target values	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Combined Standard Uncertainty (k=1)						RSS	11.5	11.3
Expanded Uncertainty (95% CONFIDENCE LEVEL)						k=2	23.0	22.6

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16 CONCLUSION

16.1 Measurement Conclusion

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

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

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APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08161

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

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 0.898 \text{ S/m}$; $\epsilon_r = 40.589$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 11-22-2016; Ambient Temp: 22.2°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3213; ConvF(6.18, 6.18, 6.18); Calibrated: 2/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/18/2016

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

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: GPRS 850, Right Head, Cheek, Mid.ch, 3 Tx slots

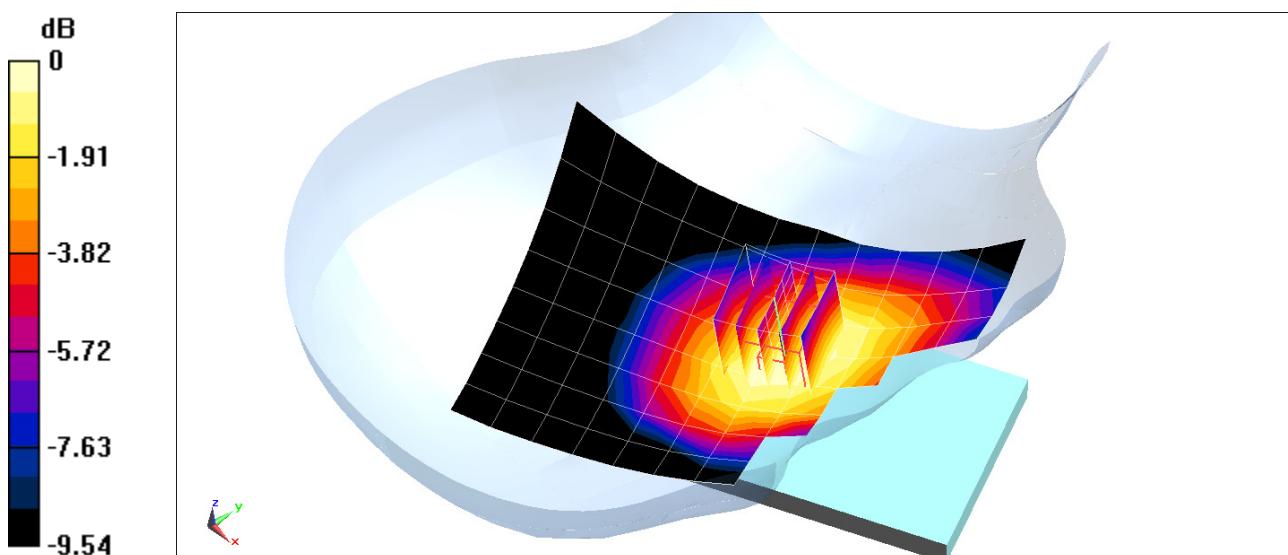
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 21.54 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.497 W/kg

SAR(1 g) = 0.390 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08211

Communication System: UID 0, GSM GPRS; 3 Tx slots; Frequency: 1880 MHz; Duty Cycle: 1:2.76

Medium: 1900 Head; Medium parameters used:

$f = 1880$ MHz; $\sigma = 1.424$ S/m; $\epsilon_r = 38.773$; $\rho = 1000$ kg/m³

Phantom section: Left Section

Test Date: 11-21-2016; Ambient Temp: 20.2°C; Tissue Temp: 20.4°C

Probe: ES3DV3 - SN3288; ConvF(5.44, 5.44, 5.44); Calibrated: 8/24/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: GPRS 1900, Left Head, Cheek, Mid.ch, 3 Tx slots

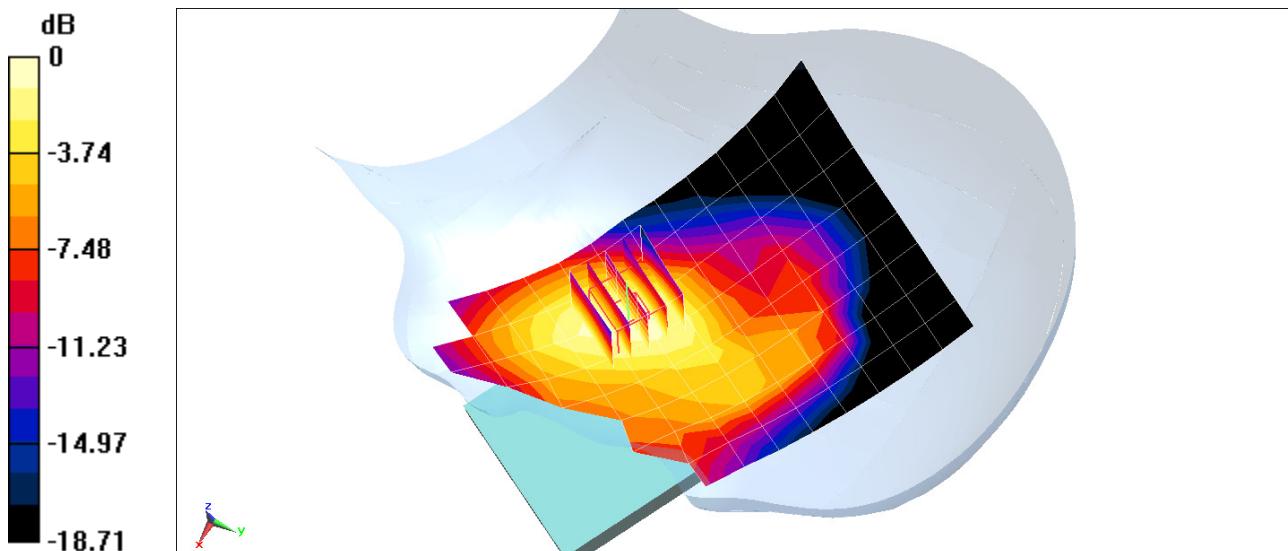
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 17.39 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 0.598 W/kg

SAR(1 g) = 0.392 W/kg



0 dB = 0.453 W/kg = -3.44 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08211

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

Medium: 835 Head; Medium parameters used (interpolated):

$f = 836.6$ MHz; $\sigma = 0.898$ S/m; $\epsilon_r = 40.589$; $\rho = 1000$ kg/m³

Phantom section: Right Section

Test Date: 11-22-2016; Ambient Temp: 22.2°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3213; ConvF(6.18, 6.18, 6.18); Calibrated: 2/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/18/2016

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

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

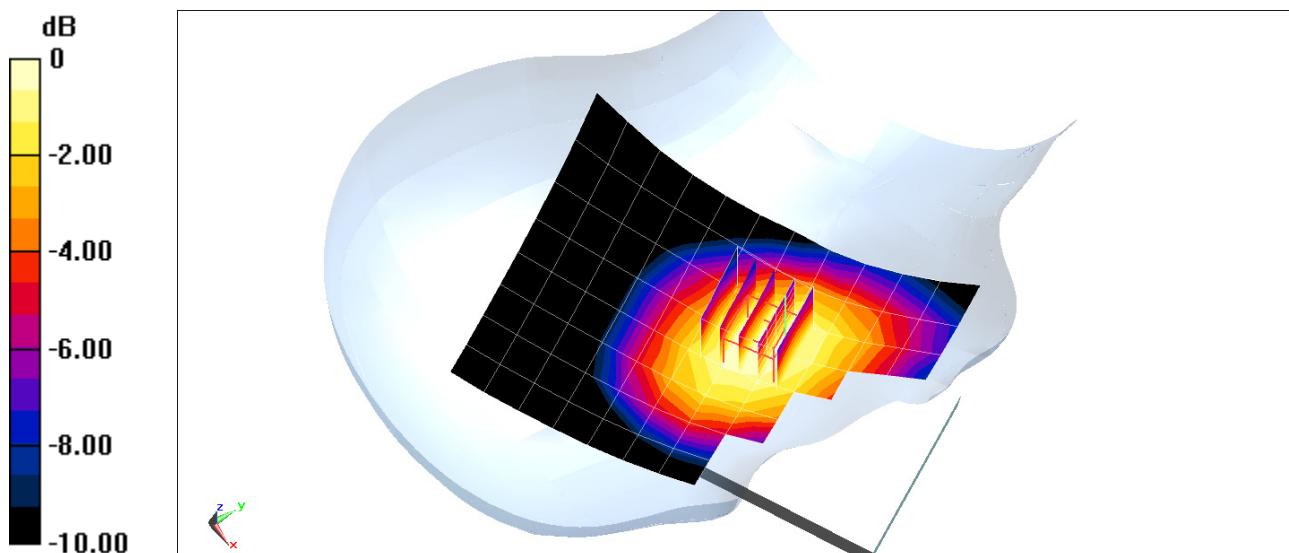
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 22.30 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.544 W/kg

SAR(1 g) = 0.416 W/kg



0 dB = 0.450 W/kg = -3.47 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08161

Communication System: UID 0, UMTS; Frequency: 1732.4 MHz; Duty Cycle: 1:1

Medium: 1750 Head; Medium parameters used (interpolated):

$f = 1732.4$ MHz; $\sigma = 1.367$ S/m; $\epsilon_r = 38.579$; $\rho = 1000$ kg/m³

Phantom section: Left Section

Test Date: 11-22-2016; Ambient Temp: 22.1°C; Tissue Temp: 22.0°C

Probe: ES3DV2 - SN3022; ConvF(5.15, 5.15, 5.15); Calibrated: 7/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1466; Calibrated: 1/15/2016

Phantom: SAM Main; Type: QD000P40CC; Serial: TP 1114

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: UMTS 1750, Left Head, Cheek, Mid.ch

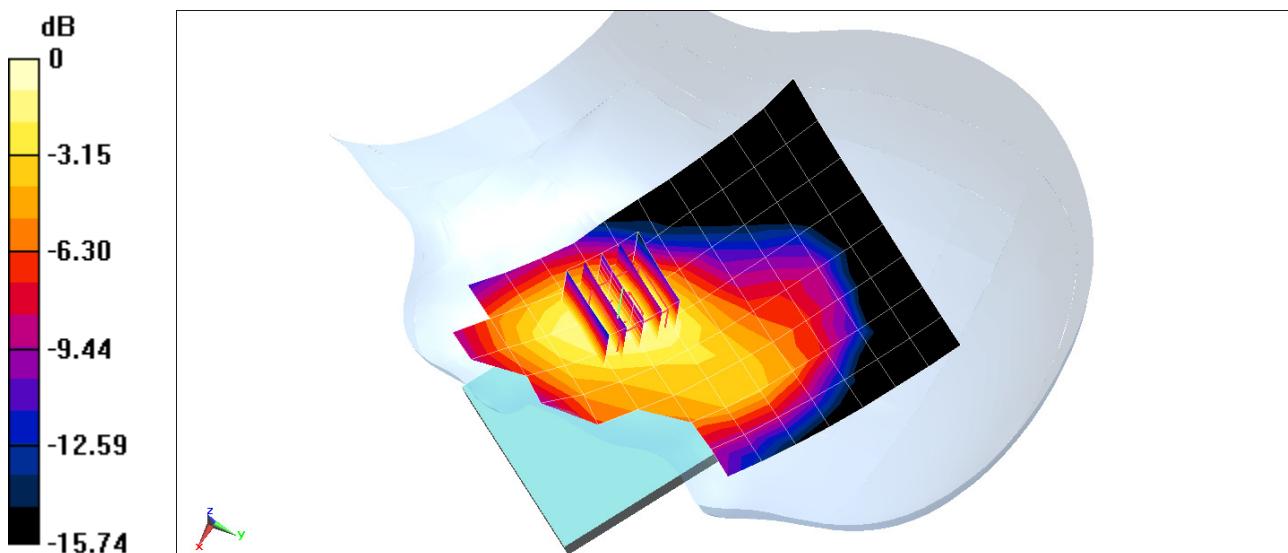
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 16.08 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.476 W/kg

SAR(1 g) = 0.320 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08161

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

Medium: 1900 Head; Medium parameters used:

$f = 1880$ MHz; $\sigma = 1.424$ S/m; $\epsilon_r = 38.773$; $\rho = 1000$ kg/m³

Phantom section: Left Section

Test Date: 11-21-2016; Ambient Temp: 20.2°C; Tissue Temp: 20.4°C

Probe: ES3DV3 - SN3288; ConvF(5.44, 5.44, 5.44); Calibrated: 8/24/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

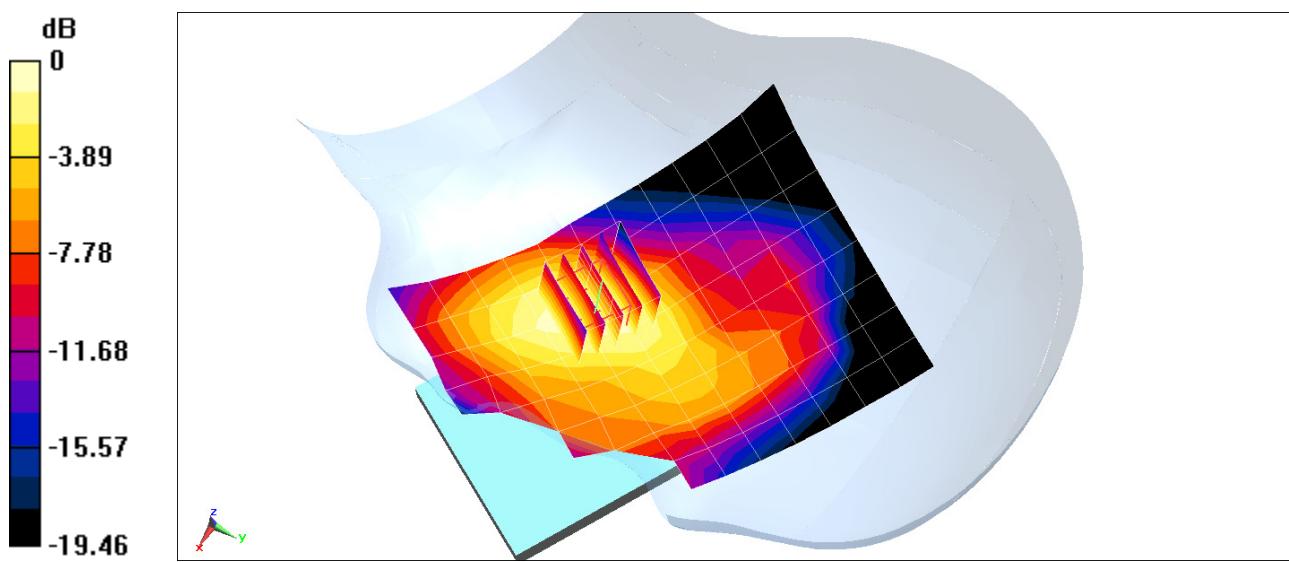
Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 17.85 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.632 W/kg

SAR(1 g) = 0.413 W/kg



0 dB = 0.475 W/kg = -3.23 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08187

Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: 750 Head; Medium parameters used (interpolated):

$f = 707.5$ MHz; $\sigma = 0.871$ S/m; $\epsilon_r = 42.131$; $\rho = 1000$ kg/m³

Phantom section: Right Section

Test Date: 11-23-2016; Ambient Temp: 22.9°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7409; ConvF(10.73, 10.73, 10.73); Calibrated: 5/17/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/11/2016

Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 12, Right Head, Cheek, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

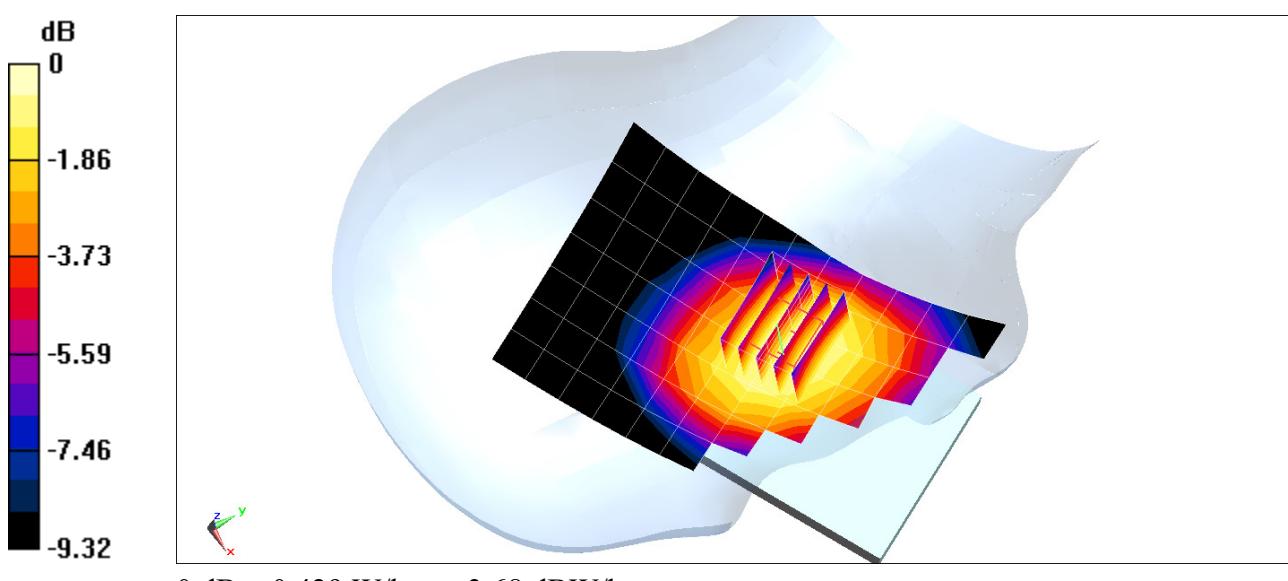
Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 21.76 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.454 W/kg

SAR(1 g) = 0.375 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08138

Communication System: UID 0, LTE Band 5 (Cell.); Frequency: 836.5 MHz; Duty Cycle: 1:1

Medium: 835 Head; Medium parameters used (interpolated):

$f = 836.5$ MHz; $\sigma = 0.898$ S/m; $\epsilon_r = 40.59$; $\rho = 1000$ kg/m³

Phantom section: Right Section

Test Date: 11-22-2016; Ambient Temp: 22.2°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3213; ConvF(6.18, 6.18, 6.18); Calibrated: 2/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/18/2016

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

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 5 (Cell.), Right Head, Cheek, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

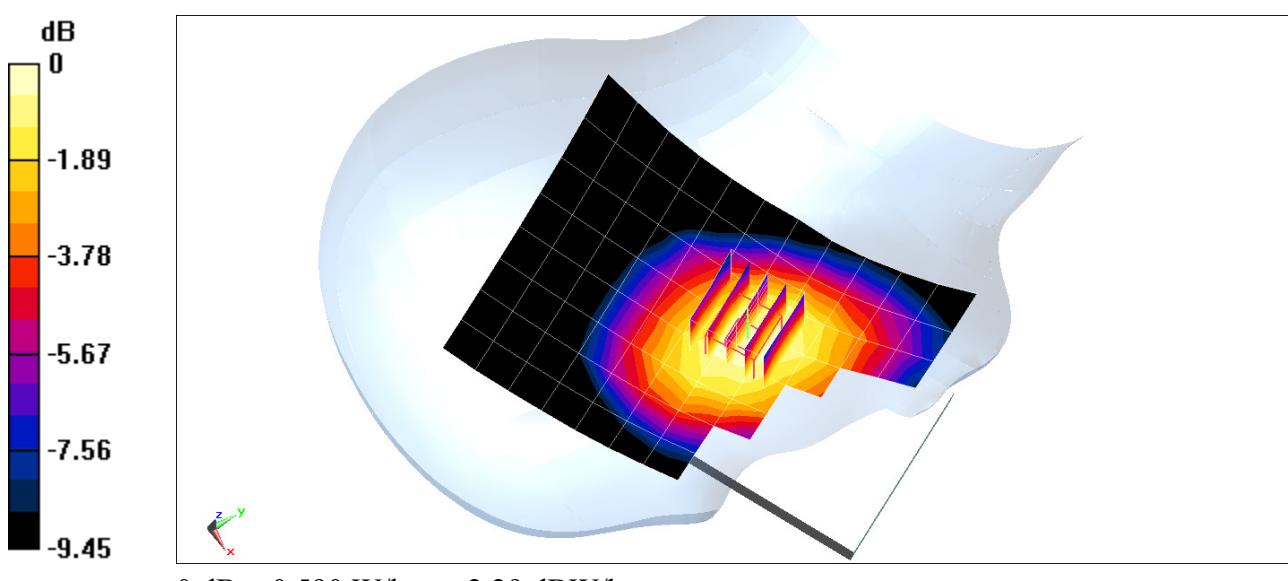
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 26.48 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.679 W/kg

SAR(1 g) = 0.538 W/kg



0 dB = 0.590 W/kg = -2.29 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08138

Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1

Medium: 1750 Head; Medium parameters used (interpolated):

$f = 1732.5$ MHz; $\sigma = 1.367$ S/m; $\epsilon_r = 38.579$; $\rho = 1000$ kg/m³

Phantom section: Left Section

Test Date: 11-22-2016; Ambient Temp: 22.1°C; Tissue Temp: 22.0°C

Probe: ES3DV2 - SN3022; ConvF(5.15, 5.15, 5.15); Calibrated: 7/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1466; Calibrated: 1/15/2016

Phantom: SAM Main; Type: QD000P40CC; Serial: TP 1114

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**

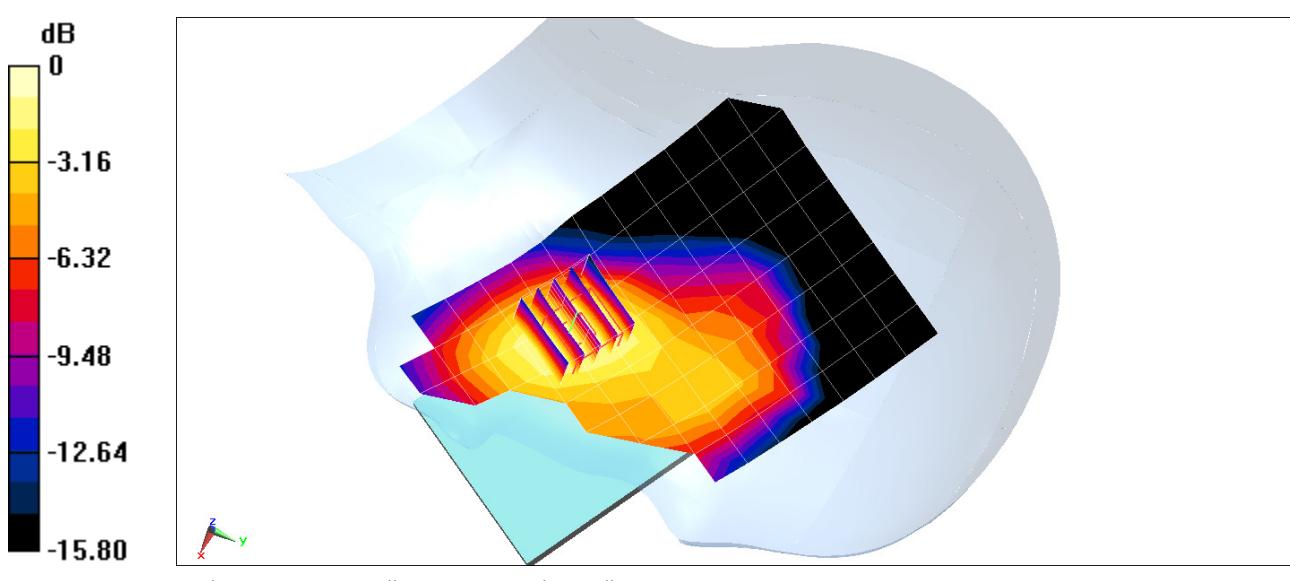
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 16.74 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.464 W/kg

SAR(1 g) = 0.307 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08138

Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Head; Medium parameters used:

$f = 1880$ MHz; $\sigma = 1.424$ S/m; $\epsilon_r = 38.773$; $\rho = 1000$ kg/m³

Phantom section: Left Section

Test Date: 11-21-2016; Ambient Temp: 20.2°C; Tissue Temp: 20.4°C

Probe: ES3DV3 - SN3288; ConvF(5.44, 5.44, 5.44); Calibrated: 8/24/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 2 (PCS), Left Head, Cheek, Mid.ch
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

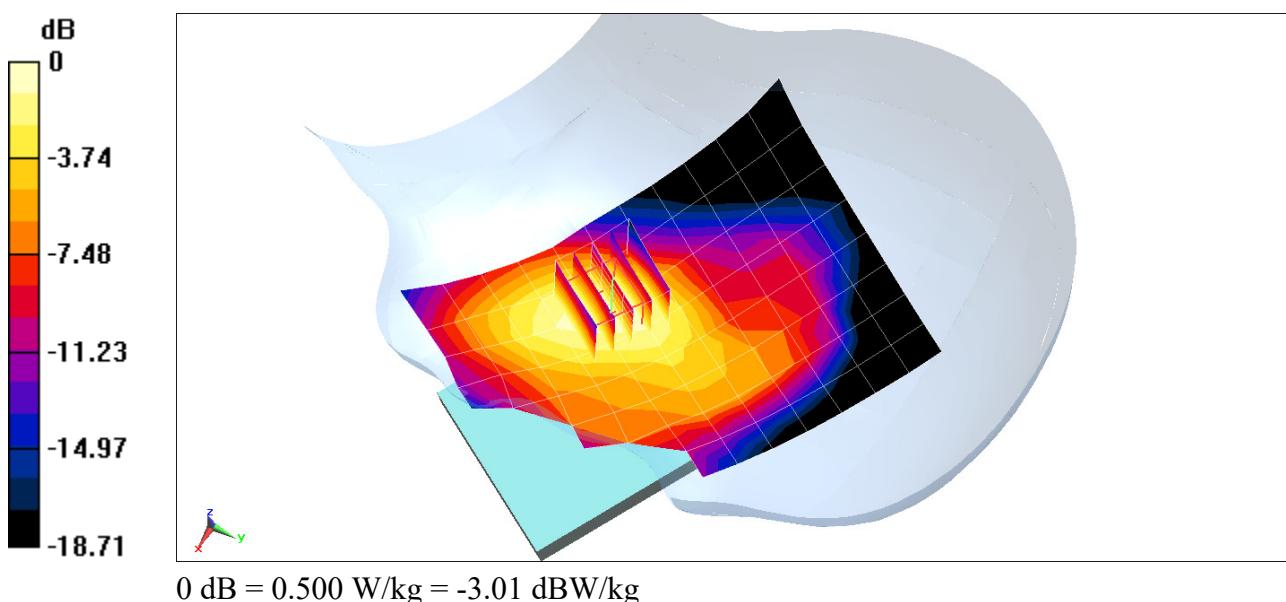
Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 19.31 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.660 W/kg

SAR(1 g) = 0.436 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 10407

Communication System: UID 0, IEEE 802.11b; Frequency: 2417 MHz; Duty Cycle: 1:1

Medium: 2450 Head; Medium parameters used (interpolated):

$f = 2417 \text{ MHz}$; $\sigma = 1.817 \text{ S/m}$; $\epsilon_r = 38.752$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 11-28-2016; Ambient Temp: 21.8°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3213; ConvF(4.58, 4.58, 4.58); Calibrated: 2/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/18/2016

Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11b, 22 MHz Bandwidth, Left Head, Cheek, Ch 2, 1 Mbps

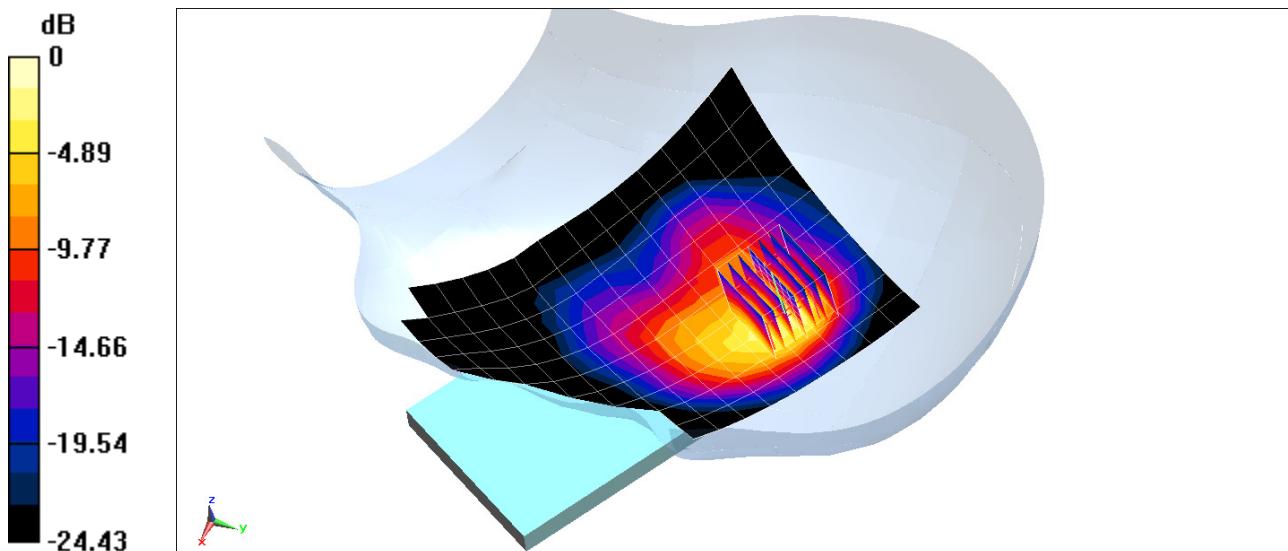
Area Scan (11x18x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 25.78 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 2.25 W/kg

SAR(1 g) = 1.01 W/kg



0 dB = 1.33 W/kg = 1.24 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08211

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; $\sigma = 0.99$ S/m; $\epsilon_r = 53.309$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-28-2016; Ambient Temp: 23.1°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

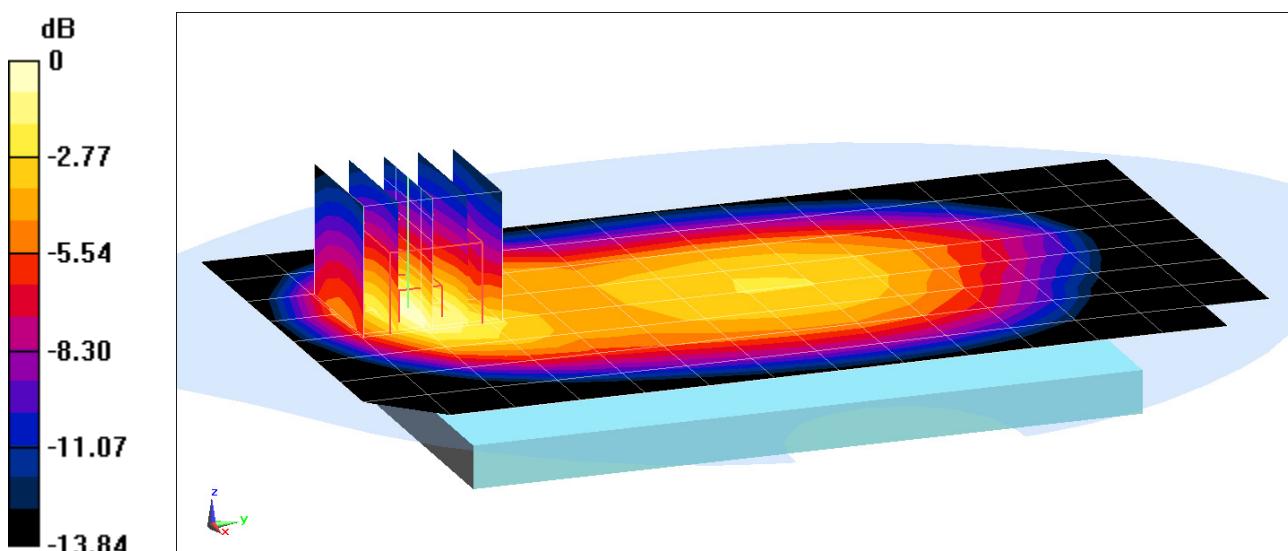
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 26.55 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 1.06 W/kg

SAR(1 g) = 0.615 W/kg



0 dB = 0.760 W/kg = -1.19 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08211

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

Medium: 835 Body; Medium parameters used (interpolated):

$f = 836.6$ MHz; $\sigma = 0.99$ S/m; $\epsilon_r = 53.309$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-28-2016; Ambient Temp: 23.1°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

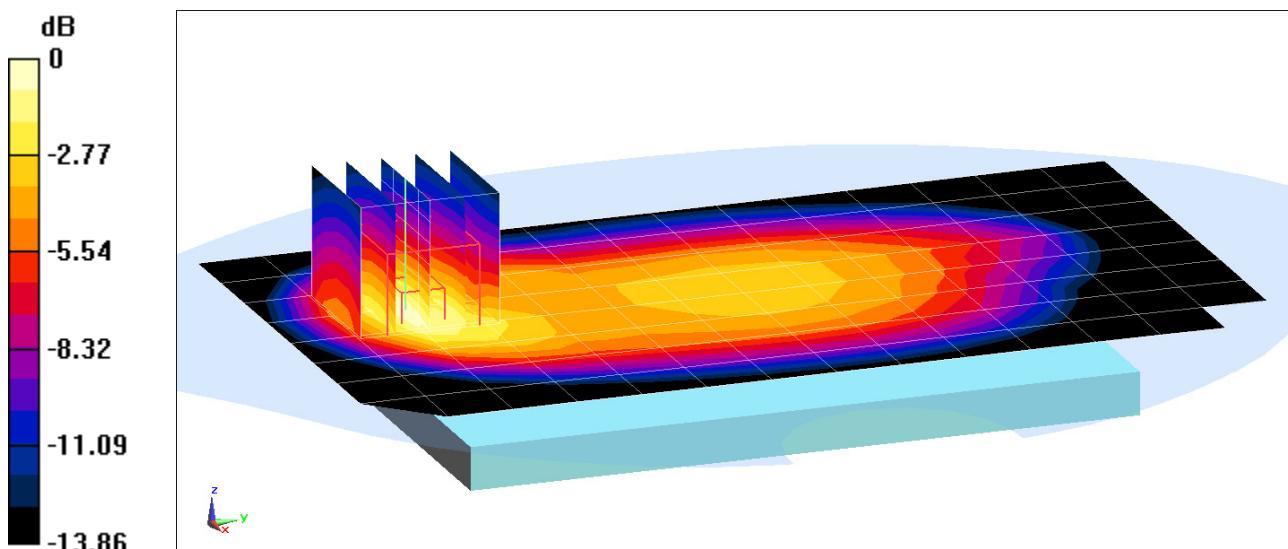
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 21.84 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.882 W/kg

SAR(1 g) = 0.514 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08161

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; $\sigma = 1.495$ S/m; $\epsilon_r = 53.634$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2016; Ambient Temp: 21.3°C; Tissue Temp: 20.1°C

Probe: ES3DV3 - SN3287; ConvF(4.94, 4.94, 4.94); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

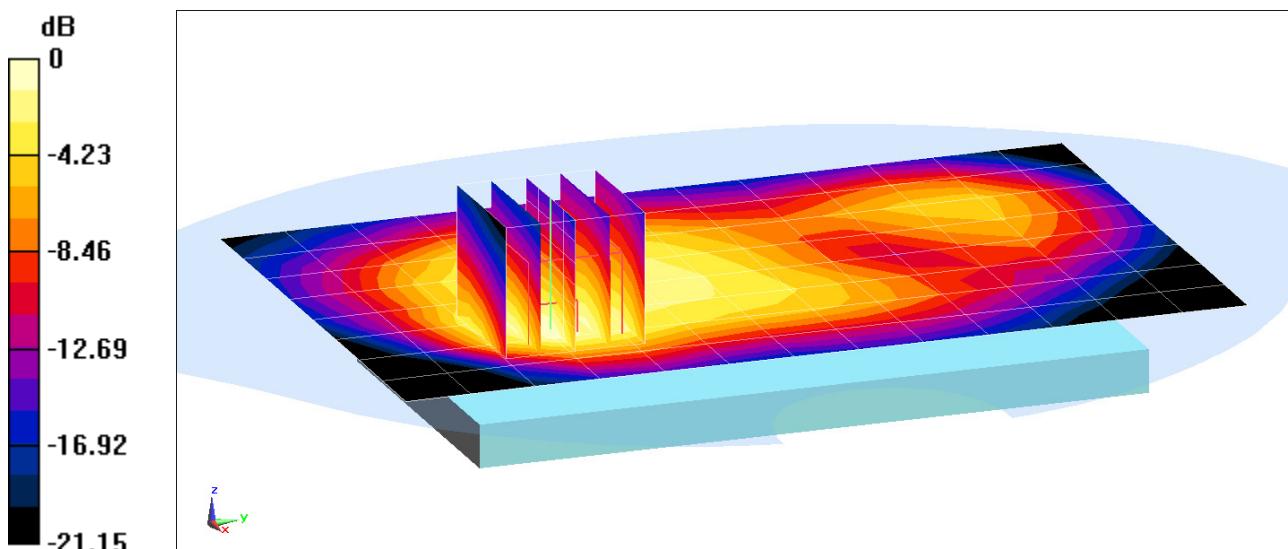
Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 20.10 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.966 W/kg

SAR(1 g) = 0.518 W/kg



0 dB = 0.653 W/kg = -1.85 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08161

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

Medium: 835 Body; Medium parameters used (interpolated):

$f = 836.6$ MHz; $\sigma = 0.979$ S/m; $\epsilon_r = 53.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2016; Ambient Temp: 20.8°C; Tissue Temp: 20.4°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

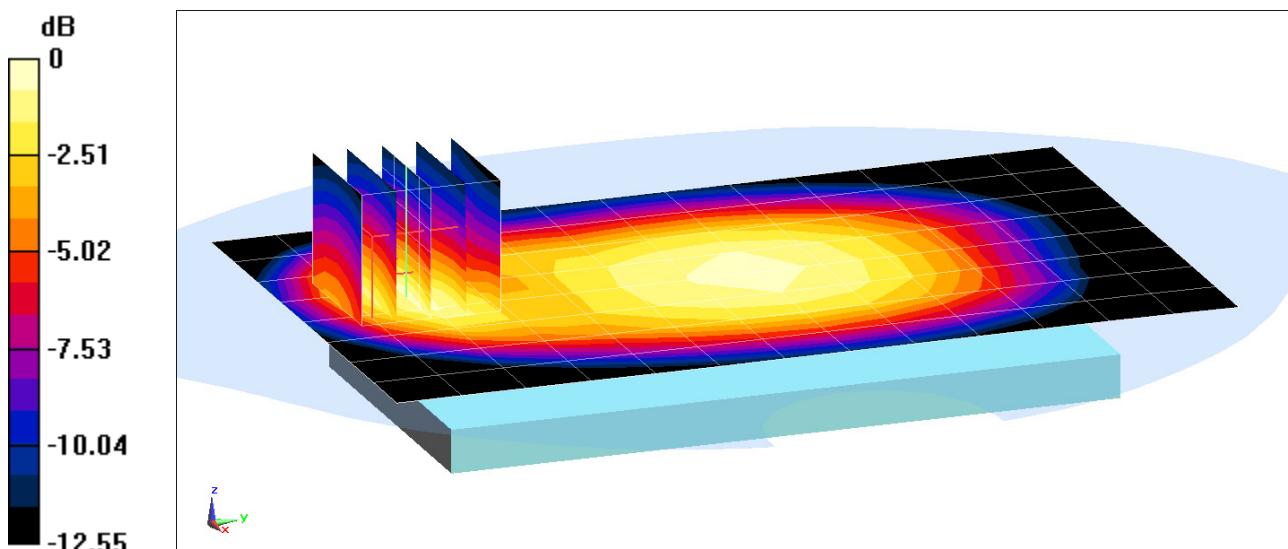
Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 24.19 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.853 W/kg

SAR(1 g) = 0.507 W/kg



0 dB = 0.619 W/kg = -2.08 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08211

Communication System: UID 0, UMTS; Frequency: 1732.4 MHz; Duty Cycle: 1:1

Medium: 1750 Body; Medium parameters used (interpolated):

$f = 1732.4$ MHz; $\sigma = 1.505$ S/m; $\epsilon_r = 51.301$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-22-2016; Ambient Temp: 23.3°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN7410; ConvF(7.95, 7.95, 7.95); Calibrated: 7/25/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 7/12/2016

Phantom: Main TWIN SAM; Type: QD000P40CC; Serial: TP-1406

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: UMTS 1750, Body SAR, Back side, Mid.ch

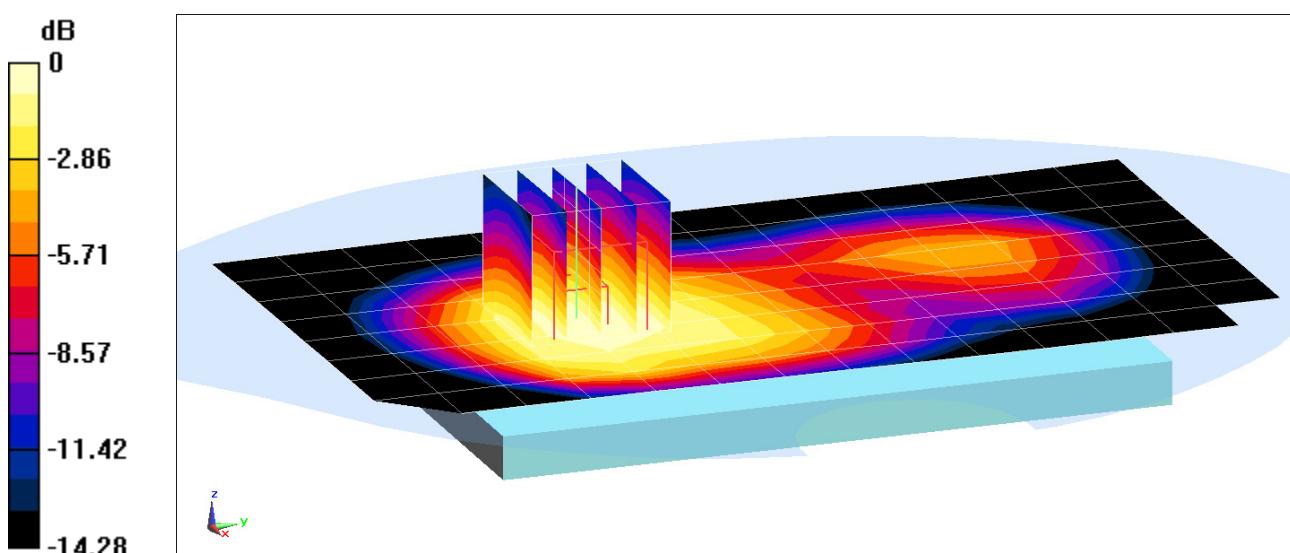
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 23.45 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 1.17 W/kg

SAR(1 g) = 0.776 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08161

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

Medium: 1900 Body; Medium parameters used:

$f = 1880$ MHz; $\sigma = 1.495$ S/m; $\epsilon_r = 53.634$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2016; Ambient Temp: 21.3°C; Tissue Temp: 20.1°C

Probe: ES3DV3 - SN3287; ConvF(4.94, 4.94, 4.94); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

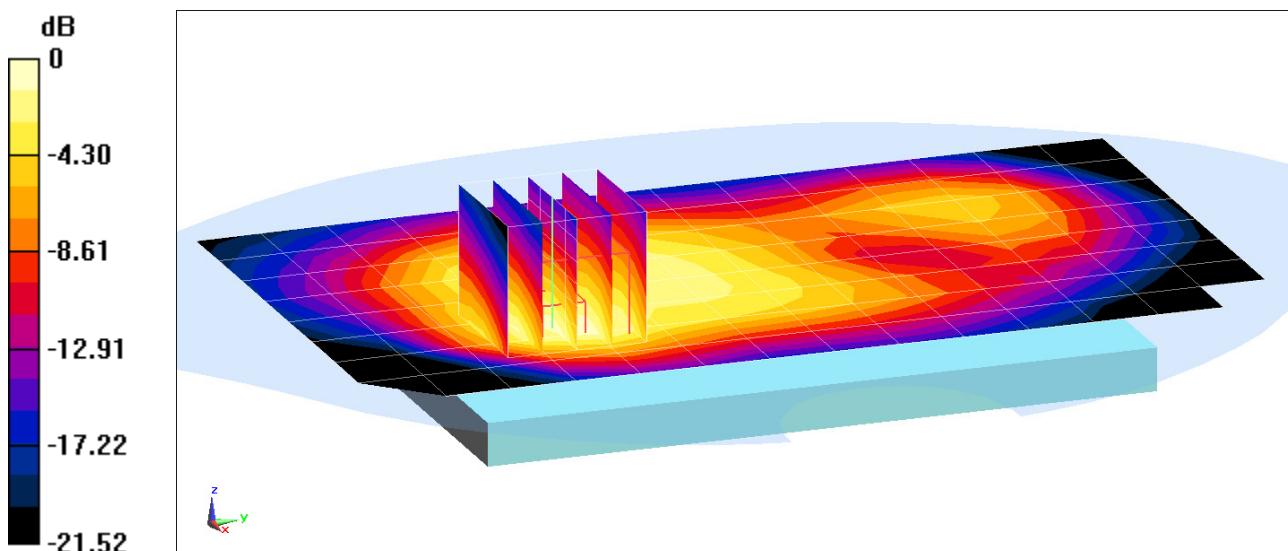
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 19.51 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.907 W/kg

SAR(1 g) = 0.489 W/kg



0 dB = 0.621 W/kg = -2.07 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08187

Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: 750 Body; Medium parameters used (interpolated):

$f = 707.5$ MHz; $\sigma = 0.919$ S/m; $\epsilon_r = 55.792$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2016; Ambient Temp: 22.1°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7409; ConvF(9.46, 9.46, 9.46); Calibrated: 5/17/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/11/2016

Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 12, Body SAR, Back side, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

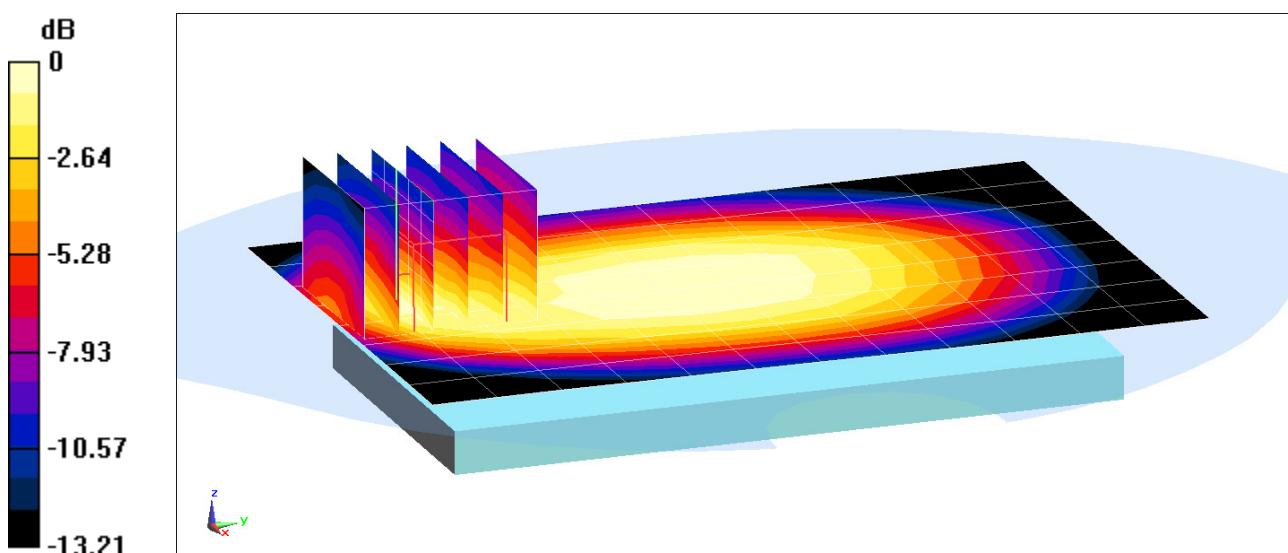
Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 21.83 V/m; Power Drift = 0.19 dB

Peak SAR (extrapolated) = 0.788 W/kg

SAR(1 g) = 0.446 W/kg



0 dB = 0.658 W/kg = -1.82 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08187

Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: 750 Body Medium parameters used (interpolated):

$f = 707.5$ MHz; $\sigma = 0.919$ S/m; $\epsilon_r = 55.792$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2016; Ambient Temp: 22.1°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7409; ConvF(9.46, 9.46, 9.46); Calibrated: 5/17/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/11/2016

Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 12, Body SAR, Right Edge, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

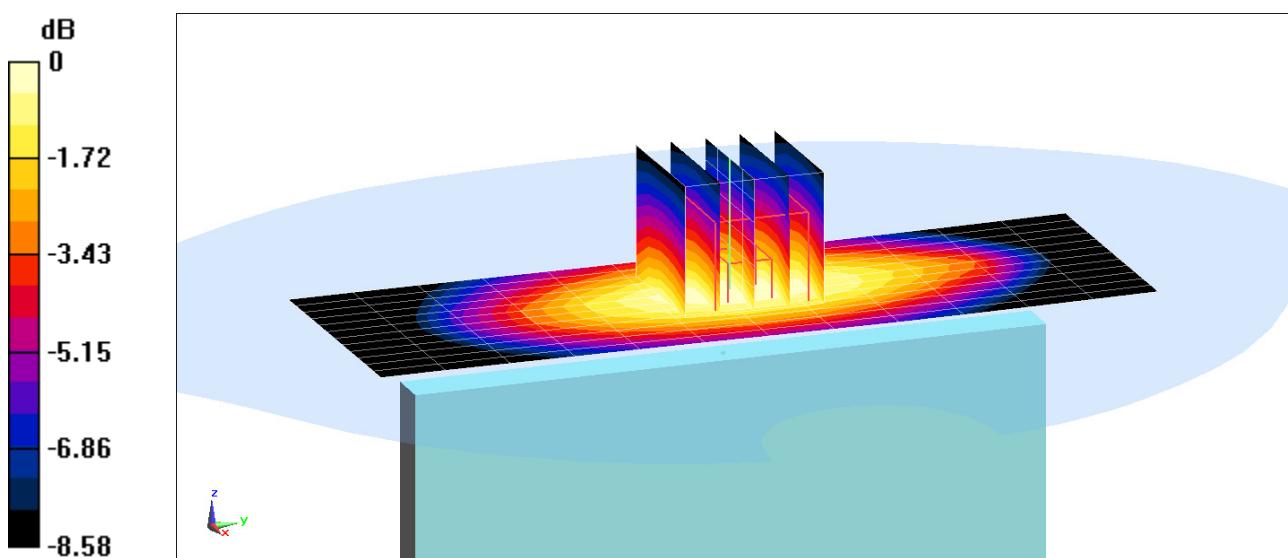
Area Scan (13x13x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 23.62 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 0.703 W/kg

SAR(1 g) = 0.492 W/kg



0 dB = 0.624 W/kg = -2.05 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08187

Communication System: UID 0, LTE Band 5; Frequency: 836.5 MHz; Duty Cycle: 1:1

Medium: 835 Body; Medium parameters used (interpolated):

$f = 836.5$ MHz; $\sigma = 0.979$ S/m; $\epsilon_r = 53.701$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2016; Ambient Temp: 20.8°C; Tissue Temp: 20.4°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 5 (Cell.), Body SAR, Back side, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

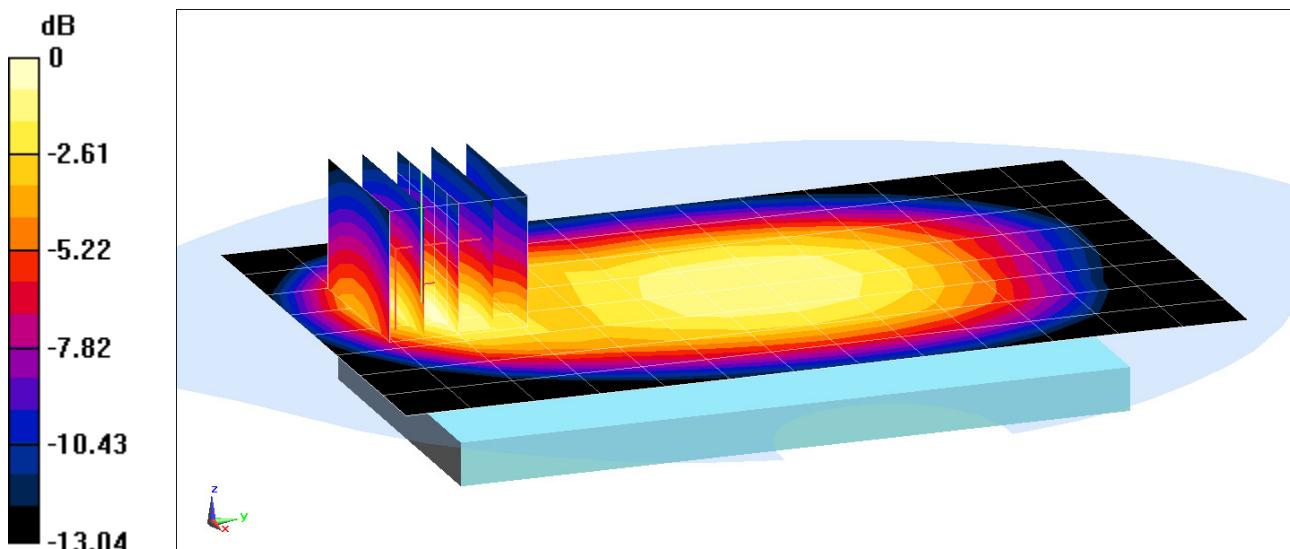
Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 25.83 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.995 W/kg

SAR(1 g) = 0.588 W/kg



0 dB = 0.709 W/kg = -1.49 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08138

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; $\sigma = 1.505$ S/m; $\epsilon_r = 51.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-22-2016; Ambient Temp: 23.3°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN7410; ConvF(7.95, 7.95, 7.95); Calibrated: 7/25/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 7/12/2016

Phantom: Main TWIN SAM; Type: QD000P40CC; Serial: TP-1406

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**

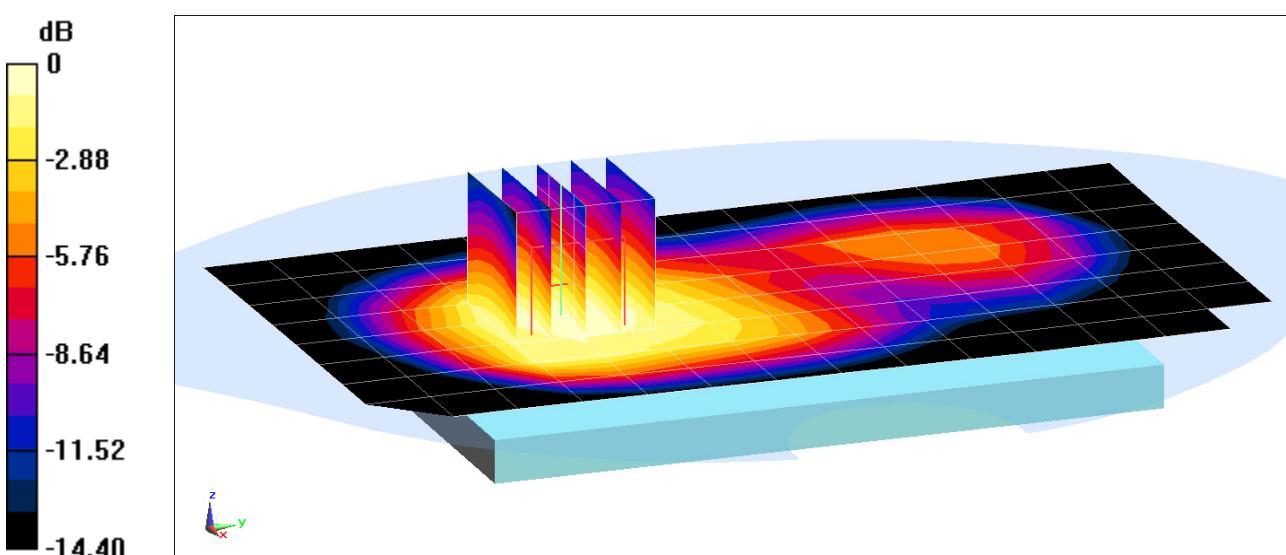
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 20.31 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.898 W/kg

SAR(1 g) = 0.591 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08187

Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Body; Medium parameters used:

$f = 1880$ MHz; $\sigma = 1.495$ S/m; $\epsilon_r = 53.634$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2016; Ambient Temp: 21.3°C; Tissue Temp: 20.1°C

Probe: ES3DV3 - SN3287; ConvF(4.94, 4.94, 4.94); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 2 (PCS), Body SAR, Back side, Mid.ch
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

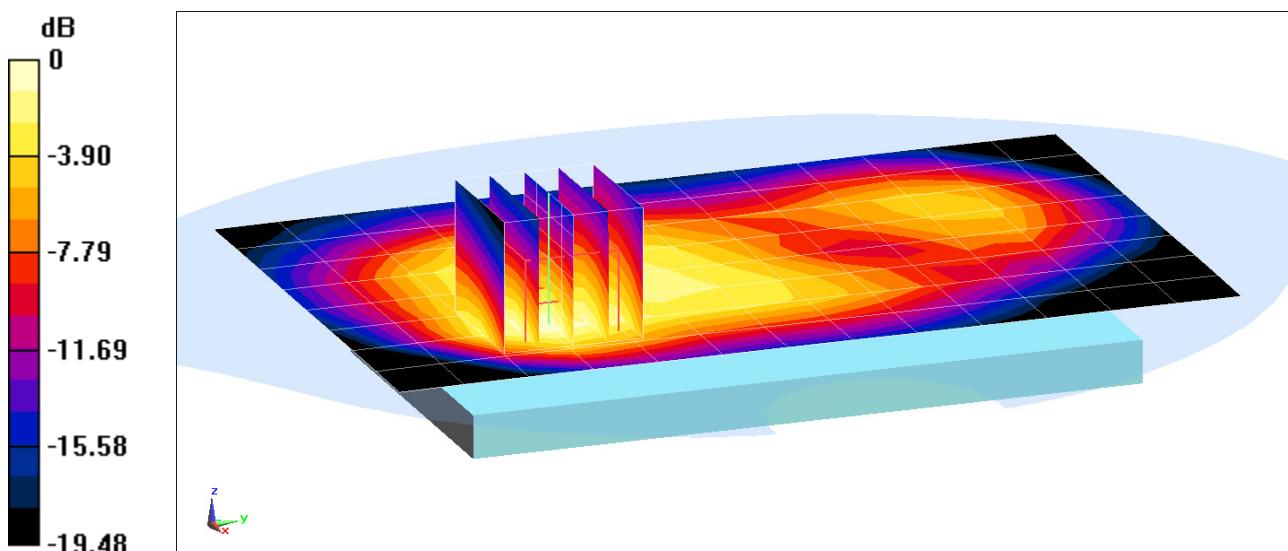
Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 19.71 V/m; Power Drift = 0.20 dB

Peak SAR (extrapolated) = 0.919 W/kg

SAR(1 g) = 0.502 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 08187

Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Body; Medium parameters used:

$f = 1880$ MHz; $\sigma = 1.495$ S/m; $\epsilon_r = 53.634$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2016; Ambient Temp: 21.3°C; Tissue Temp: 20.1°C

Probe: ES3DV3 - SN3287; ConvF(4.94, 4.94, 4.94); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 2 (PCS), Body SAR, Left Edge, Mid.ch
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

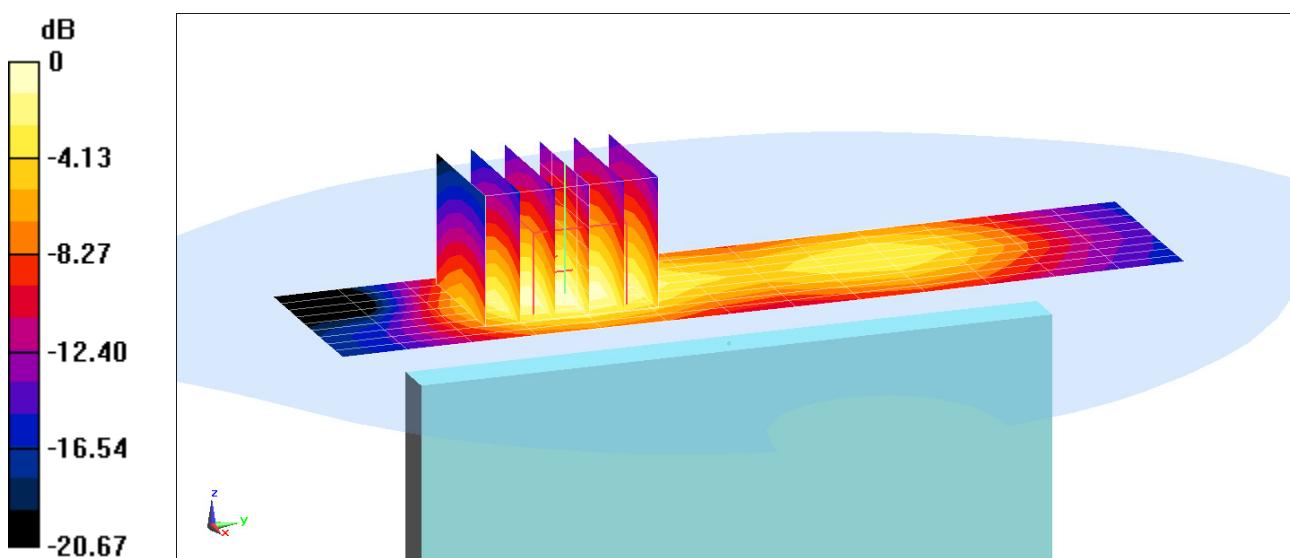
Area Scan (10x14x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 19.89 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.880 W/kg

SAR(1 g) = 0.539 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL63BL; Type: Portable Handset; Serial: 10407

Communication System: UID 0, IEEE 802.11b; Frequency: 2417 MHz; Duty Cycle: 1:1

Medium: 2450 Body; Medium parameters used (interpolated):

$f = 2417$ MHz; $\sigma = 1.945$ S/m; $\epsilon_r = 51.568$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2016; Ambient Temp: 22.9°C; Tissue Temp: 22.1°C

Probe: EX3DV4 - SN7406; ConvF(7.24, 7.24, 7.24); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/14/2016

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 802.11b, 22 MHz Bandwidth, Body SAR, Ch 2, 1 Mbps, Back Side

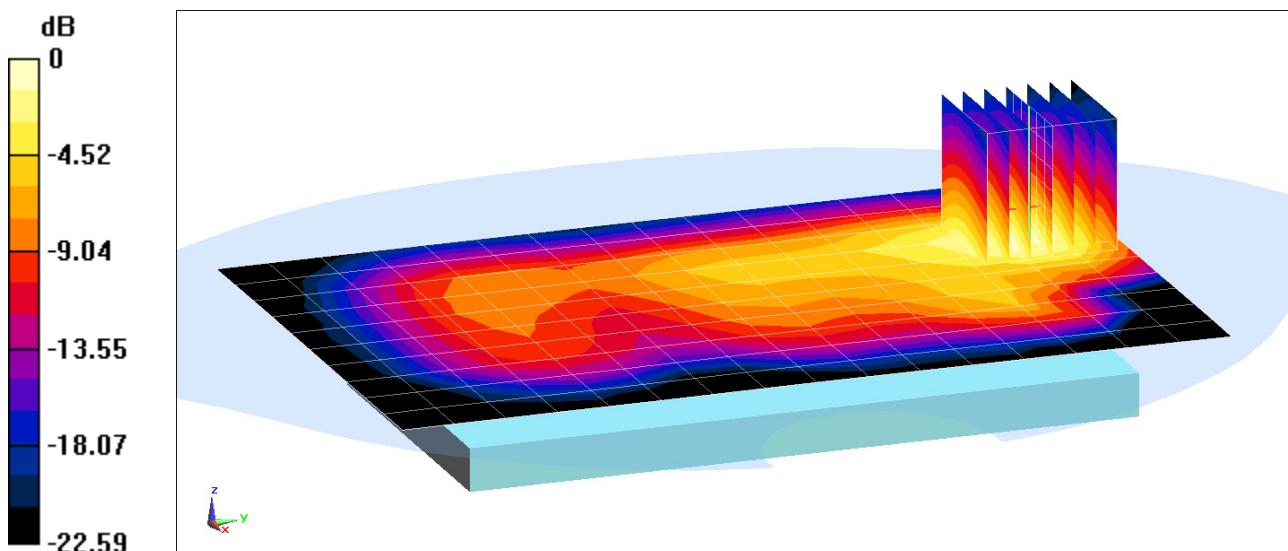
Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm

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

Reference Value = 19.84 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.42 W/kg

SAR(1 g) = 0.695 W/kg



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

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1054

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: 750 Head; Medium parameters used (interpolated):

$f = 750$ MHz; $\sigma = 0.91$ S/m; $\epsilon_r = 41.526$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-23-2016; Ambient Temp: 22.9°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7409; ConvF(10.73, 10.73, 10.73); Calibrated: 5/17/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/11/2016

Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

750 MHz System Verification at 23.0 dBm (200 mW)

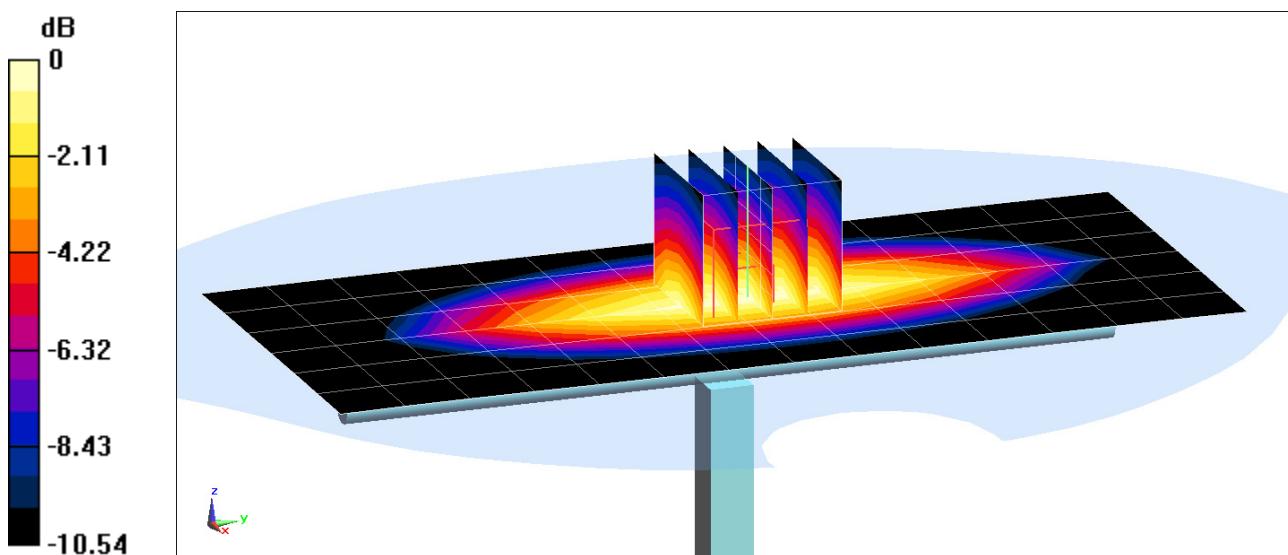
Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 2.28 W/kg

SAR(1 g) = 1.54 W/kg

Deviation(1 g) = -6.33%



PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 835 Head; Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.896 \text{ S/m}$; $\epsilon_r = 40.608$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-22-2016; Ambient Temp: 22.2°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3213; ConvF(6.18, 6.18, 6.18); Calibrated: 2/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/18/2016

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

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

835 MHz System Verification at 23.0 dBm (200 mW)

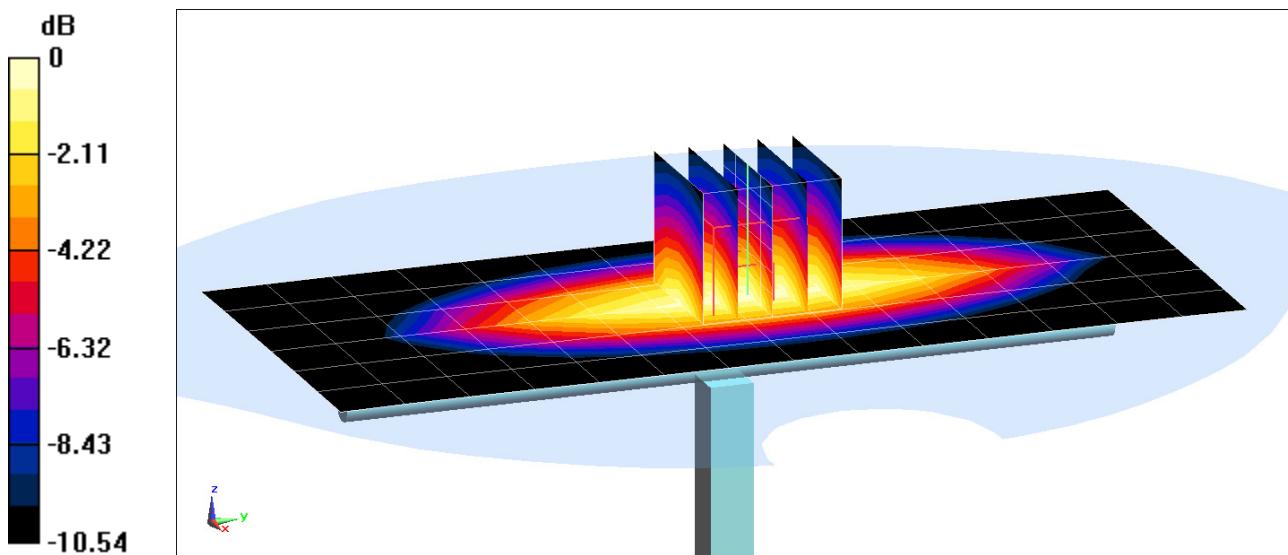
Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 2.83 W/kg

SAR(1 g) = 1.91 W/kg

Deviation(1 g) = 4.60%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1150

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: 1750 Head; Medium parameters used:

$f = 1750$ MHz; $\sigma = 1.386$ S/m; $\epsilon_r = 38.491$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-22-2016; Ambient Temp: 22.1°C; Tissue Temp: 22.0°C

Probe: ES3DV2 - SN3022; ConvF(5.15, 5.15, 5.15); Calibrated: 7/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1466; Calibrated: 1/15/2016

Phantom: SAM Main; Type: QD000P40CC; Serial: TP 1114

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification at 20.0 dBm (100 mW)

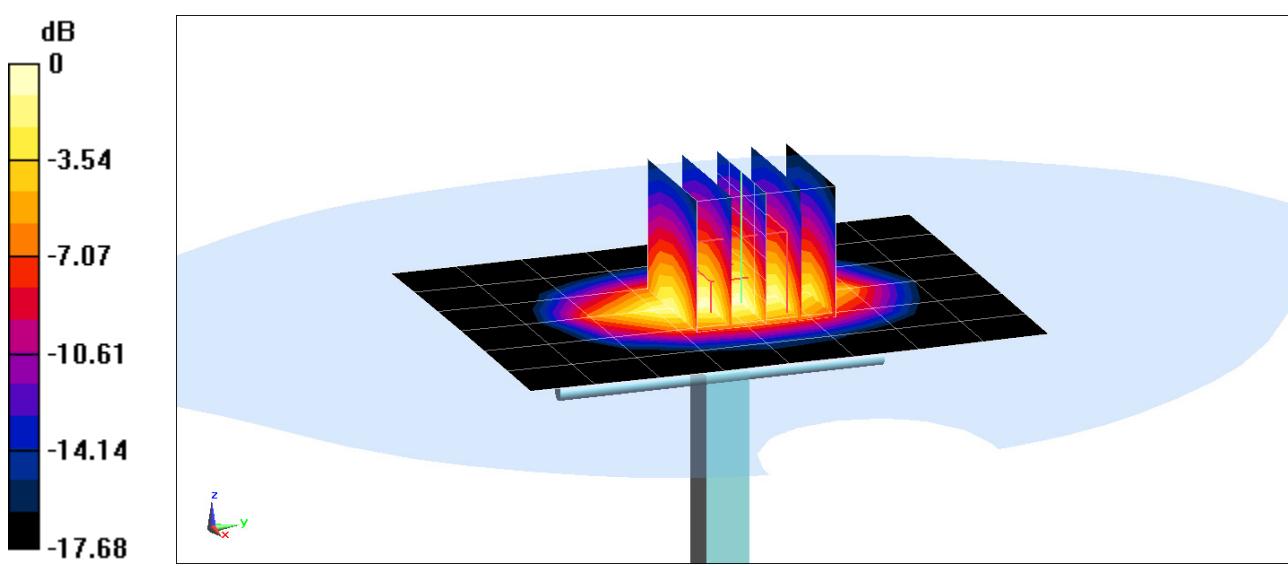
Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 6.27 W/kg

SAR(1 g) = 3.49 W/kg

Deviation(1 g) = -3.32%



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; $\sigma = 1.445$ S/m; $\epsilon_r = 38.686$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2016; Ambient Temp: 20.2°C; Tissue Temp: 20.4°C

Probe: ES3DV3 - SN3288; ConvF(5.44, 5.44, 5.44); Calibrated: 8/24/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1900 MHz System Verification at 20.0 dBm (100 mW)

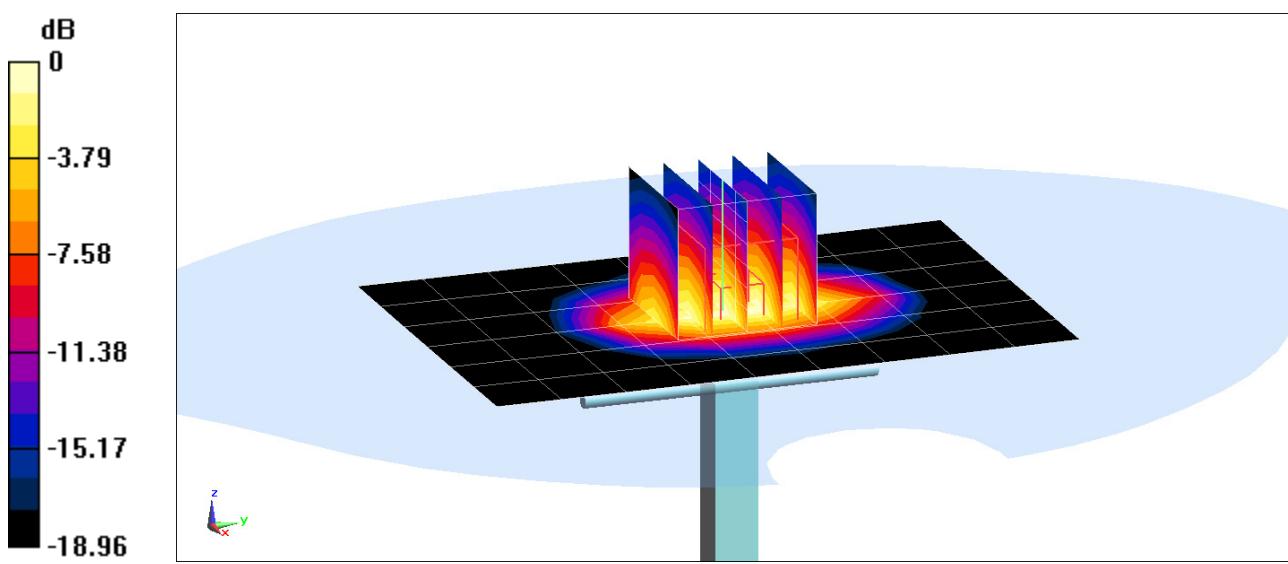
Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 7.76 W/kg

SAR(1 g) = 4.12 W/kg

Deviation(1 g) = 2.74%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 981

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

Medium: 2450 Head; Medium parameters used:

$f = 2450$ MHz; $\sigma = 1.851$ S/m; $\epsilon_r = 38.646$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-28-2016; Ambient Temp: 21.8°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3213; ConvF(4.58, 4.58, 4.58); Calibrated: 2/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/18/2016

Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

2450 MHz System Verification at 20.0 dBm (100 mW)

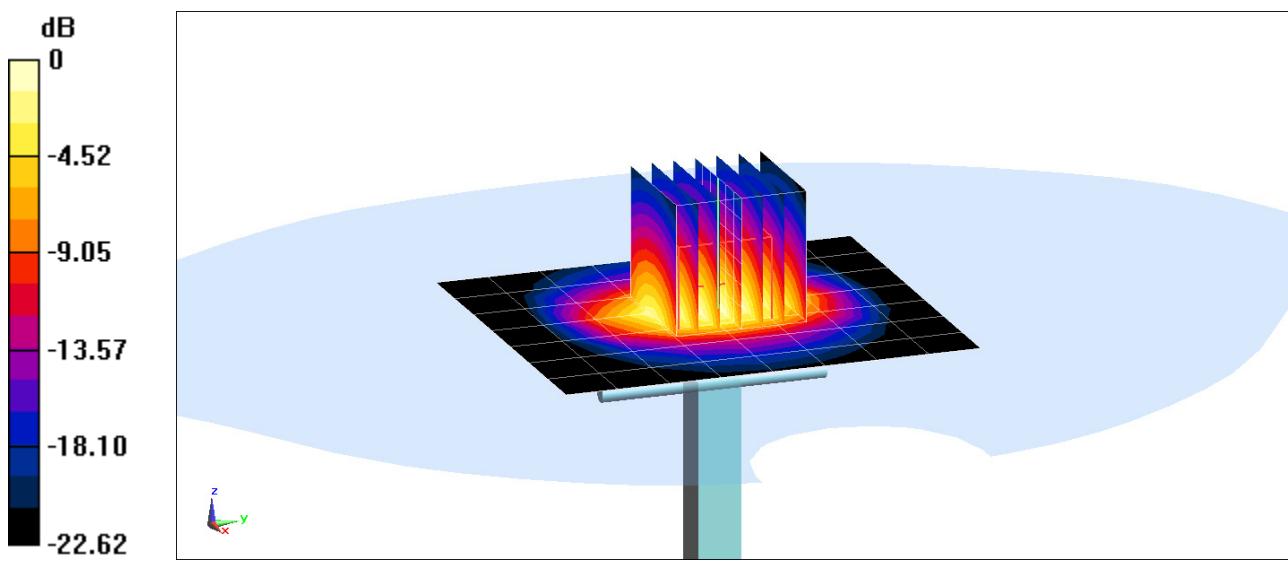
Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 10.9 W/kg

SAR(1 g) = 5.23 W/kg

Deviation(1 g) = -0.95%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1054

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: 750 Body; Medium parameters used (interpolated):

$f = 750$ MHz; $\sigma = 0.958$ S/m; $\epsilon_r = 55.38$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-21-2016; Ambient Temp: 22.1°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7409; ConvF(9.46, 9.46, 9.46); Calibrated: 5/17/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/11/2016

Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

750 MHz System Verification at 23.0 dBm (200 mW)

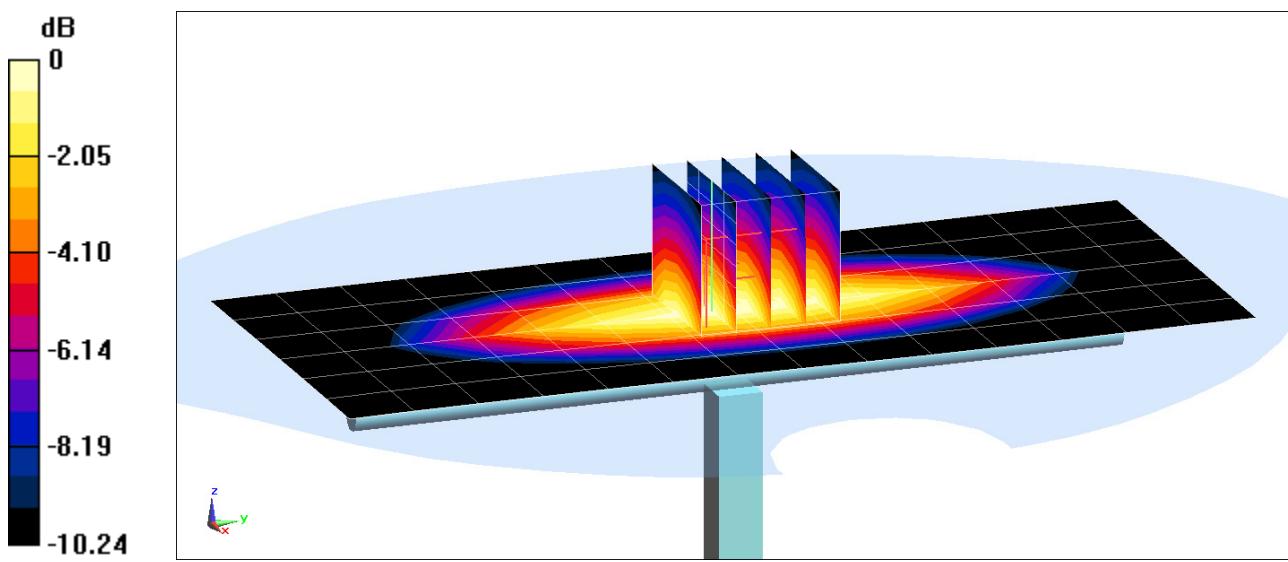
Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 2.62 W/kg

SAR(1 g) = 1.75 W/kg

Deviation(1 g) = 2.22%



0 dB = 2.32 W/kg = 3.65 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 835 Body; Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.978 \text{ S/m}$; $\epsilon_r = 53.718$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-21-2016; Ambient Temp: 20.8°C; Tissue Temp: 20.4°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

835 MHz System Verification at 23.0 dBm (200 mW)

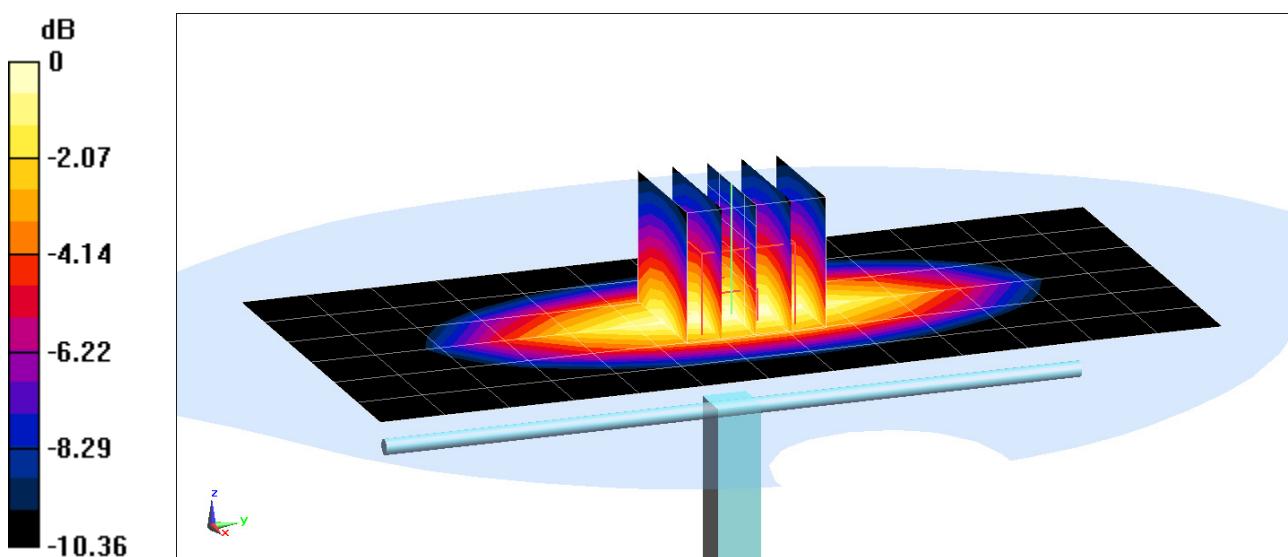
Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 2.96 W/kg

SAR(1 g) = 2.01 W/kg

Deviation(1 g) = 5.02%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1150

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: 1750 Body; Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.525 \text{ S/m}$; $\epsilon_r = 51.24$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-22-2016; Ambient Temp: 23.3°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN7410; ConvF(7.95, 7.95, 7.95); Calibrated: 7/25/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 7/12/2016

Phantom: Main TWIN SAM; Type: QD000P40CC; Serial: TP-1406

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification at 20.0 dBm (100 mW)

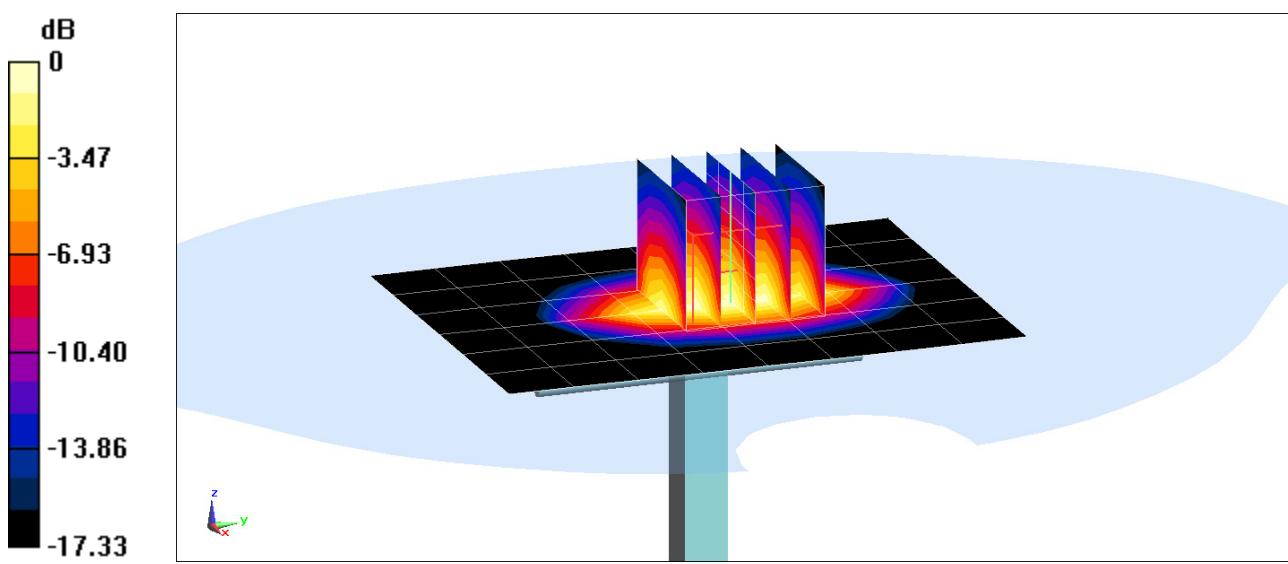
Area Scan (7x9x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 6.77 W/kg

SAR(1 g) = 3.84 W/kg

Deviation(1 g) = 5.21%



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; $\sigma = 1.518$ S/m; $\epsilon_r = 53.553$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2016; Ambient Temp: 21.3°C; Tissue Temp: 20.1°C

Probe: ES3DV3 - SN3287; ConvF(4.94, 4.94, 4.94); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1900 MHz System Verification at 20.0 dBm (100 mW)

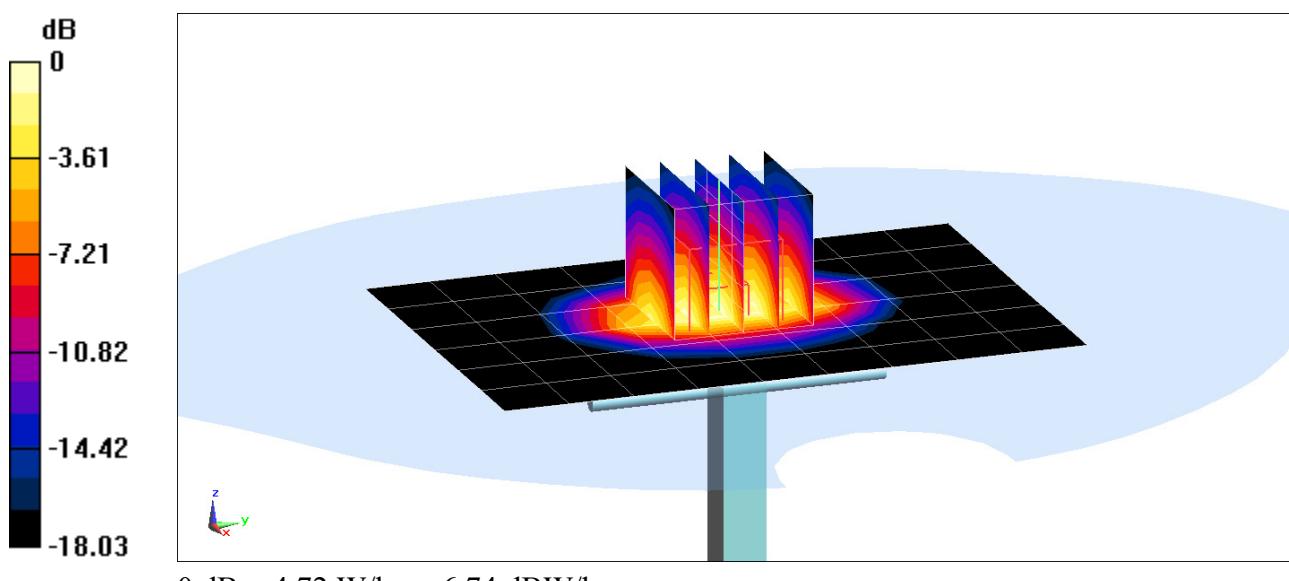
Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 6.72 W/kg

SAR(1 g) = 3.71 W/kg

Deviation(1 g) = -7.02%



PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 2450 Body; Medium parameters used:

$f = 2450$ MHz; $\sigma = 1.988$ S/m; $\epsilon_r = 51.444$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-21-2016; Ambient Temp: 22.9°C; Tissue Temp: 22.1°C

Probe: EX3DV4 - SN7406; ConvF(7.24, 7.24, 7.24); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/14/2016

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

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

2450 MHz System Verification at 20.0 dBm (100 mW)

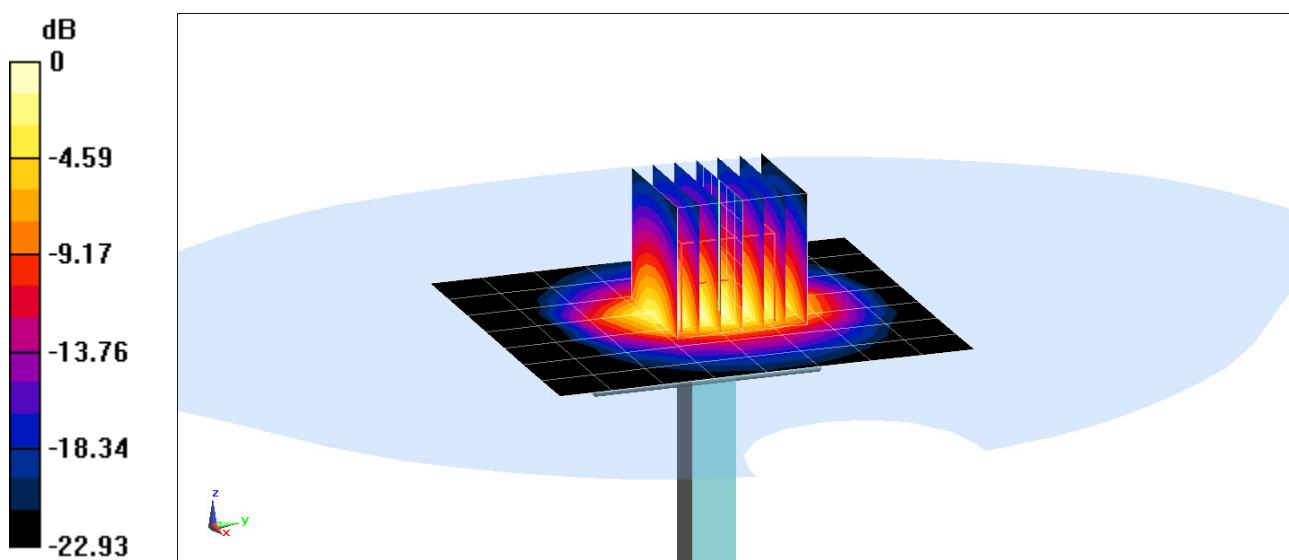
Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 10.3 W/kg

SAR(1 g) = 4.83 W/kg

Deviation(1 g) = -4.73%



APPENDIX C: PROBE CALIBRATION



Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: SCS 0108

Client PC Test

Certificate No: EX3-7409_May16

CALIBRATION CERTIFICATE

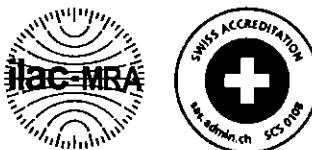
Object	EX3DV4 - SN:7409	BN ✓ 05/23/16
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes	
Calibration date:	May 17, 2016	
This calibration certificate documents the traceability to national standards, which realize the physical units 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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (No. 217-02285/02284)	In house check: Jun-16
Power sensor E4412A	SN: MY41498087	06-Apr-16 (No. 217-02285)	In house check: Jun-16
Power sensor E4412A	SN: 000110210	06-Apr-16 (No. 217-02284)	In house check: Jun-16
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Apr-13)	In house check: Jun-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

Calibrated by:	Name Michael Weber	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 18, 2016

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



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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
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- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)x,y,z = NORM_{x,y,z} * frequency_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- 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
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to $NORM_{x,y,z} * ConvF$ whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:7409

Manufactured: November 24, 2015
Calibrated: May 17, 2016

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7409

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.39	0.34	0.39	$\pm 10.1\%$
DCP (mV) ^B	106.3	102.2	99.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	141.2	$\pm 3.3\%$
		Y	0.0	0.0	1.0		127.3	
		Z	0.0	0.0	1.0		131.8	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	0.39	53.8	5.5	10.00	42.5	$\pm 1.2\%$
		Y	0.55	54.7	5.9		41.8	
		Z	0.85	58.7	9.1		41.6	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.55	75.3	22.2	1.87	149.7	$\pm 0.7\%$
		Y	3.32	72.6	21.0		139.7	
		Z	2.84	68.8	19.0		144.7	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	5.98	66.6	19.3	5.67	113.6	$\pm 0.9\%$
		Y	6.17	66.7	19.4		107.1	
		Z	6.13	66.1	18.8		110.9	
10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.59	66.2	21.1	9.29	123.5	$\pm 1.4\%$
		Y	7.27	67.9	22.1		121.1	
		Z	7.01	66.4	21.1		119.9	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	5.72	66.1	19.2	5.80	111.4	$\pm 1.2\%$
		Y	6.34	67.6	20.0		149.2	
		Z	6.02	65.9	19.0		109.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.27	66.1	21.2	9.28	116.8	$\pm 1.4\%$
		Y	6.89	67.6	22.1		114.7	
		Z	6.69	66.0	21.0		116.4	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.37	65.9	19.1	5.75	107.3	$\pm 1.2\%$
		Y	5.98	67.2	19.9		143.3	
		Z	6.01	66.7	19.4		149.2	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	5.76	66.2	19.2	5.82	109.5	$\pm 1.2\%$
		Y	6.43	67.6	20.0		148.3	
		Z	6.05	65.6	18.7		107.5	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.24	65.6	19.3	5.73	127.4	$\pm 0.9\%$
		Y	4.54	66.4	19.8		120.4	
		Z	4.62	65.9	19.3		123.8	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.91	68.0	22.7	9.21	126.7	$\pm 1.4\%$
		Y	5.24	68.8	23.3		124.0	
		Z	5.35	68.1	22.5		125.0	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.27	65.8	19.4	5.72	128.9	$\pm 0.9\%$
		Y	4.52	66.2	19.7		121.2	
		Z	4.63	65.9	19.3		125.2	

10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.26	65.7	19.4	5.72	125.9	±0.9 %
		Y	4.47	66.0	19.5		120.6	
		Z	4.60	65.7	19.2		123.0	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.89	67.9	22.6	9.21	125.9	±1.7 %
		Y	5.26	69.0	23.4		123.8	
		Z	5.32	67.8	22.3		124.3	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.04	66.8	21.7	9.24	149.2	±1.4 %
		Y	6.64	68.1	22.6		148.9	
		Z	6.48	66.5	21.4		147.5	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.27	66.1	21.2	9.30	119.1	±1.4 %
		Y	6.88	67.4	22.0		115.9	
		Z	6.73	66.1	21.1		117.6	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	5.71	66.0	19.2	5.81	110.7	±0.9 %
		Y	6.41	67.8	20.2		149.8	
		Z	5.98	65.7	18.9		107.9	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.23	66.3	19.4	6.06	112.8	±0.9 %
		Y	6.51	66.6	19.5		107.4	
		Z	6.49	66.1	19.0		109.4	

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 Norm X,Y,Z do not affect the E^2 -field uncertainty inside TSI (see Pages 6 and 7).

^B Numerical linearization parameter: uncertainty not required.

^C 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:7409

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)	Unc (k=2)
750	41.9	0.89	10.73	10.73	10.73	0.62	0.83	± 12.0 %
835	41.5	0.90	10.04	10.04	10.04	0.45	0.93	± 12.0 %
1750	40.1	1.37	8.05	8.05	8.05	0.38	0.80	± 12.0 %
1900	40.0	1.40	7.69	7.69	7.69	0.41	0.80	± 12.0 %
2300	39.5	1.67	7.22	7.22	7.22	0.25	0.92	± 12.0 %
2450	39.2	1.80	6.90	6.90	6.90	0.30	0.93	± 12.0 %
2600	39.0	1.96	6.77	6.77	6.77	0.32	0.83	± 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: EX3DV4 - SN:7409

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)	Unc (k=2)
750	55.5	0.96	9.46	9.46	9.46	0.52	0.80	± 12.0 %
835	55.2	0.97	9.33	9.33	9.33	0.34	1.04	± 12.0 %
1750	53.4	1.49	7.72	7.72	7.72	0.44	0.80	± 12.0 %
1900	53.3	1.52	7.47	7.47	7.47	0.43	0.80	± 12.0 %
2300	52.9	1.81	7.22	7.22	7.22	0.36	0.85	± 12.0 %
2450	52.7	1.95	7.10	7.10	7.10	0.39	0.80	± 12.0 %
2600	52.5	2.16	6.83	6.83	6.83	0.39	0.86	± 12.0 %

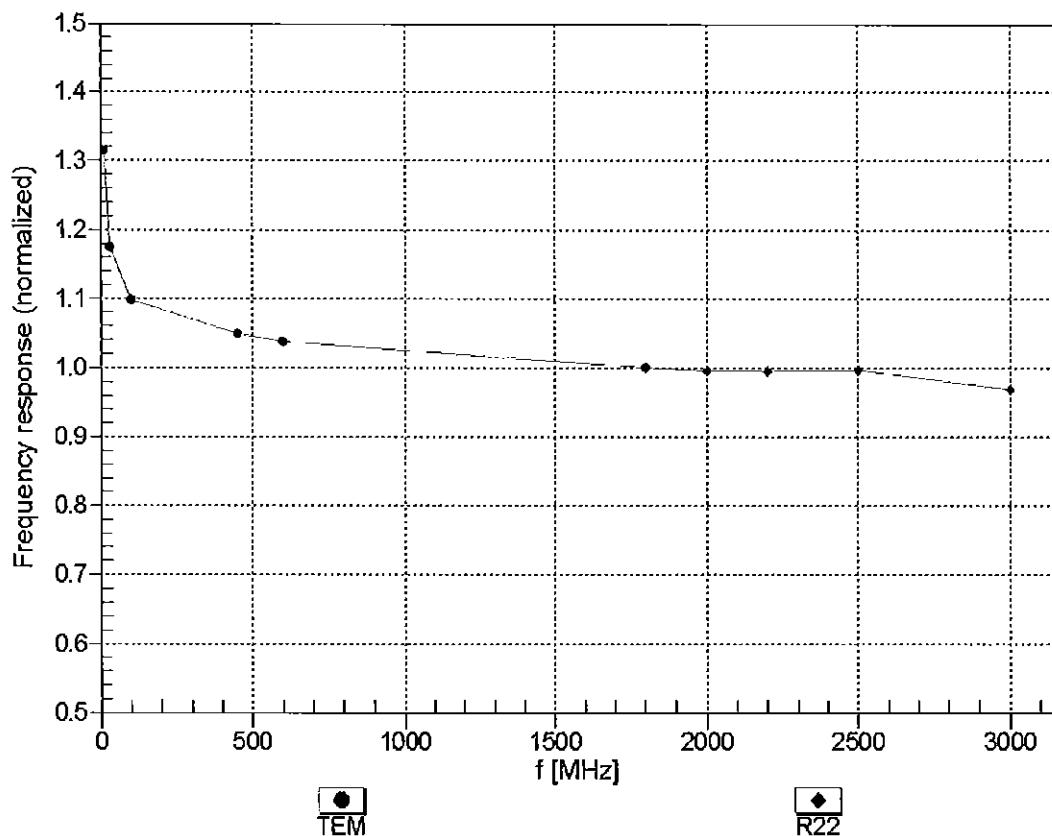
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 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.

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Frequency Response of E-Field

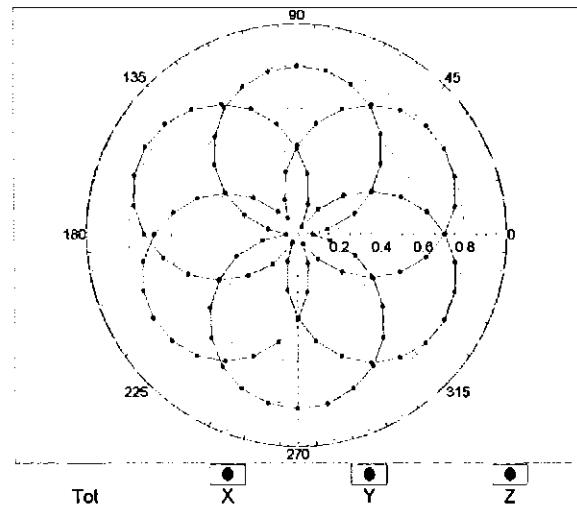
(TEM-Cell:ifi110 EXX, Waveguide: R22)



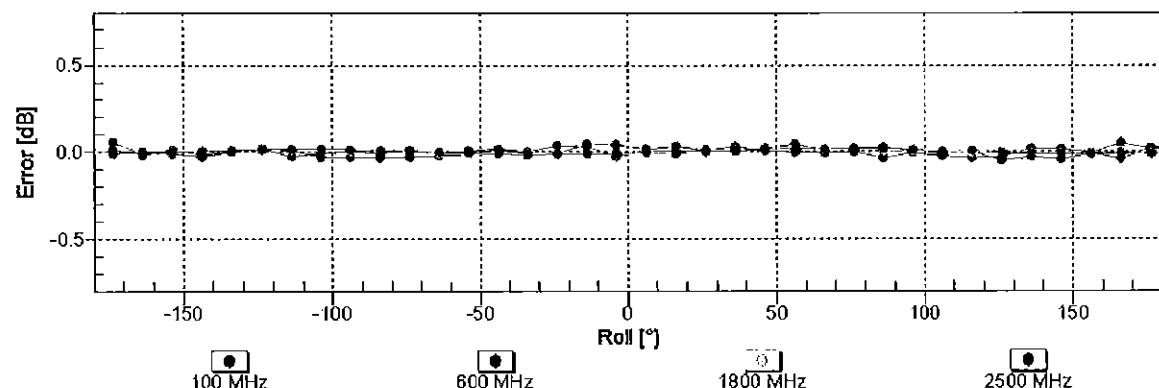
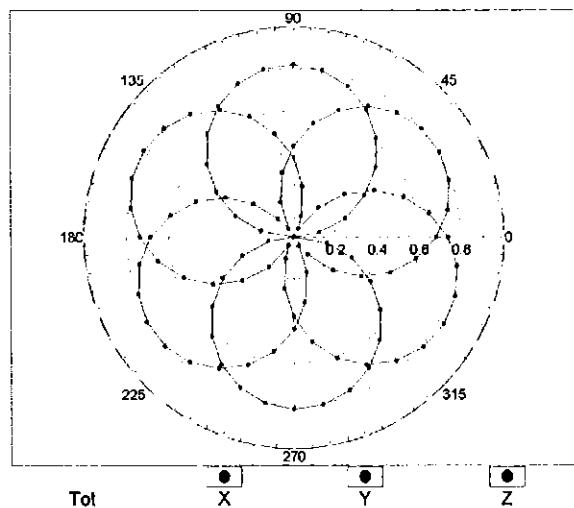
Uncertainty of Frequency Response of E-field: $\pm 6.3\% (k=2)$

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

$f=600$ MHz, TEM

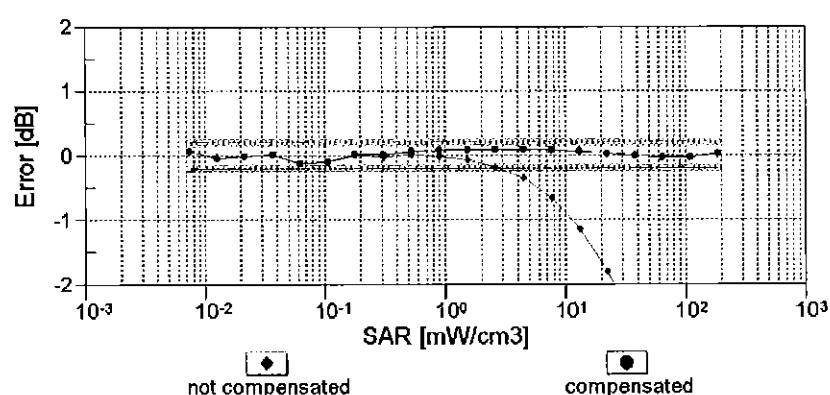
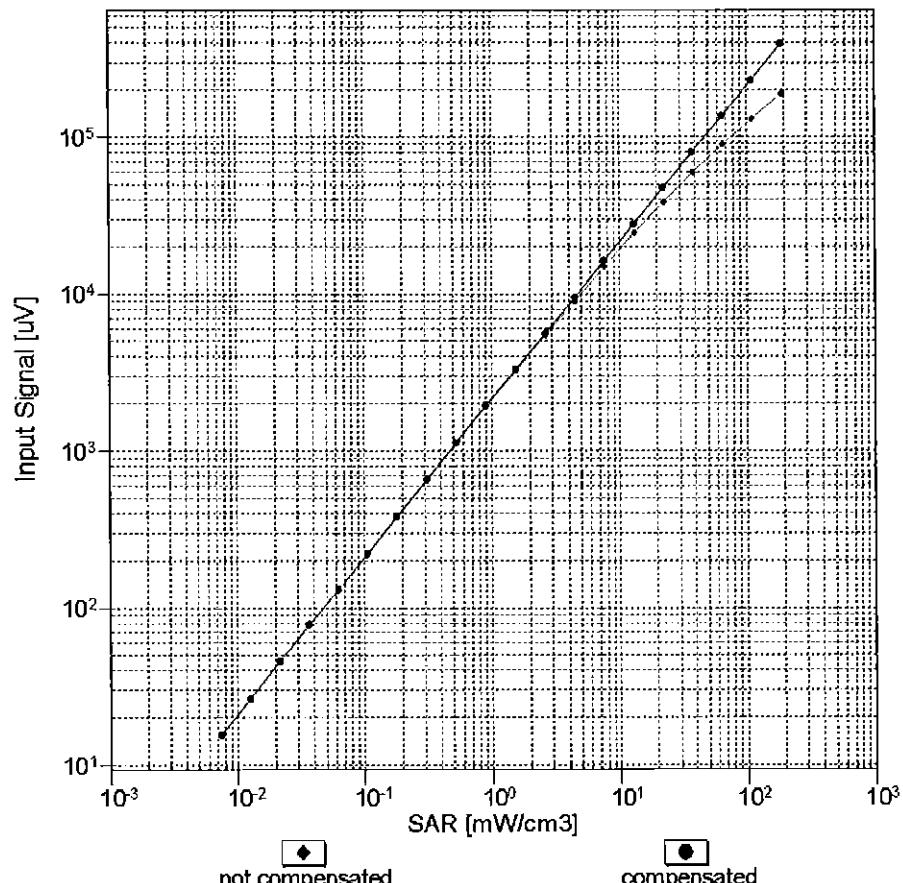


$f=1800$ MHz, R22



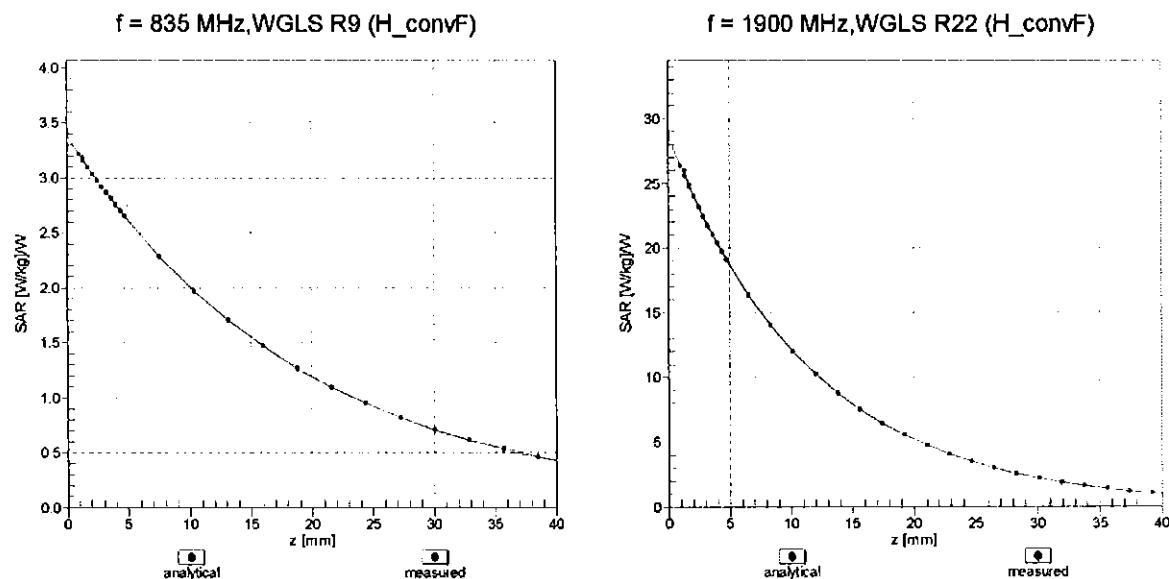
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



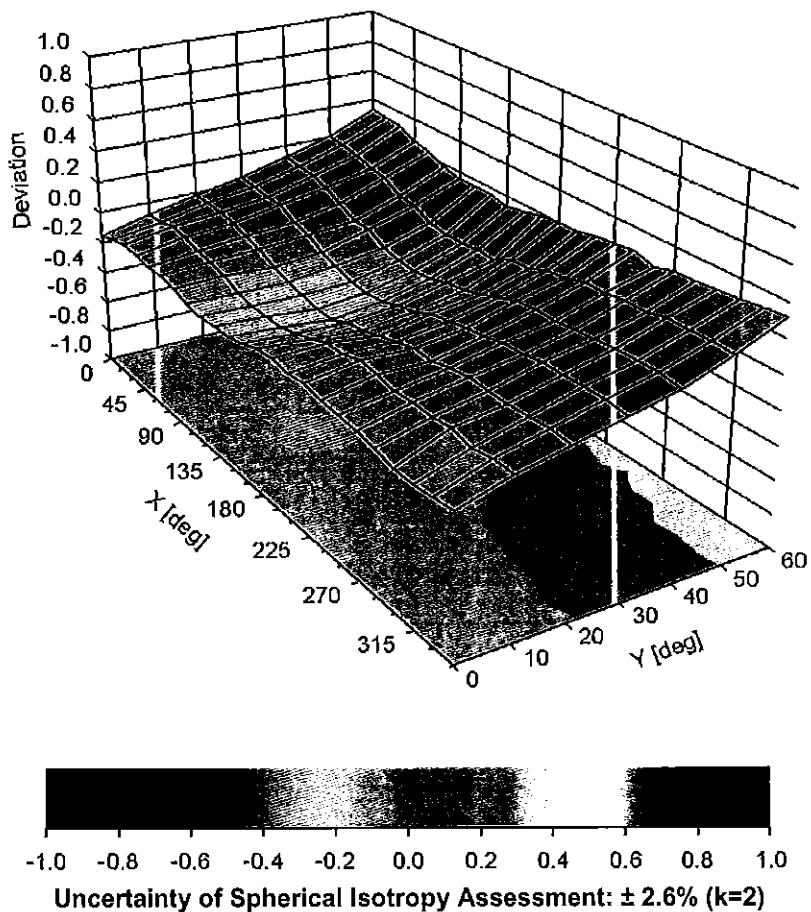
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:7409

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	36.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **ES3-3213_Feb16**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3213**

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

BN
03/01/2016

Calibration date: **February 19, 2016**

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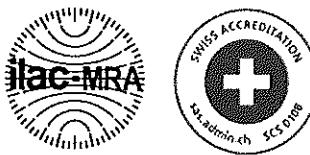
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Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
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-15)	In house check: Oct-16

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

Issued: February 20, 2016

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

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- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

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- $NORM(f)x,y,z = NORMx,y,z * frequency_response$ (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 $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to $NORMx,y,z * ConvF$ 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:3213

Manufactured: October 14, 2008
Calibrated: February 19, 2016

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3213

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.50	1.38	1.34	$\pm 10.1\%$
DCP (mV) ^B	99.8	101.9	99.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	195.2	$\pm 3.5\%$
		Y	0.0	0.0	1.0		214.0	
		Z	0.0	0.0	1.0		215.1	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	5.06	68.1	14.5	10.00	42.1	$\pm 0.9\%$
		Y	11.23	76.3	17.0		39.8	
		Z	6.02	70.0	14.9		39.7	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.09	69.2	18.8	1.87	137.2	$\pm 0.7\%$
		Y	3.15	70.3	19.6		133.1	
		Z	2.82	67.6	18.0		132.3	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.22	66.6	19.2	5.67	125.7	$\pm 1.7\%$
		Y	6.51	68.0	20.1		146.0	
		Z	6.41	67.3	19.6		143.7	
10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	10.84	76.7	26.6	9.29	143.8	$\pm 3.3\%$
		Y	10.81	77.3	27.2		137.5	
		Z	10.28	75.3	25.8		136.3	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.44	67.4	19.8	5.80	148.4	$\pm 1.7\%$
		Y	6.38	67.6	20.0		142.8	
		Z	6.32	67.1	19.5		141.5	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	10.08	75.4	26.1	9.28	137.0	$\pm 3.3\%$
		Y	10.08	76.2	26.8		131.6	
		Z	9.63	74.3	25.4		130.7	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.09	66.7	19.5	5.75	144.2	$\pm 1.4\%$
		Y	6.07	67.1	19.8		139.5	
		Z	5.98	66.4	19.3		137.4	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.59	67.5	19.8	5.82	149.8	$\pm 1.7\%$
		Y	6.51	67.6	20.1		146.2	
		Z	6.44	67.0	19.5		145.3	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.13	67.0	19.8	5.73	146.8	$\pm 1.4\%$
		Y	5.10	67.4	20.2		144.4	
		Z	4.99	66.5	19.5		141.2	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	8.31	76.6	26.9	9.21	125.5	$\pm 3.3\%$
		Y	10.61	84.9	31.4		149.4	
		Z	8.76	78.4	27.8		143.6	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.05	66.6	19.6	5.72	144.9	$\pm 1.4\%$
		Y	5.06	67.2	20.1		142.1	
		Z	4.99	66.5	19.5		140.5	

10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.12	66.9	19.8	5.72	145.1	$\pm 1.4\%$
		Y	5.09	67.3	20.2		143.7	
		Z	5.00	66.6	19.5		140.2	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	8.18	76.1	26.7	9.21	124.8	$\pm 3.3\%$
		Y	10.45	84.4	31.2		148.6	
		Z	8.75	78.3	27.7		143.4	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	9.24	74.1	25.5	9.24	126.6	$\pm 2.7\%$
		Y	9.21	74.8	26.2		122.2	
		Z	9.78	76.0	26.5		147.7	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.92	75.0	25.9	9.30	133.4	$\pm 3.3\%$
		Y	9.95	75.8	26.6		128.8	
		Z	9.55	74.0	25.3		127.2	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.43	67.3	19.8	5.81	146.2	$\pm 1.4\%$
		Y	6.42	67.7	20.1		141.6	
		Z	6.28	66.9	19.5		140.2	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.70	66.9	19.5	6.06	128.1	$\pm 1.7\%$
		Y	6.97	68.2	20.4		147.3	
		Z	6.91	67.7	20.0		146.2	

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 Norm X,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 6 and 7).

^B Numerical linearization parameter: uncertainty not required.

^C 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:3213

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)	Unc (k=2)
750	41.9	0.89	6.43	6.43	6.43	0.55	1.36	± 12.0 %
835	41.5	0.90	6.18	6.18	6.18	0.58	1.33	± 12.0 %
1750	40.1	1.37	5.23	5.23	5.23	0.80	1.14	± 12.0 %
1900	40.0	1.40	5.05	5.05	5.05	0.60	1.30	± 12.0 %
2300	39.5	1.67	4.78	4.78	4.78	0.59	1.41	± 12.0 %
2450	39.2	1.80	4.58	4.58	4.58	0.75	1.30	± 12.0 %
2600	39.0	1.96	4.38	4.38	4.38	0.71	1.38	± 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:3213

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)	Unc (k=2)
750	55.5	0.96	5.98	5.98	5.98	0.60	1.31	± 12.0 %
835	55.2	0.97	6.00	6.00	6.00	0.36	1.70	± 12.0 %
1750	53.4	1.49	4.94	4.94	4.94	0.48	1.57	± 12.0 %
1900	53.3	1.52	4.78	4.78	4.78	0.52	1.55	± 12.0 %
2300	52.9	1.81	4.50	4.50	4.50	0.74	1.34	± 12.0 %
2450	52.7	1.95	4.41	4.41	4.41	0.80	1.20	± 12.0 %
2600	52.5	2.16	4.21	4.21	4.21	0.90	1.05	± 12.0 %

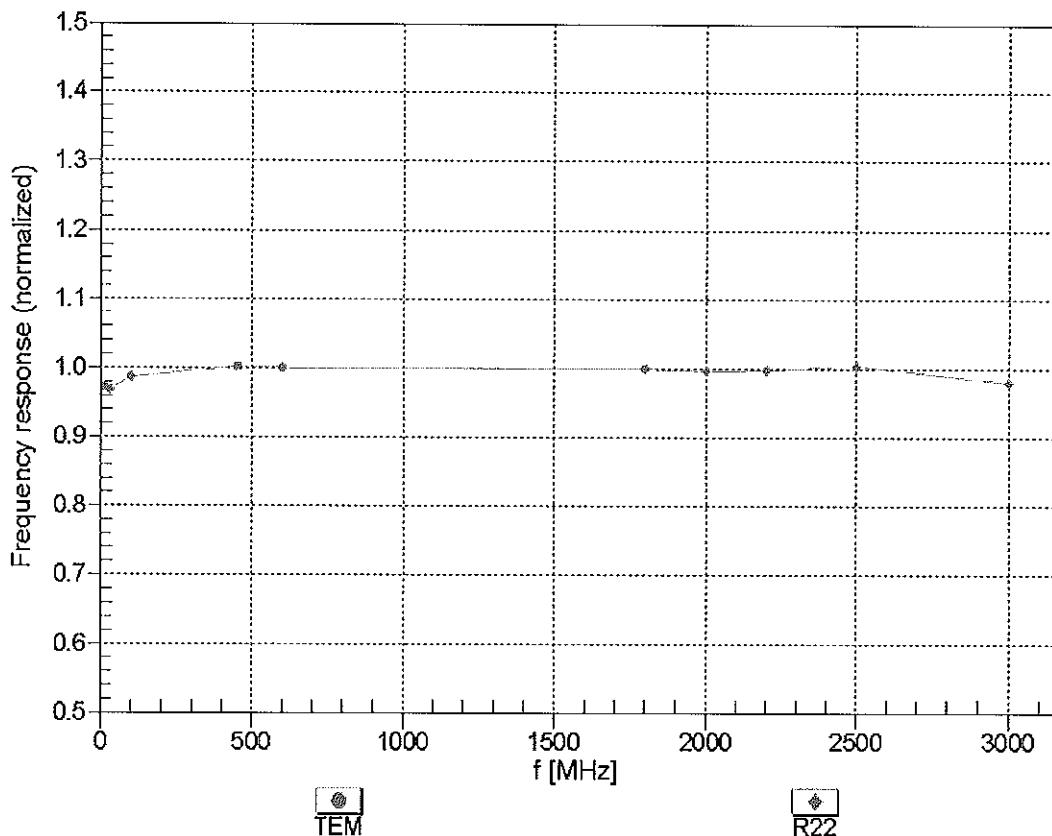
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 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

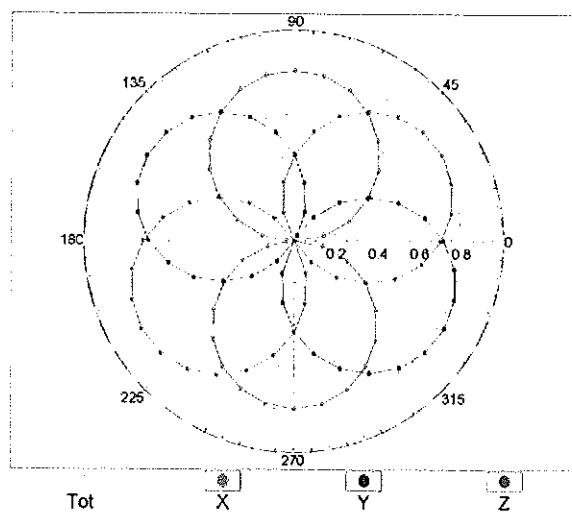
(TEM-Cell:ifi110 EXX, Waveguide: R22)



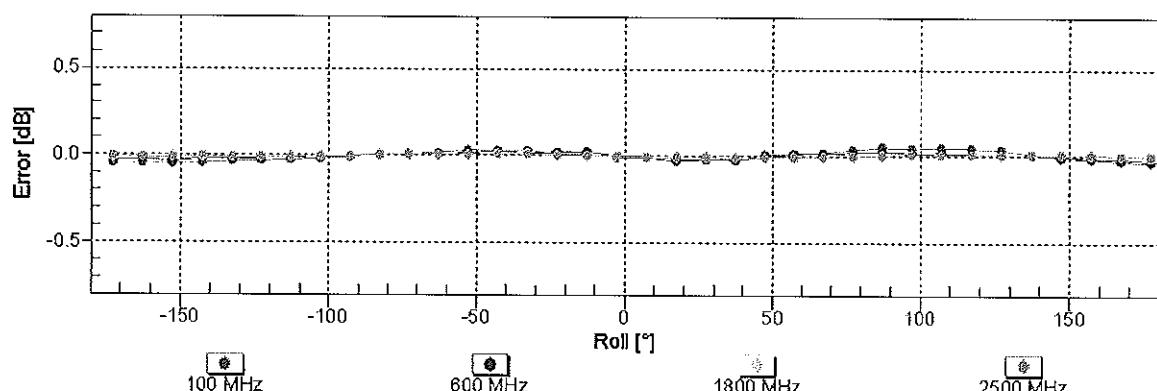
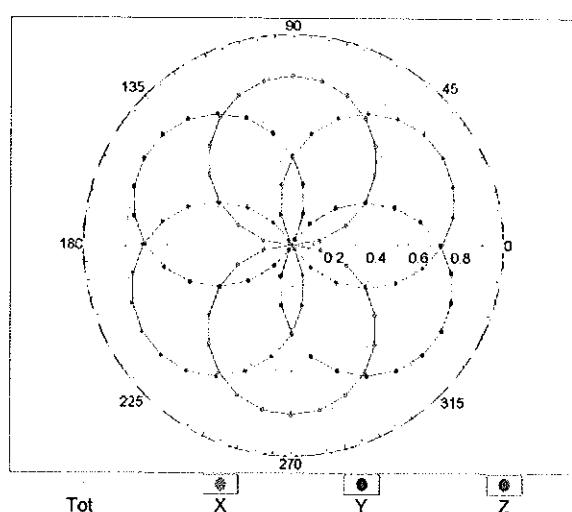
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz, TEM

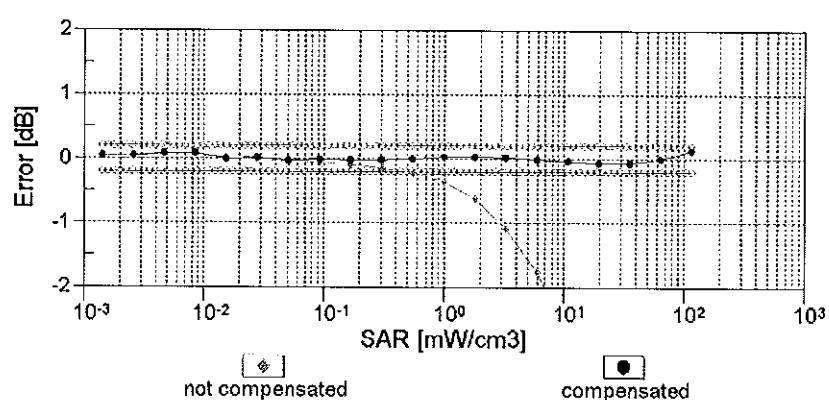
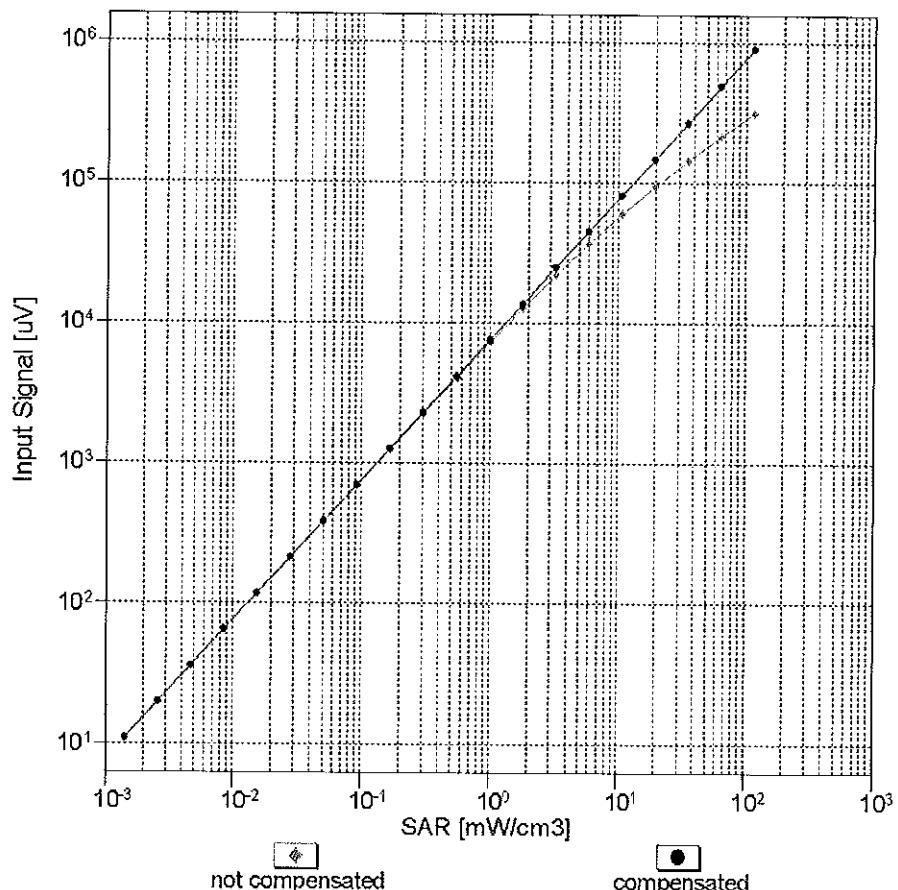


f=1800 MHz, R22

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

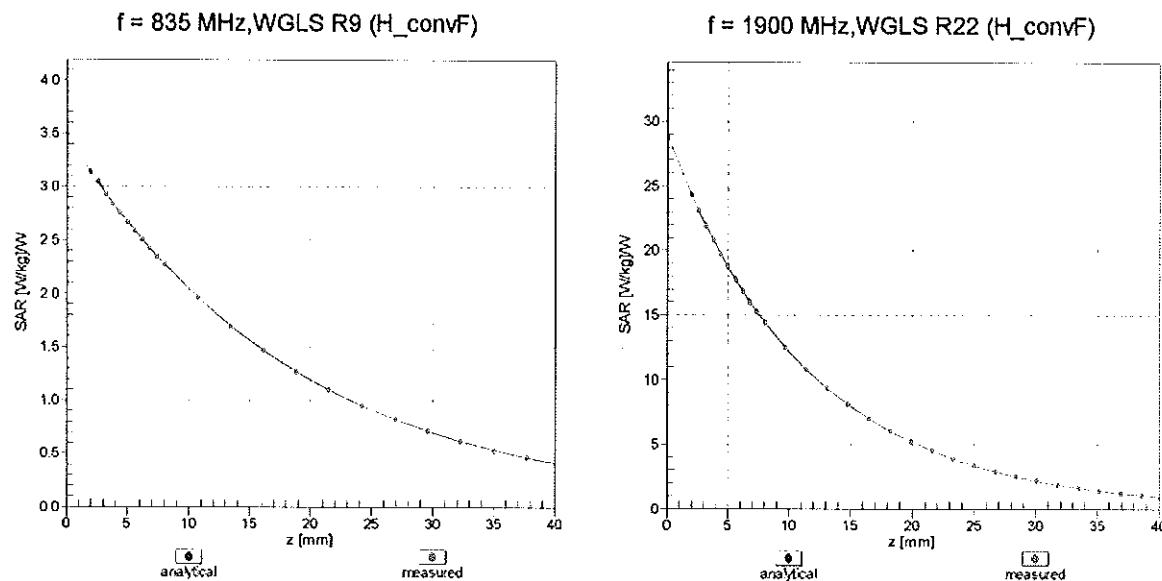
Dynamic Range $f(\text{SAR}_{\text{head}})$

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

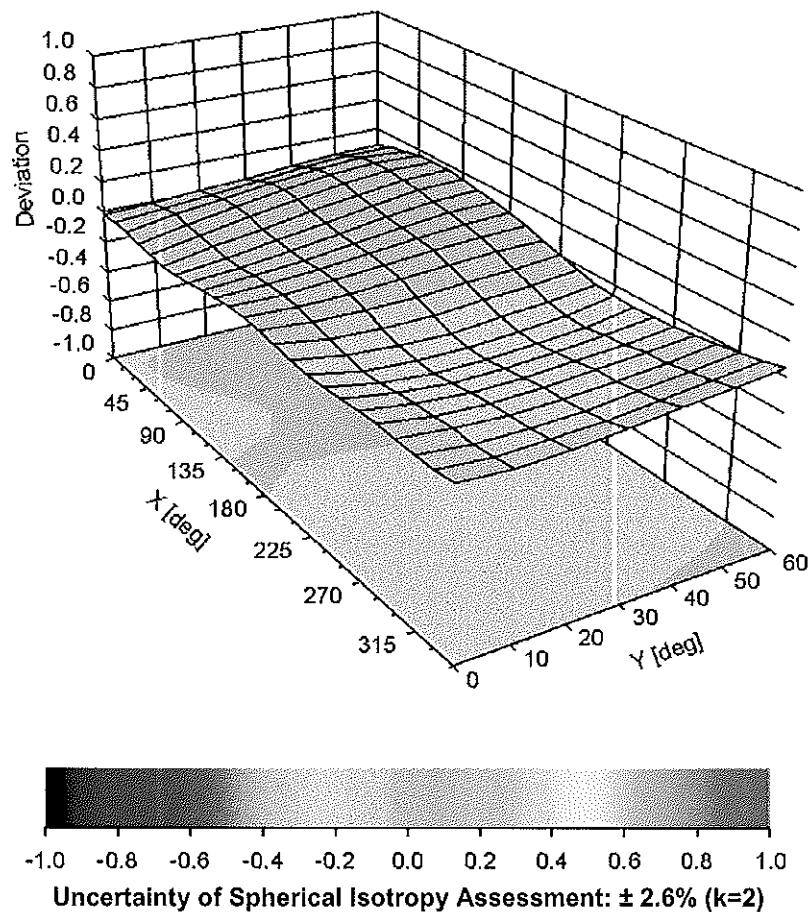


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



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



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3213

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	97.2
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