



SAR EVALUATION REPORT

Applicant Name:

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

Date of Testing:

01/19/15 - 01/27/15

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

0Y1501210201.ZNF

FCC ID:

ZNFUS995

APPLICANT:

LG ELECTRONICS MOBILECOMM U.S.A., INC.

DUT Type:

Portable Handset

Application Type:

Class II Permissive Change

FCC Rule Part(s):

CFR §2.1093

Model(s):

LG-US995, US995, LGUS995, LG-AS995, LGAS995, AS995

Permissive Change(s)

See FCC Change Document

Date of Original Certification:

01/08/2015

Equipment Class	Band & Mode	Tx Frequency	SAR		
			1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Hotspot (W/kg)
PCE	Cell. CDMA/EVDO	824.70 - 848.31 MHz	0.45	0.35	0.37
PCE	PCS CDMA/EVDO	1851.25 - 1908.75 MHz	1.00	0.56	0.62
PCE	LTE Band 12	699.7 - 715.3 MHz	0.27	0.47	0.47
PCE	LTE Band 5 (Cell)	824.7 - 848.3 MHz	0.35	0.85	0.85
PCE	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	0.76	1.13	1.13
PCE	LTE Band 25 (PCS)	1850.7 - 1914.3 MHz	0.77	0.61	0.77
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.98	0.12	0.17
NII	5.2 GHz WLAN	5180 - 5240 MHz	0.39	< 0.1	
NII	5.3 GHz WLAN	5260 - 5320 MHz	0.55	0.11	
NII	5.5 GHz WLAN	5500 - 5700 MHz	0.67	0.15	
NII	5.8 GHz WLAN	5745 - 5825 MHz	0.64	0.20	
DSS/DTS	Bluetooth	2402 - 2480 MHz	N/A		
Simultaneous SAR per KDB 690783 D01v01r03:			1.42	1.33	1.33

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 1.9 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



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

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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
Cell. CDMA/EVDO	Voice/Data	824.70 - 848.31 MHz
PCS CDMA/EVDO	Voice/Data	1851.25 - 1908.75 MHz
LTE Band 12	Data	699.7 - 715.3 MHz
LTE Band 17	Data	706.5 - 713.5 MHz
LTE Band 5 (Cell)	Data	824.7 - 848.3 MHz
LTE Band 4 (AWS)	Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Data	1850.7 - 1909.3 MHz
LTE Band 25 (PCS)	Data	1850.7 - 1914.3 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
5.2 GHz WLAN	Data	5180 - 5240 MHz
5.3 GHz WLAN	Data	5260 - 5320 MHz
5.5 GHz WLAN	Data	5500 - 5720 MHz
5.8 GHz WLAN	Data	5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
NFC	Data	13.56 MHz

1.2 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v05.

Mode / Band		Modulated Average (dBm)
Cell. CDMA/EVDO	Maximum	25.2
	Nominal	24.7
PCS CDMA/EVDO	Maximum	24.7
	Nominal	24.2

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Mode / Band		Modulated Average (dBm)
LTE Band 12	Maximum	24.5
	Nominal	24.0
LTE Band 17	Maximum	24.2
	Nominal	23.7
LTE Band 5 (Cell)	Maximum	24.2
	Nominal	23.7
LTE Band 4 (AWS)	Maximum	24.2
	Nominal	23.7
LTE Band 2 (PCS)	Maximum	24.2
	Nominal	23.7
LTE Band 25 (PCS)	Maximum	24.2
	Nominal	23.7

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	15.5
	Nominal	14.5
IEEE 802.11g (2.4 GHz)	Maximum	13.5
	Nominal	12.5
IEEE 802.11n (2.4 GHz)	Maximum	13.5
	Nominal	12.5
IEEE 802.11ac (2.4 GHz)	Maximum	11.5
	Nominal	10.5
IEEE 802.11a (5 GHz)	Maximum	14.0
	Nominal	13.0
IEEE 802.11n (5 GHz 20 MHz)	Maximum	14.0
	Nominal	13.0
IEEE 802.11n (5 GHz 40 MHz)	Maximum	13.0
	Nominal	12.0
IEEE 802.11ac (5 GHz)	Maximum	13.0
	Nominal	12.0
Bluetooth (1Mbps)	Maximum	8.5
	Nominal	7.5
Bluetooth (2Mbps)	Maximum	4.0
	Nominal	3.5
Bluetooth (3Mbps)	Maximum	4.0
	Nominal	3.5
Bluetooth LE	Maximum	7.0
	Nominal	6.0

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1.3 Hotspot Sides for SAR Testing

Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC filing. Antenna locations can be found in Appendix F.

Table 1-1
Mobile Hotspot Sides for SAR Testing

Mode	Back	Front	Top	Bottom	Right	Left
Cell. EVDO	Yes	Yes	No	Yes	Yes	Yes
PCS EVDO	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 25 (PCS)	Yes	Yes	No	Yes	No	Yes
2.4 GHz WLAN	Yes	Yes	Yes	No	No	Yes
5.8 GHz WLAN	Yes	Yes	Yes	No	No	Yes

Note: Particular DUT edges were not required to be evaluated for Wireless Router SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06 guidance, page 2. The distances between the transmit antennas and the edges of the device are included in the filing. When wireless router mode is enabled, 5.2 – 5.7 GHz WLAN operations are disabled. Therefore 5.2 – 5.7 GHz WLAN operations are not considered in this section.

1.4 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the device. The NFC antenna location diagram can be found in Appendix F.

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1.5 Simultaneous Transmission Capabilities

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

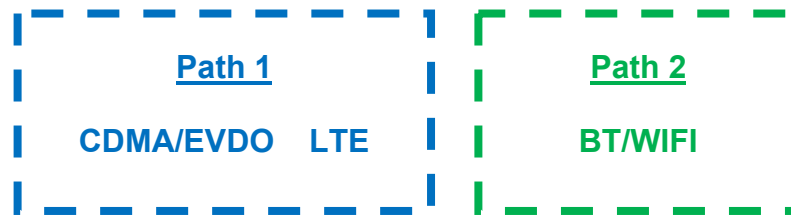


Figure 1-1
Simultaneous Transmission Paths

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

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body-Worn Accessory	Wireless Router
1	1x CDMA voice + 2.4 GHz WI-FI	Yes	Yes	N/A
2	1x CDMA voice + 5 GHz WI-FI	Yes	Yes	N/A
3	1x CDMA voice + 2.4 GHz Bluetooth	N/A	Yes	N/A
4	LTE + 2.4 GHz WI-FI	Yes*	Yes*	Yes
5	LTE + 5 GHz WI-FI	Yes*	Yes*	Yes
6	LTE + 2.4 GHz Bluetooth	N/A	Yes*	N/A
7	CDMA/EVDO data + 2.4 GHz WI-FI	Yes*	Yes*	Yes
8	CDMA/EVDO data + 5 GHz WI-FI	Yes*	Yes*	Yes
9	CDMA/EVDO data + 2.4 GHz Bluetooth	N/A	Yes*	N/A

- 2.4 GHz WLAN, 5 GHz WLAN, and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously.
- All licensed modes share the same antenna path and cannot transmit simultaneously.
- (*) = for VOIP applications possibly used by the end-user
- 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 specified above.
- 5 GHz Wireless Router is only supported for the 5.8 GHz Band by S/W, therefore 5.2 - 5.7 GHz Bands were not evaluated for wireless router conditions.
- 5.2 GHz WIFI supports WIFI-Direct (GC only).
- 5.8 GHz WIFI supports Hotspot and WIFI-Direct (GO/GC).

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1.6 SAR Test Exclusions Applied

(A) WIFI/BT

Since Wireless Router operations are not allowed by the chipset firmware using 5.2 – 5.7 GHz WIFI, only 2.4 GHz and 5.8 GHz WIFI Hotspot SAR tests and combinations are considered for SAR with respect to Wireless Router configurations according to FCC KDB 941225 D06.

Per FCC KDB 447498 D01v05, 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; $[(7/8) * \sqrt{2.480}] = 1.4 < 3.0$. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

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

IEEE 802.11ac for 2.4 GHz WIFI was not evaluated for SAR since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.

This device supports IEEE 802.11ac with the following features:

- a) Up to 80 MHz Bandwidth only
- b) No aggregate channel configurations
- c) 1 Tx antenna output
- d) 256 QAM is supported
- e) New 5 GHz channel 138 is supported

(B) Licensed Transmitter(s)

This Device additionally supports LTE B2. LTE Band 25 and LTE Band 2 share the same transmission path. LTE Band 2 was not evaluated for SAR since the supported frequency range falls within the LTE Band 25 supported frequency range and the Band 2 target power was equal to the Band 25 target power.

This Device additionally supports LTE B17. LTE Band 12 and LTE Band 17 share the same transmission path. LTE Band 17 was not evaluated for SAR since the supported frequency range falls within the LTE Band 12 supported frequency range and the Band 17 target power was less than the Band 12 target power.

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 D05.

This device supports inter-band LTE Carrier Aggregation (CA) in the downlink only. All uplink communications are identical to Release 8 specifications. Per FCC Guidance, LTE CA SAR was not needed for testing since the data sent by uplink on uplink physical channels does not change between Rel 8 and Rel 10.

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1.7 SAR Test Positioning Based on Form Factor

Due to the embowed design of the device, Body SAR was configured per FCC Guidance. For Back side, the device was tested at a distance of 8 mm at the center of the device. For Front side, the device was tested at a distance of 8 mm from the outer ends of the device. The remaining surface or edges within 25 mm of a Tx antenna were tested at a distance of 10 mm.

1.8 Power Reduction for SAR

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

1.9 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D01, D05, D06 (2G/3G/4G and Hotspot)
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r03, D02v01r01 (SAR Measurements up to 6 GHz)
- April 2013 TCB Workshop Notes (IEEE 802.11ac)

1.10 Device Serial Numbers

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

	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
Cell. CDMA/EVDO	1LWF2	1LWF2	1LWF2
PCS CDMA/EVDO	1LWF2	1LWF2	1LWF2
LTE Band 12	1LYF7	1LYF7	1LYF7
LTE Band 5 (Cell)	1LYF7	1LYF7	1LYF7
LTE Band 4 (AWS)	1LYF7	1LYF7	1LYF7
LTE Band 25 (PCS)	1LYF7	1LYF7	1LYF7
2.4 GHz WLAN	1LWF8	1LWF8	1LWF8
5 GHz WLAN	1LWF8	1LWF8	1LWF8

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LTE INFORMATION

LTE Information			
FCC ID	ZNFUS995		
Form Factor	Portable Handset		
Frequency Range of each LTE transmission band	LTE Band 12 (699.7 - 715.3 MHz)		
	LTE Band 17 (706.5 - 713.5 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 25 (PCS) (1850.7 - 1914.3 MHz)		
	LTE Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz		
	LTE Band 17: 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		
Channel Numbers and Frequencies (MHz)	LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 25 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 12: 1.4 MHz		
	LTE Band 12: 3 MHz		
	LTE Band 12: 5 MHz		
Channel Numbers and Frequencies (MHz)	LTE Band 12: 10 MHz		
	LTE Band 17: 5 MHz		
	LTE Band 17: 10 MHz		
	LTE Band 5 (Cell): 1.4 MHz		
	LTE Band 5 (Cell): 3 MHz		
Channel Numbers and Frequencies (MHz)	LTE Band 5 (Cell): 5 MHz		
	LTE Band 5 (Cell): 10 MHz		
	LTE Band 4 (AWS): 1.4 MHz		
	LTE Band 4 (AWS): 3 MHz		
	LTE Band 4 (AWS): 5 MHz		
Channel Numbers and Frequencies (MHz)	LTE Band 4 (AWS): 10 MHz		
	LTE Band 4 (AWS): 15 MHz		
	LTE Band 4 (AWS): 20 MHz		
	LTE Band 2 (PCS): 1.4 MHz		
	LTE Band 2 (PCS): 3 MHz		
Channel Numbers and Frequencies (MHz)	LTE Band 2 (PCS): 5 MHz		
	LTE Band 2 (PCS): 10 MHz		
	LTE Band 2 (PCS): 15 MHz		
	LTE Band 2 (PCS): 20 MHz		
	LTE Band 25 (PCS): 1.4 MHz		
Channel Numbers and Frequencies (MHz)	LTE Band 25 (PCS): 3 MHz		
	LTE Band 25 (PCS): 5 MHz		
	LTE Band 25 (PCS): 10 MHz		
	LTE Band 25 (PCS): 15 MHz		
	LTE Band 25 (PCS): 20 MHz		
UE Category	6		
Modulations Supported in UL	QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3-6.2.5? (manufacturer attestation to be provided)	YES		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		
LTE Carrier Aggregation Possible Combinations	LTE B4 (PCC) + LTE B12 (SCC)	LTE B4 (PCC) + LTE B5 (SCC)	LTE B5 (PCC) + LTE B4 (SCC)
	5 MHz (B4) + 5 MHz (B12)	5 MHz (B4) + 5 MHz (B5)	5 MHz (B5) + 5 MHz (B4)
	5MHz (B4) + 10MHz (B12)	5MHz (B4) + 10MHz (B5)	5MHz (B5) + 10MHz (B4)
	10MHz (B4) + 5MHz (B12)	10MHz (B4) + 5MHz (B5)	5 MHz (B5) + 15 MHz (B4)
	10MHz (B4) + 10MHz (B12)	10MHz (B4) + 10MHz (B5)	5MHz (B5) + 20MHz (B4)
	15 MHz (B4) + 5 MHz (B12)	15 MHz (B4) + 5 MHz (B5)	10MHz (B5) + 5MHz (B4)
	15MHz (B4) + 10MHz (B12)	15MHz (B4) + 10MHz (B5)	10MHz (B5) + 10MHz (B4)
	20MHz (B4) + 5MHz (B12)	20MHz (B4) + 5MHz (B5)	10MHz (B5) + 15MHz (B4)
	20MHz (B4) + 10MHz (B12)	20MHz (B4) + 10MHz (B5)	10MHz (B5) + 20MHz (B4)
LTE Carrier Aggregation Additional Information	This device does not support full CA features on 3GPP Release 10. It supports a maximum of 2 carriers in the downlink with a total maximum bandwidth of 30 MHz of the spectrum. All uplink communications are identical to the Release 8 Specifications. Uplink communications are done on the PCC. Due to carrier capability, only the combinations listed above are supported. The following LTE Release 10 Features are not supported: Relay, HetNet, Enhanced MIMO, eICI, WiFi Offloading, MDH, eMBMA, Cross-Carrier Scheduling, Enhanced SC-FDMA.		

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

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

3.1 SAR Definition

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

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

- σ = conductivity of the tissue-simulating material (S/m)
- ρ = mass density of the tissue-simulating material (kg/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 D01v01 and IEEE 1528-2013:

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

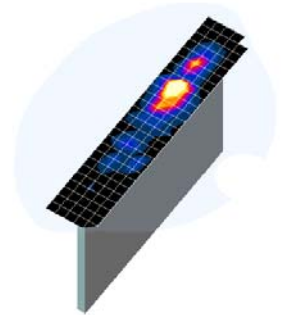


Figure 4-1
Sample SAR Area Scan

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

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

*Also compliant to IEEE 1528-2013 Table 6

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5

DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

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

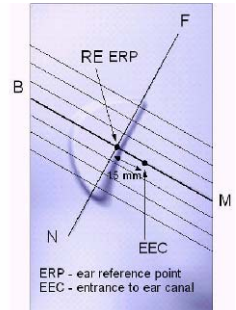


Figure 5-1
Close-Up Side view
of ERP

5.2 HANDSET REFERENCE POINTS

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the acoustic output located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (See Figure 5-3). The acoustic output was 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

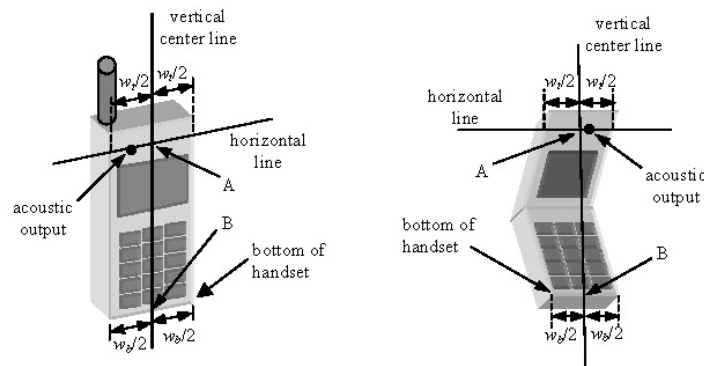


Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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6 TEST CONFIGURATION POSITIONS FOR HANDSETS

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.

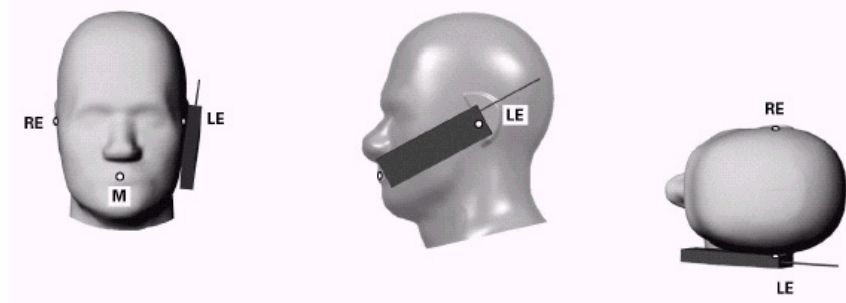


Figure 6-1 Front, Side and Top View of Cheek Position

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

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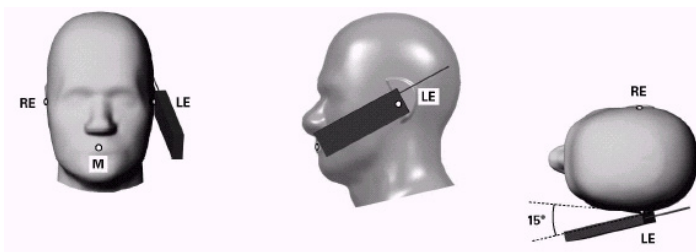


Figure 6-2 Front, Side and Top View of Ear/15° Tilt Position

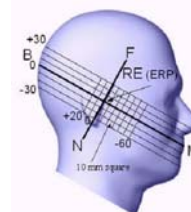


Figure 6-3 Side view w/ relevant markings

6.4 Body-Worn Accessory Configurations

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

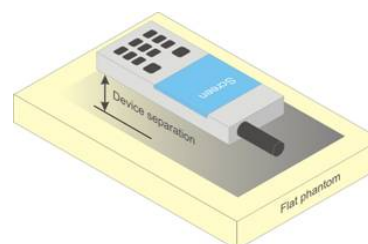


Figure 6-4 Sample Body-Worn Diagram

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

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

6.5 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

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the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 44798 D01v05 should be applied to determine SAR test requirements.

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

6.6 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 D06 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 D01v05 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

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

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

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

8.1 Measured and Reported SAR

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

8.2 Procedures Used to Establish RF Signal for SAR

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

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

8.3 SAR Measurement Conditions for CDMA2000

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

8.3.1 Output Power Verification

See 3GPP2 C.S0011/TIA-98-E as recommended by "SAR Measurement Procedures for 3G Devices" v02, October 2007. Maximum output power is verified on the High, Middle and Low channels according to procedures in section 4.4.5.2 of 3GPP2 C.S0011/TIA-98-E. SO55 tests were measured with power control bits in the "All Up" condition.

1. If the mobile station (MS) supports Reverse TCH RC 1 and Forward TCH RC 1, set up a call using Fundamental Channel Test Mode 1 (RC=1/1) with 9600 bps data rate only.
2. Under RC1, C.S0011 Table 4.4.5.2-1, Table 8-1 parameters were applied.
3. If the MS supports the RC 3 Reverse FCH, RC3 Reverse SCH₀ and demodulation of RC 3,4, or 5, set up a call using Supplemental Channel Test Mode 3 (RC 3/3) with 9600 bps Fundamental Channel and 9600 bps SCH₀ data rate.
4. Under RC3, C.S0011 Table 4.4.5.2-2, Table 8-2 was applied.

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Table 8-1
Parameters for Max. Power for RC1

Parameter	Units	Value
I_{or}	dBm/1.23 MHz	-104
$\frac{Pilot E_c}{I_{or}}$	dB	-7
$\frac{Traffic E_c}{I_{or}}$	dB	-7.4

Table 8-2
Parameters for Max. Power for RC3

Parameter	Units	Value
I_{or}	dBm/1.23 MHz	-86
$\frac{Pilot E_c}{I_{or}}$	dB	-7
$\frac{Traffic E_c}{I_{or}}$	dB	-7.4

5. FCHs were configured at full rate for maximum SAR with “All Up” power control bits.

8.3.2 Head SAR Measurements

SAR for head exposure configurations is measured in RC3 with the DUT configured to transmit at full rate using Loopback Service Option SO55. SAR for RC1 is not required when the maximum average output of each channel is less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel in RC1 using the exposure configuration that results in the highest SAR for that channel in RC3.

Head SAR was additionally evaluated using EVDO Rev. A to support compliance for VoIP operations. See Section 8.3.4 for EVDO Rev. A configuration parameters.

8.3.3 Body SAR Measurements

SAR for body exposure configurations is measured in RC3 with the DUT configured to transmit at full rate on FCH with all other code channels disabled using TDSO / SO32. SAR for multiple code channels (FCH + SCH_n) is not required when the maximum average output of each RF channel is less than ¼ dB higher than that measured with FCH only. Otherwise, SAR is measured on the maximum output channel (FCH + SCH_n) with FCH at full rate and SCH₀ enabled at 9600 bps using the exposure configuration that results in the highest SAR for that channel with FCH only. When multiple code channels are enabled, the DUT output may shift by more than 0.5 dB and lead to higher SAR drifts and SCH dropouts. Body SAR was measured using TDSO / SO32 with power control bits in the “All Up”

Body SAR in RC1 is not required when the maximum average output of each channel is less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel in RC1; with Loopback Service Option SO55, at full rate, using the body exposure configuration that results in the highest SAR for that channel in RC3.

8.3.4 Handsets with EVDO

For handsets with Ev-Do capabilities, when the maximum average output of each channel in Rev. 0 is less than ¼ dB higher than that measured in RC3 (1x RTT), body SAR for EV-DO is not required. Otherwise, SAR for Rev. 0 is measured on the maximum output channel at 153.6 kbps using the body exposure configuration that results in the highest SAR for that channel in RC3. SAR for Rev. A is not required when the maximum average output of each channel is less than that measured in Rev. 0 or less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel for Rev. A using a Reverse Data Channel payload size of 4096 bits and a Termination Target of 16 slots defined for Subtype 2 Physical Layer configurations. A Forward Traffic Channel data rate corresponding to the 2-slot version of 307.2 kbps with the ACK Channel transmitting in all slots would be configured in the downlink for both Rev. 0 and Rev. A.

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8.3.5 Body SAR Measurements for EVDO Hotspot

Hotspot Body SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0 per KDB Publication 941225 D01 procedures for “1x Ev-Do data Devices”. SAR for Subtype 2 Physical layer configurations is not required for Rev. A when the maximum average output of each RF channels is less than that measured in Subtype 0/1 Physical layer configurations. Otherwise, SAR is measured on the maximum output channel for Rev. A using the exposure configuration that results in the highest SAR for the RF channels in Rev. 0. The AT is tested with a Reverse Data Channel rate of 153.6 kbps in Subtype 0/1 Physical Layer configurations; and a Reverse Data Channel payload size of 4096 bits and Termination Target of 16 slots in Subtype 2 Physical Layer configurations.

SAR is not required for 1x RTT for Ev-Do devices that also support 1x RTT voice and/or data operations, when the maximum average output of each channel is less than 1/4 dB higher than that measured in Subtype 0/1 Physical Layer configurations for Rev. 0. Otherwise, CDMA “Body-SAR Measurement” procedures for “CDMA 2000 1x Handsets” were applied.

8.4 SAR Measurement Conditions for LTE

LTE modes were tested according to FCC KDB 941225 D05 publication. Please see notes after the tabulated SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 was used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

8.4.1 Spectrum Plots for RB Configurations

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

8.4.2 MPR

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

8.4.3 A-MPR

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

8.4.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05:

- 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.

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- 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.

8.4.5 Carrier Aggregation

LTE Carrier Aggregation (CA) measurements were made in accordance to 3GPP TS 36.521-1 V10.4.0 (2012-12). The RRC connection is only handled by one cell, the Primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds the Secondary component carrier (SCC) on the downlink only. All uplink communications and acknowledgements remain identical to release 8 specifications on the PCC. Additional output powers were measured using two carriers in the downlink for the release 8 configurations with the highest output power among all channels, RB configurations and bandwidths for each uplink band. Per FCC Guidance, no SAR measurements were required.

8.5 SAR Testing with 802.11 Transmitters

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

8.5.1 General Device Setup

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

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8.5.2 Frequency Channel Configurations [24]

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

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

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

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9 RF CONDUCTED POWERS

9.1 CDMA Conducted Powers

Band	Channel	Frequency	SO55 [dBm]	SO55 [dBm]	TDSO SO32 [dBm]	TDSO SO32 [dBm]	1x EvDO Rev. 0 [dBm]	1x EvDO Rev. A [dBm]
	F-RC	MHz	RC1	RC3	FCH+SCH	FCH	(RTAP)	(RETAP)
Cellular	1013	824.7	25.05	25.04	25.05	25.03	25.11	25.05
	384	836.52	25.09	25.15	25.07	25.10	25.13	25.12
	777	848.31	25.10	25.11	25.10	25.01	25.05	25.03
PCS	25	1851.25	24.54	24.58	24.55	24.57	24.67	24.65
	600	1880	24.55	24.67	24.58	24.60	24.69	24.68
	1175	1908.75	24.60	24.59	24.56	24.50	24.60	24.61

Note: RC1 is only applicable for IS-95 compatibility.

Per KDB Publication 941225 D01:

1. Head SAR was tested with SO55 RC3. SO55 RC1 was not required since the average output power was not more than 0.25 dB than the SO55 RC3 powers. Head SAR was additionally evaluated with EVDO Rev. A to determine compliance for held-to-ear VOIP operations.
2. Body-Worn SAR was tested with 1x RTT with TDSO / SO32 FCH Only. Ev-Do and TDSO / SO32 FCH+SCH SAR tests were not required since the average output power was not more than 0.25 dB higher than the TDSO / SO32 FCH only powers.
3. Hotspot SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0. If the average output power of Subtype 2 for Rev. A is less than the Rev. 0 power levels, then Rev. A SAR is not required. Otherwise, SAR is measured on the maximum output channel for Rev. A using the exposure configuration that results in the highest SAR for that RF channel in Rev. 0. SAR is not required for 1x RTT for Ev-Do hotspot devices when the maximum average output of each channel is less than 1/4 dB higher than that measured in Subtype 0/1 Physical Layer configurations for Rev. 0

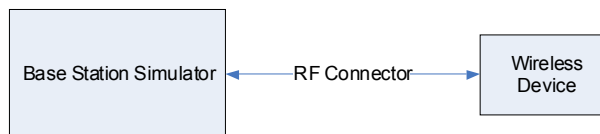


Figure 9-1
Power Measurement Setup

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9.2 LTE Conducted Powers

9.2.1 LTE Band 12

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	707.5	23095	10	QPSK	1	0	24.50	0	0
	707.5	23095	10	QPSK	1	25	24.45	0	0
	707.5	23095	10	QPSK	1	49	24.46	0	0
	707.5	23095	10	QPSK	25	0	23.39	0-1	1
	707.5	23095	10	QPSK	25	12	23.19	0-1	1
	707.5	23095	10	QPSK	25	25	23.31	0-1	1
	707.5	23095	10	QPSK	50	0	23.35	0-1	1
	707.5	23095	10	16QAM	1	0	23.12	0-1	1
	707.5	23095	10	16QAM	1	25	23.49	0-1	1
	707.5	23095	10	16QAM	1	49	23.19	0-1	1
	707.5	23095	10	16QAM	25	0	22.08	0-2	2
	707.5	23095	10	16QAM	25	12	22.00	0-2	2
	707.5	23095	10	16QAM	25	25	22.14	0-2	2
	707.5	23095	10	16QAM	50	0	22.13	0-2	2

Note: LTE Band 12 at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05, 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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	701.5	23035	5	QPSK	1	0	24.29	0	0
	701.5	23035	5	QPSK	1	12	24.36	0	0
	701.5	23035	5	QPSK	1	24	24.28	0	0
	701.5	23035	5	QPSK	12	0	23.50	0-1	1
	701.5	23035	5	QPSK	12	6	23.45	0-1	1
	701.5	23035	5	QPSK	12	13	23.50	0-1	1
	701.5	23035	5	QPSK	25	0	23.47	0-1	1
	701.5	23035	5	16-QAM	1	0	23.23	0-1	1
	701.5	23035	5	16-QAM	1	12	23.29	0-1	1
	701.5	23035	5	16-QAM	1	24	23.24	0-1	1
	701.5	23035	5	16-QAM	12	0	22.19	0-2	2
	701.5	23035	5	16-QAM	12	6	22.23	0-2	2
	701.5	23035	5	16-QAM	12	13	22.26	0-2	2
	701.5	23035	5	16-QAM	25	0	22.14	0-2	2
Mid	707.5	23095	5	QPSK	1	0	24.36	0	0
	707.5	23095	5	QPSK	1	12	24.47	0	0
	707.5	23095	5	QPSK	1	24	24.28	0	0
	707.5	23095	5	QPSK	12	0	23.38	0-1	1
	707.5	23095	5	QPSK	12	6	23.42	0-1	1
	707.5	23095	5	QPSK	12	13	23.47	0-1	1
	707.5	23095	5	QPSK	25	0	23.47	0-1	1
	707.5	23095	5	16-QAM	1	0	23.00	0-1	1
	707.5	23095	5	16-QAM	1	12	23.07	0-1	1
	707.5	23095	5	16-QAM	1	24	23.22	0-1	1
	707.5	23095	5	16-QAM	12	0	22.16	0-2	2
	707.5	23095	5	16-QAM	12	6	22.24	0-2	2
	707.5	23095	5	16-QAM	12	13	22.32	0-2	2
	707.5	23095	5	16-QAM	25	0	22.26	0-2	2
High	713.5	23155	5	QPSK	1	0	24.25	0	0
	713.5	23155	5	QPSK	1	12	24.48	0	0
	713.5	23155	5	QPSK	1	24	24.32	0	0
	713.5	23155	5	QPSK	12	0	23.30	0-1	1
	713.5	23155	5	QPSK	12	6	23.29	0-1	1
	713.5	23155	5	QPSK	12	13	23.37	0-1	1
	713.5	23155	5	QPSK	25	0	23.34	0-1	1
	713.5	23155	5	16-QAM	1	0	23.48	0-1	1
	713.5	23155	5	16-QAM	1	12	23.44	0-1	1
	713.5	23155	5	16-QAM	1	24	23.50	0-1	1
	713.5	23155	5	16-QAM	12	0	22.10	0-2	2
	713.5	23155	5	16-QAM	12	6	22.17	0-2	2
	713.5	23155	5	16-QAM	12	13	22.06	0-2	2
	713.5	23155	5	16-QAM	25	0	22.00	0-2	2

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	700.5	23025	3	QPSK	1	0	24.14	0	0
	700.5	23025	3	QPSK	1	7	24.45	0	0
	700.5	23025	3	QPSK	1	14	24.30	0	0
	700.5	23025	3	QPSK	8	0	23.12	0-1	1
	700.5	23025	3	QPSK	8	4	23.14	0-1	1
	700.5	23025	3	QPSK	8	7	23.18	0-1	1
	700.5	23025	3	QPSK	15	0	23.14	0-1	1
	700.5	23025	3	16-QAM	1	0	23.44	0-1	1
	700.5	23025	3	16-QAM	1	7	23.40	0-1	1
	700.5	23025	3	16-QAM	1	14	23.33	0-1	1
	700.5	23025	3	16-QAM	8	0	22.00	0-2	2
	700.5	23025	3	16-QAM	8	4	22.01	0-2	2
	700.5	23025	3	16-QAM	8	7	22.04	0-2	2
	700.5	23025	3	16-QAM	15	0	22.13	0-2	2
	707.5	23095	3	QPSK	1	0	24.40	0	0
Mid	707.5	23095	3	QPSK	1	7	24.50	0	0
	707.5	23095	3	QPSK	1	14	24.47	0	0
	707.5	23095	3	QPSK	8	0	23.33	0-1	1
	707.5	23095	3	QPSK	8	4	23.36	0-1	1
	707.5	23095	3	QPSK	8	7	23.44	0-1	1
	707.5	23095	3	QPSK	15	0	23.37	0-1	1
	707.5	23095	3	16-QAM	1	0	23.46	0-1	1
	707.5	23095	3	16-QAM	1	7	23.36	0-1	1
	707.5	23095	3	16-QAM	1	14	23.49	0-1	1
	707.5	23095	3	16-QAM	8	0	22.01	0-2	2
	707.5	23095	3	16-QAM	8	4	22.05	0-2	2
	707.5	23095	3	16-QAM	8	7	22.10	0-2	2
	707.5	23095	3	16-QAM	15	0	22.05	0-2	2
	714.5	23165	3	QPSK	1	0	24.41	0	0
	714.5	23165	3	QPSK	1	7	24.48	0	0
High	714.5	23165	3	QPSK	1	14	24.35	0	0
	714.5	23165	3	QPSK	8	0	23.22	0-1	1
	714.5	23165	3	QPSK	8	4	23.23	0-1	1
	714.5	23165	3	QPSK	8	7	23.21	0-1	1
	714.5	23165	3	QPSK	15	0	23.24	0-1	1
	714.5	23165	3	16-QAM	1	0	23.35	0-1	1
	714.5	23165	3	16-QAM	1	7	23.15	0-1	1
	714.5	23165	3	16-QAM	1	14	23.04	0-1	1
	714.5	23165	3	16-QAM	8	0	22.08	0-2	2
	714.5	23165	3	16-QAM	8	4	22.02	0-2	2
	714.5	23165	3	16-QAM	8	7	22.06	0-2	2
	714.5	23165	3	16-QAM	15	0	22.00	0-2	2

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	699.7	23017	1.4	QPSK	1	0	24.31	0	0
	699.7	23017	1.4	QPSK	1	2	24.17	0	0
	699.7	23017	1.4	QPSK	1	5	24.45	0	0
	699.7	23017	1.4	QPSK	3	0	24.32	0	0
	699.7	23017	1.4	QPSK	3	2	24.32	0	0
	699.7	23017	1.4	QPSK	3	3	24.22	0	0
	699.7	23017	1.4	QPSK	6	0	23.11	0-1	1
	699.7	23017	1.4	16-QAM	1	0	23.09	0-1	1
	699.7	23017	1.4	16-QAM	1	2	23.17	0-1	1
	699.7	23017	1.4	16-QAM	1	5	23.16	0-1	1
	699.7	23017	1.4	16-QAM	3	0	23.22	0-1	1
	699.7	23017	1.4	16-QAM	3	2	23.23	0-1	1
Mid	707.5	23095	1.4	QPSK	1	0	24.44	0	0
	707.5	23095	1.4	QPSK	1	2	24.43	0	0
	707.5	23095	1.4	QPSK	1	5	24.44	0	0
	707.5	23095	1.4	QPSK	3	0	24.47	0	0
	707.5	23095	1.4	QPSK	3	2	24.44	0	0
	707.5	23095	1.4	QPSK	3	3	24.44	0	0
	707.5	23095	1.4	QPSK	6	0	23.07	0-1	1
	707.5	23095	1.4	16-QAM	1	0	23.42	0-1	1
	707.5	23095	1.4	16-QAM	1	2	23.22	0-1	1
	707.5	23095	1.4	16-QAM	1	5	23.49	0-1	1
	707.5	23095	1.4	16-QAM	3	0	23.50	0-1	1
	707.5	23095	1.4	16-QAM	3	2	23.40	0-1	1
High	715.3	23173	1.4	QPSK	3	3	23.49	0-1	1
	707.5	23095	1.4	16-QAM	6	0	22.50	0-2	2
	715.3	23173	1.4	QPSK	1	0	24.18	0	0
	715.3	23173	1.4	QPSK	1	2	24.25	0	0
	715.3	23173	1.4	QPSK	1	5	24.08	0	0
	715.3	23173	1.4	QPSK	3	0	24.20	0	0
	715.3	23173	1.4	QPSK	3	2	24.23	0	0
	715.3	23173	1.4	QPSK	3	3	24.19	0	0
	715.3	23173	1.4	QPSK	6	0	23.19	0-1	1
	715.3	23173	1.4	16-QAM	1	0	23.32	0-1	1
	715.3	23173	1.4	16-QAM	1	2	23.40	0-1	1
	715.3	23173	1.4	16-QAM	1	5	23.02	0-1	1
	715.3	23173	1.4	16-QAM	3	0	23.27	0-1	1
	715.3	23173	1.4	16-QAM	3	2	23.03	0-1	1
	715.3	23173	1.4	16-QAM	3	3	23.00	0-1	1
	715.3	23173	1.4	16-QAM	6	0	22.05	0-2	2

9.2.2 LTE Band 5 (Cell)

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	836.5	20525	10	QPSK	1	0	24.12	0	0
	836.5	20525	10	QPSK	1	25	23.92	0	0
	836.5	20525	10	QPSK	1	49	24.01	0	0
	836.5	20525	10	QPSK	25	0	22.85	0-1	1
	836.5	20525	10	QPSK	25	12	22.87	0-1	1
	836.5	20525	10	QPSK	25	25	22.84	0-1	1
	836.5	20525	10	QPSK	50	0	22.81	0-1	1
	836.5	20525	10	16QAM	1	0	22.82	0-1	1
	836.5	20525	10	16QAM	1	25	22.71	0-1	1
	836.5	20525	10	16QAM	1	49	22.78	0-1	1
	836.5	20525	10	16QAM	25	0	21.71	0-2	2
	836.5	20525	10	16QAM	25	12	21.75	0-2	2
	836.5	20525	10	16QAM	25	25	21.73	0-2	2
	836.5	20525	10	16QAM	50	0	21.70	0-2	2

Note: LTE Band 5 (Cell) at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	826.5	20425	5	QPSK	1	0	23.82	0	0
	826.5	20425	5	QPSK	1	12	24.11	0	0
	826.5	20425	5	QPSK	1	24	23.95	0	0
	826.5	20425	5	QPSK	12	0	22.46	0-1	1
	826.5	20425	5	QPSK	12	6	22.49	0-1	1
	826.5	20425	5	QPSK	12	13	22.48	0-1	1
	826.5	20425	5	QPSK	25	0	22.50	0-1	1
	826.5	20425	5	16-QAM	1	0	22.82	0-1	1
	826.5	20425	5	16-QAM	1	12	22.61	0-1	1
	826.5	20425	5	16-QAM	1	24	22.87	0-1	1
	826.5	20425	5	16-QAM	12	0	21.31	0-2	2
	826.5	20425	5	16-QAM	12	6	21.36	0-2	2
	826.5	20425	5	16-QAM	12	13	21.35	0-2	2
	826.5	20425	5	16-QAM	25	0	21.28	0-2	2
	836.5	20525	5	QPSK	1	0	24.00	0	0
	836.5	20525	5	QPSK	1	12	23.96	0	0
Mid	836.5	20525	5	QPSK	1	24	23.91	0	0
	836.5	20525	5	QPSK	12	0	22.74	0-1	1
	836.5	20525	5	QPSK	12	6	22.60	0-1	1
	836.5	20525	5	QPSK	12	13	22.56	0-1	1
	836.5	20525	5	QPSK	25	0	22.64	0-1	1
	836.5	20525	5	16-QAM	1	0	22.54	0-1	1
	836.5	20525	5	16-QAM	1	12	22.22	0-1	1
	836.5	20525	5	16-QAM	1	24	22.50	0-1	1
	836.5	20525	5	16-QAM	12	0	21.49	0-2	2
	836.5	20525	5	16-QAM	12	6	21.54	0-2	2
	836.5	20525	5	16-QAM	12	13	21.48	0-2	2
	836.5	20525	5	16-QAM	25	0	21.52	0-2	2
	846.5	20625	5	QPSK	1	0	23.96	0	0
	846.5	20625	5	QPSK	1	12	23.99	0	0
	846.5	20625	5	QPSK	1	24	23.85	0	0
	846.5	20625	5	QPSK	12	0	22.68	0-1	1
High	846.5	20625	5	QPSK	12	6	22.61	0-1	1
	846.5	20625	5	QPSK	12	13	22.54	0-1	1
	846.5	20625	5	QPSK	25	0	22.62	0-1	1
	846.5	20625	5	16-QAM	1	0	22.58	0-1	1
	846.5	20625	5	16-QAM	1	12	22.46	0-1	1
	846.5	20625	5	16-QAM	1	24	22.52	0-1	1
	846.5	20625	5	16-QAM	12	0	21.57	0-2	2
	846.5	20625	5	16-QAM	12	6	21.55	0-2	2
	846.5	20625	5	16-QAM	12	13	21.50	0-2	2
	846.5	20625	5	16-QAM	25	0	21.49	0-2	2

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	825.5	20415	3	QPSK	1	0	23.71	0	0
	825.5	20415	3	QPSK	1	7	23.71	0	0
	825.5	20415	3	QPSK	1	14	23.66	0	0
	825.5	20415	3	QPSK	8	0	22.53	0-1	1
	825.5	20415	3	QPSK	8	4	22.50	0-1	1
	825.5	20415	3	QPSK	8	7	22.48	0-1	1
	825.5	20415	3	QPSK	15	0	22.49	0-1	1
	825.5	20415	3	16-QAM	1	0	22.76	0-1	1
	825.5	20415	3	16-QAM	1	7	22.59	0-1	1
	825.5	20415	3	16-QAM	1	14	22.74	0-1	1
	825.5	20415	3	16-QAM	8	0	21.50	0-2	2
	825.5	20415	3	16-QAM	8	4	21.43	0-2	2
	825.5	20415	3	16-QAM	8	7	21.41	0-2	2
	825.5	20415	3	16-QAM	15	0	21.30	0-2	2
	825.5	20415	3	16-QAM	15	0	21.30	0-2	2
Mid	836.5	20525	3	QPSK	1	0	23.96	0	0
	836.5	20525	3	QPSK	1	7	23.91	0	0
	836.5	20525	3	QPSK	1	14	23.82	0	0
	836.5	20525	3	QPSK	8	0	22.62	0-1	1
	836.5	20525	3	QPSK	8	4	22.63	0-1	1
	836.5	20525	3	QPSK	8	7	22.65	0-1	1
	836.5	20525	3	QPSK	15	0	22.64	0-1	1
	836.5	20525	3	16-QAM	1	0	22.42	0-1	1
	836.5	20525	3	16-QAM	1	7	22.40	0-1	1
	836.5	20525	3	16-QAM	1	14	22.32	0-1	1
	836.5	20525	3	16-QAM	8	0	21.46	0-2	2
	836.5	20525	3	16-QAM	8	4	21.38	0-2	2
	836.5	20525	3	16-QAM	8	7	21.43	0-2	2
	836.5	20525	3	16-QAM	15	0	21.46	0-2	2
	836.5	20525	3	16-QAM	15	0	21.46	0-2	2
High	847.5	20635	3	QPSK	1	0	23.84	0	0
	847.5	20635	3	QPSK	1	7	24.12	0	0
	847.5	20635	3	QPSK	1	14	23.81	0	0
	847.5	20635	3	QPSK	8	0	22.69	0-1	1
	847.5	20635	3	QPSK	8	4	22.65	0-1	1
	847.5	20635	3	QPSK	8	7	22.63	0-1	1
	847.5	20635	3	QPSK	15	0	22.68	0-1	1
	847.5	20635	3	16-QAM	1	0	22.40	0-1	1
	847.5	20635	3	16-QAM	1	7	22.77	0-1	1
	847.5	20635	3	16-QAM	1	14	22.51	0-1	1
	847.5	20635	3	16-QAM	8	0	21.46	0-2	2
	847.5	20635	3	16-QAM	8	4	21.45	0-2	2
	847.5	20635	3	16-QAM	8	7	21.43	0-2	2
	847.5	20635	3	16-QAM	15	0	21.62	0-2	2
	847.5	20635	3	16-QAM	15	0	21.62	0-2	2

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	824.7	20407	1.4	QPSK	1	0	23.79	0	0
	824.7	20407	1.4	QPSK	1	2	23.76	0	0
	824.7	20407	1.4	QPSK	1	5	23.75	0	0
	824.7	20407	1.4	QPSK	3	0	23.56	0	0
	824.7	20407	1.4	QPSK	3	2	23.62	0	0
	824.7	20407	1.4	QPSK	3	3	23.63	0	0
	824.7	20407	1.4	QPSK	6	0	22.44	0-1	1
	824.7	20407	1.4	16-QAM	1	0	22.21	0-1	1
	824.7	20407	1.4	16-QAM	1	2	22.26	0-1	1
	824.7	20407	1.4	16-QAM	1	5	22.34	0-1	1
	824.7	20407	1.4	16-QAM	3	0	22.23	0-1	1
	824.7	20407	1.4	16-QAM	3	2	22.22	0-1	1
Mid	824.7	20407	1.4	16-QAM	3	3	22.24	0-1	1
	824.7	20407	1.4	16-QAM	6	0	21.45	0-2	2
	836.5	20525	1.4	QPSK	1	0	23.90	0	0
	836.5	20525	1.4	QPSK	1	2	23.87	0	0
	836.5	20525	1.4	QPSK	1	5	23.87	0	0
	836.5	20525	1.4	QPSK	3	0	23.74	0	0
	836.5	20525	1.4	QPSK	3	2	23.73	0	0
	836.5	20525	1.4	QPSK	3	3	23.73	0	0
	836.5	20525	1.4	QPSK	6	0	22.56	0-1	1
	836.5	20525	1.4	16-QAM	1	0	22.45	0-1	1
	836.5	20525	1.4	16-QAM	1	2	22.71	0-1	1
	836.5	20525	1.4	16-QAM	1	5	22.44	0-1	1
High	836.5	20525	1.4	16-QAM	3	0	22.43	0-1	1
	836.5	20525	1.4	16-QAM	3	2	22.42	0-1	1
	836.5	20525	1.4	16-QAM	3	3	22.46	0-1	1
	836.5	20525	1.4	16-QAM	6	0	21.48	0-2	2
	848.3	20643	1.4	QPSK	1	0	23.85	0	0
	848.3	20643	1.4	QPSK	1	2	23.93	0	0
	848.3	20643	1.4	QPSK	1	5	23.86	0	0
	848.3	20643	1.4	QPSK	3	0	23.69	0	0
	848.3	20643	1.4	QPSK	3	2	23.74	0	0
	848.3	20643	1.4	QPSK	3	3	23.71	0	0
	848.3	20643	1.4	QPSK	6	0	22.54	0-1	1
	848.3	20643	1.4	16-QAM	1	0	22.29	0-1	1
	848.3	20643	1.4	16-QAM	1	2	22.24	0-1	1
	848.3	20643	1.4	16-QAM	1	5	22.35	0-1	1
	848.3	20643	1.4	16-QAM	3	0	22.85	0-1	1
	848.3	20643	1.4	16-QAM	3	2	22.87	0-1	1
	848.3	20643	1.4	16-QAM	3	3	22.81	0-1	1
	848.3	20643	1.4	16-QAM	6	0	22.20	0-2	2

9.2.3

LTE Band 4 (AWS)

Table 9-9

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	1732.5	20175	20	QPSK	1	0	24.17	0	0
	1732.5	20175	20	QPSK	1	50	23.92	0	0
	1732.5	20175	20	QPSK	1	99	23.87	0	0
	1732.5	20175	20	QPSK	50	0	22.47	0-1	1
	1732.5	20175	20	QPSK	50	25	22.39	0-1	1
	1732.5	20175	20	QPSK	50	50	22.33	0-1	1
	1732.5	20175	20	QPSK	100	0	22.36	0-1	1
	1732.5	20175	20	16QAM	1	0	23.20	0-1	1
	1732.5	20175	20	16QAM	1	50	22.84	0-1	1
	1732.5	20175	20	16QAM	1	99	22.88	0-1	1
	1732.5	20175	20	16QAM	50	0	21.35	0-2	2
	1732.5	20175	20	16QAM	50	25	21.22	0-2	2
	1732.5	20175	20	16QAM	50	50	21.22	0-2	2
	1732.5	20175	20	16QAM	100	0	21.21	0-2	2

Note: LTE Band 4 (AWS) at 20 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05, 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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1717.5	20025	15	QPSK	1	0	23.33	0	0
	1717.5	20025	15	QPSK	1	36	23.52	0	0
	1717.5	20025	15	QPSK	1	74	23.62	0	0
	1717.5	20025	15	QPSK	36	0	22.71	0-1	1
	1717.5	20025	15	QPSK	36	18	22.38	0-1	1
	1717.5	20025	15	QPSK	36	37	22.45	0-1	1
	1717.5	20025	15	QPSK	75	0	22.47	0-1	1
	1717.5	20025	15	16QAM	1	0	23.00	0-1	1
	1717.5	20025	15	16QAM	1	36	22.61	0-1	1
	1717.5	20025	15	16QAM	1	74	22.82	0-1	1
	1717.5	20025	15	16QAM	36	0	21.72	0-2	2
	1717.5	20025	15	16QAM	36	18	21.27	0-2	2
	1717.5	20025	15	16QAM	36	37	21.29	0-2	2
	1717.5	20025	15	16QAM	75	0	21.35	0-2	2
Mid	1732.5	20175	15	QPSK	1	0	23.35	0	0
	1732.5	20175	15	QPSK	1	36	23.31	0	0
	1732.5	20175	15	QPSK	1	74	23.25	0	0
	1732.5	20175	15	QPSK	36	0	22.50	0-1	1
	1732.5	20175	15	QPSK	36	18	22.32	0-1	1
	1732.5	20175	15	QPSK	36	37	22.33	0-1	1
	1732.5	20175	15	QPSK	75	0	22.37	0-1	1
	1732.5	20175	15	16QAM	1	0	22.87	0-1	1
	1732.5	20175	15	16QAM	1	36	22.68	0-1	1
	1732.5	20175	15	16QAM	1	74	22.69	0-1	1
	1732.5	20175	15	16QAM	36	0	21.32	0-2	2
	1732.5	20175	15	16QAM	36	18	21.22	0-2	2
	1732.5	20175	15	16QAM	36	37	21.21	0-2	2
	1732.5	20175	15	16QAM	75	0	21.21	0-2	2
High	1747.5	20325	15	QPSK	1	0	23.31	0	0
	1747.5	20325	15	QPSK	1	36	23.20	0	0
	1747.5	20325	15	QPSK	1	74	23.42	0	0
	1747.5	20325	15	QPSK	36	0	22.24	0-1	1
	1747.5	20325	15	QPSK	36	18	22.35	0-1	1
	1747.5	20325	15	QPSK	36	37	22.34	0-1	1
	1747.5	20325	15	QPSK	75	0	22.28	0-1	1
	1747.5	20325	15	16QAM	1	0	22.81	0-1	1
	1747.5	20325	15	16QAM	1	36	22.72	0-1	1
	1747.5	20325	15	16QAM	1	74	22.75	0-1	1
	1747.5	20325	15	16QAM	36	0	21.43	0-2	2
	1747.5	20325	15	16QAM	36	18	21.22	0-2	2
	1747.5	20325	15	16QAM	36	37	21.22	0-2	2
	1747.5	20325	15	16QAM	75	0	21.20	0-2	2

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1715	20000	10	QPSK	1	0	23.40	0	0
	1715	20000	10	QPSK	1	25	23.25	0	0
	1715	20000	10	QPSK	1	49	23.30	0	0
	1715	20000	10	QPSK	25	0	22.25	0-1	1
	1715	20000	10	QPSK	25	12	22.20	0-1	1
	1715	20000	10	QPSK	25	25	22.22	0-1	1
	1715	20000	10	QPSK	50	0	22.21	0-1	1
	1715	20000	10	16QAM	1	0	22.67	0-1	1
	1715	20000	10	16QAM	1	25	22.44	0-1	1
	1715	20000	10	16QAM	1	49	22.54	0-1	1
	1715	20000	10	16QAM	25	0	21.27	0-2	2
	1715	20000	10	16QAM	25	12	21.20	0-2	2
	1715	20000	10	16QAM	25	25	21.23	0-2	2
	1715	20000	10	16QAM	50	0	21.21	0-2	2
Mid	1732.5	20175	10	QPSK	1	0	23.78	0	0
	1732.5	20175	10	QPSK	1	25	23.63	0	0
	1732.5	20175	10	QPSK	1	49	23.73	0	0
	1732.5	20175	10	QPSK	25	0	22.50	0-1	1
	1732.5	20175	10	QPSK	25	12	22.31	0-1	1
	1732.5	20175	10	QPSK	25	25	22.33	0-1	1
	1732.5	20175	10	QPSK	50	0	22.34	0-1	1
	1732.5	20175	10	16QAM	1	0	23.00	0-1	1
	1732.5	20175	10	16QAM	1	25	22.92	0-1	1
	1732.5	20175	10	16QAM	1	49	22.96	0-1	1
	1732.5	20175	10	16QAM	25	0	21.38	0-2	2
	1732.5	20175	10	16QAM	25	12	21.24	0-2	2
	1732.5	20175	10	16QAM	25	25	21.27	0-2	2
	1732.5	20175	10	16QAM	50	0	21.26	0-2	2
High	1750	20350	10	QPSK	1	0	23.54	0	0
	1750	20350	10	QPSK	1	25	23.52	0	0
	1750	20350	10	QPSK	1	49	23.35	0	0
	1750	20350	10	QPSK	25	0	22.33	0-1	1
	1750	20350	10	QPSK	25	12	22.22	0-1	1
	1750	20350	10	QPSK	25	25	22.22	0-1	1
	1750	20350	10	QPSK	50	0	22.21	0-1	1
	1750	20350	10	16QAM	1	0	23.18	0-1	1
	1750	20350	10	16QAM	1	25	23.10	0-1	1
	1750	20350	10	16QAM	1	49	23.06	0-1	1
	1750	20350	10	16QAM	25	0	21.35	0-2	2
	1750	20350	10	16QAM	25	12	21.20	0-2	2
	1750	20350	10	16QAM	25	25	21.20	0-2	2
	1750	20350	10	16QAM	50	0	21.21	0-2	2

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1712.5	19975	5	QPSK	1	0	23.36	0	0
	1712.5	19975	5	QPSK	1	12	24.00	0	0
	1712.5	19975	5	QPSK	1	24	23.51	0	0
	1712.5	19975	5	QPSK	12	0	22.23	0-1	1
	1712.5	19975	5	QPSK	12	6	22.21	0-1	1
	1712.5	19975	5	QPSK	12	13	22.22	0-1	1
	1712.5	19975	5	QPSK	25	0	22.25	0-1	1
	1712.5	19975	5	16-QAM	1	0	23.05	0-1	1
	1712.5	19975	5	16-QAM	1	12	23.00	0-1	1
	1712.5	19975	5	16-QAM	1	24	23.15	0-1	1
	1712.5	19975	5	16-QAM	12	0	21.20	0-2	2
	1712.5	19975	5	16-QAM	12	6	21.20	0-2	2
Mid	1732.5	20175	5	QPSK	1	0	23.44	0	0
	1732.5	20175	5	QPSK	1	12	23.49	0	0
	1732.5	20175	5	QPSK	1	24	23.49	0	0
	1732.5	20175	5	QPSK	12	0	22.20	0-1	1
	1732.5	20175	5	QPSK	12	6	22.22	0-1	1
	1732.5	20175	5	QPSK	12	13	22.20	0-1	1
	1732.5	20175	5	QPSK	25	0	22.21	0-1	1
	1732.5	20175	5	16-QAM	1	0	22.51	0-1	1
	1732.5	20175	5	16-QAM	1	12	22.54	0-1	1
	1732.5	20175	5	16-QAM	1	24	22.47	0-1	1
	1732.5	20175	5	16-QAM	12	0	21.24	0-2	2
	1732.5	20175	5	16-QAM	12	6	21.20	0-2	2
High	1752.5	20375	5	QPSK	1	0	23.44	0	0
	1752.5	20375	5	QPSK	1	12	24.16	0	0
	1752.5	20375	5	QPSK	1	24	23.55	0	0
	1752.5	20375	5	QPSK	12	0	22.20	0-1	1
	1752.5	20375	5	QPSK	12	6	22.20	0-1	1
	1752.5	20375	5	QPSK	12	13	22.21	0-1	1
	1752.5	20375	5	QPSK	25	0	22.20	0-1	1
	1752.5	20375	5	16-QAM	1	0	22.32	0-1	1
	1752.5	20375	5	16-QAM	1	12	22.24	0-1	1
	1752.5	20375	5	16-QAM	1	24	22.22	0-1	1
	1752.5	20375	5	16-QAM	12	0	21.21	0-2	2
	1752.5	20375	5	16-QAM	12	6	21.20	0-2	2
	1752.5	20375	5	16-QAM	12	13	21.20	0-2	2
	1752.5	20375	5	16-QAM	25	0	21.20	0-2	2

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1711.5	19965	3	QPSK	1	0	23.30	0	0
	1711.5	19965	3	QPSK	1	7	23.45	0	0
	1711.5	19965	3	QPSK	1	14	23.31	0	0
	1711.5	19965	3	QPSK	8	0	22.21	0-1	1
	1711.5	19965	3	QPSK	8	4	22.26	0-1	1
	1711.5	19965	3	QPSK	8	7	22.23	0-1	1
	1711.5	19965	3	QPSK	15	0	22.27	0-1	1
	1711.5	19965	3	16-QAM	1	0	22.40	0-1	1
	1711.5	19965	3	16-QAM	1	7	23.10	0-1	1
	1711.5	19965	3	16-QAM	1	14	22.38	0-1	1
	1711.5	19965	3	16-QAM	8	0	21.20	0-2	2
	1711.5	19965	3	16-QAM	8	4	21.22	0-2	2
Mid	1732.5	20175	3	QPSK	1	0	23.41	0	0
	1732.5	20175	3	QPSK	1	7	23.50	0	0
	1732.5	20175	3	QPSK	1	14	23.33	0	0
	1732.5	20175	3	QPSK	8	0	22.21	0-1	1
	1732.5	20175	3	QPSK	8	4	22.23	0-1	1
	1732.5	20175	3	QPSK	8	7	22.25	0-1	1
	1732.5	20175	3	QPSK	15	0	22.28	0-1	1
	1732.5	20175	3	16-QAM	1	0	22.36	0-1	1
	1732.5	20175	3	16-QAM	1	7	22.32	0-1	1
	1732.5	20175	3	16-QAM	1	14	22.23	0-1	1
	1732.5	20175	3	16-QAM	8	0	21.20	0-2	2
	1732.5	20175	3	16-QAM	8	4	21.21	0-2	2
High	1732.5	20175	3	16-QAM	8	7	21.20	0-2	2
	1732.5	20175	3	16-QAM	15	0	21.23	0-2	2
	1753.5	20385	3	QPSK	1	0	23.35	0	0
	1753.5	20385	3	QPSK	1	7	23.26	0	0
	1753.5	20385	3	QPSK	1	14	23.25	0	0
	1753.5	20385	3	QPSK	8	0	22.20	0-1	1
	1753.5	20385	3	QPSK	8	4	22.26	0-1	1
	1753.5	20385	3	QPSK	8	7	22.21	0-1	1
	1753.5	20385	3	QPSK	15	0	22.20	0-1	1
	1753.5	20385	3	16-QAM	1	0	22.29	0-1	1
	1753.5	20385	3	16-QAM	1	7	23.00	0-1	1
	1753.5	20385	3	16-QAM	1	14	22.22	0-1	1
	1753.5	20385	3	16-QAM	8	0	21.20	0-2	2
	1753.5	20385	3	16-QAM	8	4	21.21	0-2	2
	1753.5	20385	3	16-QAM	8	7	21.20	0-2	2
	1753.5	20385	3	16-QAM	15	0	21.22	0-2	2

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1710.7	19957	1.4	QPSK	1	0	23.28	0	0
	1710.7	19957	1.4	QPSK	1	2	23.36	0	0
	1710.7	19957	1.4	QPSK	1	5	23.21	0	0
	1710.7	19957	1.4	QPSK	3	0	23.27	0	0
	1710.7	19957	1.4	QPSK	3	2	23.30	0	0
	1710.7	19957	1.4	QPSK	3	3	23.23	0	0
	1710.7	19957	1.4	QPSK	6	0	22.20	0-1	1
	1710.7	19957	1.4	16-QAM	1	0	22.36	0-1	1
	1710.7	19957	1.4	16-QAM	1	2	22.32	0-1	1
	1710.7	19957	1.4	16-QAM	1	5	22.38	0-1	1
	1710.7	19957	1.4	16-QAM	3	0	22.24	0-1	1
	1710.7	19957	1.4	16-QAM	3	2	22.25	0-1	1
Mid	1710.7	19957	1.4	16-QAM	3	3	22.35	0-1	1
	1710.7	19957	1.4	16-QAM	6	0	21.20	0-2	2
	1732.5	20175	1.4	QPSK	1	0	23.32	0	0
	1732.5	20175	1.4	QPSK	1	2	23.39	0	0
	1732.5	20175	1.4	QPSK	1	5	23.40	0	0
	1732.5	20175	1.4	QPSK	3	0	23.27	0	0
	1732.5	20175	1.4	QPSK	3	2	23.98	0	0
	1732.5	20175	1.4	QPSK	3	3	23.86	0	0
	1732.5	20175	1.4	QPSK	6	0	22.83	0-1	1
	1732.5	20175	1.4	16-QAM	1	0	22.36	0-1	1
	1732.5	20175	1.4	16-QAM	1	2	22.58	0-1	1
	1732.5	20175	1.4	16-QAM	1	5	22.56	0-1	1
High	1732.5	20175	1.4	16-QAM	3	0	22.41	0-1	1
	1732.5	20175	1.4	16-QAM	3	2	22.99	0-1	1
	1732.5	20175	1.4	16-QAM	3	3	22.60	0-1	1
	1732.5	20175	1.4	16-QAM	6	0	21.28	0-2	2
	1754.3	20393	1.4	QPSK	1	0	23.28	0	0
	1754.3	20393	1.4	QPSK	1	2	24.00	0	0
	1754.3	20393	1.4	QPSK	1	5	23.25	0	0
	1754.3	20393	1.4	QPSK	3	0	23.20	0	0
	1754.3	20393	1.4	QPSK	3	2	23.22	0	0
	1754.3	20393	1.4	QPSK	3	3	23.21	0	0
	1754.3	20393	1.4	QPSK	6	0	22.20	0-1	1
	1754.3	20393	1.4	16-QAM	1	0	22.23	0-1	1
	1754.3	20393	1.4	16-QAM	1	2	23.10	0-1	1
	1754.3	20393	1.4	16-QAM	1	5	23.12	0-1	1
	1754.3	20393	1.4	16-QAM	3	0	23.15	0-1	1
	1754.3	20393	1.4	16-QAM	3	2	23.16	0-1	1
	1754.3	20393	1.4	16-QAM	3	3	23.20	0-1	1
	1754.3	20393	1.4	16-QAM	6	0	22.20	0-2	2

9.2.4

LTE Band 25 (PCS)

Table 9-15

LTE Band 25 (PCS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1860	26140	20	QPSK	1	0	23.84	0	0
	1860	26140	20	QPSK	1	50	23.80	0	0
	1860	26140	20	QPSK	1	99	23.89	0	0
	1860	26140	20	QPSK	50	0	23.10	0-1	1
	1860	26140	20	QPSK	50	25	22.84	0-1	1
	1860	26140	20	QPSK	50	50	22.76	0-1	1
	1860	26140	20	QPSK	100	0	22.78	0-1	1
	1860	26140	20	16QAM	1	0	23.20	0-1	1
	1860	26140	20	16QAM	1	50	23.17	0-1	1
	1860	26140	20	16QAM	1	99	23.14	0-1	1
	1860	26140	20	16QAM	50	0	21.76	0-2	2
	1860	26140	20	16QAM	50	25	21.73	0-2	2
	1860	26140	20	16QAM	50	50	21.72	0-2	2
	1860	26140	20	16QAM	100	0	21.72	0-2	2
Mid	1882.5	26365	20	QPSK	1	0	24.15	0	0
	1882.5	26365	20	QPSK	1	50	24.13	0	0
	1882.5	26365	20	QPSK	1	99	24.11	0	0
	1882.5	26365	20	QPSK	50	0	23.16	0-1	1
	1882.5	26365	20	QPSK	50	25	22.71	0-1	1
	1882.5	26365	20	QPSK	50	50	22.83	0-1	1
	1882.5	26365	20	QPSK	100	0	22.83	0-1	1
	1882.5	26365	20	16QAM	1	0	23.20	0-1	1
	1882.5	26365	20	16QAM	1	50	23.18	0-1	1
	1882.5	26365	20	16QAM	1	99	23.12	0-1	1
	1882.5	26365	20	16QAM	50	0	22.16	0-2	2
	1882.5	26365	20	16QAM	50	25	21.71	0-2	2
	1882.5	26365	20	16QAM	50	50	21.70	0-2	2
	1882.5	26365	20	16QAM	100	0	21.76	0-2	2
High	1905	26590	20	QPSK	1	0	23.98	0	0
	1905	26590	20	QPSK	1	50	23.92	0	0
	1905	26590	20	QPSK	1	99	24.02	0	0
	1905	26590	20	QPSK	50	0	22.74	0-1	1
	1905	26590	20	QPSK	50	25	22.72	0-1	1
	1905	26590	20	QPSK	50	50	22.73	0-1	1
	1905	26590	20	QPSK	100	0	22.72	0-1	1
	1905	26590	20	16QAM	1	0	23.08	0-1	1
	1905	26590	20	16QAM	1	50	23.10	0-1	1
	1905	26590	20	16QAM	1	99	23.13	0-1	1
	1905	26590	20	16QAM	50	0	22.02	0-2	2
	1905	26590	20	16QAM	50	25	21.72	0-2	2
	1905	26590	20	16QAM	50	50	21.70	0-2	2
	1905	26590	20	16QAM	100	0	21.71	0-2	2

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Table 9-16
LTE Band 25 (PCS) Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1857.5	26115	15	QPSK	1	0	23.71	0	0
	1857.5	26115	15	QPSK	1	36	23.60	0	0
	1857.5	26115	15	QPSK	1	74	23.45	0	0
	1857.5	26115	15	QPSK	36	0	22.73	0-1	1
	1857.5	26115	15	QPSK	36	18	22.25	0-1	1
	1857.5	26115	15	QPSK	36	37	22.23	0-1	1
	1857.5	26115	15	QPSK	75	0	22.22	0-1	1
	1857.5	26115	15	16QAM	1	0	22.63	0-1	1
	1857.5	26115	15	16QAM	1	36	22.54	0-1	1
	1857.5	26115	15	16QAM	1	74	22.43	0-1	1
	1857.5	26115	15	16QAM	36	0	21.27	0-2	2
	1857.5	26115	15	16QAM	36	18	21.30	0-2	2
	1857.5	26115	15	16QAM	36	37	21.28	0-2	2
	1857.5	26115	15	16QAM	75	0	21.29	0-2	2
Mid	1882.5	26365	15	QPSK	1	0	23.40	0	0
	1882.5	26365	15	QPSK	1	36	23.20	0	0
	1882.5	26365	15	QPSK	1	74	23.34	0	0
	1882.5	26365	15	QPSK	36	0	22.59	0-1	1
	1882.5	26365	15	QPSK	36	18	22.28	0-1	1
	1882.5	26365	15	QPSK	36	37	22.32	0-1	1
	1882.5	26365	15	QPSK	75	0	22.38	0-1	1
	1882.5	26365	15	16QAM	1	0	23.02	0-1	1
	1882.5	26365	15	16QAM	1	36	22.69	0-1	1
	1882.5	26365	15	16QAM	1	74	23.01	0-1	1
	1882.5	26365	15	16QAM	36	0	21.34	0-2	2
	1882.5	26365	15	16QAM	36	18	21.24	0-2	2
	1882.5	26365	15	16QAM	36	37	21.24	0-2	2
	1882.5	26365	15	16QAM	75	0	21.24	0-2	2
High	1907.5	26615	15	QPSK	1	0	23.85	0	0
	1907.5	26615	15	QPSK	1	36	23.52	0	0
	1907.5	26615	15	QPSK	1	74	23.72	0	0
	1907.5	26615	15	QPSK	36	0	22.40	0-1	1
	1907.5	26615	15	QPSK	36	18	22.21	0-1	1
	1907.5	26615	15	QPSK	36	37	22.30	0-1	1
	1907.5	26615	15	QPSK	75	0	22.24	0-1	1
	1907.5	26615	15	16QAM	1	0	22.82	0-1	1
	1907.5	26615	15	16QAM	1	36	22.48	0-1	1
	1907.5	26615	15	16QAM	1	74	22.68	0-1	1
	1907.5	26615	15	16QAM	36	0	21.42	0-2	2
	1907.5	26615	15	16QAM	36	18	21.24	0-2	2
	1907.5	26615	15	16QAM	36	37	21.20	0-2	2
	1907.5	26615	15	16QAM	75	0	21.27	0-2	2

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Table 9-17
LTE Band 25 (PCS) Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1855	26090	10	QPSK	1	0	23.38	0	0
	1855	26090	10	QPSK	1	25	23.23	0	0
	1855	26090	10	QPSK	1	49	23.42	0	0
	1855	26090	10	QPSK	25	0	22.23	0-1	1
	1855	26090	10	QPSK	25	12	22.20	0-1	1
	1855	26090	10	QPSK	25	25	22.23	0-1	1
	1855	26090	10	QPSK	50	0	22.20	0-1	1
	1855	26090	10	16QAM	1	0	22.44	0-1	1
	1855	26090	10	16QAM	1	25	22.35	0-1	1
	1855	26090	10	16QAM	1	49	22.40	0-1	1
	1855	26090	10	16QAM	25	0	21.24	0-2	2
	1855	26090	10	16QAM	25	12	21.20	0-2	2
	1855	26090	10	16QAM	25	25	21.23	0-2	2
	1855	26090	10	16QAM	50	0	21.20	0-2	2
	1882.5	26365	10	QPSK	1	0	23.53	0	0
Mid	1882.5	26365	10	QPSK	1	25	23.43	0	0
	1882.5	26365	10	QPSK	1	49	23.56	0	0
	1882.5	26365	10	QPSK	25	0	22.49	0-1	1
	1882.5	26365	10	QPSK	25	12	22.22	0-1	1
	1882.5	26365	10	QPSK	25	25	22.21	0-1	1
	1882.5	26365	10	QPSK	50	0	22.22	0-1	1
	1882.5	26365	10	16QAM	1	0	22.75	0-1	1
	1882.5	26365	10	16QAM	1	25	22.82	0-1	1
	1882.5	26365	10	16QAM	1	49	22.74	0-1	1
	1882.5	26365	10	16QAM	25	0	21.25	0-2	2
	1882.5	26365	10	16QAM	25	12	21.23	0-2	2
	1882.5	26365	10	16QAM	25	25	21.23	0-2	2
	1882.5	26365	10	16QAM	50	0	21.20	0-2	2
	1910	26640	10	QPSK	1	0	23.50	0	0
	1910	26640	10	QPSK	1	25	23.22	0	0
High	1910	26640	10	QPSK	1	49	23.56	0	0
	1910	26640	10	QPSK	25	0	22.36	0-1	1
	1910	26640	10	QPSK	25	12	22.34	0-1	1
	1910	26640	10	QPSK	25	25	22.27	0-1	1
	1910	26640	10	QPSK	50	0	22.31	0-1	1
	1910	26640	10	16QAM	1	0	23.01	0-1	1
	1910	26640	10	16QAM	1	25	23.20	0-1	1
	1910	26640	10	16QAM	1	49	23.06	0-1	1
	1910	26640	10	16QAM	25	0	21.32	0-2	2
	1910	26640	10	16QAM	25	12	21.25	0-2	2
	1910	26640	10	16QAM	25	25	21.24	0-2	2
	1910	26640	10	16QAM	50	0	21.25	0-2	2

Table 9-18
LTE Band 25 (PCS) Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1852.5	26065	5	QPSK	1	0	23.44	0	0
	1852.5	26065	5	QPSK	1	12	23.95	0	0
	1852.5	26065	5	QPSK	1	24	23.47	0	0
	1852.5	26065	5	QPSK	12	0	22.20	0-1	1
	1852.5	26065	5	QPSK	12	6	22.20	0-1	1
	1852.5	26065	5	QPSK	12	13	22.28	0-1	1
	1852.5	26065	5	QPSK	25	0	22.21	0-1	1
	1852.5	26065	5	16-QAM	1	0	22.23	0-1	1
	1852.5	26065	5	16-QAM	1	12	22.38	0-1	1
	1852.5	26065	5	16-QAM	1	24	22.30	0-1	1
	1852.5	26065	5	16-QAM	12	0	21.21	0-2	2
	1852.5	26065	5	16-QAM	12	6	21.20	0-2	2
	1852.5	26065	5	16-QAM	12	13	21.21	0-2	2
	1852.5	26065	5	16-QAM	25	0	21.22	0-2	2
Mid	1882.5	26365	5	QPSK	1	0	23.29	0	0
	1882.5	26365	5	QPSK	1	12	23.24	0	0
	1882.5	26365	5	QPSK	1	24	23.43	0	0
	1882.5	26365	5	QPSK	12	0	22.23	0-1	1
	1882.5	26365	5	QPSK	12	6	22.23	0-1	1
	1882.5	26365	5	QPSK	12	13	22.23	0-1	1
	1882.5	26365	5	QPSK	25	0	22.21	0-1	1
	1882.5	26365	5	16-QAM	1	0	22.55	0-1	1
	1882.5	26365	5	16-QAM	1	12	22.60	0-1	1
	1882.5	26365	5	16-QAM	1	24	22.57	0-1	1
	1882.5	26365	5	16-QAM	12	0	21.23	0-2	2
	1882.5	26365	5	16-QAM	12	6	21.22	0-2	2
	1882.5	26365	5	16-QAM	12	13	21.20	0-2	2
	1882.5	26365	5	16-QAM	25	0	21.23	0-2	2
High	1912.5	26665	5	QPSK	1	0	23.43	0	0
	1912.5	26665	5	QPSK	1	12	23.33	0	0
	1912.5	26665	5	QPSK	1	24	23.59	0	0
	1912.5	26665	5	QPSK	12	0	22.33	0-1	1
	1912.5	26665	5	QPSK	12	6	22.35	0-1	1
	1912.5	26665	5	QPSK	12	13	22.28	0-1	1
	1912.5	26665	5	QPSK	25	0	22.26	0-1	1
	1912.5	26665	5	16-QAM	1	0	22.68	0-1	1
	1912.5	26665	5	16-QAM	1	12	22.56	0-1	1
	1912.5	26665	5	16-QAM	1	24	22.70	0-1	1
	1912.5	26665	5	16-QAM	12	0	21.32	0-2	2
	1912.5	26665	5	16-QAM	12	6	21.34	0-2	2
	1912.5	26665	5	16-QAM	12	13	21.24	0-2	2
	1912.5	26665	5	16-QAM	25	0	21.20	0-2	2

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Table 9-19
LTE Band 25 (PCS) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1851.5	26055	3	QPSK	1	0	23.51	0	0
	1851.5	26055	3	QPSK	1	7	23.42	0	0
	1851.5	26055	3	QPSK	1	14	23.35	0	0
	1851.5	26055	3	QPSK	8	0	22.23	0-1	1
	1851.5	26055	3	QPSK	8	4	22.35	0-1	1
	1851.5	26055	3	QPSK	8	7	22.22	0-1	1
	1851.5	26055	3	QPSK	15	0	22.29	0-1	1
	1851.5	26055	3	16-QAM	1	0	22.72	0-1	1
	1851.5	26055	3	16-QAM	1	7	22.83	0-1	1
	1851.5	26055	3	16-QAM	1	14	22.81	0-1	1
	1851.5	26055	3	16-QAM	8	0	21.26	0-2	2
	1851.5	26055	3	16-QAM	8	4	21.22	0-2	2
	1851.5	26055	3	16-QAM	8	7	21.35	0-2	2
	1851.5	26055	3	16-QAM	15	0	21.20	0-2	2
Mid	1882.5	26365	3	QPSK	1	0	23.37	0	0
	1882.5	26365	3	QPSK	1	7	23.40	0	0
	1882.5	26365	3	QPSK	1	14	23.39	0	0
	1882.5	26365	3	QPSK	8	0	22.21	0-1	1
	1882.5	26365	3	QPSK	8	4	22.24	0-1	1
	1882.5	26365	3	QPSK	8	7	22.23	0-1	1
	1882.5	26365	3	QPSK	15	0	22.20	0-1	1
	1882.5	26365	3	16-QAM	1	0	22.24	0-1	1
	1882.5	26365	3	16-QAM	1	7	22.29	0-1	1
	1882.5	26365	3	16-QAM	1	14	22.26	0-1	1
	1882.5	26365	3	16-QAM	8	0	21.20	0-2	2
	1882.5	26365	3	16-QAM	8	4	21.21	0-2	2
	1882.5	26365	3	16-QAM	8	7	21.22	0-2	2
	1882.5	26365	3	16-QAM	15	0	21.32	0-2	2
High	1913.5	26675	3	QPSK	1	0	23.48	0	0
	1913.5	26675	3	QPSK	1	7	23.55	0	0
	1913.5	26675	3	QPSK	1	14	23.42	0	0
	1913.5	26675	3	QPSK	8	0	22.41	0-1	1
	1913.5	26675	3	QPSK	8	4	22.31	0-1	1
	1913.5	26675	3	QPSK	8	7	22.35	0-1	1
	1913.5	26675	3	QPSK	15	0	22.30	0-1	1
	1913.5	26675	3	16-QAM	1	0	22.50	0-1	1
	1913.5	26675	3	16-QAM	1	7	23.00	0-1	1
	1913.5	26675	3	16-QAM	1	14	22.60	0-1	1
	1913.5	26675	3	16-QAM	8	0	21.21	0-2	2
	1913.5	26675	3	16-QAM	8	4	21.21	0-2	2
	1913.5	26675	3	16-QAM	8	7	21.23	0-2	2
	1913.5	26675	3	16-QAM	15	0	21.24	0-2	2

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Table 9-20
LTE Band 25 (PCS) Conducted Powers - 1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1850.7	26047	1.4	QPSK	1	0	23.43	0	0
	1850.7	26047	1.4	QPSK	1	2	23.43	0	0
	1850.7	26047	1.4	QPSK	1	5	23.55	0	0
	1850.7	26047	1.4	QPSK	3	0	23.23	0	0
	1850.7	26047	1.4	QPSK	3	2	23.31	0	0
	1850.7	26047	1.4	QPSK	3	3	23.29	0	0
	1850.7	26047	1.4	QPSK	6	0	22.24	0-1	1
	1850.7	26047	1.4	16-QAM	1	0	22.47	0-1	1
	1850.7	26047	1.4	16-QAM	1	2	22.81	0-1	1
	1850.7	26047	1.4	16-QAM	1	5	22.59	0-1	1
	1850.7	26047	1.4	16-QAM	3	0	22.26	0-1	1
	1850.7	26047	1.4	16-QAM	3	2	22.44	0-1	1
Mid	1850.7	26047	1.4	16-QAM	3	3	22.35	0-1	1
	1850.7	26047	1.4	16-QAM	6	0	21.20	0-2	2
	1882.5	26365	1.4	QPSK	1	0	23.26	0	0
	1882.5	26365	1.4	QPSK	1	2	23.45	0	0
	1882.5	26365	1.4	QPSK	1	5	23.24	0	0
	1882.5	26365	1.4	QPSK	3	0	23.20	0	0
	1882.5	26365	1.4	QPSK	3	2	23.24	0	0
	1882.5	26365	1.4	QPSK	3	3	23.21	0	0
	1882.5	26365	1.4	QPSK	6	0	22.22	0-1	1
	1882.5	26365	1.4	16-QAM	1	0	22.60	0-1	1
	1882.5	26365	1.4	16-QAM	1	2	22.26	0-1	1
	1882.5	26365	1.4	16-QAM	1	5	22.33	0-1	1
	1882.5	26365	1.4	16-QAM	3	0	22.66	0-1	1
	1882.5	26365	1.4	16-QAM	3	2	22.72	0-1	1
	1882.5	26365	1.4	16-QAM	3	3	22.60	0-1	1
	1882.5	26365	1.4	16-QAM	6	0	21.30	0-2	2
High	1914.3	26683	1.4	QPSK	1	0	23.44	0	0
	1914.3	26683	1.4	QPSK	1	2	23.61	0	0
	1914.3	26683	1.4	QPSK	1	5	23.55	0	0
	1914.3	26683	1.4	QPSK	3	0	23.47	0	0
	1914.3	26683	1.4	QPSK	3	2	23.48	0	0
	1914.3	26683	1.4	QPSK	3	3	23.46	0	0
	1914.3	26683	1.4	QPSK	6	0	22.23	0-1	1
	1914.3	26683	1.4	16-QAM	1	0	22.41	0-1	1
	1914.3	26683	1.4	16-QAM	1	2	22.89	0-1	1
	1914.3	26683	1.4	16-QAM	1	5	22.42	0-1	1
	1914.3	26683	1.4	16-QAM	3	0	22.32	0-1	1
	1914.3	26683	1.4	16-QAM	3	2	22.35	0-1	1
	1914.3	26683	1.4	16-QAM	3	3	22.35	0-1	1
	1914.3	26683	1.4	16-QAM	6	0	21.20	0-2	2

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9.2.5

LTE Carrier Aggregation Conducted Powers

Table 9-21

LTE Carrier Aggregation Conducted Powers – Band 4 (PCC) 20 MHz BW + Band 12 (SCC) 10 MHz BW

Band 4 (PCC) 20 MHz BW + Band 12 (SCC) 10 MHz BW				
1732.5 MHz / ch.20175 + 737.5 MHz / ch. 5095	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	LTE B4 Rel. 8 Tx.Power (dBm)
	1	0	24.16	24.17

Table 9-22

LTE Carrier Aggregation Conducted Powers – Band 4 (PCC) 20 MHz BW + Band 5 (SCC) 10 MHz BW

Band 4 (PCC) 20 MHz BW + Band 5 (SCC) 10 MHz BW				
1732.5 MHz / ch.20175 + 881.5 MHz / ch. 2525	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	LTE B4 Rel. 8 Tx.Power (dBm)
	1	0	24.15	24.17

Table 9-23

LTE Carrier Aggregation Conducted Powers – Band 5 (PCC) 10 MHz BW + Band 4 (SCC) 20 MHz BW

Band 5 (PCC) 10 MHz BW + Band 4 (SCC) 20 MHz BW				
836.5 MHz / ch.20525 + 2132.5 MHz / ch.2175	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	LTE B5 Rel. 8 Tx.Power (dBm)
	1	0	24.10	24.12

Notes:

1. The device does not support all Rel. 10 Carrier Aggregation features due to modem chipset limitation.
2. The device only supports LTE downlink Carrier Aggregation. Uplink Carrier Aggregation is not supported. Power measurements were performed with two DL carriers for the Release 8 configuration that had the highest output power (across all bandwidths, channels and RB Configurations) for each band
3. This device only supports inter-band CA with 2 carriers (B4+B12, B4+B5, B5+B4) with a maximum of 10 MHz of spectrum for LTE Band 12 and 5 and a maximum of 20 MHz of spectrum for LTE Band 4.
4. All control and acknowledge data is sent on uplink channels that operate identical to release 8 specifications.

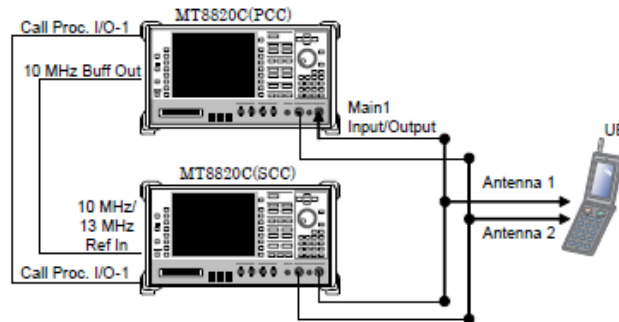


Figure 9-2
Power Measurement Setup

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9.3 WLAN Conducted Powers

Table 9-24
IEEE 802.11b Average RF Power

Mode	Freq [MHz]	Channel	802.11b (2.4 GHz) Conducted Power [dBm]			
			Data Rate [Mbps]			
			1	2	5.5	11
802.11b	2412	1*	14.01	14.17	14.16	14.24
802.11b	2437	6*	13.70	14.07	14.01	13.95
802.11b	2462	11*	13.90	14.06	14.24	14.21

Table 9-25
IEEE 802.11g Average RF Power

Mode	Freq [MHz]	Channel	802.11g (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11g	2412	1	12.74	12.62	12.68	12.57	12.97	12.55	12.88	13.02
802.11g	2437	6	12.33	12.42	12.41	12.30	12.70	12.43	12.48	12.71
802.11g	2462	11	12.73	12.67	12.79	12.47	12.80	12.57	12.74	12.65

Table 9-26
IEEE 802.11n Average RF Power

Mode	Freq [MHz]	Channel	802.11n (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	20	26	39	52	58	65
802.11n	2412	1	12.29	12.30	12.22	12.45	12.62	12.60	12.55	12.63
802.11n	2437	6	11.84	11.90	11.80	12.25	12.15	12.20	12.12	12.01
802.11n	2462	11	12.15	12.20	12.12	12.49	12.50	12.48	12.45	12.42

Table 9-27
IEEE 802.11ac Average RF Power

802.11ac (2.4GHz) Conducted Power [dBm]			
Mode	Freq [MHz]	Channel	Data Rate
			6.5 Mbps
802.11ac	2412	1	11.25
802.11ac	2437	6	10.97
802.11ac	2462	11	11.30

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Table 9-28
IEEE 802.11a Average RF Power

Mode	Freq [MHz]	Channel	802.11a Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11a	5180	36*	13.41	13.47	13.53	13.40	13.71	13.61	13.74	13.60
802.11a	5200	40	13.55	13.58	13.66	13.50	13.82	13.69	13.84	13.81
802.11a	5220	44	13.60	13.72	13.71	13.60	13.80	13.81	13.84	13.73
802.11a	5240	48*	13.45	13.46	13.61	13.44	13.76	13.61	13.78	13.60
802.11a	5260	52*	13.67	13.38	13.32	13.22	13.55	13.50	13.70	13.33
802.11a	5280	56	13.37	13.41	13.48	13.30	13.66	13.57	13.79	13.40
802.11a	5300	60	13.35	13.44	13.41	13.34	13.63	13.56	13.72	13.46
802.11a	5320	64*	13.36	13.47	13.43	13.23	13.62	13.57	13.77	13.45
802.11a	5500	100	13.71	13.74	13.32	13.40	13.73	13.60	13.78	13.68
802.11a	5520	104*	13.47	13.33	13.76	13.83	13.52	13.47	13.50	13.51
802.11a	5540	108	13.50	13.39	13.77	13.81	13.65	13.60	13.76	13.65
802.11a	5560	112	13.58	13.49	13.87	13.87	13.60	13.68	13.67	13.65
802.11a	5580	116*	13.46	13.32	13.78	13.80	13.78	13.67	13.67	13.48
802.11a	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5660	132	13.70	13.57	13.92	13.48	13.51	13.66	13.51	13.60
802.11a	5680	136*	13.54	13.45	13.77	13.93	13.67	13.68	13.80	13.67
802.11a	5700	140	13.55	13.47	13.79	13.95	13.78	13.56	13.67	13.76
802.11a	5720	144	13.70	13.75	13.62	13.67	13.78	13.60	13.50	13.67
802.11a	5745	149*	13.25	13.25	13.20	13.20	13.45	13.36	13.49	13.15
802.11a	5765	153	13.30	13.28	13.28	13.30	13.52	13.37	13.51	13.21
802.11a	5785	157*	13.27	13.26	13.24	13.25	13.49	13.32	13.51	13.21
802.11a	5805	161	13.15	13.15	13.10	13.10	13.29	13.31	13.38	13.07
802.11a	5825	165*	13.10	13.10	13.01	13.10	13.21	13.11	13.22	13.01

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

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

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Table 9-29
IEEE 802.11n Average RF Power – 20 MHz Bandwidth

Mode	Freq [MHz]	Channel	20MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	19.5	26	39	52	58.5	65
802.11n	5180	36	12.46	12.55	12.50	12.85	12.83	12.85	12.92	12.80
802.11n	5200	40	12.55	12.64	12.60	12.93	12.96	12.96	12.94	12.90
802.11n	5220	44	12.65	12.81	12.69	12.82	12.80	12.86	12.86	12.84
802.11n	5240	48	12.72	12.88	12.73	12.84	12.88	12.94	12.96	12.80
802.11n	5260	52	12.52	12.20	12.21	12.54	12.55	12.50	12.56	12.43
802.11n	5280	56	12.67	12.33	12.38	12.72	12.79	12.71	12.80	12.61
802.11n	5300	60	12.81	12.44	12.49	12.82	12.81	12.78	12.81	12.79
802.11n	5320	64	12.85	12.49	12.57	12.88	12.88	12.88	12.82	12.77
802.11n	5500	100	12.60	12.53	12.41	12.87	12.68	12.70	12.84	12.84
802.11n	5520	104	12.45	12.29	12.20	12.65	12.55	12.51	12.73	12.64
802.11n	5540	108	12.35	12.21	12.12	12.64	12.48	12.38	12.63	12.58
802.11n	5560	112	12.45	12.37	12.23	12.68	12.53	12.53	12.72	12.64
802.11n	5580	116	12.46	12.30	12.24	12.71	12.49	12.52	12.69	12.70
802.11n	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5660	132	12.37	12.28	12.19	12.65	12.42	12.42	12.62	12.60
802.11n	5680	136	12.46	12.41	12.28	12.75	12.51	12.61	12.72	12.71
802.11n	5700	140	12.24	12.21	12.06	12.55	12.28	12.27	12.52	12.54
802.11n	5720	144	12.00	12.10	12.05	12.10	12.00	12.20	12.05	12.00
802.11n	5745	149	12.00	12.10	12.03	12.01	12.00	12.00	12.05	12.01
802.11n	5765	153	12.05	12.10	12.00	12.10	12.10	12.00	12.01	12.00
802.11n	5785	157	12.01	12.06	12.11	12.12	12.07	12.00	12.00	12.02
802.11n	5805	161	12.10	12.29	12.00	12.01	12.09	12.13	12.08	12.10
802.11n	5825	165	12.10	12.25	12.00	12.01	12.09	12.02	12.02	12.02

Table 9-30
IEEE 802.11n Average RF Power – 40 MHz Bandwidth

Mode	Freq [MHz]	Channel	40MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			13.5	27	40.5	54	81	108	121.5	135
802.11n	5190	38	12.85	12.24	12.23	12.65	12.70	12.48	12.56	12.50
802.11n	5230	46	12.43	11.85	11.80	12.24	12.23	12.05	12.17	12.14
802.11n	5270	54	12.23	12.32	12.31	12.44	12.52	12.44	12.46	12.39
802.11n	5310	62	12.39	12.52	12.43	12.60	12.71	12.64	12.63	12.56
802.11n	5510	102	11.82	11.88	11.89	11.17	11.98	11.85	12.00	12.08
802.11n	5550	110	12.00	12.02	12.08	11.35	12.18	11.97	12.21	12.24
802.11n	5590	118	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5630	126	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5670	134	11.72	11.75	11.86	11.08	11.81	11.69	11.95	12.04
802.11n	5710	142	11.60	11.62	11.65	11.70	11.62	11.67	11.68	11.70
802.11n	5755	151	11.18	11.24	11.25	11.45	11.40	11.51	11.30	11.40
802.11n	5795	159	11.40	11.40	11.49	11.70	11.70	11.72	11.49	11.64

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Table 9-31
IEEE 802.11ac Average RF Power – 80 MHz Bandwidth

Mode	Freq [MHz]	Channel	80MHz BW 802.11ac (5GHz) Conducted Power [dBm]									
			Data Rate [Mbps]									
			29.3	58.5	87.8	117	175.5	234	263.3	292.5	351	390
802.11ac	5210	42	12.71	12.50	12.46	12.90	12.84	12.80	12.87	12.81	12.83	12.89
802.11ac	5290	58	12.74	12.53	12.49	12.93	12.88	12.93	12.92	12.97	12.94	12.86
802.11ac	5530	106	12.20	12.25	12.08	12.68	12.57	12.64	12.57	12.57	12.55	12.50
802.11ac	5690	138	12.50	12.43	12.53	12.60	12.56	12.70	12.57	12.45	12.64	12.71
802.11ac	5775	155	12.19	11.85	11.75	12.26	12.36	12.35	12.36	12.40	12.40	12.30

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

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

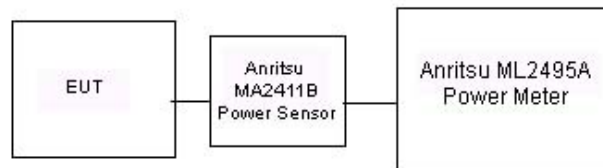


Figure 9-3
Power Measurement Setup for Bandwidths < 50 MHz

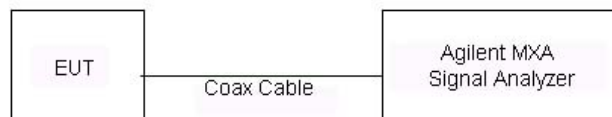


Figure 9-4
Power Measurement Setup for Bandwidths > 50 MHz

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10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
Measured Head Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C°)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ϵ	% dev σ	% dev ϵ
1/26/2015	750H	20.5	695	0.870	42.610	0.889	42.227	-2.14%	0.91%
			710	0.885	42.420	0.890	42.149	-0.56%	0.64%
			725	0.898	42.237	0.891	42.071	0.79%	0.39%
			740	0.912	42.034	0.893	41.994	2.13%	0.10%
			755	0.926	41.837	0.894	41.916	3.58%	-0.19%
1/19/2015	835H	21.1	820	0.885	41.221	0.899	41.578	-1.56%	-0.86%
			835	0.900	41.034	0.900	41.500	0.00%	-1.12%
			850	0.915	40.822	0.916	41.500	-0.11%	-1.63%
1/23/2015	835H	22.5	820	0.898	41.021	0.899	41.578	-0.11%	-1.34%
			835	0.911	40.832	0.900	41.500	1.22%	-1.61%
			850	0.926	40.637	0.916	41.500	1.09%	-2.08%
1/21/2015	1750H	22.4	1710	1.322	39.356	1.348	40.142	-1.93%	-1.96%
			1750	1.361	39.194	1.371	40.079	-0.73%	-2.21%
			1790	1.396	38.996	1.394	40.016	0.14%	-2.55%
1/20/2015	1900H	22.8	1850	1.388	38.916	1.400	40.000	-0.86%	-2.71%
			1880	1.419	38.785	1.400	40.000	1.36%	-3.04%
			1910	1.450	38.648	1.400	40.000	3.57%	-3.38%
1/27/2015	2450H	23.0	2401	1.758	38.812	1.756	39.287	0.11%	-1.21%
			2450	1.812	38.552	1.800	39.200	0.67%	-1.65%
			2499	1.866	38.434	1.853	39.138	0.70%	-1.80%
01/23/2015	5200H-5800H	20.1	5200	4.449	35.741	4.655	35.986	-4.43%	-0.68%
			5220	4.468	35.684	4.676	35.963	-4.45%	-0.78%
			5260	4.507	35.644	4.717	35.917	-4.45%	-0.76%
			5280	4.530	35.583	4.737	35.894	-4.37%	-0.87%
			5300	4.549	35.571	4.758	35.871	-4.39%	-0.84%
			5320	4.575	35.543	4.778	35.849	-4.25%	-0.85%
			5500	4.748	35.287	4.963	35.643	-4.33%	-1.00%
			5560	4.813	35.229	5.024	35.574	-4.20%	-0.97%
			5600	4.849	35.184	5.065	35.529	-4.26%	-0.97%
			5660	4.914	35.088	5.127	35.460	-4.15%	-1.05%
			5680	4.930	35.046	5.147	35.437	-4.22%	-1.10%
			5700	4.951	35.020	5.168	35.414	-4.20%	-1.11%
			5765	5.026	34.989	5.234	35.340	-3.97%	-0.99%
			5785	5.039	34.914	5.255	35.317	-4.11%	-1.14%
			5800	5.054	34.890	5.270	35.300	-4.10%	-1.16%
			5805	5.064	34.868	5.275	35.294	-4.00%	-1.21%

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Table 10-2
Measured Body Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C°)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ϵ	% dev σ	% dev ϵ
01/26/2015	750B	20.7	695	0.921	56.427	0.959	55.745	-3.96%	1.22%
			710	0.936	56.292	0.960	55.687	-2.50%	1.09%
			725	0.950	56.147	0.961	55.629	-1.14%	0.93%
			740	0.964	56.015	0.963	55.570	0.10%	0.80%
			755	0.978	55.852	0.964	55.512	1.45%	0.61%
01/20/2015	835B	20.1	820	0.940	54.370	0.969	55.258	-2.99%	-1.61%
			835	0.956	54.224	0.970	55.200	-1.44%	-1.77%
			850	0.971	54.072	0.988	55.154	-1.72%	-1.96%
01/21/2015	1750B	22.4	1710	1.493	51.087	1.463	53.537	2.05%	-4.58%
			1750	1.534	50.966	1.488	53.432	3.09%	-4.62%
			1790	1.573	50.780	1.514	53.326	3.90%	-4.77%
01/20/2015	1900B	22.8	1850	1.485	51.142	1.520	53.300	-2.30%	-4.05%
			1880	1.519	51.052	1.520	53.300	-0.07%	-4.22%
			1910	1.552	50.961	1.520	53.300	2.11%	-4.39%
01/22/2015	2450B	23.8	2401	1.858	51.158	1.903	52.765	-2.36%	-3.05%
			2450	1.925	50.991	1.950	52.700	-1.28%	-3.24%
			2499	1.987	50.821	2.019	52.638	-1.58%	-3.45%
01/20/2015	5200B-5800B	22.8	5200	5.308	48.366	5.299	49.014	0.17%	-1.32%
			5220	5.332	48.246	5.323	48.987	0.17%	-1.51%
			5260	5.397	48.178	5.369	48.933	0.52%	-1.54%
			5280	5.424	48.093	5.393	48.906	0.57%	-1.66%
			5300	5.452	48.044	5.416	48.879	0.66%	-1.71%
			5500	5.772	47.649	5.650	48.607	2.16%	-1.97%
			5600	5.928	47.449	5.766	48.471	2.81%	-2.11%
			5680	6.044	47.234	5.860	48.363	3.14%	-2.33%
			5700	6.072	47.223	5.883	48.336	3.21%	-2.30%
			5765	6.153	47.044	5.959	48.248	3.26%	-2.50%
			5785	6.191	46.942	5.982	48.220	3.49%	-2.65%
			5800	6.220	46.948	6.000	48.200	3.67%	-2.60%

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

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10.2 Test System Verification

Prior to SAR assessment, the system is verified to $\pm 10\%$ 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 10-3
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR _{1g} (W/kg)	1 W Target SAR _{1g} (W/kg)	1 W Normalized SAR _{1g} (W/kg)	Deviation _{1g} (%)
B	750	HEAD	01/26/2015	22.7	20.9	0.100	1046	3334	0.803	8.270	8.030	-2.90%
J	835	HEAD	01/19/2015	22.8	21.1	0.100	4d133	3022	0.918	9.200	9.180	-0.22%
B	835	HEAD	01/23/2015	23.1	22.4	0.100	4d119	3334	0.868	9.220	8.680	-5.86%
A	1750	HEAD	01/21/2015	24.0	22.4	0.100	1051	3331	3.650	36.200	36.500	0.83%
C	1900	HEAD	01/20/2015	21.6	21.0	0.100	5d148	3333	3.980	40.700	39.800	-2.21%
G	2450	HEAD	01/27/2015	21.3	22.2	0.100	719	3258	5.340	52.100	53.400	2.50%
H	5200	HEAD	01/23/2015	23.9	21.5	0.100	1120	3920	7.540	79.100	75.400	-4.68%
H	5300	HEAD	01/23/2015	23.9	21.5	0.100	1120	3920	8.030	83.400	80.300	-3.72%
H	5500	HEAD	01/23/2015	23.9	21.6	0.100	1120	3920	8.190	84.900	81.900	-3.53%
H	5600	HEAD	01/23/2015	24.0	21.8	0.100	1120	3920	7.910	82.200	79.100	-3.77%
H	5800	HEAD	01/23/2015	23.9	21.6	0.100	1120	3920	7.800	79.100	78.000	-1.39%
B	750	BODY	01/26/2015	23.1	21.0	0.100	1046	3334	0.914	8.540	9.140	7.03%
B	835	BODY	01/20/2015	22.6	20.0	0.100	4d119	3334	0.910	9.340	9.100	-2.57%
C	1750	BODY	01/21/2015	21.5	21.4	0.100	1051	3333	3.650	37.400	36.500	-2.41%
J	1900	BODY	01/20/2015	23.4	22.8	0.100	5d141	3022	3.940	40.600	39.400	-2.96%
I	2450	BODY	01/22/2015	23.5	23.8	0.100	719	3209	5.200	51.800	52.000	0.39%
A	5200	BODY	01/20/2015	22.8	21.2	0.100	1120	3949	7.800	74.000	78.000	5.41%
A	5300	BODY	01/20/2015	22.8	21.2	0.100	1120	3949	8.010	75.800	80.100	5.67%
A	5500	BODY	01/20/2015	22.9	21.2	0.100	1120	3949	8.510	79.200	85.100	7.45%
A	5600	BODY	01/20/2015	22.9	21.2	0.100	1120	3949	8.640	79.400	86.400	8.82%
A	5800	BODY	01/20/2015	22.9	21.3	0.100	1120	3949	7.810	74.400	78.100	4.97%

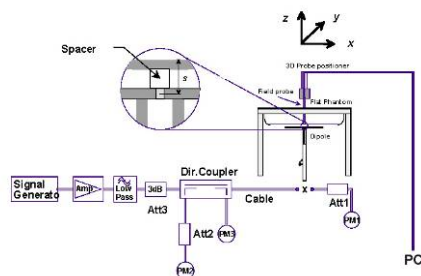


Figure 10-1
System Verification Setup Diagram



Figure 10-2
System Verification Setup Photo

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11 SAR DATA SUMMARY

11.1 Standalone Head SAR Data

Table 11-1
Cell CDMA Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.52	384	Cell. CDMA	RC3 / SO55	25.2	25.15	0.06	Right	Cheek	1LWF2	1:1	0.440	1.012	0.445	A1
836.52	384	Cell. CDMA	RC3 / SO55	25.2	25.15	0.14	Right	Tilt	1LWF2	1:1	0.200	1.012	0.202	
836.52	384	Cell. CDMA	RC3 / SO55	25.2	25.15	-0.09	Left	Cheek	1LWF2	1:1	0.385	1.012	0.390	
836.52	384	Cell. CDMA	RC3 / SO55	25.2	25.15	0.04	Left	Tilt	1LWF2	1:1	0.194	1.012	0.196	
836.52	384	Cell. CDMA	EVDO Rev. A	25.2	25.12	-0.03	Right	Cheek	1LWF2	1:1	0.210	1.019	0.214	
836.52	384	Cell. CDMA	EVDO Rev. A	25.2	25.12	0.01	Right	Tilt	1LWF2	1:1	0.077	1.019	0.078	
836.52	384	Cell. CDMA	EVDO Rev. A	25.2	25.12	-0.05	Left	Cheek	1LWF2	1:1	0.198	1.019	0.202	
836.52	384	Cell. CDMA	EVDO Rev. A	25.2	25.12	-0.08	Left	Tilt	1LWF2	1:1	0.101	1.019	0.103	
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
PCS CDMA Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.67	-0.02	Right	Cheek	1LWF2	1:1	0.360	1.007	0.363	
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.67	0.05	Right	Tilt	1LWF2	1:1	0.328	1.007	0.330	
1851.25	25	PCS CDMA	RC3 / SO55	24.7	24.58	-0.15	Left	Cheek	1LWF2	1:1	0.816	1.028	0.839	
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.67	-0.19	Left	Cheek	1LWF2	1:1	0.843	1.007	0.849	
1908.75	1175	PCS CDMA	RC3 / SO55	24.7	24.59	-0.15	Left	Cheek	1LWF2	1:1	0.979	1.026	1.004	A2
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.67	0.02	Left	Tilt	1LWF2	1:1	0.303	1.007	0.305	
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.68	-0.16	Right	Cheek	1LWF2	1:1	0.361	1.005	0.363	
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.68	0.03	Right	Tilt	1LWF2	1:1	0.339	1.005	0.341	
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.68	0.17	Left	Cheek	1LWF2	1:1	0.773	1.005	0.777	
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.68	0.03	Left	Tilt	1LWF2	1:1	0.330	1.005	0.332	
1908.75	1175	PCS CDMA	RC3 / SO55	24.7	24.59	-0.15	Left	Cheek	1LWF2	1:1	0.978	1.026	1.003	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Blue entry represents variability data.

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Table 11-3
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	Scaled SAR(1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
707.50	23095	Mid	LTE Band 12	10	24.5	24.50	-0.08	0	Right	Cheek	QPSK	1	0	1LYF7	1:1	0.270	1.000	0.270	A3
707.50	23095	Mid	LTE Band 12	10	23.5	23.39	0.15	1	Right	Cheek	QPSK	25	0	1LYF7	1:1	0.212	1.026	0.218	
707.50	23095	Mid	LTE Band 12	10	24.5	24.50	-0.19	0	Right	Tilt	QPSK	1	0	1LYF7	1:1	0.149	1.000	0.149	
707.50	23095	Mid	LTE Band 12	10	23.5	23.39	0.02	1	Right	Tilt	QPSK	25	0	1LYF7	1:1	0.116	1.026	0.119	
707.50	23095	Mid	LTE Band 12	10	24.5	24.50	0.02	0	Left	Cheek	QPSK	1	0	1LYF7	1:1	0.227	1.000	0.227	
707.50	23095	Mid	LTE Band 12	10	23.5	23.39	-0.03	1	Left	Cheek	QPSK	25	0	1LYF7	1:1	0.181	1.026	0.186	
707.50	23095	Mid	LTE Band 12	10	24.5	24.50	-0.11	0	Left	Tilt	QPSK	1	0	1LYF7	1:1	0.139	1.000	0.139	
707.50	23095	Mid	LTE Band 12	10	23.5	23.39	0.05	1	Left	Tilt	QPSK	25	0	1LYF7	1:1	0.118	1.026	0.121	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT									Head										
Spatial Peak									1.6 W/kg (mW/g)										
Uncontrolled Exposure/General Population									averaged over 1 gram										

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

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.12	0.08	0	Right	Cheek	QPSK	1	0	1LYF7	1:1	0.331	1.019	0.337	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	22.87	0.01	1	Right	Cheek	QPSK	25	12	1LYF7	1:1	0.254	1.079	0.274	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.12	0.14	0	Right	Tilt	QPSK	1	0	1LYF7	1:1	0.182	1.019	0.185	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	22.87	0.03	1	Right	Tilt	QPSK	25	12	1LYF7	1:1	0.153	1.079	0.165	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.12	0.15	0	Left	Cheek	QPSK	1	0	1LYF7	1:1	0.339	1.019	0.345	A4
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	22.87	0.07	1	Left	Cheek	QPSK	25	12	1LYF7	1:1	0.262	1.079	0.283	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.12	0.12	0	Left	Tilt	QPSK	1	0	1LYF7	1:1	0.186	1.019	0.190	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	22.87	-0.05	1	Left	Tilt	QPSK	25	12	1LYF7	1:1	0.150	1.079	0.162	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

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

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maxim um Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.2	24.17	0.07	0	Right	Cheek	QPSK	1	0	1LYF7	1:1	0.327	1.007	0.329	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	22.47	0.13	1	Right	Cheek	QPSK	50	0	1LYF7	1:1	0.223	1.183	0.264	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.2	24.17	0.05	0	Right	Tilt	QPSK	1	0	1LYF7	1:1	0.373	1.007	0.376	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	22.47	0.01	1	Right	Tilt	QPSK	50	0	1LYF7	1:1	0.252	1.183	0.298	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.2	24.17	0.16	0	Left	Cheek	QPSK	1	0	1LYF7	1:1	0.751	1.007	0.756	A5
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	22.47	-0.05	1	Left	Cheek	QPSK	50	0	1LYF7	1:1	0.504	1.183	0.596	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.2	24.17	0.07	0	Left	Tilt	QPSK	1	0	1LYF7	1:1	0.345	1.007	0.347	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	22.47	0.06	1	Left	Tilt	QPSK	50	0	1LYF7	1:1	0.234	1.183	0.277	
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 25 (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	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1882.50	26365	Mid	LTE Band 25 (PCS)	20	24.2	24.15	-0.16	0	Right	Cheek	QPSK	1	0	1LYF7	1:1	0.321	1.012	0.325	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	23.2	23.16	0.12	1	Right	Cheek	QPSK	50	0	1LYF7	1:1	0.226	1.009	0.228	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	24.2	24.15	-0.04	0	Right	Tilt	QPSK	1	0	1LYF7	1:1	0.319	1.012	0.323	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	23.2	23.16	0.08	1	Right	Tilt	QPSK	50	0	1LYF7	1:1	0.223	1.009	0.225	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	24.2	24.15	0.19	0	Left	Cheek	QPSK	1	0	1LYF7	1:1	0.761	1.012	0.770	A6
1882.50	26365	Mid	LTE Band 25 (PCS)	20	23.2	23.16	0.13	1	Left	Cheek	QPSK	50	0	1LYF7	1:1	0.548	1.009	0.553	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	24.2	24.15	0.03	0	Left	Tilt	QPSK	1	0	1LYF7	1:1	0.274	1.012	0.277	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	23.2	23.16	-0.05	1	Left	Tilt	QPSK	50	0	1LYF7	1:1	0.206	1.009	0.208	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram									

Table 11-7
DTS Head SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
2412	1	IEEE 802.11b	DSSS	15.5	14.01	0.07	Right	Cheek	1	1LWF8	1	1:1	0.627	1.409	0.883	
2437	6	IEEE 802.11b	DSSS	15.5	13.70	0.03	Right	Cheek	1	1LWF8	1	1:1	0.645	1.514	0.977	A7
2462	11	IEEE 802.11b	DSSS	15.5	13.90	0.16	Right	Cheek	1	1LWF8	1	1:1	0.603	1.445	0.871	
2412	1	IEEE 802.11b	DSSS	15.5	14.01	0.12	Right	Tilt	1	1LWF8	1	1:1	0.506	1.409	0.713	
2412	1	IEEE 802.11b	DSSS	15.5	14.01	0.10	Left	Cheek	1	1LWF8	1	1:1	0.287	1.409	0.404	
2412	1	IEEE 802.11b	DSSS	15.5	14.01	0.02	Left	Tilt	1	1LWF8	1	1:1	0.213	1.409	0.300	
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 11-8
NII Head SAR**

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
5220	44	IEEE 802.11a	OFDM	14.0	13.60	-0.01	Right	Cheek	1LWF8	6	1:1	0.352	1.096	0.386	
5210	42	IEEE 802.11ac	OFDM	13.0	12.71	0.05	Right	Cheek	1LWF8	29.3	1:1	0.225	1.069	0.241	
5220	44	IEEE 802.11a	OFDM	14.0	13.60	0.14	Right	Tilt	1LWF8	6	1:1	0.327	1.096	0.358	
5220	44	IEEE 802.11a	OFDM	14.0	13.60	0.07	Left	Cheek	1LWF8	6	1:1	0.161	1.096	0.176	
5220	44	IEEE 802.11a	OFDM	14.0	13.60	0.13	Left	Tilt	1LWF8	6	1:1	0.127	1.096	0.139	
5260	52	IEEE 802.11a	OFDM	14.0	13.67	0.13	Right	Cheek	1LWF8	6	1:1	0.413	1.079	0.446	
5320	64	IEEE 802.11a	OFDM	14.0	13.36	0.18	Right	Cheek	1LWF8	6	1:1	0.478	1.159	0.554	
5290	58	IEEE 802.11ac	OFDM	13.0	12.74	0.14	Right	Cheek	1LWF8	29.3	1:1	0.243	1.062	0.258	
5260	52	IEEE 802.11a	OFDM	14.0	13.67	0.12	Right	Tilt	1LWF8	6	1:1	0.358	1.079	0.386	
5260	52	IEEE 802.11a	OFDM	14.0	13.67	-0.04	Left	Cheek	1LWF8	6	1:1	0.215	1.079	0.232	
5260	52	IEEE 802.11a	OFDM	14.0	13.67	0.11	Left	Tilt	1LWF8	6	1:1	0.170	1.079	0.183	
5500	100	IEEE 802.11a	OFDM	14.0	13.71	0.11	Right	Cheek	1LWF8	6	1:1	0.617	1.069	0.660	A8
5560	112	IEEE 802.11a	OFDM	14.0	13.58	0.03	Right	Cheek	1LWF8	6	1:1	0.605	1.102	0.667	
5660	132	IEEE 802.11a	OFDM	14.0	13.70	0.13	Right	Cheek	1LWF8	6	1:1	0.541	1.072	0.580	
5690	138	IEEE 802.11ac	OFDM	13.0	12.50	0.13	Right	Cheek	1LWF8	29.3	1:1	0.298	1.122	0.334	
5500	100	IEEE 802.11a	OFDM	14.0	13.71	-0.01	Right	Tilt	1LWF8	6	1:1	0.545	1.069	0.583	
5560	112	IEEE 802.11a	OFDM	14.0	13.58	0.11	Right	Tilt	1LWF8	6	1:1	0.547	1.102	0.603	
5660	132	IEEE 802.11a	OFDM	14.0	13.70	0.13	Right	Tilt	1LWF8	6	1:1	0.486	1.072	0.521	
5500	100	IEEE 802.11a	OFDM	14.0	13.71	0.04	Left	Cheek	1LWF8	6	1:1	0.327	1.069	0.350	
5500	100	IEEE 802.11a	OFDM	14.0	13.71	0.01	Left	Tilt	1LWF8	6	1:1	0.287	1.069	0.307	
5765	153	IEEE 802.11a	OFDM	14.0	13.30	0.12	Right	Cheek	1LWF8	6	1:1	0.515	1.175	0.605	
5785	157	IEEE 802.11a	OFDM	14.0	13.27	0.16	Right	Cheek	1LWF8	6	1:1	0.541	1.183	0.640	
5805	161	IEEE 802.11a	OFDM	14.0	13.15	0.19	Right	Cheek	1LWF8	6	1:1	0.510	1.216	0.620	
5775	155	IEEE 802.11ac	OFDM	13.0	12.19	0.11	Right	Cheek	1LWF8	29.3	1:1	0.275	1.205	0.331	
5765	153	IEEE 802.11a	OFDM	14.0	13.30	0.13	Right	Tilt	1LWF8	6	1:1	0.477	1.175	0.560	
5785	157	IEEE 802.11a	OFDM	14.0	13.27	0.15	Right	Tilt	1LWF8	6	1:1	0.469	1.183	0.555	
5805	161	IEEE 802.11a	OFDM	14.0	13.15	0.06	Right	Tilt	1LWF8	6	1:1	0.475	1.216	0.578	
5765	153	IEEE 802.11a	OFDM	14.0	13.30	-0.17	Left	Cheek	1LWF8	6	1:1	0.297	1.175	0.349	
5765	153	IEEE 802.11a	OFDM	14.0	13.30	0.11	Left	Tilt	1LWF8	6	1:1	0.283	1.175	0.333	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram								

11.2 Standalone Body-Worn SAR Data

**Table 11-9
CDMA Body-Worn SAR Data**

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maxim um Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.52	384	Cell. CDMA	TDSO /SO32	25.2	25.10	-0.07	8 mm	1LWF2	1:1	back	0.338	1.023	0.346	A9
1880.00	600	PCS CDMA	TDSO /SO32	24.7	24.60	0.05	8 mm	1LWF2	1:1	back	0.546	1.023	0.559	A11
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 11-10
LTE Body-Worn SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
707.50	23095	Mid	LTE Band 12	10	24.5	24.50	-0.03	0	1LYF7	QPSK	1	0	8 mm	back	1:1	0.474	1.000	0.474	A13
707.50	23095	Mid	LTE Band 12	10	23.5	23.39	-0.06	1	1LYF7	QPSK	25	0	8 mm	back	1:1	0.385	1.026	0.395	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.12	0.01	0	1LYF7	QPSK	1	0	8 mm	back	1:1	0.835	1.019	0.851	A14
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	22.87	0.05	1	1LYF7	QPSK	25	12	8 mm	back	1:1	0.631	1.079	0.681	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	22.81	-0.02	1	1LYF7	QPSK	50	0	8 mm	back	1:1	0.626	1.094	0.685	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.12	0.04	0	1LYF7	QPSK	1	0	8 mm	back	1:1	0.816	1.019	0.832	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.2	24.17	-0.01	0	1LYF7	QPSK	1	0	8 mm	back	1:1	1.120	1.007	1.128	A15
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	22.47	0.09	1	1LYF7	QPSK	50	0	8 mm	back	1:1	0.750	1.183	0.887	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	22.36	-0.01	1	1LYF7	QPSK	100	0	8 mm	back	1:1	0.723	1.213	0.877	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.2	24.17	-0.04	0	1LYF7	QPSK	1	0	8 mm	back	1:1	1.090	1.007	1.098	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	24.2	24.15	0.00	0	1LYF7	QPSK	1	0	8 mm	back	1:1	0.601	1.012	0.608	A16
1882.50	26365	Mid	LTE Band 25 (PCS)	20	23.2	23.16	-0.01	1	1LYF7	QPSK	50	0	8 mm	back	1:1	0.423	1.009	0.427	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram										

Blue entries represent variability data.

Table 11-11
DTS Body-Worn SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2412	1	IEEE 802.11b	DSSS	15.5	14.01	-0.01	8 mm	1LWF8	1	back	1:1	0.088	1.409	0.124	A18
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

Table 11-12
NII Body-Worn SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
5220	44	IEEE 802.11a	OFDM	14.0	13.60	0.09	8 mm	1LWF8	6	back	1:1	0.082	1.096	0.090	
5210	42	IEEE 802.11ac	OFDM	13.0	12.71	0.15	8 mm	1LWF8	29.3	back	1:1	0.069	1.069	0.074	
5260	52	IEEE 802.11a	OFDM	14.0	13.67	-0.11	8 mm	1LWF8	6	back	1:1	0.099	1.079	0.107	
5290	58	IEEE 802.11ac	OFDM	13.0	12.74	0.09	8 mm	1LWF8	29.3	back	1:1	0.067	1.062	0.071	
5500	100	IEEE 802.11a	OFDM	14.0	13.71	-0.07	8 mm	1LWF8	6	back	1:1	0.137	1.069	0.146	
5690	138	IEEE 802.11ac	OFDM	13.0	12.50	0.15	8 mm	1LWF8	29.3	back	1:1	0.111	1.122	0.125	
5765	153	IEEE 802.11a	OFDM	14.0	13.30	0.07	8 mm	1LWF8	6	back	1:1	0.169	1.175	0.199	A20
5775	155	IEEE 802.11ac	OFDM	13.0	12.19	-0.14	8 mm	1LWF8	29.3	back	1:1	0.109	1.205	0.131	
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 Wireless Router SAR Data

Table 11-13
CDMA Hotspot SAR Data

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.52	384	Cell. CDMA	EVDO Rev. 0	25.2	25.13	-0.09	8 mm	1LWF2	1:1	back	0.366	1.016	0.372	A10
836.52	384	Cell. CDMA	EVDO Rev. 0	25.2	25.13	0.05	8 mm	1LWF2	1:1	front	0.278	1.016	0.282	
836.52	384	Cell. CDMA	EVDO Rev. 0	25.2	25.13	-0.14	10 mm	1LWF2	1:1	bottom	0.162	1.016	0.165	
836.52	384	Cell. CDMA	EVDO Rev. 0	25.2	25.13	0.00	10 mm	1LWF2	1:1	right	0.259	1.016	0.263	
836.52	384	Cell. CDMA	EVDO Rev. 0	25.2	25.13	0.06	10 mm	1LWF2	1:1	left	0.227	1.016	0.231	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.69	-0.02	8 mm	1LWF2	1:1	back	0.544	1.002	0.545	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.69	0.02	8 mm	1LWF2	1:1	front	0.515	1.002	0.516	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.69	-0.07	10 mm	1LWF2	1:1	bottom	0.344	1.002	0.345	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.69	-0.12	10 mm	1LWF2	1:1	left	0.614	1.002	0.615	A12
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 11-14
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	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
707.50	23095	Mid	LTE Band 12	10	24.5	24.50	-0.03	0	1LYF7	QPSK	1	0	8 mm	back	1:1	0.474	1.000	0.474	A13
707.50	23095	Mid	LTE Band 12	10	23.5	23.39	-0.06	1	1LYF7	QPSK	25	0	8 mm	back	1:1	0.385	1.026	0.395	
707.50	23095	Mid	LTE Band 12	10	24.5	24.50	0.03	0	1LYF7	QPSK	1	0	8 mm	front	1:1	0.368	1.000	0.368	
707.50	23095	Mid	LTE Band 12	10	23.5	23.39	0.00	1	1LYF7	QPSK	25	0	8 mm	front	1:1	0.288	1.026	0.295	
707.50	23095	Mid	LTE Band 12	10	24.5	24.50	0.11	0	1LYF7	QPSK	1	0	10 mm	bottom	1:1	0.131	1.000	0.131	
707.50	23095	Mid	LTE Band 12	10	23.5	23.39	-0.04	1	1LYF7	QPSK	25	0	10 mm	bottom	1:1	0.103	1.026	0.106	
707.50	23095	Mid	LTE Band 12	10	24.5	24.50	0.15	0	1LYF7	QPSK	1	0	10 mm	right	1:1	0.424	1.000	0.424	
707.50	23095	Mid	LTE Band 12	10	23.5	23.39	-0.01	1	1LYF7	QPSK	25	0	10 mm	right	1:1	0.367	1.026	0.377	
707.50	23095	Mid	LTE Band 12	10	24.5	24.50	0.04	0	1LYF7	QPSK	1	0	10 mm	left	1:1	0.182	1.000	0.182	
707.50	23095	Mid	LTE Band 12	10	23.5	23.39	0.10	1	1LYF7	QPSK	25	0	10 mm	left	1:1	0.158	1.026	0.162	
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 11-15
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	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.12	0.01	0	1LYF7	QPSK	1	0	8 mm	back	1:1	0.835	1.019	0.851	A14
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	22.87	0.05	1	1LYF7	QPSK	25	12	8 mm	back	1:1	0.631	1.079	0.681	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	22.81	-0.02	1	1LYF7	QPSK	50	0	8 mm	back	1:1	0.626	1.094	0.685	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.12	0.00	0	1LYF7	QPSK	1	0	8 mm	front	1:1	0.367	1.019	0.374	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	22.87	0.04	1	1LYF7	QPSK	25	12	8 mm	front	1:1	0.294	1.079	0.317	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.12	-0.06	0	1LYF7	QPSK	1	0	10 mm	bottom	1:1	0.244	1.019	0.249	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	22.87	0.03	1	1LYF7	QPSK	25	12	10 mm	bottom	1:1	0.194	1.079	0.209	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.12	-0.04	0	1LYF7	QPSK	1	0	10 mm	right	1:1	0.311	1.019	0.317	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	22.87	-0.03	1	1LYF7	QPSK	25	12	10 mm	right	1:1	0.251	1.079	0.271	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.12	0.15	0	1LYF7	QPSK	1	0	10 mm	left	1:1	0.296	1.019	0.302	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.2	22.87	0.10	1	1LYF7	QPSK	25	12	10 mm	left	1:1	0.238	1.079	0.257	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.2	24.12	0.04	0	1LYF7	QPSK	1	0	8 mm	back	1:1	0.816	1.019	0.832	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

Blue entry represents variability data.

Table 11-16
LTE Band 4 (AWS) Hotspot SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.2	24.17	-0.01	0	1LYF7	QPSK	1	0	8 mm	back	1:1	1.120	1.007	1.128	A15
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	22.47	0.09	1	1LYF7	QPSK	50	0	8 mm	back	1:1	0.750	1.183	0.887	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	22.36	-0.01	1	1LYF7	QPSK	100	0	8 mm	back	1:1	0.723	1.213	0.877	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.2	24.17	-0.03	0	1LYF7	QPSK	1	0	8 mm	front	1:1	1.110	1.007	1.118	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	22.47	-0.05	1	1LYF7	QPSK	50	0	8 mm	front	1:1	0.744	1.183	0.880	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	22.36	0.08	1	1LYF7	QPSK	100	0	10 mm	front	1:1	0.713	1.213	0.865	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.2	24.17	-0.12	0	1LYF7	QPSK	1	0	10 mm	bottom	1:1	0.279	1.007	0.281	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	22.47	0.05	1	1LYF7	QPSK	50	0	10 mm	bottom	1:1	0.196	1.183	0.232	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.2	24.17	0.18	0	1LYF7	QPSK	1	0	10 mm	left	1:1	0.618	1.007	0.622	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	22.47	-0.06	1	1LYF7	QPSK	50	0	10 mm	left	1:1	0.426	1.183	0.504	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.2	24.17	-0.04	0	1LYF7	QPSK	1	0	8 mm	back	1:1	1.090	1.007	1.098	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

Blue entry represents variability data.

Table 11-17
LTE Band 25 (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	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1882.50	26365	Mid	LTE Band 25 (PCS)	20	24.2	24.15	0.00	0	1LYF7	QPSK	1	0	8 mm	back	1:1	0.601	1.012	0.608	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	23.2	23.16	-0.01	1	1LYF7	QPSK	50	0	8 mm	back	1:1	0.423	1.009	0.427	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	24.2	24.15	0.01	0	1LYF7	QPSK	1	0	8 mm	front	1:1	0.764	1.012	0.773	A17
1882.50	26365	Mid	LTE Band 25 (PCS)	20	23.2	23.16	-0.07	1	1LYF7	QPSK	50	0	8 mm	front	1:1	0.538	1.009	0.543	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	24.2	24.15	0.07	0	1LYF7	QPSK	1	0	10 mm	bottom	1:1	0.276	1.012	0.279	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	23.2	23.16	-0.03	1	1LYF7	QPSK	50	0	10 mm	bottom	1:1	0.150	1.009	0.151	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	24.2	24.15	0.02	0	1LYF7	QPSK	1	0	10 mm	right	1:1	0.112	1.012	0.113	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	23.2	23.16	0.01	1	1LYF7	QPSK	50	0	10 mm	right	1:1	0.078	1.009	0.079	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	24.2	24.15	-0.20	0	1LYF7	QPSK	1	0	10 mm	left	1:1	0.449	1.012	0.454	
1882.50	26365	Mid	LTE Band 25 (PCS)	20	23.2	23.16	-0.03	1	1LYF7	QPSK	50	0	10 mm	left	1:1	0.314	1.009	0.317	
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 11-18
WLAN Hotspot SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
2412	1	IEEE 802.11b	DSSS	15.5	14.01	-0.01	8 mm	1	1LWF8	1	back	1:1	0.088	1.409	0.124	
2412	1	IEEE 802.11b	DSSS	15.5	14.01	-0.08	8 mm	1	1LWF8	1	front	1:1	0.123	1.409	0.173	A19
2412	1	IEEE 802.11b	DSSS	15.5	14.01	0.07	10 mm	1	1LWF8	1	top	1:1	0.058	1.409	0.082	
2412	1	IEEE 802.11b	DSSS	15.5	14.01	0.07	10 mm	1	1LWF8	1	left	1:1	0.039	1.409	0.055	
5765	153	IEEE 802.11a	OFDM	14.0	13.30	0.07	8 mm	1	1LWF8	6	back	1:1	0.169	1.175	0.199	
5765	153	IEEE 802.11a	OFDM	14.0	13.30	0.14	8 mm	1	1LWF8	6	front	1:1	0.152	1.175	0.179	
5765	153	IEEE 802.11a	OFDM	14.0	13.30	0.04	10 mm	1	1LWF8	6	top	1:1	0.129	1.175	0.152	
5765	153	IEEE 802.11a	OFDM	14.0	13.30	0.01	10 mm	1	1LWF8	6	left	1:1	0.237	1.175	0.278	A21
5775	155	IEEE 802.11ac	OFDM	13.0	12.19	0.16	10 mm	1	1LWF8	29.3	left	1:1	0.114	1.205	0.137	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram									

11.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Due to the embowed design of the device, Body SAR was configured per FCC Guidance. See section 1.7 for more information.
7. Per FCC KDB Publication 648474 D04v01, body-worn SAR was evaluated without a headset connected to the device. Since the standalone reported body-worn SAR was ≤ 1.2 W/kg, no additional body-worn SAR evaluations using a headset cable were required.
8. Per FCC KDB 865664 D01 v01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 13 for variability analysis.
9. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.6 for more details).

CDMA Notes:

1. Head SAR for CDMA2000 mode was tested under RC3/SO55 per FCC KDB Publication 941225 D01.
2. Body-Worn SAR was tested with 1x RTT with TDSO / SO32 FCH Only. EVDO and TDSO / SO32 FCH+SCH SAR tests were not required since the average output power was not more than 0.25 dB higher than the TDSO / SO32 FCH only powers, per FCC KDB Publication 941225 D01v02.
3. CDMA Wireless Router SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0 according to KDB 941225 D01 procedures for data devices. Since the average output power of Subtype 2 for Rev. A is less than the Rev. 0 power levels, EVDO Rev. A SAR is not required. SAR is not required for 1x RTT for Ev-Do hotspot devices when the maximum average

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output of each channel is less than 1/4 dB higher than that measured in Subtype 0/1 Physical Layer configurations for Rev. 0.

4. Head SAR was additionally evaluated using EVDO Rev. A to determine compliance for VoIP operations.
5. Per FCC KDB Publication 447498 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel was used.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05. The general test procedures used for testing can be found in Section 8.4.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).
4. Per FCC Guidance, LTE CA SAR was not needed for testing since the data sent by uplink on the uplink physical channels does not change between Rel. 8 and Rel. 10.

WLAN Notes:

1. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 2.4 GHz WIFI operations: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11b. Other IEEE 802.11 modes (including 802.11g/n/ac) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
2. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 5 GHz WIFI operations: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11a. Other IEEE 802.11 modes (including 802.11n 20 MHz and 40 MHz BW) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
3. Per April 2013 TCB Workshop notes, full SAR tests for all IEEE 802.11ac configurations were not required because the average output power was not more than 0.25 dB higher than IEEE 802.11a mode. IEEE 802.11ac was evaluated for the highest IEEE 802.11a position in each 5 GHz band and exposure condition.
4. When Hotspot is enabled, 5.2 – 5.7 GHz bands are disabled. Therefore no 5.2 – 5.7 GHz WIFI Wireless Router SAR Data was required.
5. WIFI transmission was verified using an uncalibrated spectrum analyzer.
6. When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is > 1.6 W/kg and the reported 1g averaged SAR is > 0.8 W/kg, SAR testing on other default channels was required.

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12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

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

12.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05 IV.C.1.iii and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific physical test configuration is ≤ 1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05 4.3.2.2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

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

Table 12-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2480	8.50	8	0.184

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

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12.3 Head SAR Simultaneous Transmission Analysis

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

Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.445	0.977	1.422	Head SAR	Right Cheek	0.214	0.977	1.191
	Right Tilt	0.202	0.713	0.915		Right Tilt	0.078	0.713	0.791
	Left Cheek	0.390	0.404	0.794		Left Cheek	0.202	0.404	0.606
	Left Tilt	0.196	0.300	0.496		Left Tilt	0.103	0.300	0.403
Simult Tx	Configuration	PCS CDMA SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.363	0.977	1.340	Head SAR	Right Cheek	0.363	0.977	1.340
	Right Tilt	0.330	0.713	1.043		Right Tilt	0.341	0.713	1.054
	Left Cheek	1.004	0.404	1.408		Left Cheek	0.777	0.404	1.181
	Left Tilt	0.305	0.300	0.605		Left Tilt	0.332	0.300	0.632
Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.270	0.977	1.247	Head SAR	Right Cheek	0.337	0.977	1.314
	Right Tilt	0.149	0.713	0.862		Right Tilt	0.185	0.713	0.898
	Left Cheek	0.227	0.404	0.631		Left Cheek	0.345	0.404	0.749
	Left Tilt	0.139	0.300	0.439		Left Tilt	0.190	0.300	0.490
Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 25 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.329	0.977	1.306	Head SAR	Right Cheek	0.325	0.977	1.302
	Right Tilt	0.376	0.713	1.089		Right Tilt	0.323	0.713	1.036
	Left Cheek	0.756	0.404	1.160		Left Cheek	0.770	0.404	1.174
	Left Tilt	0.347	0.300	0.647		Left Tilt	0.277	0.300	0.577

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Table 12-3
Simultaneous Transmission Scenario with 5 GHz WLAN (Held to Ear)

Simult Tx	Configuration	Cell. CDMA SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.445	0.667	1.112	Head SAR	Right Cheek	0.214	0.667	0.881
	Right Tilt	0.202	0.603	0.805		Right Tilt	0.078	0.603	0.681
	Left Cheek	0.390	0.350	0.740		Left Cheek	0.202	0.350	0.552
	Left Tilt	0.196	0.333	0.529		Left Tilt	0.103	0.333	0.436
Simult Tx	Configuration	PCS CDMA SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.363	0.667	1.030	Head SAR	Right Cheek	0.363	0.977	1.340
	Right Tilt	0.330	0.603	0.933		Right Tilt	0.341	0.713	1.054
	Left Cheek	1.004	0.350	1.354		Left Cheek	0.777	0.404	1.181
	Left Tilt	0.305	0.333	0.638		Left Tilt	0.332	0.300	0.632
Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.270	0.667	0.937	Head SAR	Right Cheek	0.337	0.667	1.004
	Right Tilt	0.149	0.603	0.752		Right Tilt	0.185	0.603	0.788
	Left Cheek	0.227	0.350	0.577		Left Cheek	0.345	0.350	0.695
	Left Tilt	0.139	0.333	0.472		Left Tilt	0.190	0.333	0.523
Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 25 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.329	0.667	0.996	Head SAR	Right Cheek	0.325	0.667	0.992
	Right Tilt	0.376	0.603	0.979		Right Tilt	0.323	0.603	0.926
	Left Cheek	0.756	0.350	1.106		Left Cheek	0.770	0.350	1.120
	Left Tilt	0.347	0.333	0.680		Left Tilt	0.277	0.333	0.610

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

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12.4 Body-Worn Simultaneous Transmission Analysis

Table 12-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 0.8 cm)

Configuration	Mode	CDMA/LTE SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	Cell. CDMA	0.346	0.124	0.470
Back Side	PCS CDMA	0.559	0.124	0.683
Back Side	LTE Band 12	0.474	0.124	0.598
Back Side	LTE Band 5 (Cell)	0.851	0.124	0.975
Back Side	LTE Band 4 (AWS)	1.128	0.124	1.252
Back Side	LTE Band 25 (PCS)	0.608	0.124	0.732

Table 12-5
Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 0.8 cm)

Configuration	Mode	CDMA/LTE SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	Cell. CDMA	0.346	0.199	0.545
Back Side	PCS CDMA	0.559	0.199	0.758
Back Side	LTE Band 12	0.474	0.199	0.673
Back Side	LTE Band 5 (Cell)	0.851	0.199	1.050
Back Side	LTE Band 4 (AWS)	1.128	0.199	1.327
Back Side	LTE Band 25 (PCS)	0.608	0.199	0.807

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

Table 12-6
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 0.8 cm)

Configuration	Mode	CDMA/LTE SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back Side	Cell. CDMA	0.346	0.184	0.530
Back Side	PCS CDMA	0.559	0.184	0.743
Back Side	LTE Band 12	0.474	0.184	0.658
Back Side	LTE Band 5 (Cell)	0.851	0.184	1.035
Back Side	LTE Band 4 (AWS)	1.128	0.184	1.312
Back Side	LTE Band 25 (PCS)	0.608	0.184	0.792

Note: Bluetooth SAR was not required to be measured per FCC KDB 447498. Estimated SAR results were used in the above table to determine simultaneous transmission SAR test exclusion.

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12.5 Hotspot SAR Simultaneous Transmission Analysis

Per FCC KDB Publication 941225 D06, the devices edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR (“-”).

Table 12-7
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Hotspot)

Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.372	0.124	0.496	Body SAR	Back	0.545	0.124	0.669
	Front	0.282	0.173	0.455		Front	0.516	0.173	0.689
	Top	-	0.082	0.082		Top	-	0.082	0.082
	Bottom	0.165	-	0.165		Bottom	0.345	-	0.345
	Right	0.263	-	0.263		Right	-	-	0.000
	Left	0.231	0.055	0.286		Left	0.615	0.055	0.670
Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.474	0.124	0.598	Body SAR	Back	0.851	0.124	0.975
	Front	0.368	0.173	0.541		Front	0.374	0.173	0.547
	Top	-	0.082	0.082		Top	-	0.082	0.082
	Bottom	0.131	-	0.131		Bottom	0.249	-	0.249
	Right	0.424	-	0.424		Right	0.317	-	0.317
	Left	0.182	0.055	0.237		Left	0.302	0.055	0.357
Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 25 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	1.128	0.124	1.252	Body SAR	Back	0.608	0.124	0.732
	Front	1.118	0.173	1.291		Front	0.773	0.173	0.946
	Top	-	0.082	0.082		Top	-	0.082	0.082
	Bottom	0.281	-	0.281		Bottom	0.279	-	0.279
	Right	-	-	0.000		Right	0.113	-	0.113
	Left	0.622	0.055	0.677		Left	0.454	0.055	0.509

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Table 12-8
Simultaneous Transmission Scenario with 5 GHz WLAN (Hotspot)

Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	PCS EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.372	0.199	0.571	Body SAR	Back	0.545	0.199	0.744
	Front	0.282	0.179	0.461		Front	0.516	0.179	0.695
	Top	-	0.152	0.152		Top	-	0.152	0.152
	Bottom	0.165	-	0.165		Bottom	0.345	-	0.345
	Right	0.263	-	0.263		Right	-	-	0.000
	Left	0.231	0.278	0.509		Left	0.615	0.278	0.893
Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.474	0.199	0.673	Body SAR	Back	0.851	0.199	1.050
	Front	0.368	0.179	0.547		Front	0.374	0.179	0.553
	Top	-	0.152	0.152		Top	-	0.152	0.152
	Bottom	0.131	-	0.131		Bottom	0.249	-	0.249
	Right	0.424	-	0.424		Right	0.317	-	0.317
	Left	0.182	0.278	0.460		Left	0.302	0.278	0.580
Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 25 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	1.128	0.199	1.327	Body SAR	Back	0.608	0.199	0.807
	Front	1.118	0.179	1.297		Front	0.773	0.179	0.952
	Top	-	0.152	0.152		Top	-	0.152	0.152
	Bottom	0.281	-	0.281		Bottom	0.279	-	0.279
	Right	-	-	0.000		Right	0.113	-	0.113
	Left	0.622	0.278	0.900		Left	0.454	0.278	0.732

12.6 Simultaneous Transmission Conclusion

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

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13 SAR MEASUREMENT VARIABILITY

13.1 Measurement Variability

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

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

- 1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
- 2) A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg ($\sim 10\%$ 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

Table 13-1
Head SAR Measurement Variability Results

HEAD VARIABILITY RESULTS													
Band	FREQUENCY		Mode/Band	Service	Side	Test Position	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)	
1900	1908.75	1175	PCS CDMA	RC3 / SO55	Left	Cheek	0.979	0.978	1.00	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT						Head							
Spatial Peak						1.6 W/kg (mW/g)							
Uncontrolled Exposure/General Population						averaged over 1 gram							

Table 13-2
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS													
Band	FREQUENCY		Mode	Service	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)	
835	836.50	20525	LTE Band 5 (Cell)	QPSK, 1 RB, 0 RB Offset	back	8 mm	0.835	0.816	1.02	N/A	N/A	N/A	N/A
1750	1732.50	20175	LTE Band 4 (AWS)	QPSK, 1 RB, 0 RB Offset	back	8 mm	1.120	1.090	1.03	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT						Body							
Spatial Peak						1.6 W/kg (mW/g)							
Uncontrolled Exposure/General Population						averaged over 1 gram							

13.2 Measurement Uncertainty

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

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14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	CBT	N/A	CBT	3051A00187
Agilent	8648D	(9kHz-4GHz) Signal Generator	4/15/2014	Annual	4/15/2015	3629U00687
Agilent	8753E	(30kHz-6GHz) Network Analyzer	12/30/2014	Annual	12/30/2015	JP38020182
Agilent	8753ES	S-Parameter Network Analyzer	5/22/2014	Annual	5/22/2015	US39170118
Agilent	E4438C	ESG Vector Signal Generator	4/25/2014	Annual	4/25/2015	MY42082385
Agilent	E5515C	Wireless Communications Test Set	6/26/2013	Biennial	6/26/2015	GB41450275
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/15/2014	Annual	4/15/2015	MY45470194
Agilent	N5182A	MXG Vector Signal Generator	4/15/2014	Annual	4/15/2015	MY47420651
Agilent	N9020A	MXA Signal Analyzer	10/27/2014	Annual	10/27/2015	US46470561
Amplifier Research	1551G6	Amplifier	CBT	N/A	CBT	433971
Amplifier Research	1551G6	Amplifier	CBT	N/A	CBT	433972
Amplifier Research	1551G6	Amplifier	CBT	N/A	CBT	433974
Anritsu	MA24106A	USB Power Sensor	5/14/2014	Annual	5/14/2015	1231535
Anritsu	MA24106A	USB Power Sensor	5/14/2014	Annual	5/14/2015	1231538
Anritsu	MA24106A	USB Power Sensor	5/15/2014	Annual	5/15/2015	1244512
Anritsu	MA24106A	USB Power Sensor	5/14/2014	Annual	5/14/2015	1244515
Anritsu	MA2411B	Pulse Power Sensor	11/17/2014	Annual	11/17/2015	1126066
Anritsu	ML2469A	Power Meter	3/14/2014	Annual	3/14/2015	1306009
Anritsu	ML2495A	Power Meter	7/12/2013	Biennial	7/12/2015	1328004
Anritsu	MT8820C	Radio Communication Analyzer	9/19/2014	Annual	9/19/2015	6201144418
Anritsu	MT8820C	Radio Communication Analyzer	5/6/2014	Annual	5/6/2015	6201144419
COMTECH	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M155A00-009
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
Control Company	4052	Long Stem Thermometer	9/27/2013	Biennial	9/27/2015	130567447
Control Company	36934-158	Wall-Mounted Thermometer	4/29/2014	Biennial	4/29/2016	122014488
Fisher Scientific	15-077-960	Digital Thermometer	12/4/2013	Biennial	12/4/2015	130764551
Fisher Scientific	S407993	Long Stem Thermometer	11/4/2013	Biennial	11/4/2015	130671801
Fisher Scientific	S97611	Thermometer	4/12/2013	Biennial	4/12/2015	130219303
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
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	5/8/2014	Biennial	5/8/2016	13264162
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-53W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	6/6/2014	Annual	6/6/2015	109892
Rohde & Schwarz	CMW500	Radio Communication Tester	10/3/2014	Annual	10/3/2015	100976
Rohde & Schwarz	CMW500	Radio Communication Tester	4/17/2014	Annual	4/17/2015	101699
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	22313
SPEAG	D1750V2	1750 MHz SAR Dipole	4/10/2014	Annual	4/10/2015	1051
SPEAG	D1900V2	1900 MHz SAR Dipole	4/9/2014	Annual	4/9/2015	5d141
SPEAG	D1900V2	1900 MHz SAR Dipole	2/27/2014	Annual	2/27/2015	5d148
SPEAG	D2450V2	2450 MHz SAR Dipole	8/11/2014	Annual	8/11/2015	719
SPEAG	D56HzV2	5 GHz SAR Dipole	2/26/2014	Annual	2/26/2015	1120
SPEAG	D750V3	750 MHz Dipole	2/27/2014	Annual	2/27/2015	1046
SPEAG	D835V2	835 MHz SAR Dipole	4/7/2014	Annual	4/7/2015	4d119
SPEAG	D835V2	835 MHz SAR Dipole	7/24/2014	Annual	7/24/2015	4d133
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/26/2014	Annual	2/26/2015	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/12/2014	Annual	8/12/2015	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/31/2014	Annual	10/31/2015	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/17/2014	Annual	3/17/2015	1334
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/11/2014	Annual	4/11/2015	1368
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/23/2014	Annual	10/23/2015	1408
SPEAG	DAE4	Dasy Data Acquisition Electronics	12/12/2014	Annual	12/12/2015	1415
SPEAG	ES3DV2	SAR Probe	8/19/2014	Annual	8/19/2015	3022
SPEAG	ES3DV3	SAR Probe	3/19/2014	Annual	3/19/2015	3209
SPEAG	ES3DV3	SAR Probe	2/25/2014	Annual	2/25/2015	3258
SPEAG	ES3DV3	SAR Probe	8/20/2014	Annual	8/20/2015	3331
SPEAG	ES3DV3	SAR Probe	10/24/2014	Annual	10/24/2015	3333
SPEAG	ES3DV3	SAR Probe	12/16/2014	Annual	12/16/2015	3334
SPEAG	EX3DV4	SAR Probe	12/12/2014	Annual	12/12/2015	3920
SPEAG	EX3DV4	SAR Probe	8/21/2014	Annual	8/21/2015	3949

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

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15 MEASUREMENT UNCERTAINTIES

Applicable for frequencies less than 3000 MHz.

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

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

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Applicable for frequencies up to 6 GHz.

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

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

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16 CONCLUSION

16.1 Measurement Conclusion

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

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

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APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LWF2

Communication System: UID 0, CDMA; Frequency: 836.52 MHz; Duty Cycle: 1:1

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.52 \text{ MHz}$; $\sigma = 0.902 \text{ S/m}$; $\epsilon_r = 41.013$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-19-2015; Ambient Temp: 22.8°C; Tissue Temp: 21.1°C

Probe: ES3DV2 - SN3022; ConvF(6.18, 6.18, 6.18); Calibrated: 8/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/12/2014

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800

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

Mode: Cell. CDMA, Right Head, Cheek, Mid.ch

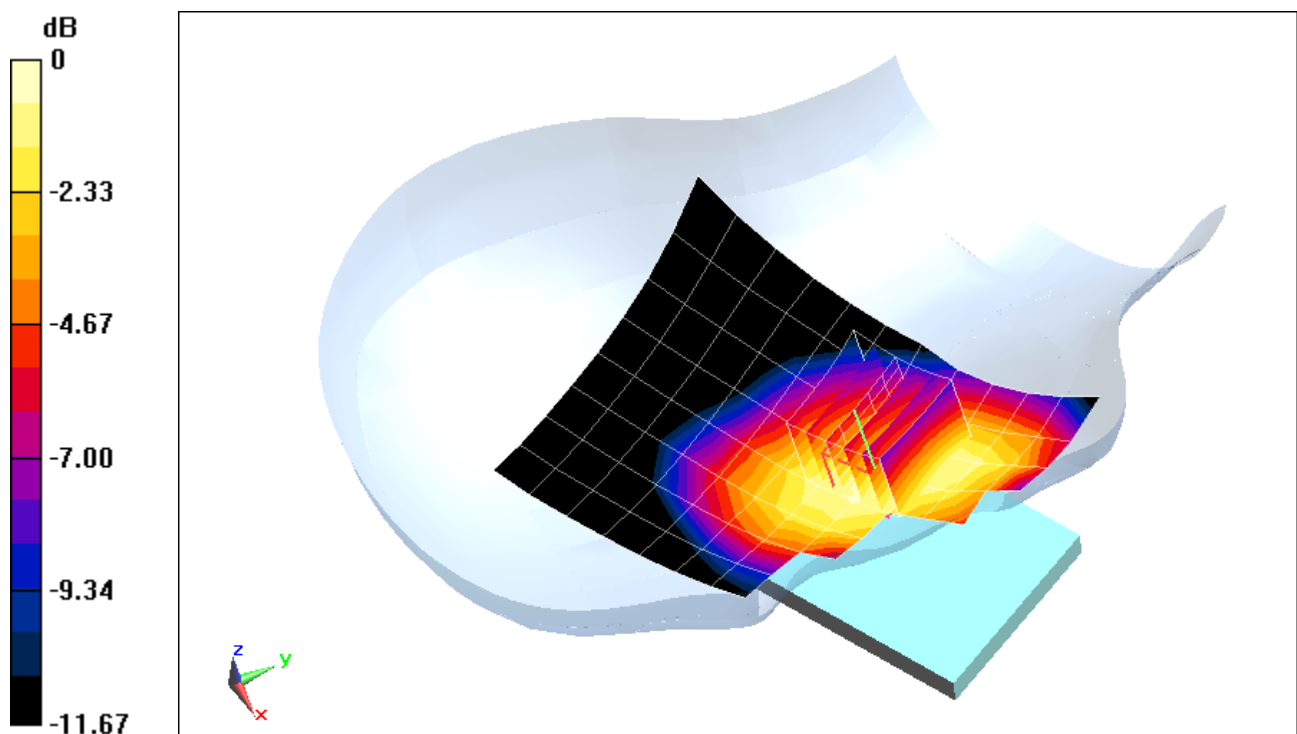
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 22.85 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.572 W/kg

SAR(1 g) = 0.440 W/kg



0 dB = 0.482 W/kg = -3.17 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LWF2

Communication System: UID 0, CDMA; Frequency: 1908.75 MHz; Duty Cycle: 1:1

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1908.75 \text{ MHz}$; $\sigma = 1.449 \text{ S/m}$; $\epsilon_r = 38.654$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-20-2015; Ambient Temp: 21.6°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3333; ConvF(5.11, 5.11, 5.11); Calibrated: 10/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 10/23/2014

Phantom: Sub TWIN SAM; Type: QD000P40CC; Serial: TP-1357

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

Mode: PCS CDMA, Left Head, Cheek, High ch

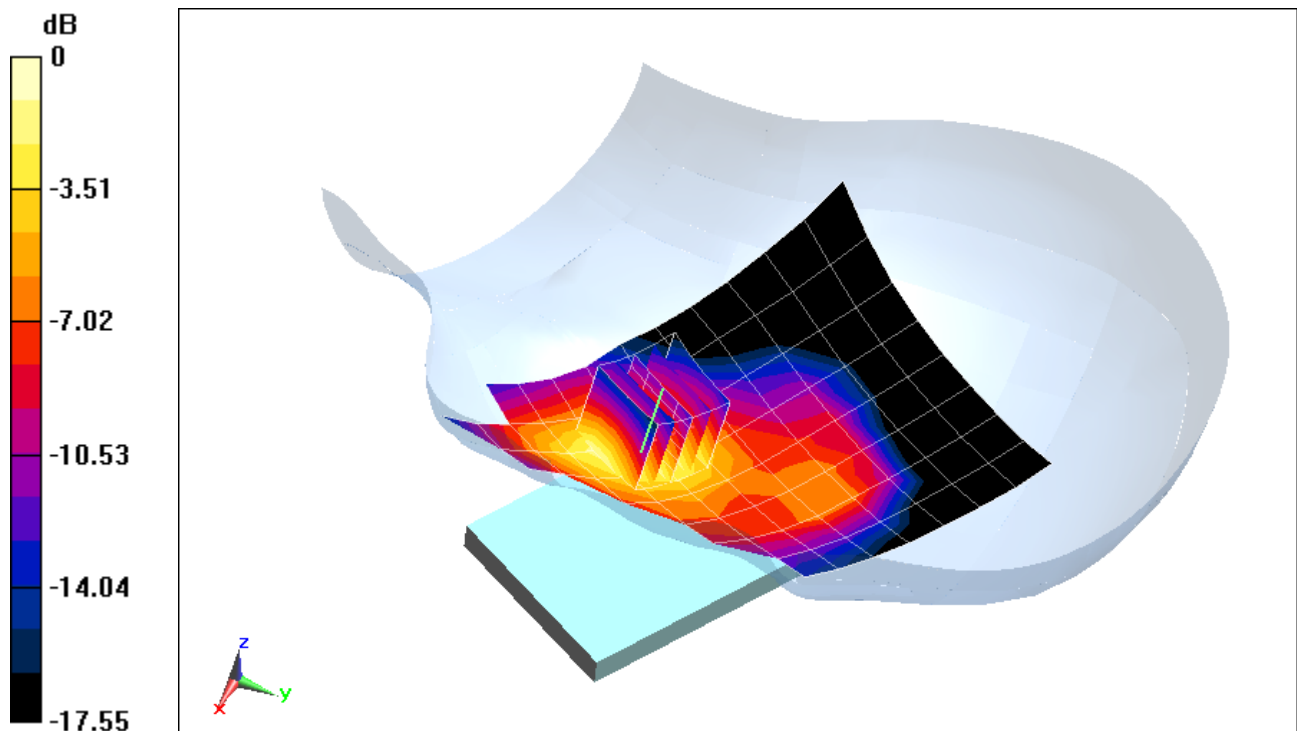
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 25.73 V/m; Power Drift = -0.15 dB

Peak SAR (extrapolated) = 1.56 W/kg

SAR(1 g) = 0.979 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LYF7

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

Medium: 750 Head Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.883 \text{ S/m}$; $\epsilon_r = 42.452$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-26-2015; Ambient Temp: 22.7°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3334; ConvF(6.51, 6.51, 6.51); Calibrated: 12/16/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 12/12/2014

Phantom: Sub Twin Sam v5.0; Type: QD000P40CD; Serial: TP:1626

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

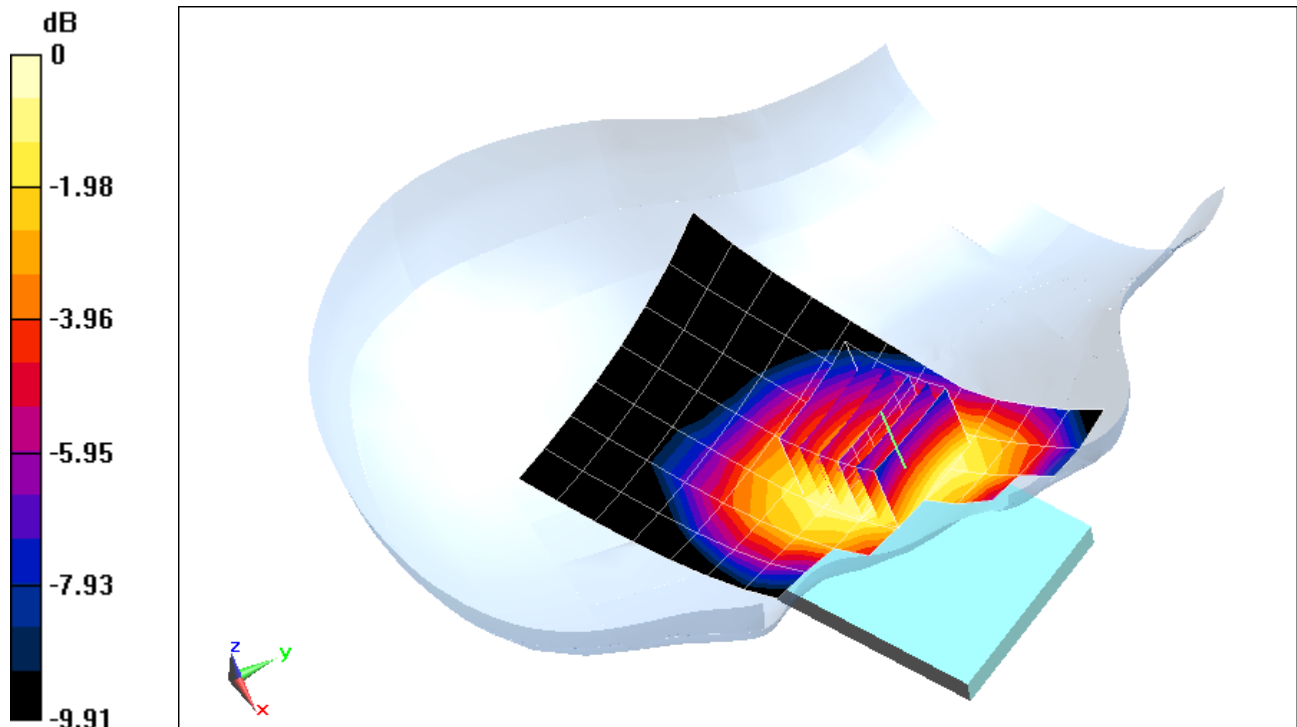
Area Scan (8x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 18.82 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 0.345 W/kg

SAR(1 g) = 0.270 W/kg



0 dB = 0.295 W/kg = -5.30 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LYF7

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

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 0.912 \text{ S/m}$; $\epsilon_r = 40.813$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-23-2015; Ambient Temp: 23.1°C; Tissue Temp: 22.4°C

Probe: ES3DV3 - SN3334; ConvF(6.25, 6.25, 6.25); Calibrated: 12/16/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 12/12/2014

Phantom: Sub Twin Sam v5.0; Type: QD000P40CD; Serial: TP:1626

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

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

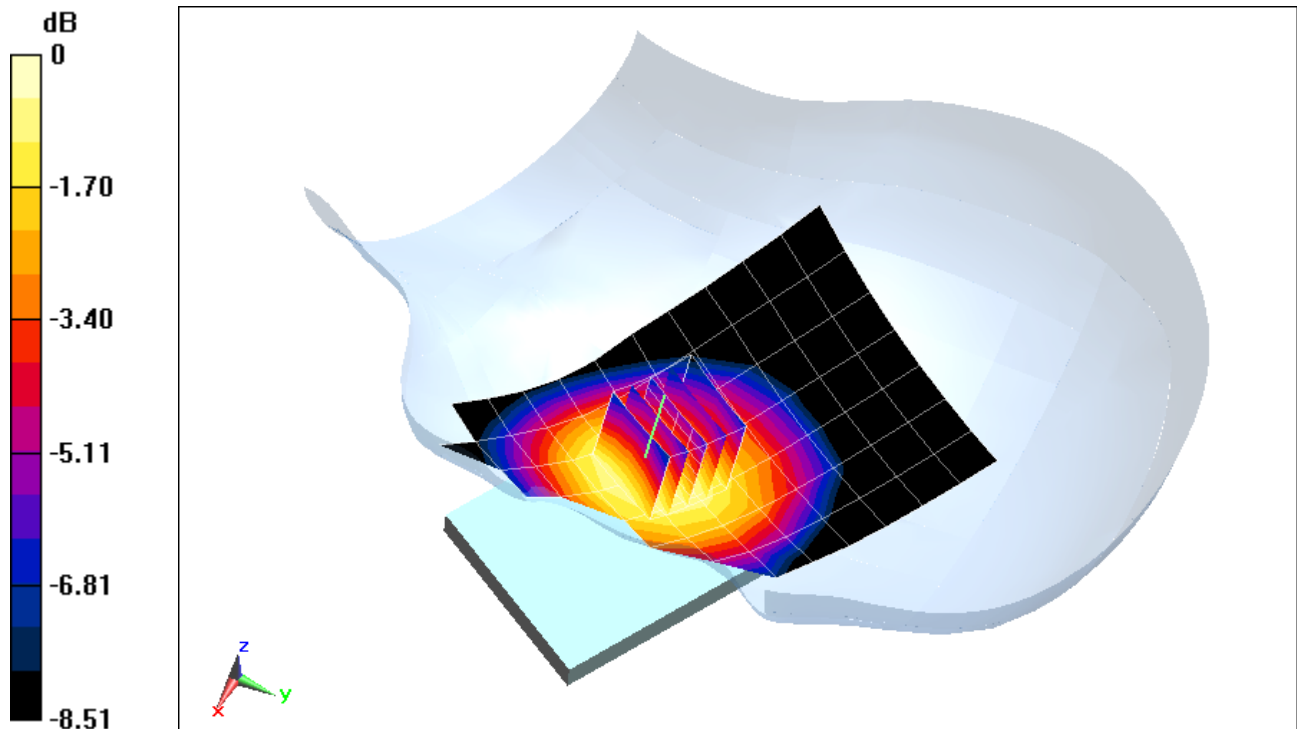
Area Scan (8x13x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 20.16 V/m; Power Drift = 0.15 dB

Peak SAR (extrapolated) = 0.413 W/kg

SAR(1 g) = 0.339 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LYF7

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

Medium: 1750 Head Medium parameters used (interpolated):

$f = 1732.5 \text{ MHz}$; $\sigma = 1.344 \text{ S/m}$; $\epsilon_r = 39.265$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-21-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.4°C

Probe: ES3DV3 - SN3331; ConvF(5.28, 5.28, 5.28); Calibrated: 8/20/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 10/31/2014

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

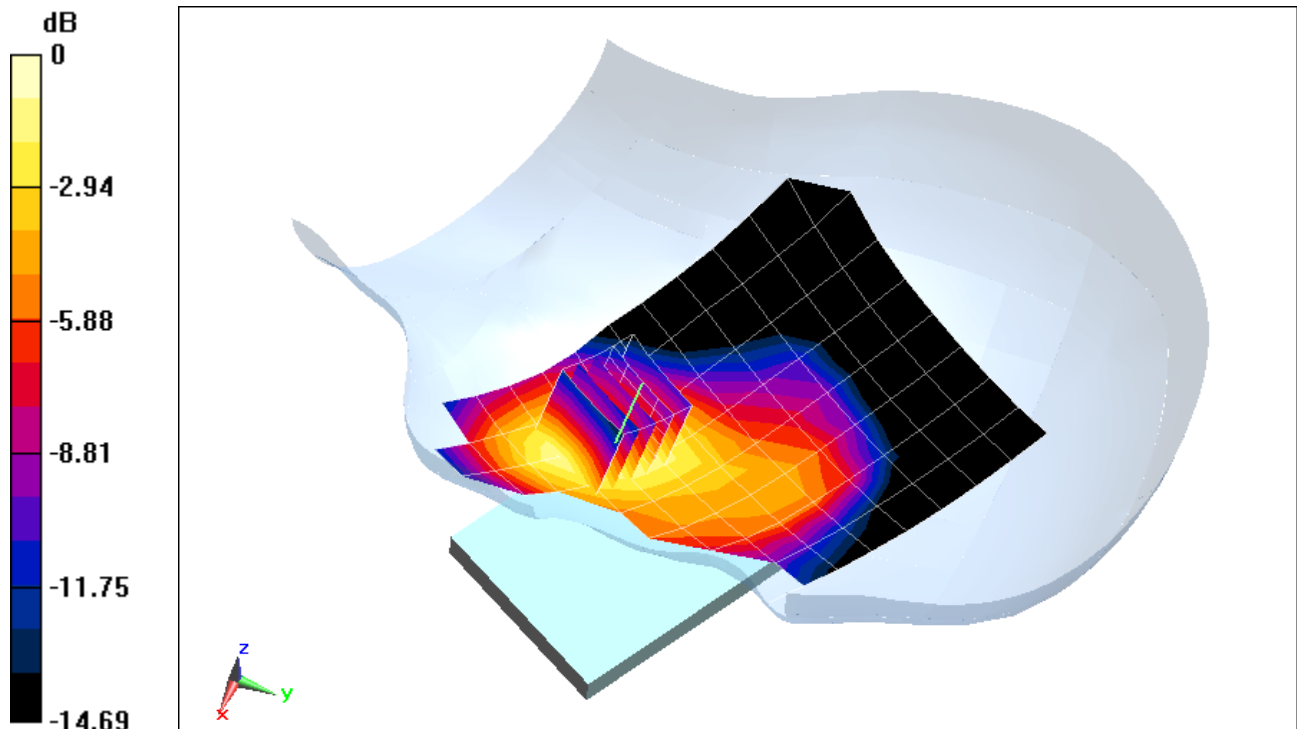
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 26.00 V/m; Power Drift = 0.16 dB

Peak SAR (extrapolated) = 1.12 W/kg

SAR(1 g) = 0.751 W/kg



0 dB = 0.866 W/kg = -0.62 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LYF7

Communication System: UID 0, LTE Band 25 (PCS); Frequency: 1882.5 MHz; Duty Cycle: 1:1

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1882.5 \text{ MHz}$; $\sigma = 1.422 \text{ S/m}$; $\epsilon_r = 38.774$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-20-2015; Ambient Temp: 21.6°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3333; ConvF(5.11, 5.11, 5.11); Calibrated: 10/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 10/23/2014

Phantom: Sub TWIN SAM; Type: QD000P40CC; Serial: TP-1357

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

Mode: LTE Band 25 (PCS), Left Head, Cheek, Mid.ch
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

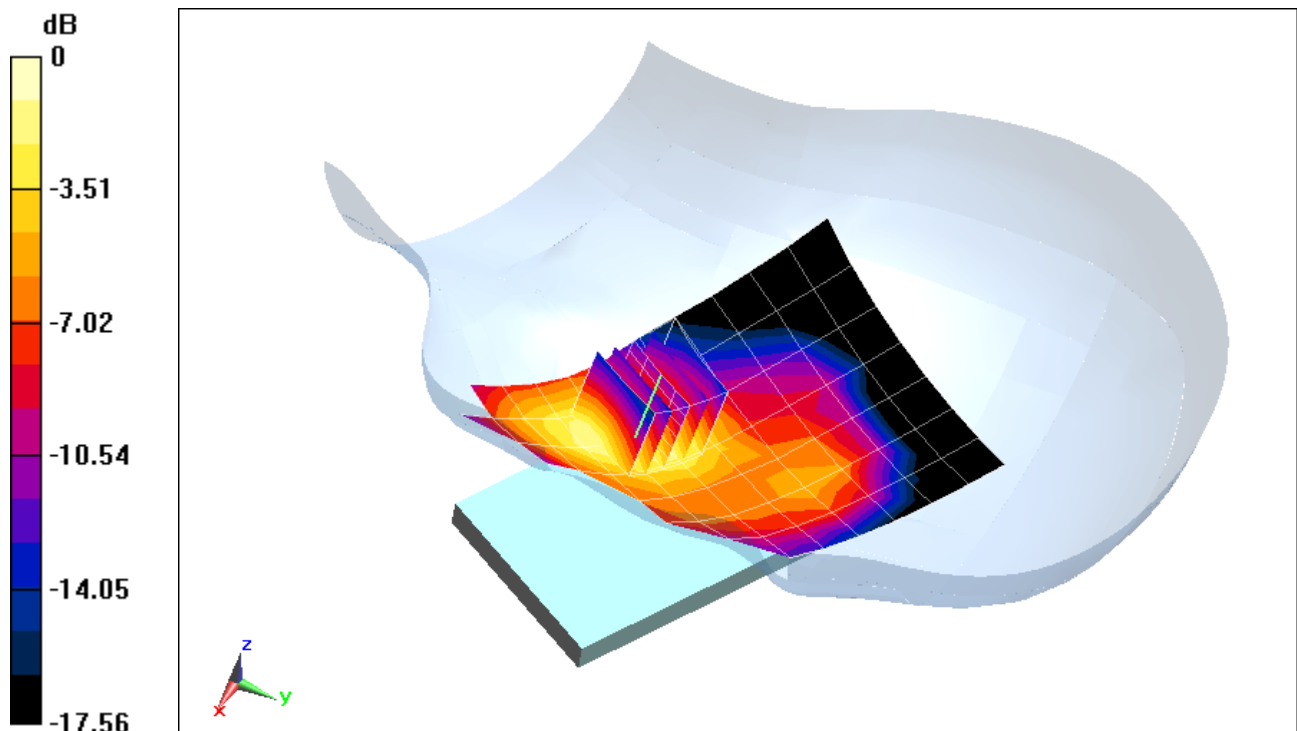
Area Scan (8x13x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 24.94 V/m; Power Drift = 0.19 dB

Peak SAR (extrapolated) = 1.20 W/kg

SAR(1 g) = 0.761 W/kg



0 dB = 0.913 W/kg = -0.40 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LWF8

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

Medium: 2450 Head Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 1.798 \text{ S/m}$; $\epsilon_r = 38.621$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

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

Probe: ES3DV3 - SN3258; ConvF(4.52, 4.52, 4.52); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

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

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

Mode: IEEE 802.11b, Right Head, Cheek, Ch 06, 1 Mbps

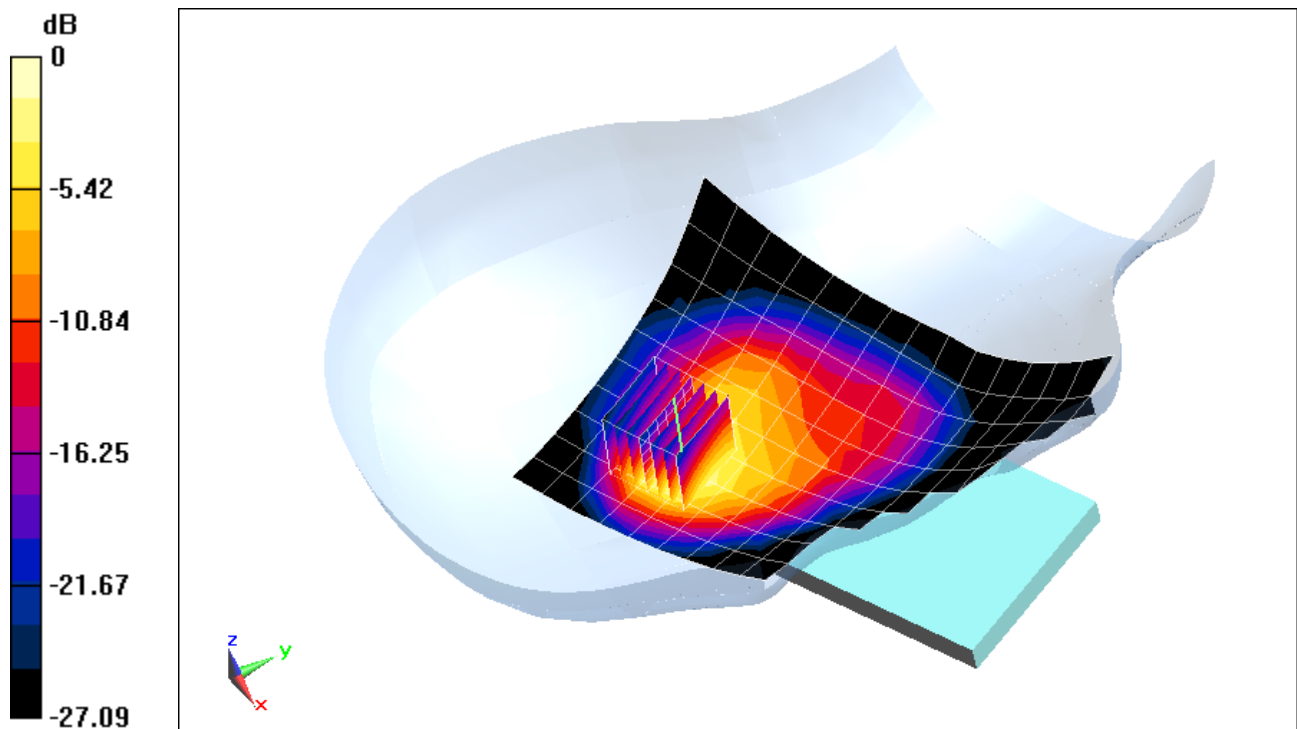
Area Scan (11x17x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 18.80 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.30 W/kg

SAR(1 g) = 0.645 W/kg



0 dB = 0.826 W/kg = -0.83 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LWF8

Communication System: UID 0, 802.11a 5.2-5.8 GHz Band, Frequency: 5500 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5500 \text{ MHz}$; $\sigma = 4.748 \text{ S/m}$; $\epsilon_r = 35.287$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-23-2015; Ambient Temp: 23.9°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3920; ConvF(4.44, 4.44, 4.44); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

Phantom: SAM, Left; Type: QD000P40CD; Serial: TP:1759

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

Mode: IEEE 802.11a, 5.5 GHz, Right Head, Cheek, Ch 100, 6 Mbps

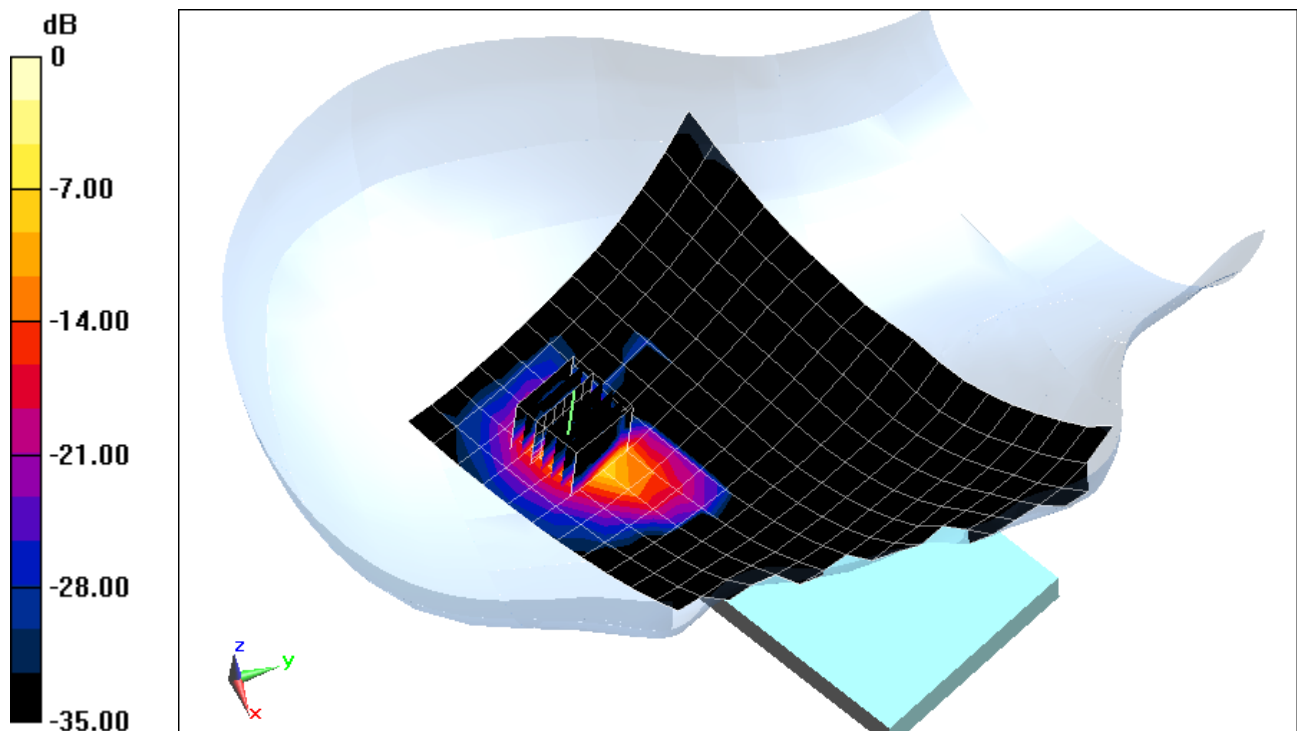
Area Scan (13x20x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Reference Value = 11.30 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 2.62 W/kg

SAR(1 g) = 0.617 W/kg



0 dB = 1.63 W/kg = 2.12 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LWF2

Communication System: UID 0, CDMA; Frequency: 836.52 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.52 \text{ MHz}$; $\sigma = 0.958 \text{ S/m}$; $\epsilon_r = 54.209$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.8 cm

Test Date: 01-20-2015; Ambient Temp: 22.6°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3334; ConvF(6.14, 6.14, 6.14); Calibrated: 12/16/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 12/12/2014

Phantom: Main Twin Sam; Type: QD000P40CC; Serial: TP: 1375

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

Mode: Cell. CDMA, Body SAR, Back side, Mid.ch

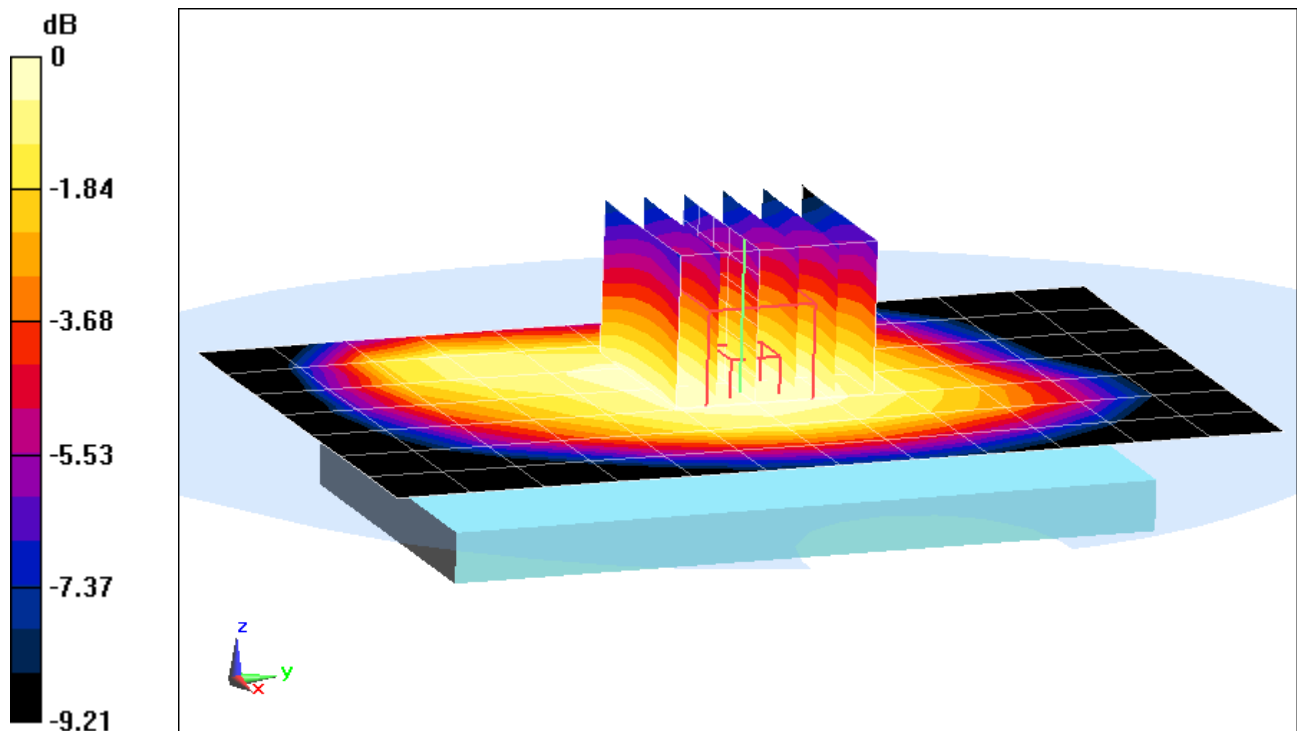
Area Scan (8x13x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 19.40 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 0.420 W/kg

SAR(1 g) = 0.338 W/kg



0 dB = 0.368 W/kg = -4.35 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LWF2

Communication System: UID 0, CDMA; Frequency: 836.52 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.52 \text{ MHz}$; $\sigma = 0.958 \text{ S/m}$; $\epsilon_r = 54.209$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.8 cm

Test Date: 01-20-2015; Ambient Temp: 22.6°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3334; ConvF(6.14, 6.14, 6.14); Calibrated: 12/16/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 12/12/2014

Phantom: Main Twin Sam; Type: QD000P40CC; Serial: TP: 1375

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

Mode: Cell. EVDO Rev.0, Body SAR, Back side, Mid.ch

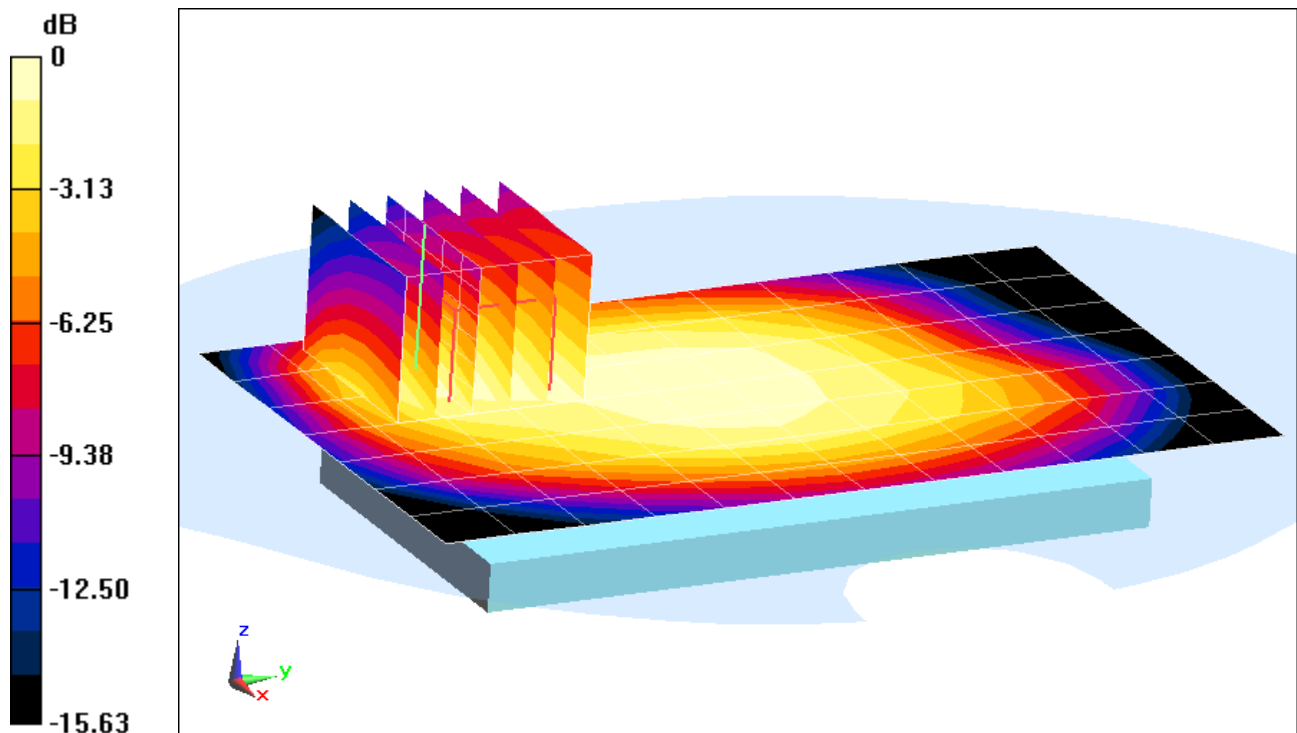
Area Scan (8x13x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 19.87 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 0.523 W/kg

SAR(1 g) = 0.366 W/kg



0 dB = 0.419 W/kg = -3.78 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LWF2

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

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.519 \text{ S/m}$; $\epsilon_r = 51.052$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.8 cm

Test Date: 01-20-2015; Ambient Temp: 23.4°C; Tissue Temp: 22.8°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/12/2014

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1226

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

Mode: PCS CDMA, Body SAR, Back side, Mid.ch

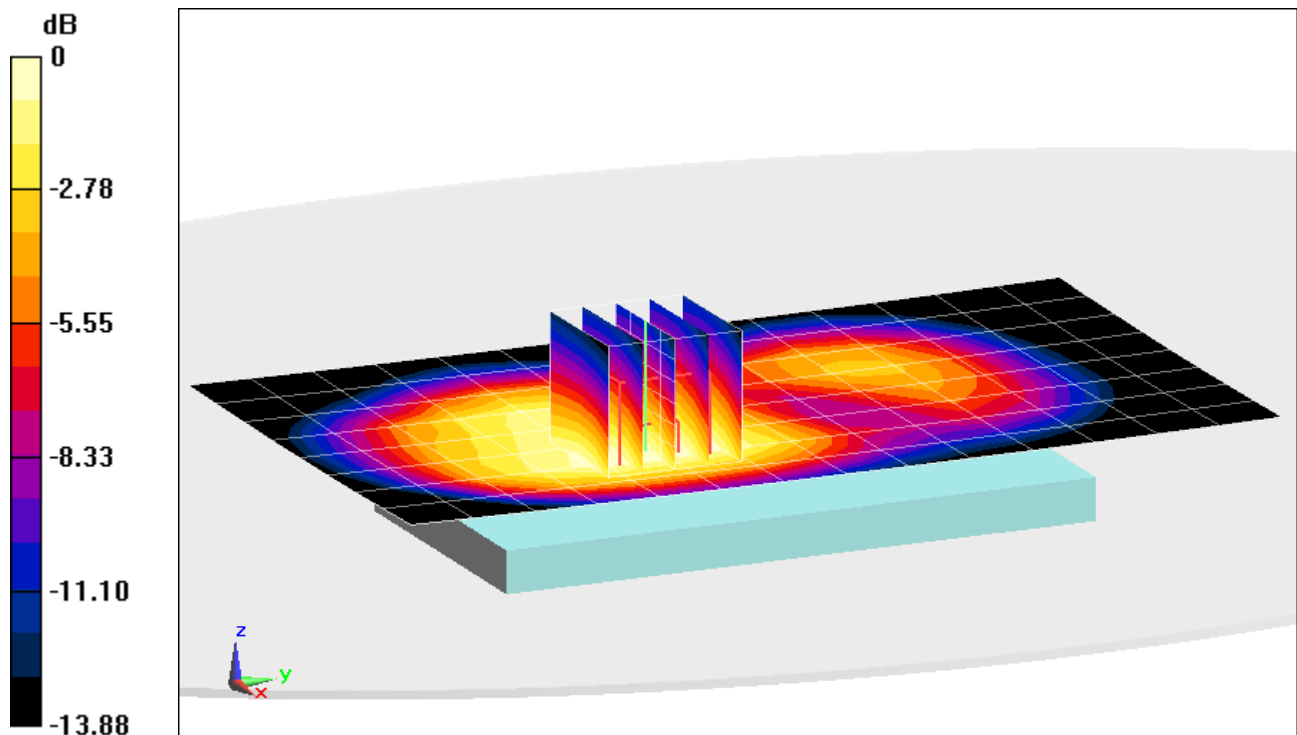
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 19.47 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.803 W/kg

SAR(1 g) = 0.546 W/kg



0 dB = 0.632 W/kg = -1.99 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LWF2

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

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.519 \text{ S/m}$; $\epsilon_r = 51.052$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-20-2015; Ambient Temp: 23.4°C; Tissue Temp: 22.8°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/12/2014

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1226

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

Mode: PCS EVDO Rev.0, Body SAR, Left Edge, Mid.ch

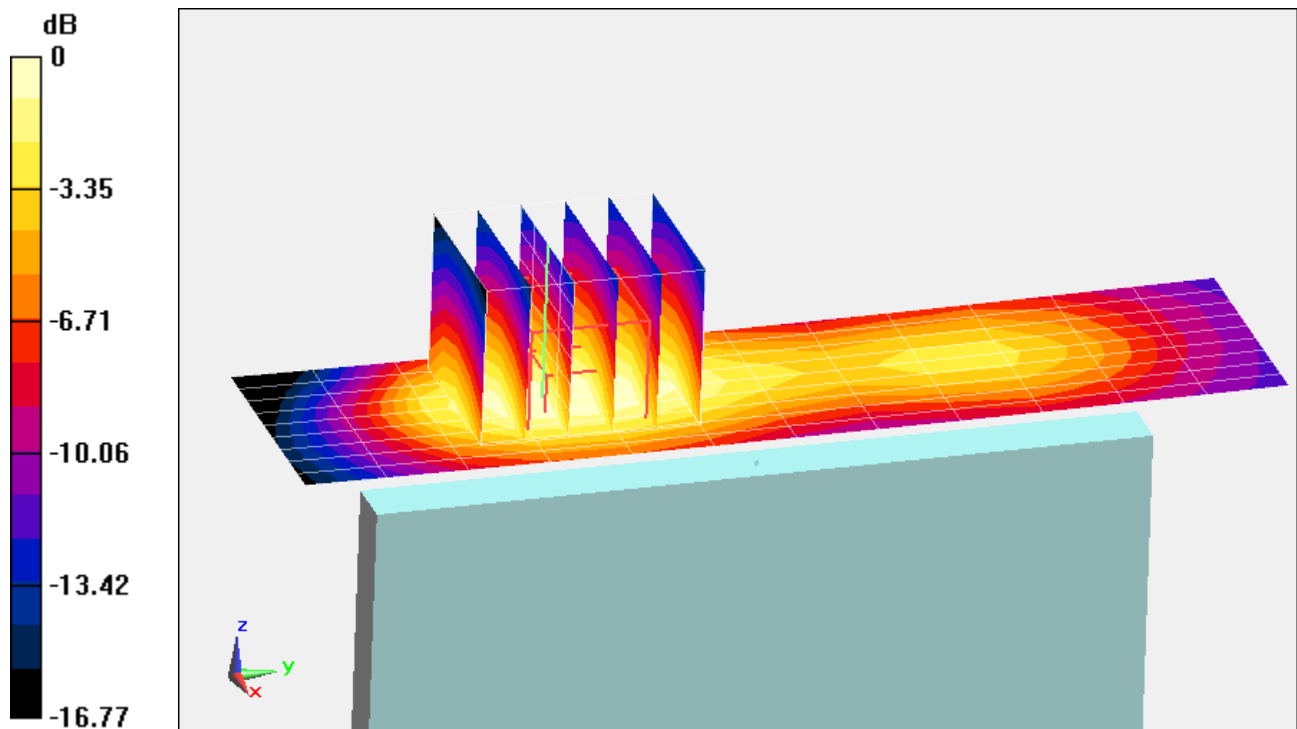
Area Scan (10x13x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 21.62 V/m; Power Drift = -0.12 dB

Peak SAR (extrapolated) = 0.977 W/kg

SAR(1 g) = 0.614 W/kg



0 dB = 0.734 W/kg = -1.34 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LYF7

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

Medium: 750 Body Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.934 \text{ S/m}$; $\epsilon_r = 56.314$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.8 cm

Test Date: 01-26-2015; Ambient Temp: 23.1°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3334; ConvF(6.09, 6.09, 6.09); Calibrated: 12/16/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 12/12/2014

Phantom: Main Twin Sam; Type: QD000P40CC; Serial: TP: 1375

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

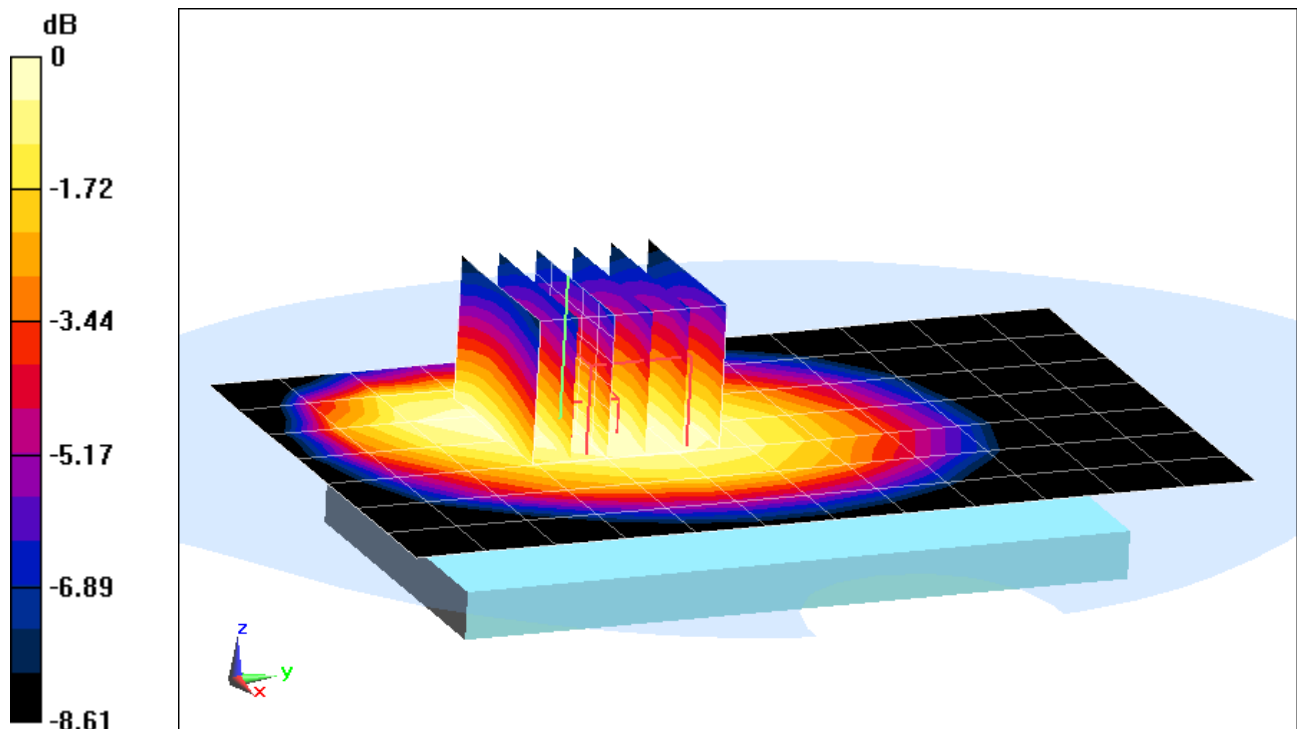
Area Scan (8x13x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 23.23 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.611 W/kg

SAR(1 g) = 0.474 W/kg



0 dB = 0.523 W/kg = -2.81 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LYF7

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; $\sigma = 0.957$ S/m; $\epsilon_r = 54.209$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 0.8 cm

Test Date: 01-20-2015; Ambient Temp: 22.6°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3334; ConvF(6.14, 6.14, 6.14); Calibrated: 12/16/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 12/12/2014

Phantom: Main Twin Sam; Type: QD000P40CC; Serial: TP: 1375

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

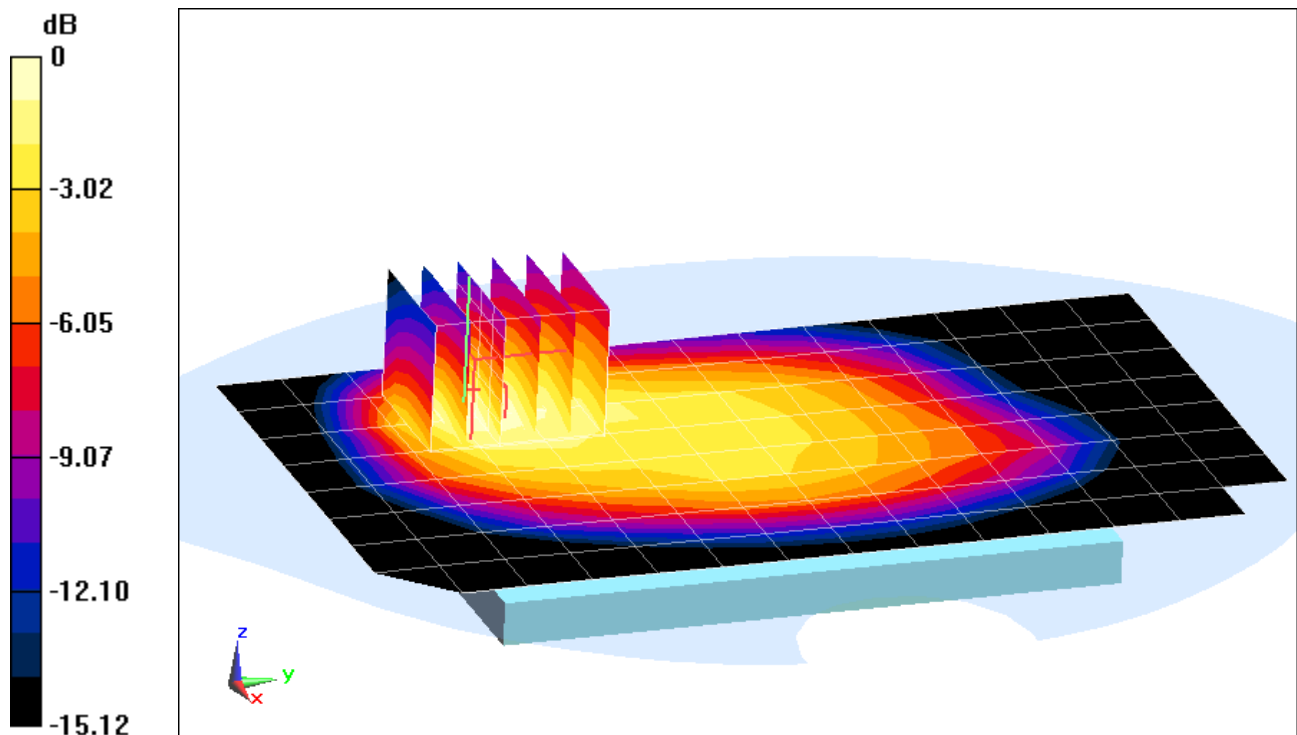
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 30.48 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.28 W/kg

SAR(1 g) = 0.835 W/kg



0 dB = 0.958 W/kg = -0.19 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LYF7

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

Medium: 1750 Body Medium parameters used (interpolated):

$f = 1732.5 \text{ MHz}$; $\sigma = 1.516 \text{ S/m}$; $\epsilon_r = 51.019$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.8 cm

Test Date: 01-21-2015; Ambient Temp: 21.5°C; Tissue Temp: 21.4°C

Probe: ES3DV3 - SN3333; ConvF(4.89, 4.89, 4.89); Calibrated: 10/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 10/23/2014

Phantom: Sub TWIN SAM; Type: QD000P40CC; Serial: TP-1357

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

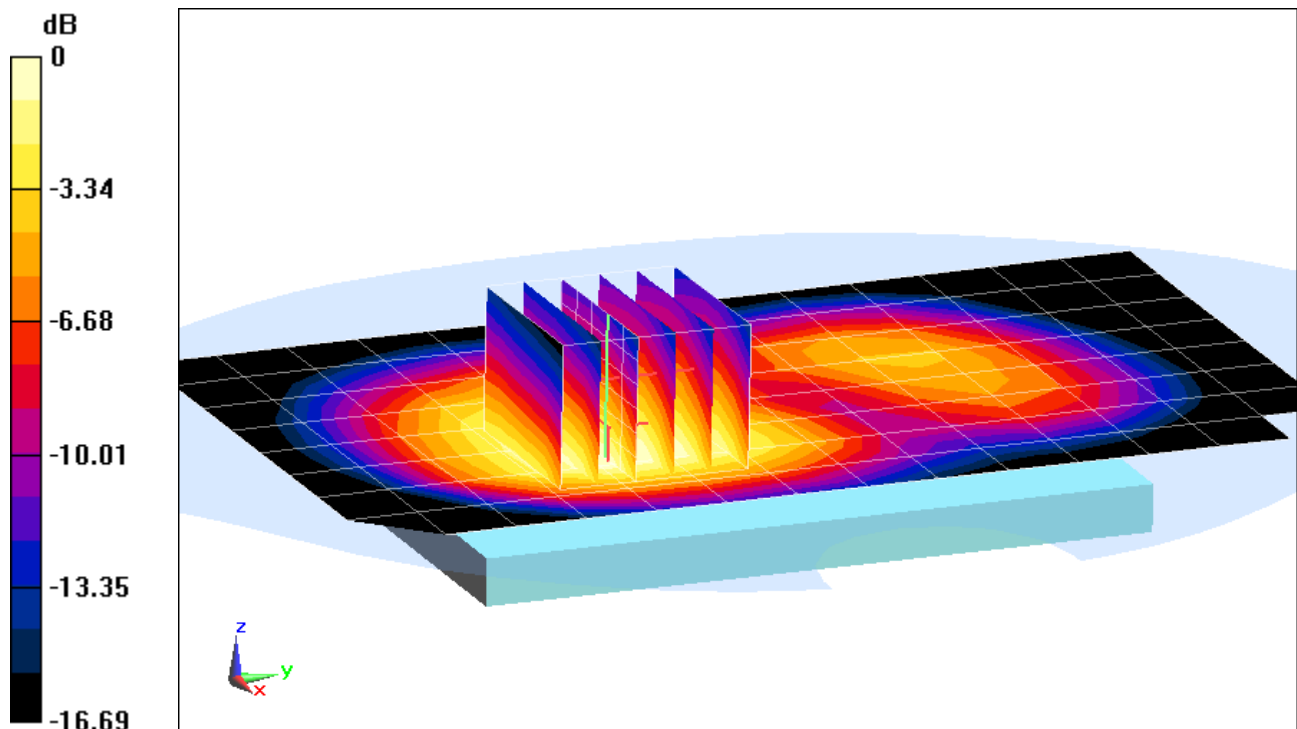
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 28.50 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 1.74 W/kg

SAR(1 g) = 1.12 W/kg



0 dB = 1.32 W/kg = 1.21 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LYF7

Communication System: UID 0, LTE Band 25 (PCS); Frequency: 1882.5 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1882.5 \text{ MHz}$; $\sigma = 1.522 \text{ S/m}$; $\epsilon_r = 51.044$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.8 cm

Test Date: 01-20-2015; Ambient Temp: 23.4°C; Tissue Temp: 22.8°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/12/2014

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1226

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

Mode: LTE Band 25 (PCS), Body SAR, Back side, Mid.ch
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

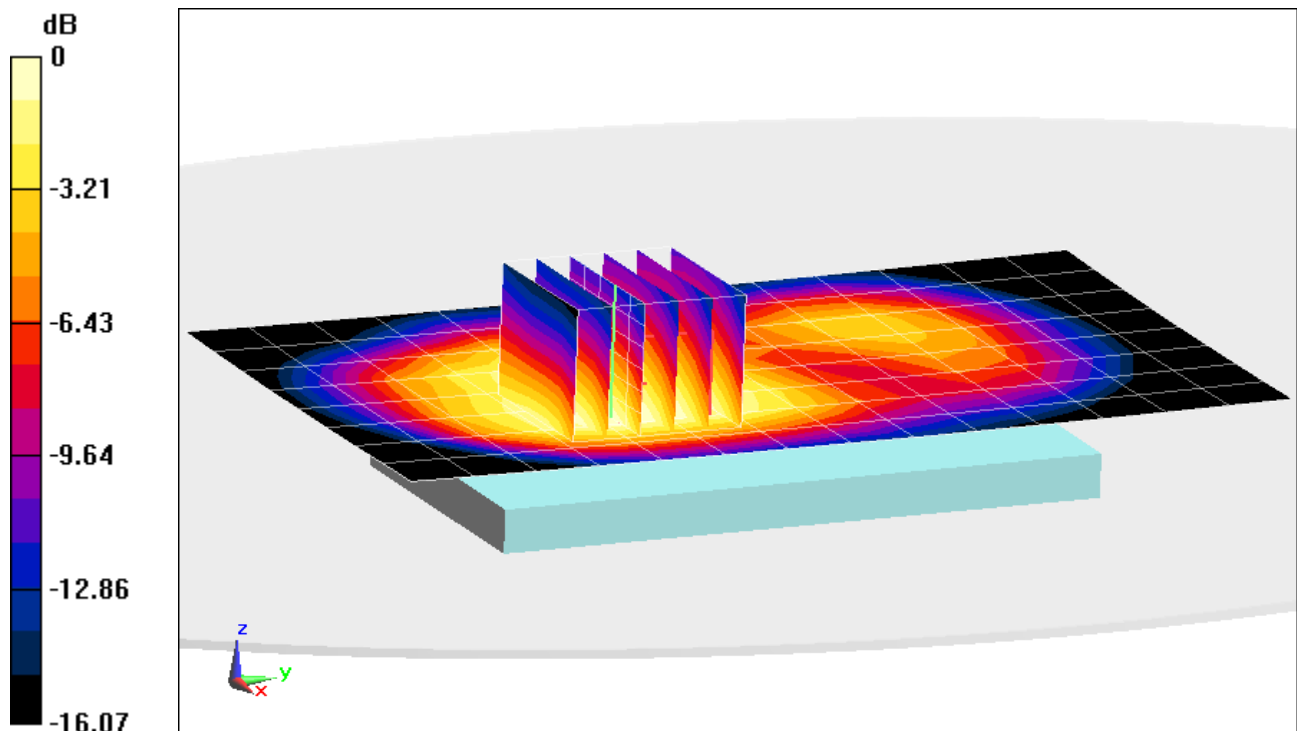
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 20.87 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.901 W/kg

SAR(1 g) = 0.601 W/kg



0 dB = 0.691 W/kg = -1.61 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LYF7

Communication System: UID 0, LTE Band 25 (PCS); Frequency: 1882.5 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1882.5 \text{ MHz}$; $\sigma = 1.522 \text{ S/m}$; $\epsilon_r = 51.044$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.8 cm

Test Date: 01-20-2015; Ambient Temp: 23.4°C; Tissue Temp: 22.8°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/12/2014

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1226

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

Mode: LTE Band 25 (PCS), Body SAR, Front side, Mid.ch
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

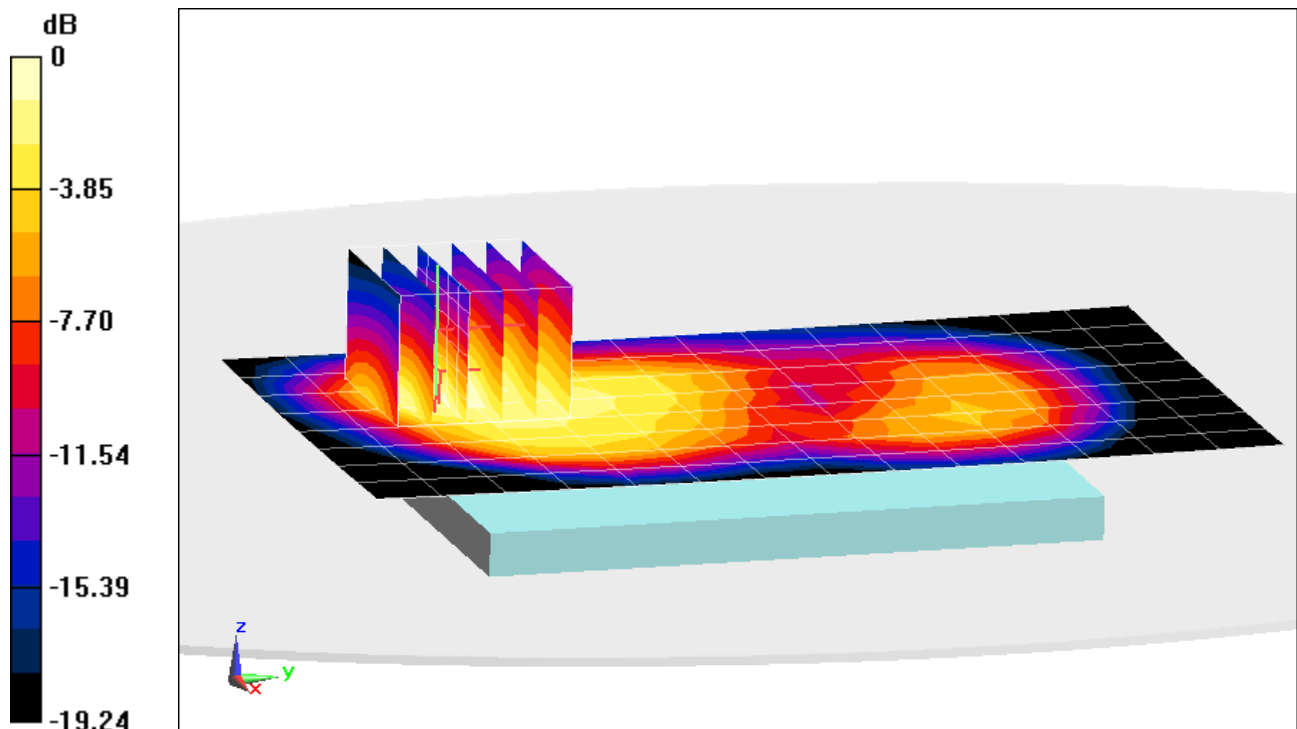
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 23.59 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.37 W/kg

SAR(1 g) = 0.764 W/kg



0 dB = 0.922 W/kg = -0.35 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LWF8

Communication System: UID 0, IEEE 802.11b; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2412 \text{ MHz}$; $\sigma = 1.873 \text{ S/m}$; $\epsilon_r = 51.121$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.8 cm

Test Date: 01-22-2015; Ambient Temp: 23.5°C; Tissue Temp: 23.8°C

Probe: ES3DV3 - SN3209; ConvF(4.2, 4.2, 4.2); Calibrated: 3/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/17/2014

Phantom: SAM left; Type: QD000P40CD; Serial: TP:1715

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

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

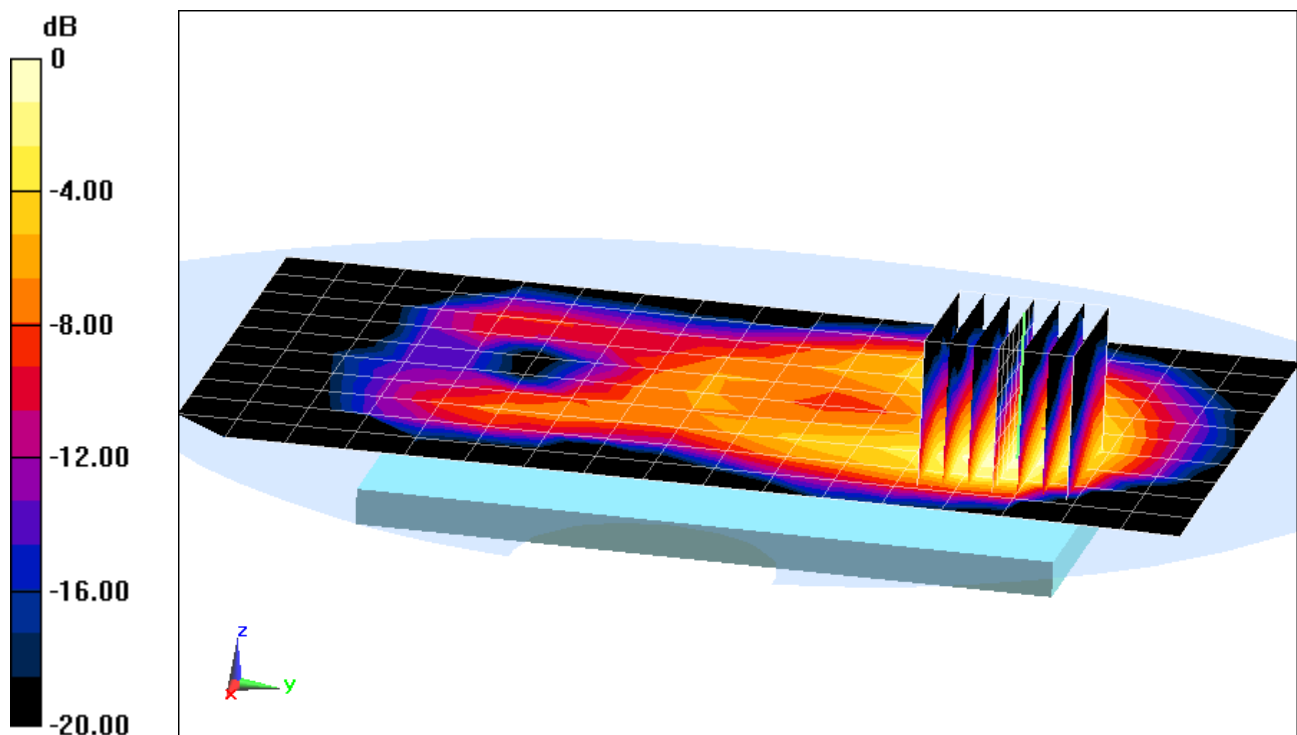
Area Scan (11x18x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

Zoom Scan (8x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 7.191 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.191 W/kg

SAR(1 g) = 0.088 W/kg



0 dB = 0.111 W/kg = -9.55 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LWF8

Communication System: UID 0, IEEE 802.11b; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2412 \text{ MHz}$; $\sigma = 1.873 \text{ S/m}$; $\epsilon_r = 51.121$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.8 cm

Test Date: 01-22-2015; Ambient Temp: 23.5°C; Tissue Temp: 23.8°C

Probe: ES3DV3 - SN3209; ConvF(4.2, 4.2, 4.2); Calibrated: 3/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/17/2014

Phantom: SAM left; Type: QD000P40CD; Serial: TP:1715

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

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

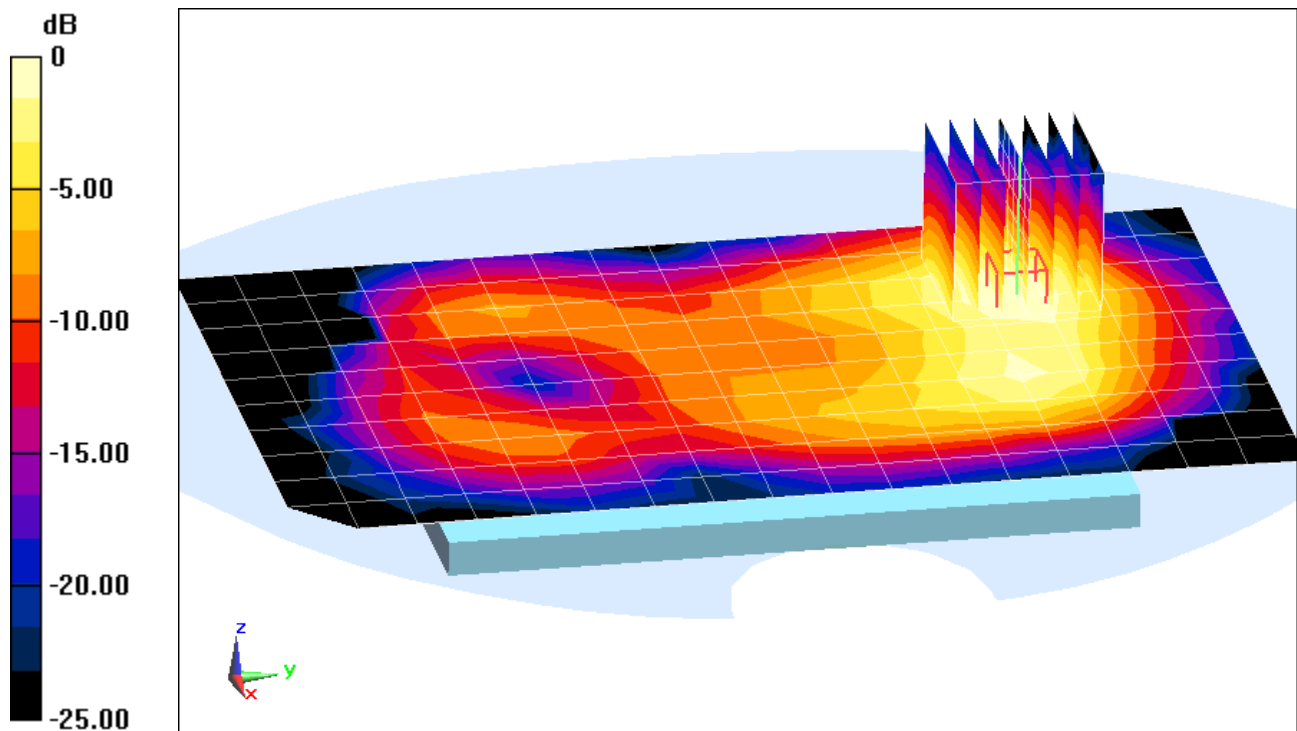
Area Scan (11x18x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 8.248 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 0.251 W/kg

SAR(1 g) = 0.123 W/kg



0 dB = 0.155 W/kg = -8.10 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LWF8

Communication System: UID 0, IEEE 802.11a; Frequency: 5765 MHz; Duty Cycle: 1:1

Medium: 5GHz Medium parameters used:

$f = 5765 \text{ MHz}$; $\sigma = 6.153 \text{ S/m}$; $\epsilon_r = 47.044$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.8 cm

Test Date: 01-20-2015; Ambient Temp: 22.9°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN3949; ConvF(4.27, 4.27, 4.27); Calibrated: 8/21/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 10/31/2014

Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357

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

Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 153, 6 Mbps, Back Side

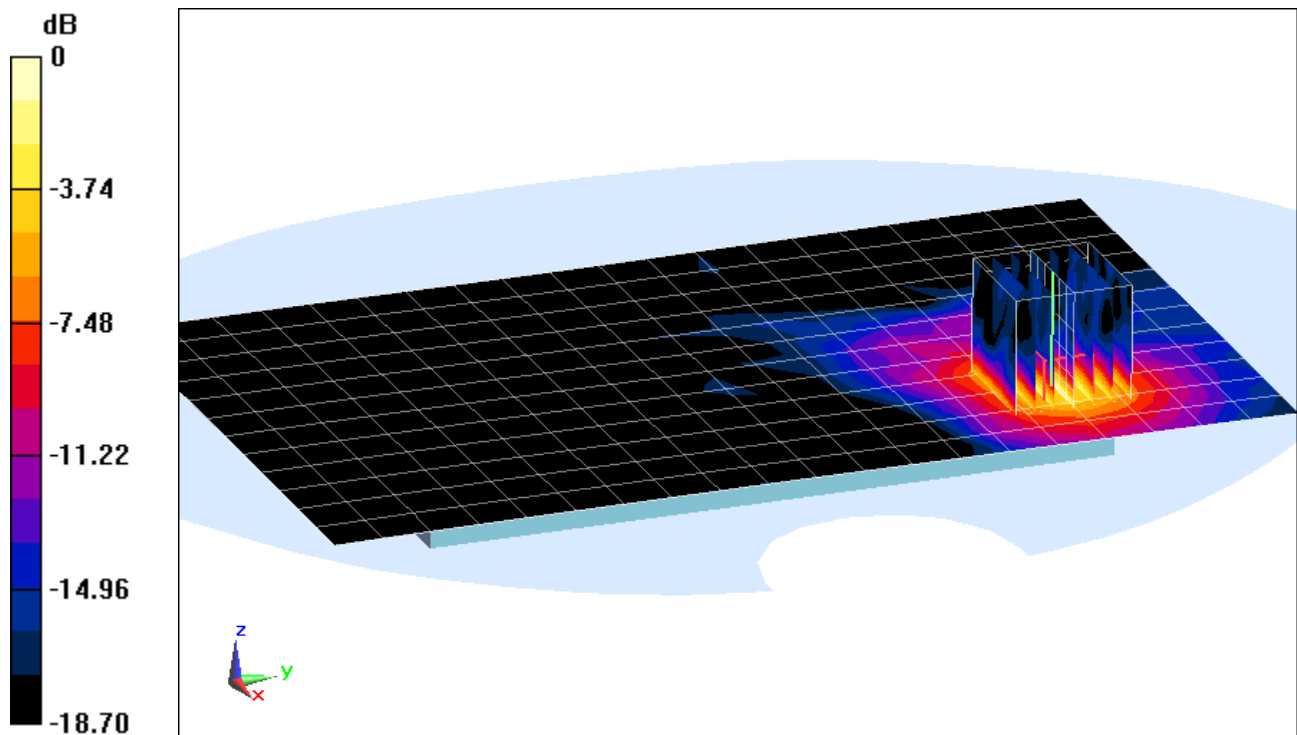
Area Scan (13x21x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 5.425 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 0.717 W/kg

SAR(1 g) = 0.169 W/kg



0 dB = 0.417 W/kg = -3.80 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFUS995; Type: Portable Handset; Serial: 1LWF8

Communication System: UID 0, IEEE 802.11a (0); Frequency: 5765 MHz; Duty Cycle: 1:1

Medium: 5GHz Medium parameters used:

$f = 5765 \text{ MHz}$; $\sigma = 6.153 \text{ S/m}$; $\epsilon_r = 47.044$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-20-2015; Ambient Temp: 22.9°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN3949; ConvF(4.27, 4.27, 4.27); Calibrated: 8/21/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 10/31/2014

Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357

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

Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 153, 6 Mbps, Left Edge

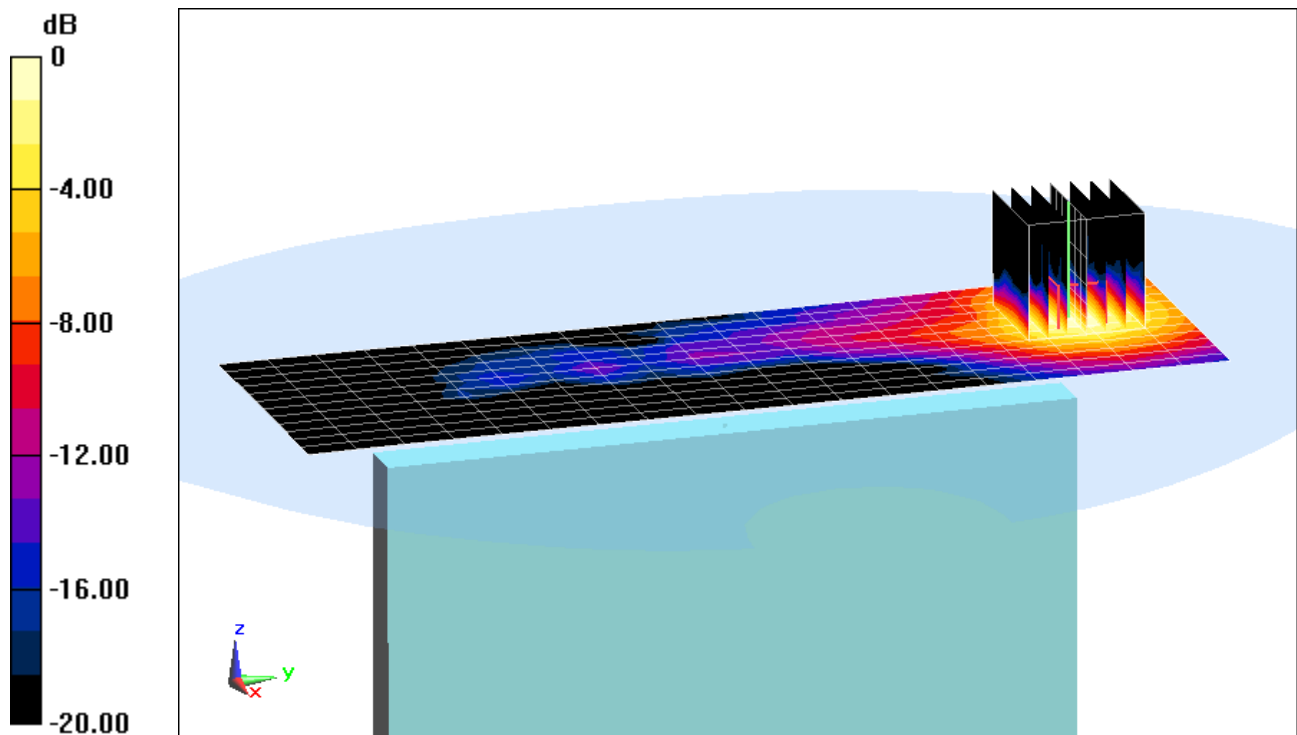
Area Scan (13x20x1): Measurement grid: dx=5mm, dy=10mm

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 6.191 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.03 W/kg

SAR(1 g) = 0.237 W/kg



0 dB = 0.569 W/kg = -2.45 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1046

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

Medium: 750 Head Medium parameters used (interpolated):

$f = 750 \text{ MHz}$; $\sigma = 0.921 \text{ S/m}$; $\epsilon_r = 41.903$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-26-2015; Ambient Temp: 22.7°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3334; ConvF(6.51, 6.51, 6.51); Calibrated: 12/16/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 12/12/2014

Phantom: Sub Twin Sam v5.0; Type: QD000P40CD; Serial: TP:1626

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

750 MHz System Verification

Area Scan (7x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

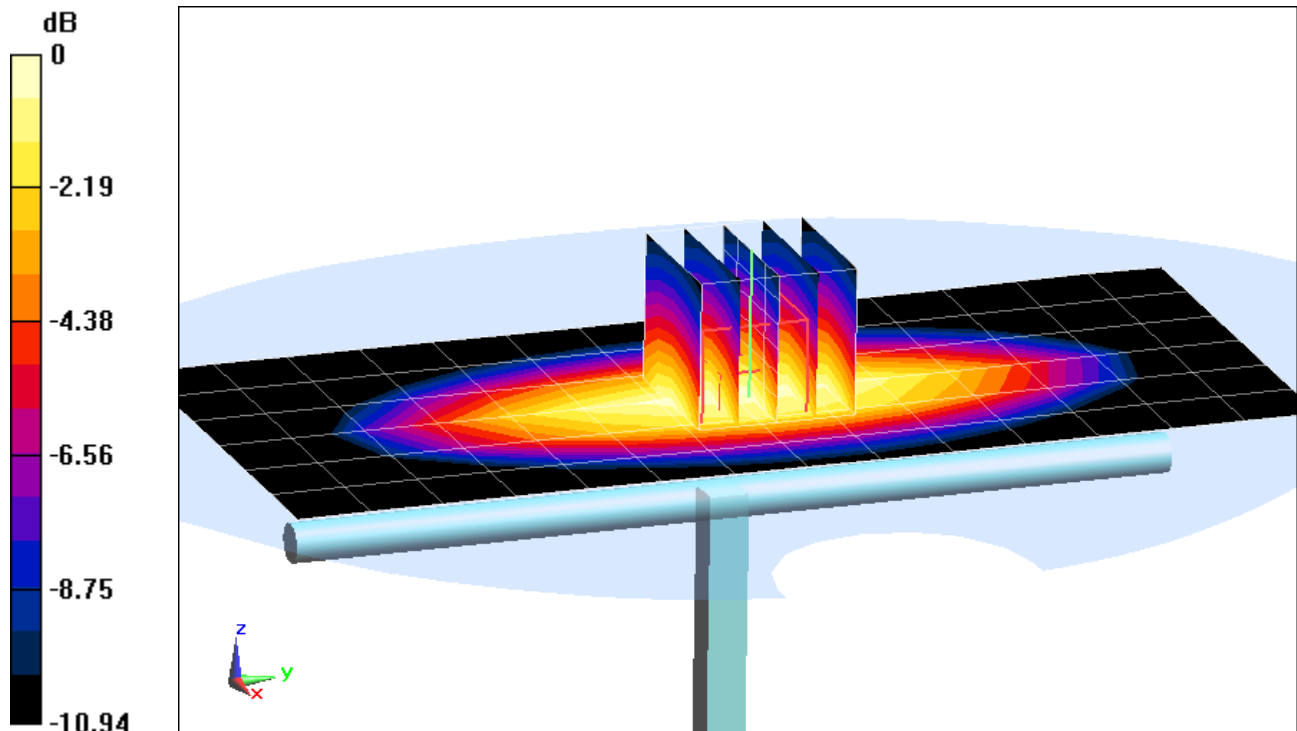
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.21 W/kg

SAR(1 g) = 0.803 W/kg

Deviation = -2.90%



PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 835 Head Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.9 \text{ S/m}$; $\epsilon_r = 41.034$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-19-2015; Ambient Temp: 22.8°C; Tissue Temp: 21.1°C

Probe: ES3DV2 - SN3022; ConvF(6.18, 6.18, 6.18); Calibrated: 8/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/12/2014

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800

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

835 MHz System Verification

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

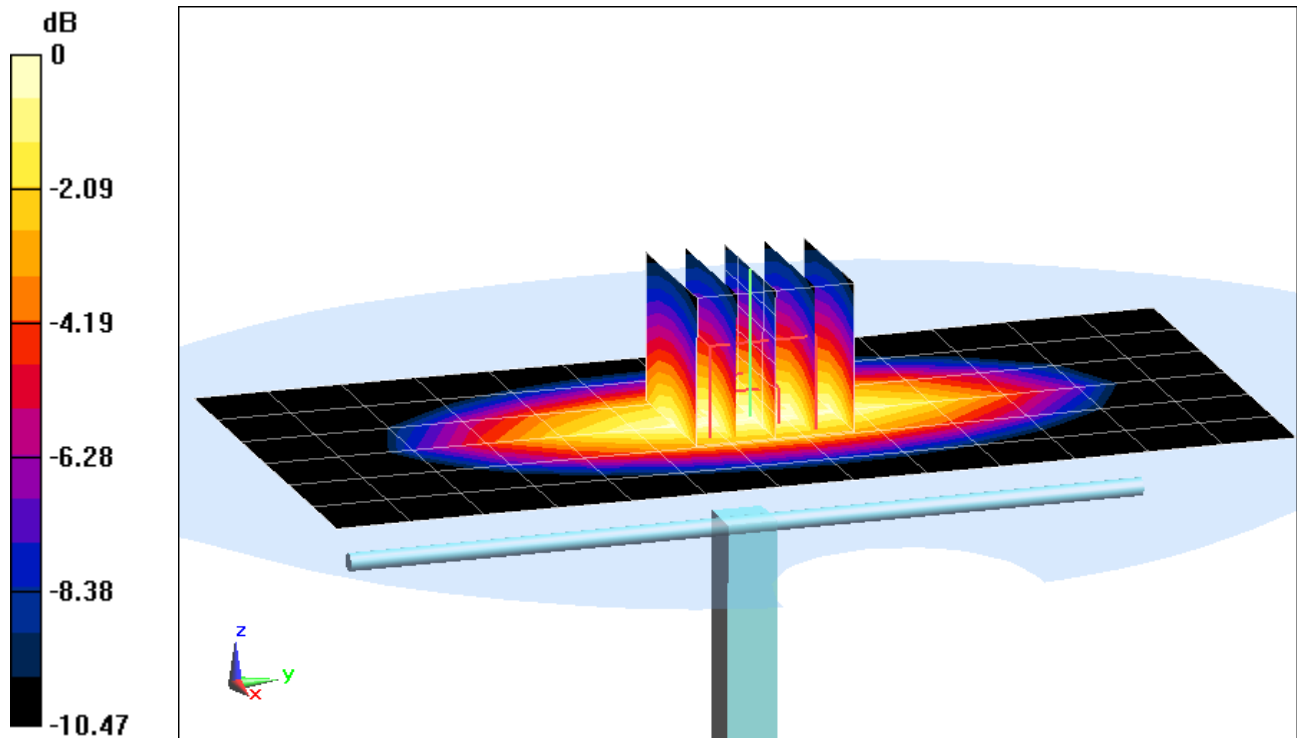
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.34 W/kg

SAR(1 g) = 0.918 W/kg

Deviation = -0.22%



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

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 835 Head Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.911 \text{ S/m}$; $\epsilon_r = 40.832$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-23-2015; Ambient Temp: 23.1°C; Tissue Temp: 22.4°C

Probe: ES3DV3 - SN3334; ConvF(6.25, 6.25, 6.25); Calibrated: 12/16/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 12/12/2014

Phantom: Sub Twin Sam v5.0; Type: QD000P40CD; Serial: TP:1626

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

835 MHz System Verification

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

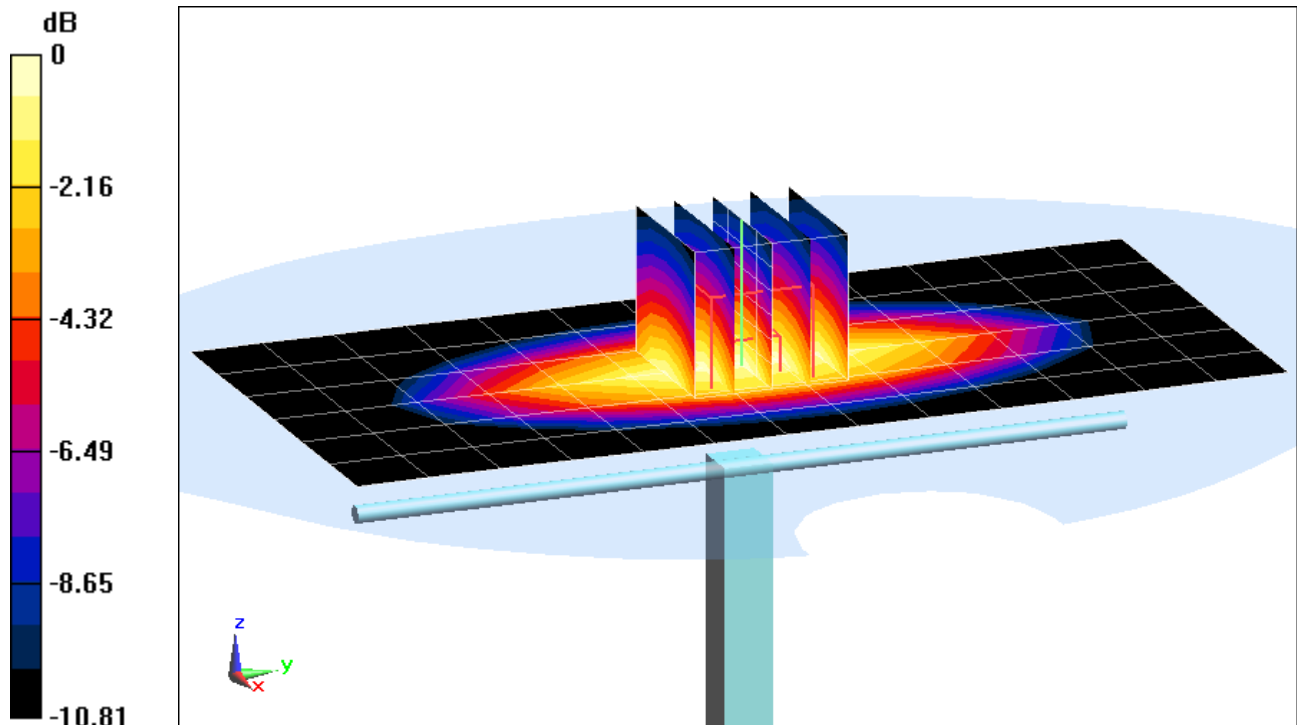
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.31 W/kg

SAR(1 g) = 0.868 W/kg

Deviation = -5.86%



0 dB = 1.02 W/kg = 0.09 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1051

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

Medium: 1750 Head Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.361 \text{ S/m}$; $\epsilon_r = 39.194$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-21-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.4°C

Probe: ES3DV3 - SN3331; ConvF(5.28, 5.28, 5.28); Calibrated: 8/20/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 10/31/2014

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

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

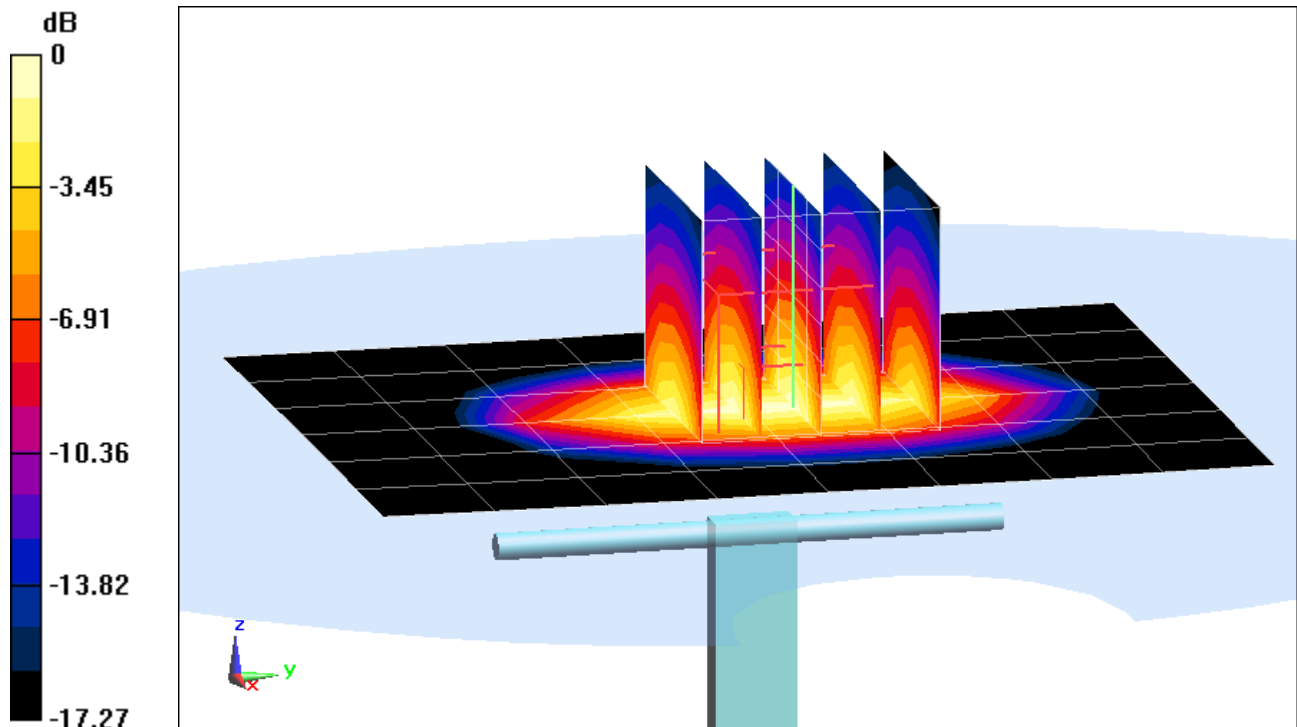
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 6.62 W/kg

SAR(1 g) = 3.65 W/kg

Deviation = 0.83%



0 dB = 4.59 W/kg = 6.62 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d148

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

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.44 \text{ S/m}$; $\epsilon_r = 38.694$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-20-2015; Ambient Temp: 21.6°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3333; ConvF(5.11, 5.11, 5.11); Calibrated: 10/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 10/23/2014

Phantom: Sub TWIN SAM; Type: QD000P40CC; Serial: TP-1357

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

1900 MHz System Verification

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

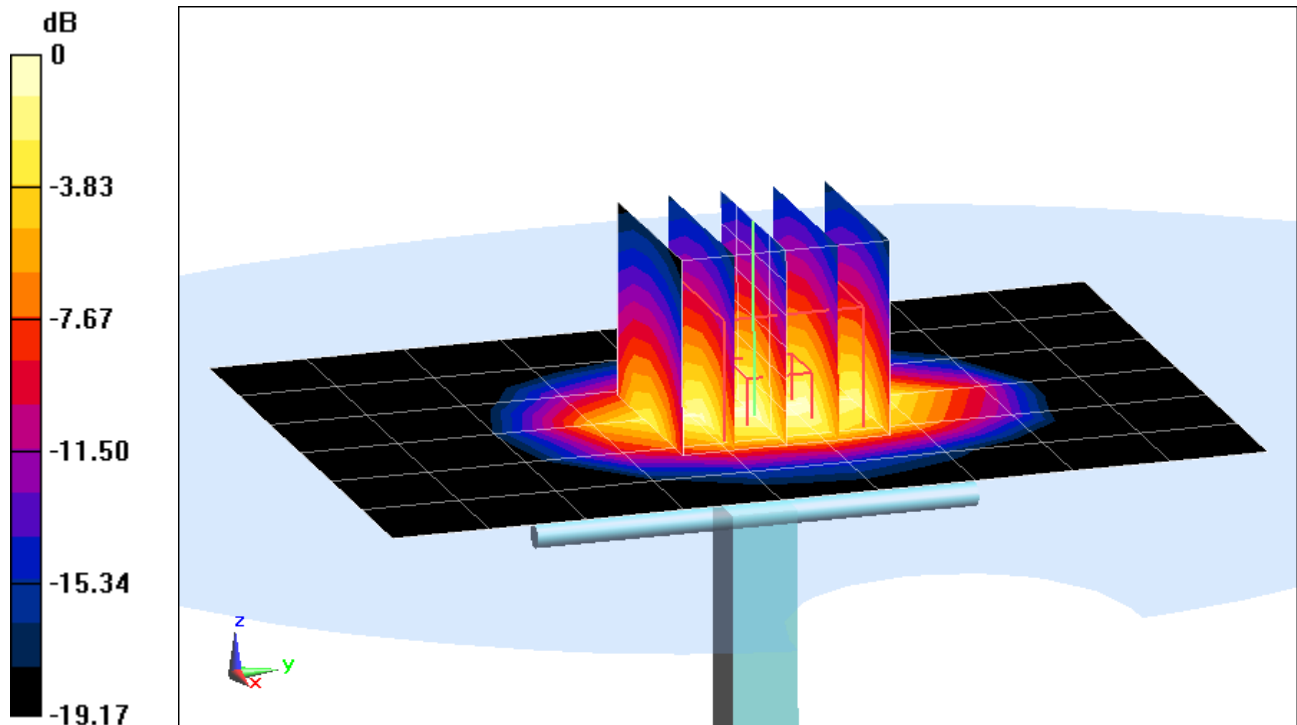
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 7.37 W/kg

SAR(1 g) = 3.98 W/kg

Deviation = -2.21%



0 dB = 5.01 W/kg = 7.00 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 2450 Head Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.812 \text{ S/m}$; $\epsilon_r = 38.552$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

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

Probe: ES3DV3 - SN3258; ConvF(4.52, 4.52, 4.52); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

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

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

2450 MHz System Verification

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

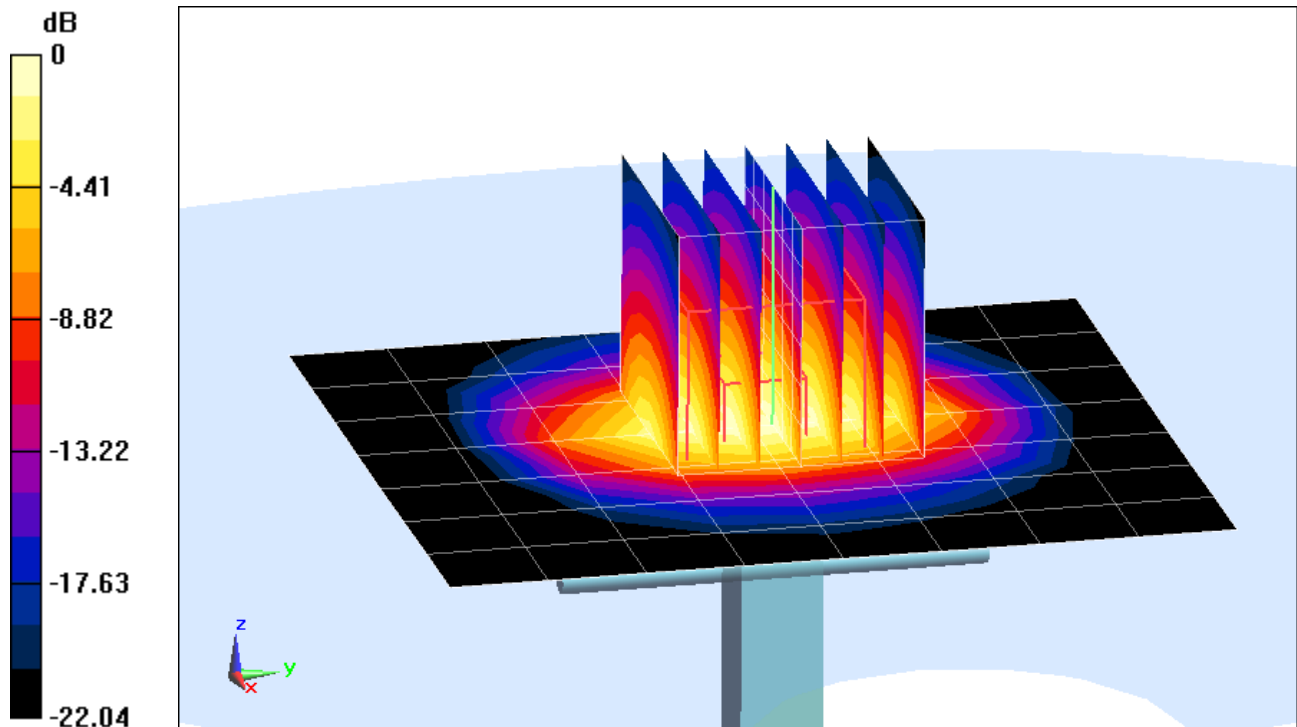
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 11.0 W/kg

SAR(1 g) = 5.34 W/kg

Deviation = 2.50%



0 dB = 7.01 W/kg = 8.46 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 5200 MHz; Type: D5GHzV2; Serial: 1120

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

Medium: 5 GHz Head Medium parameters used:

$f = 5200 \text{ MHz}$; $\sigma = 4.449 \text{ S/m}$; $\epsilon_r = 35.741$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-23-2015; Ambient Temp: 23.9°C; Tissue Temp: 21.5°C

Probe: EX3DV4 - SN3920; ConvF(4.87, 4.87, 4.87); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

Phantom: SAM, Left; Type: QD000P40CD; Serial: TP:1759

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

5200 MHz System Verification

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

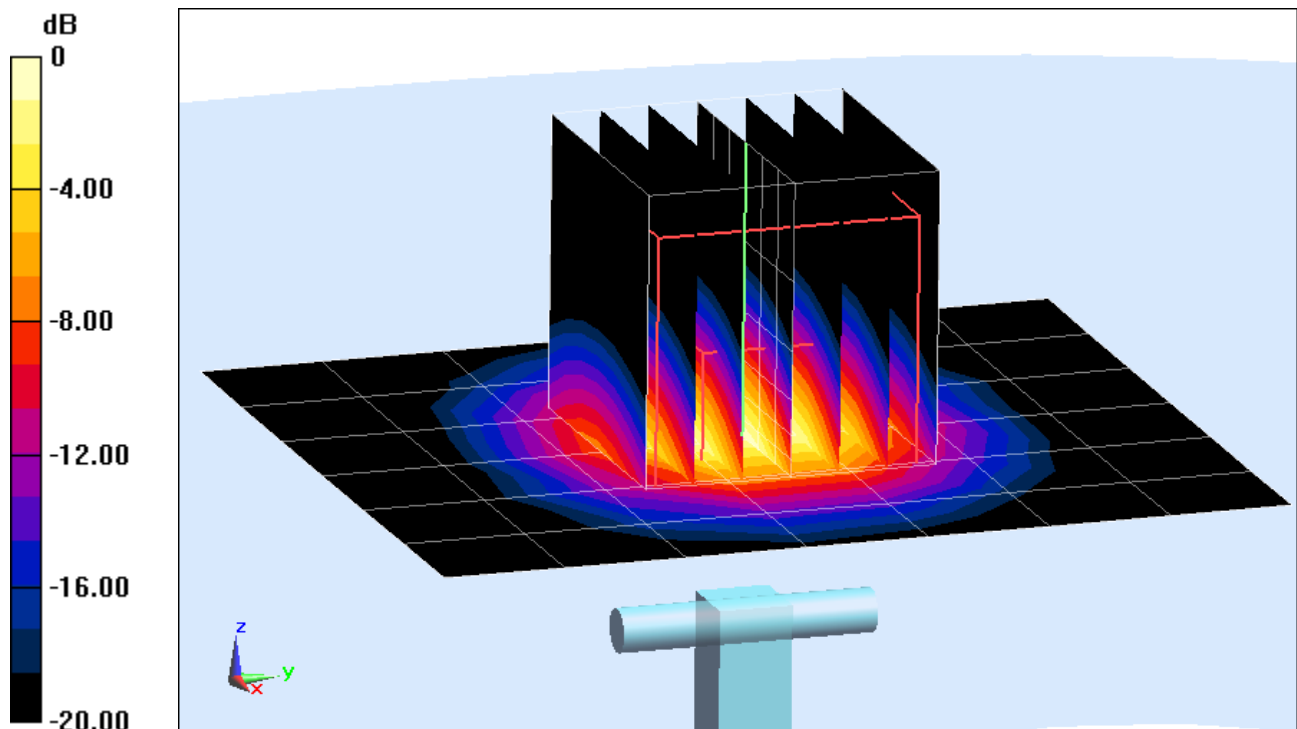
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 30.0 W/kg

SAR(1 g) = 7.54 W/kg

Deviation = -4.68%



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

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Head Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 4.549 \text{ S/m}$; $\epsilon_r = 35.571$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-23-2015; Ambient Temp: 23.9°C; Tissue Temp: 21.5°C

Probe: EX3DV4 - SN3920; ConvF(4.69, 4.69, 4.69); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

Phantom: SAM, Left; Type: QD000P40CD; Serial: TP:1759

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

5300 MHz System Verification

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

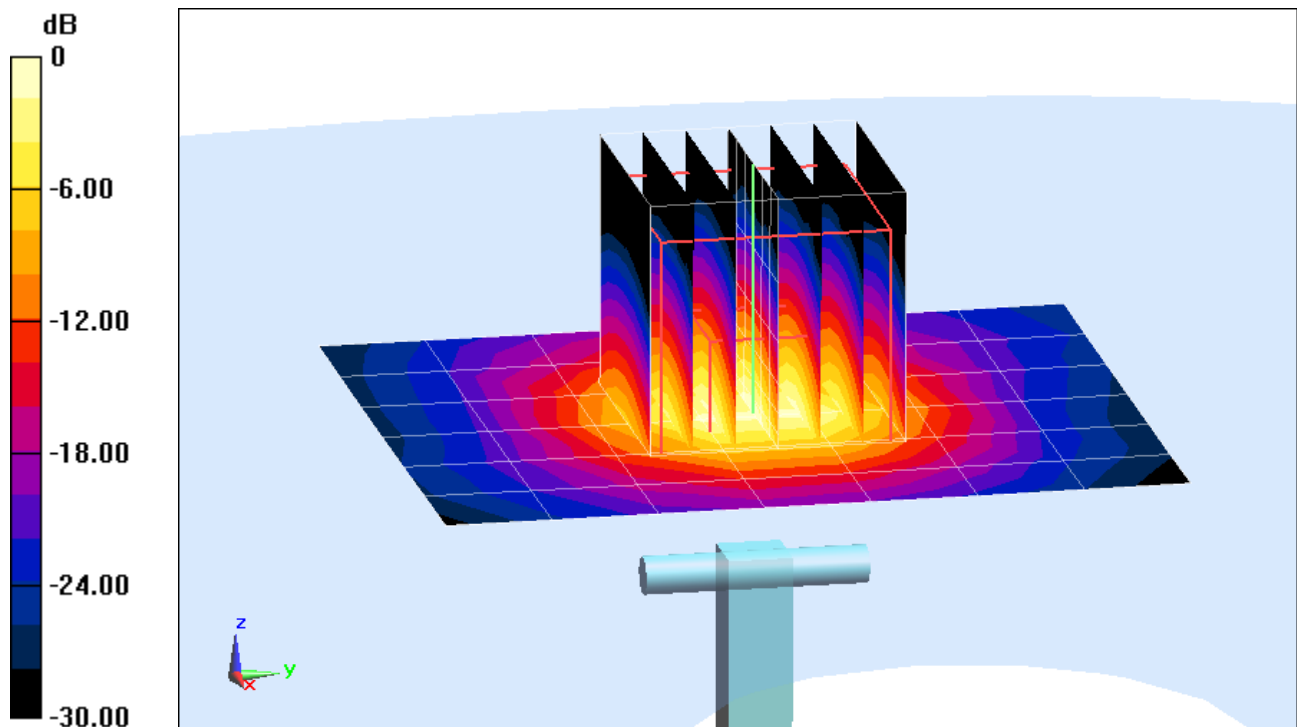
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 32.4 W/kg

SAR(1 g) = 8.03 W/kg

Deviation = -3.72%



0 dB = 20.2 W/kg = 13.05 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5500 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head Medium parameters used:

$f = 5500 \text{ MHz}$; $\sigma = 4.748 \text{ S/m}$; $\epsilon_r = 35.287$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-23-2015; Ambient Temp: 23.9°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3920; ConvF(4.44, 4.44, 4.44); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

Phantom: SAM, Left; Type: QD000P40CD; Serial: TP:1759

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

5500 MHz System Verification

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

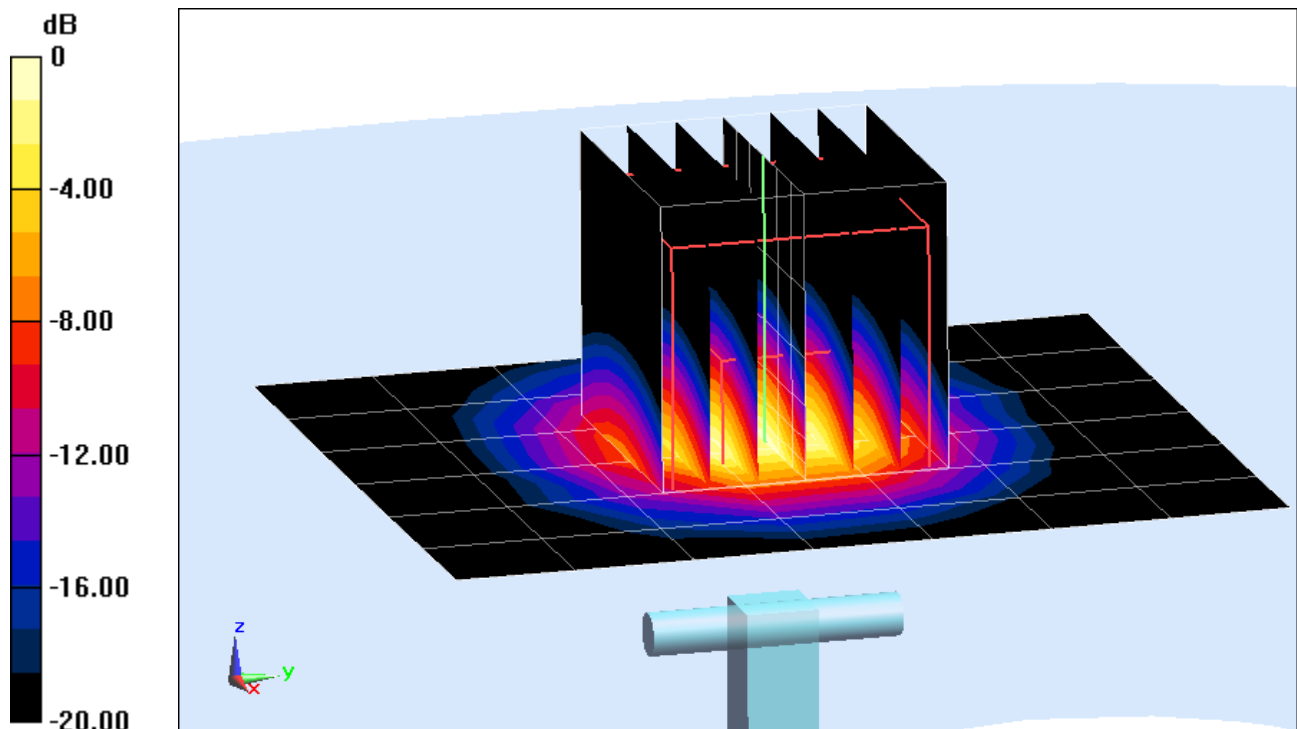
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 33.1 W/kg

SAR(1 g) = 8.19 W/kg

Deviation = -3.53%



0 dB = 21.0 W/kg = 13.22 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Head Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 4.849 \text{ S/m}$; $\epsilon_r = 35.184$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-23-2015; Ambient Temp: 24.0°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN3920; ConvF(4.35, 4.35, 4.35); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

Phantom: SAM, Left; Type: QD000P40CD; Serial: TP:1759

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

5600 MHz System Verification

Area Scan (7x7x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

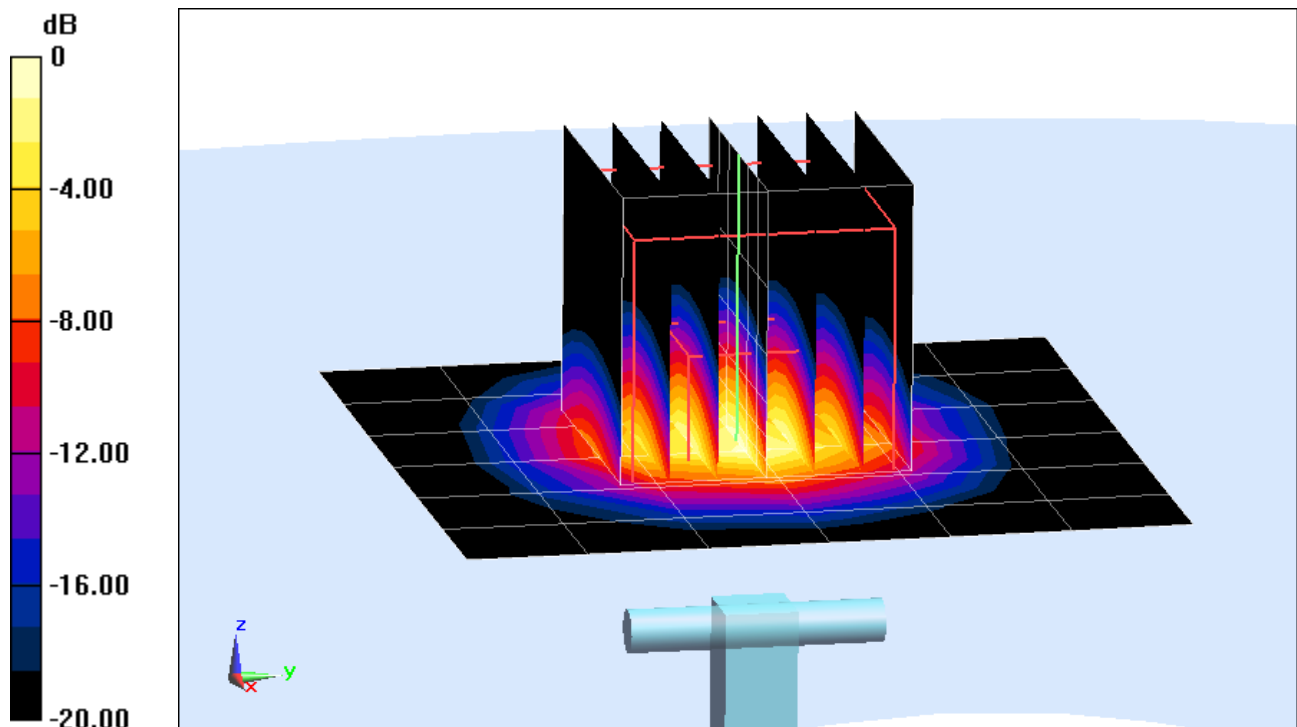
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 33.0 W/kg

SAR(1 g) = 7.91 W/kg

Deviation = -3.77%



PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Head Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 5.054 \text{ S/m}$; $\epsilon_r = 34.89$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-23-2015; Ambient Temp: 23.9°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3920; ConvF(4.27, 4.27, 4.27); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

Phantom: SAM, Left; Type: QD000P40CD; Serial: TP:1759

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

5800 MHz System Verification

Area Scan (7x7x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

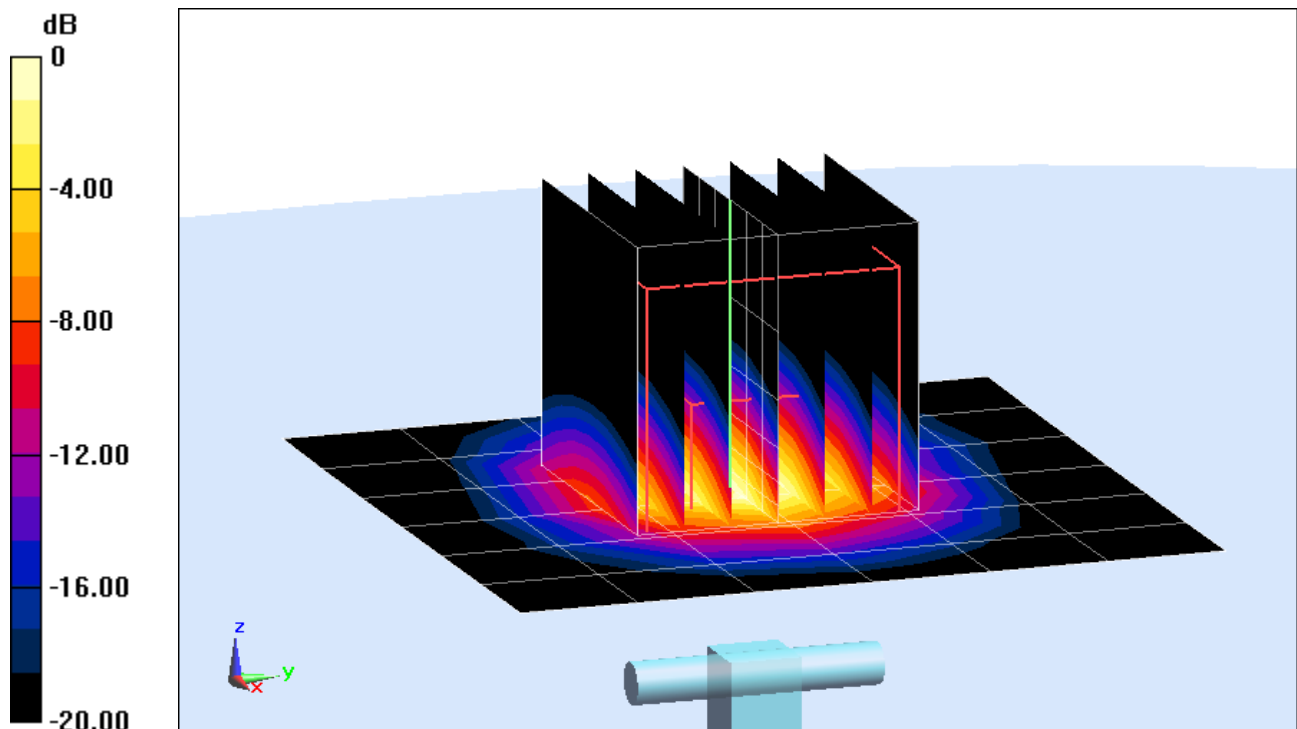
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 34.3 W/kg

SAR(1 g) = 7.8 W/kg

Deviation = -1.39%



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1046

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

Medium: 750 Body Medium parameters used (interpolated):

$f = 750 \text{ MHz}$; $\sigma = 0.973 \text{ S/m}$; $\epsilon_r = 55.906$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-26-2015; Ambient Temp: 23.1°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3334; ConvF(6.09, 6.09, 6.09); Calibrated: 12/16/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 12/12/2014

Phantom: Main Twin Sam; Type: QD000P40CC; Serial: TP: 1375

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

750 MHz System Verification

Area Scan (7x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

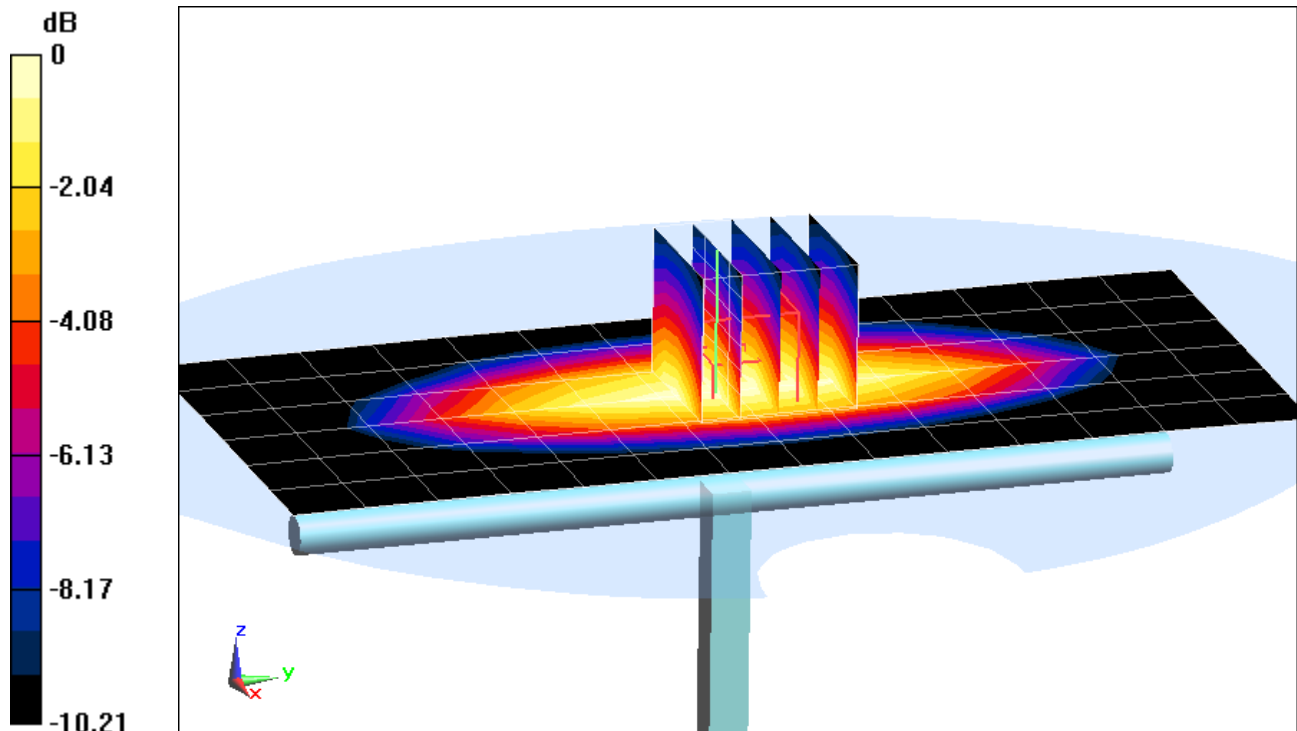
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.34 W/kg

SAR(1 g) = 0.914 W/kg

Deviation = 7.03%



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

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 835 Body Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.956 \text{ S/m}$; $\epsilon_r = 54.224$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-20-2015; Ambient Temp: 22.6°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3334; ConvF(6.14, 6.14, 6.14); Calibrated: 12/16/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 12/12/2014

Phantom: Main Twin Sam; Type: QD000P40CC; Serial: TP: 1375

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

835 MHz System Verification

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

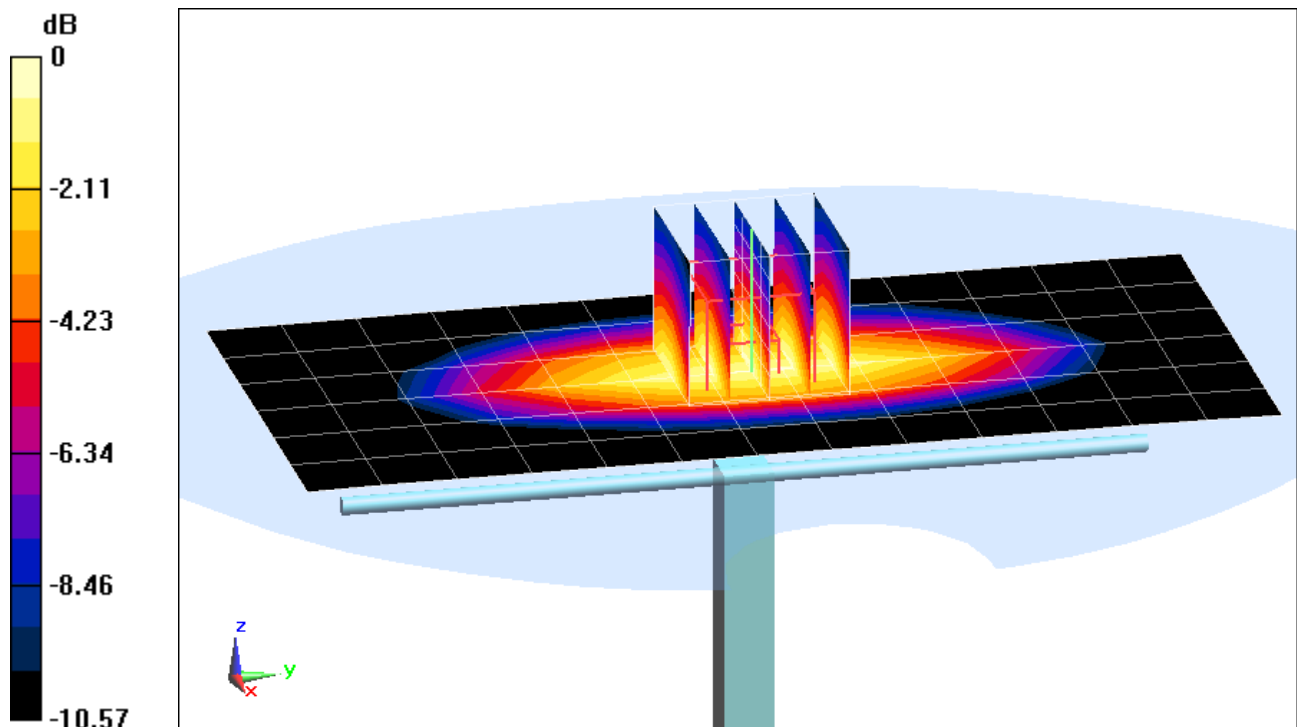
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.34 W/kg

SAR(1 g) = 0.910 W/kg

Deviation = -2.57%



0 dB = 1.04 W/kg = 0.17 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1051

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

Medium: 1750 Body Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.534 \text{ S/m}$; $\epsilon_r = 50.966$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-21-2015; Ambient Temp: 21.5°C; Tissue Temp: 21.4°C

Probe: ES3DV3 - SN3333; ConvF(4.89, 4.89, 4.89); Calibrated: 10/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 10/23/2014

Phantom: Sub TWIN SAM; Type: QD000P40CC; Serial: TP-1357

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

1750 MHz System Verification

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

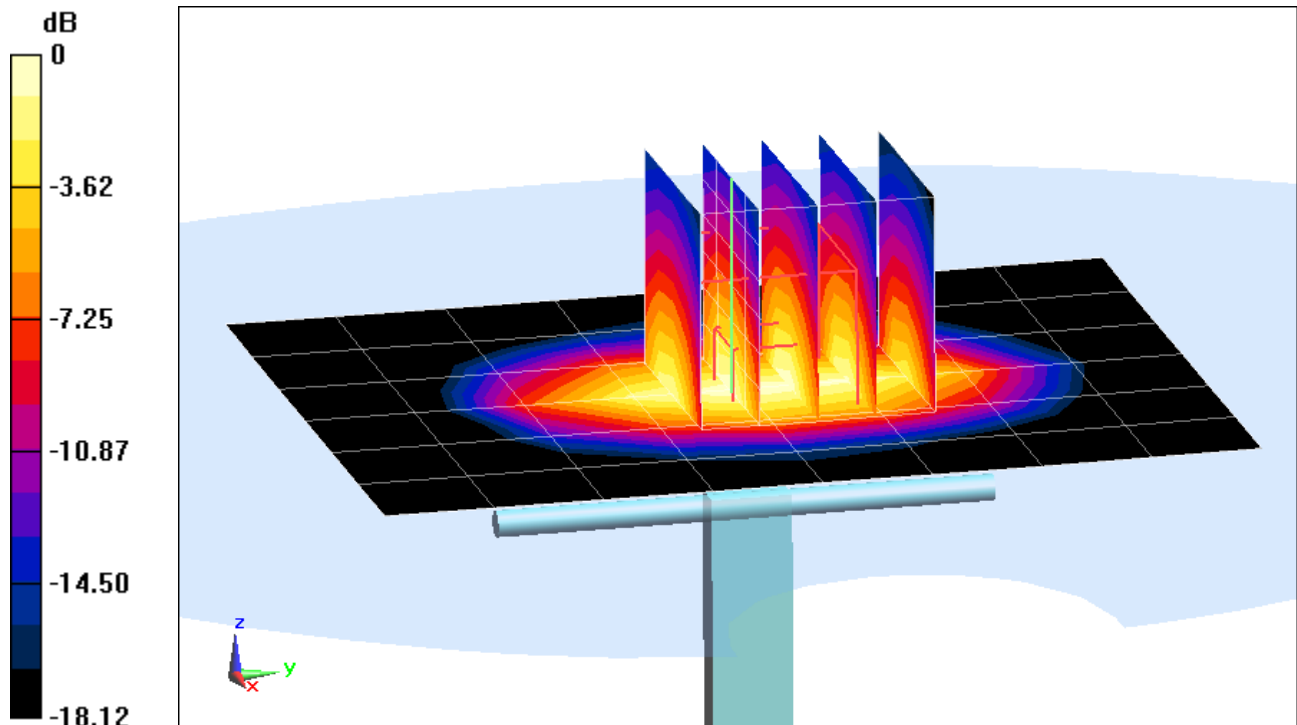
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 6.65 W/kg

SAR(1 g) = 3.65 W/kg

Deviation = -2.41%



0 dB = 4.42 W/kg = 6.45 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.541 \text{ S/m}$; $\epsilon_r = 50.991$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-20-2015; Ambient Temp: 23.4°C; Tissue Temp: 22.8°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/12/2014

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1226

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

1900 MHz System Verification

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

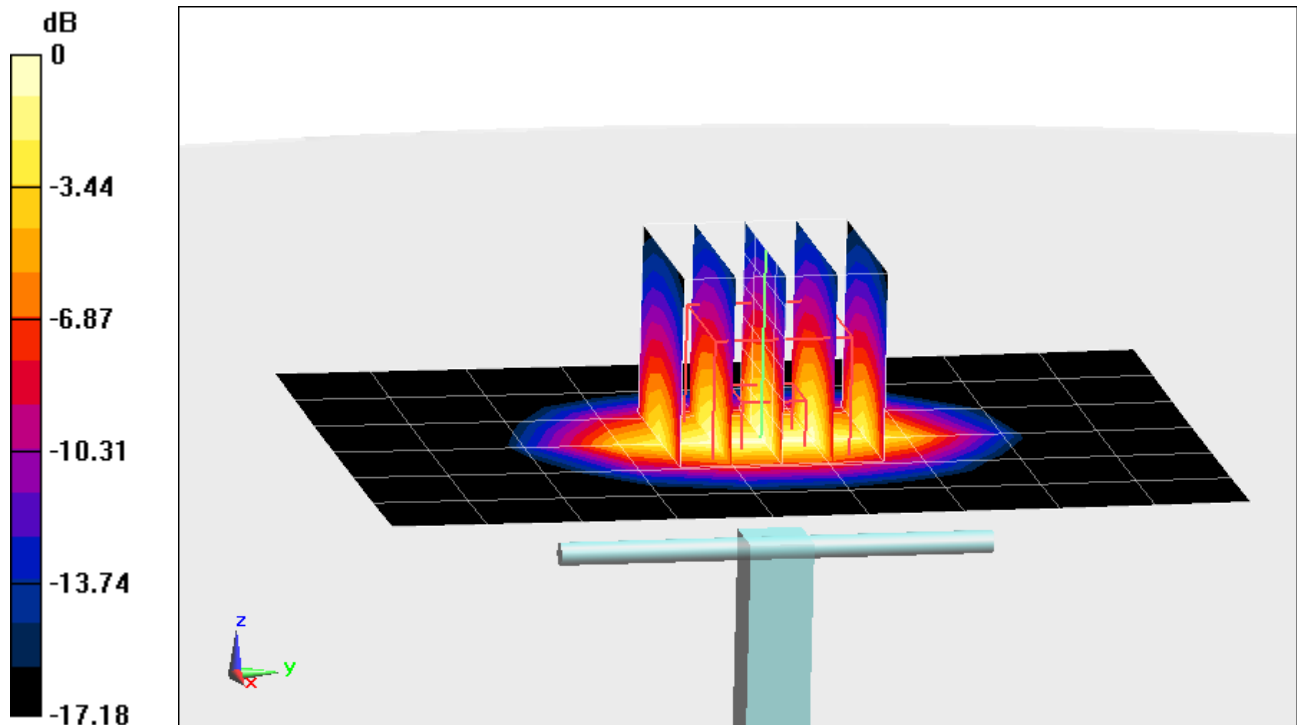
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 6.89 W/kg

SAR(1 g) = 3.94 W/kg

Deviation = -2.96%



0 dB = 4.97 W/kg = 6.96 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.925 \text{ S/m}$; $\epsilon_r = 50.991$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-22-2015; Ambient Temp: 23.5°C; Tissue Temp: 23.8°C

Probe: ES3DV3 - SN3209; ConvF(4.2, 4.2, 4.2); Calibrated: 3/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/17/2014

Phantom: SAM left; Type: QD000P40CD; Serial: TP:1715

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

2450 MHz System Verification

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

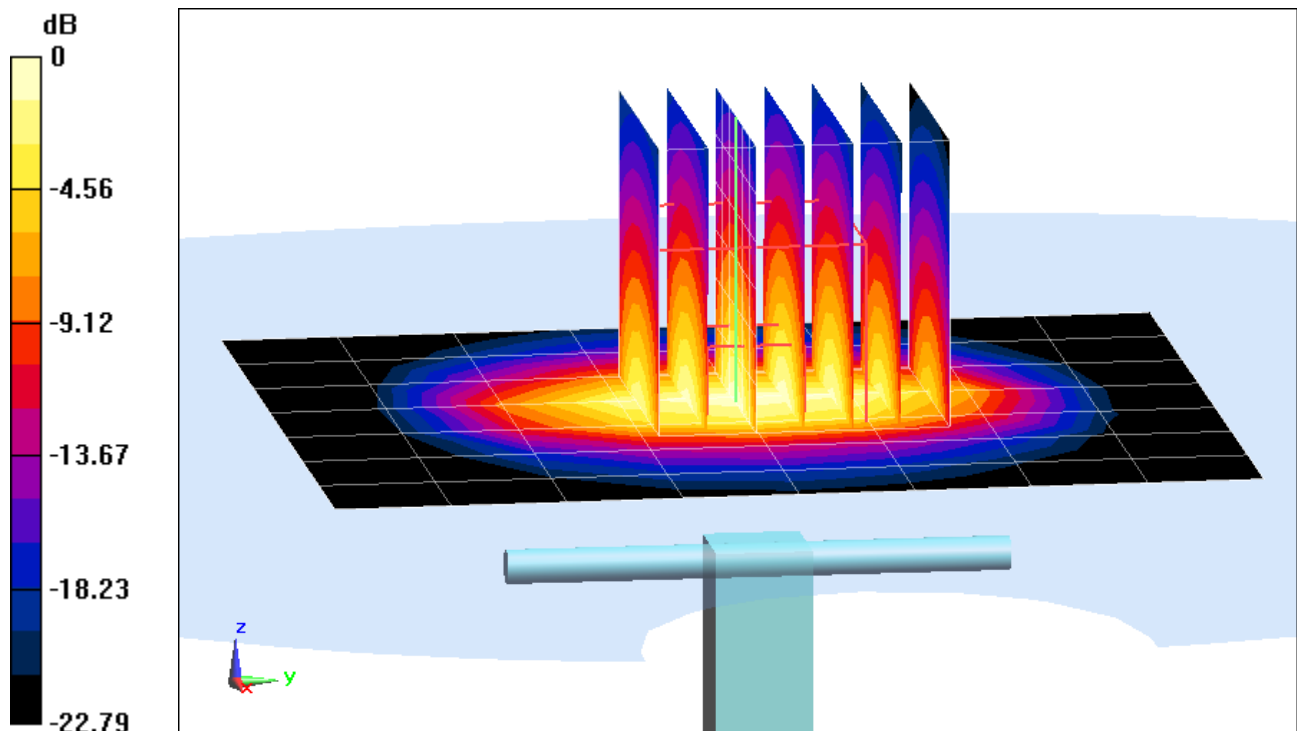
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 11.2 W/kg

SAR(1 g) = 5.2 W/kg

Deviation = 0.39%



0 dB = 6.86 W/kg = 8.36 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5200 MHz; Type: D5GHzV2; Serial: 1120

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

Medium: 5GHz Body Medium parameters used:

$f = 5200 \text{ MHz}$; $\sigma = 5.308 \text{ S/m}$; $\epsilon_r = 48.366$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-20-2015; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3949; ConvF(4.68, 4.68, 4.68); Calibrated: 8/21/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 10/31/2014

Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357

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

5200 MHz System Verification

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

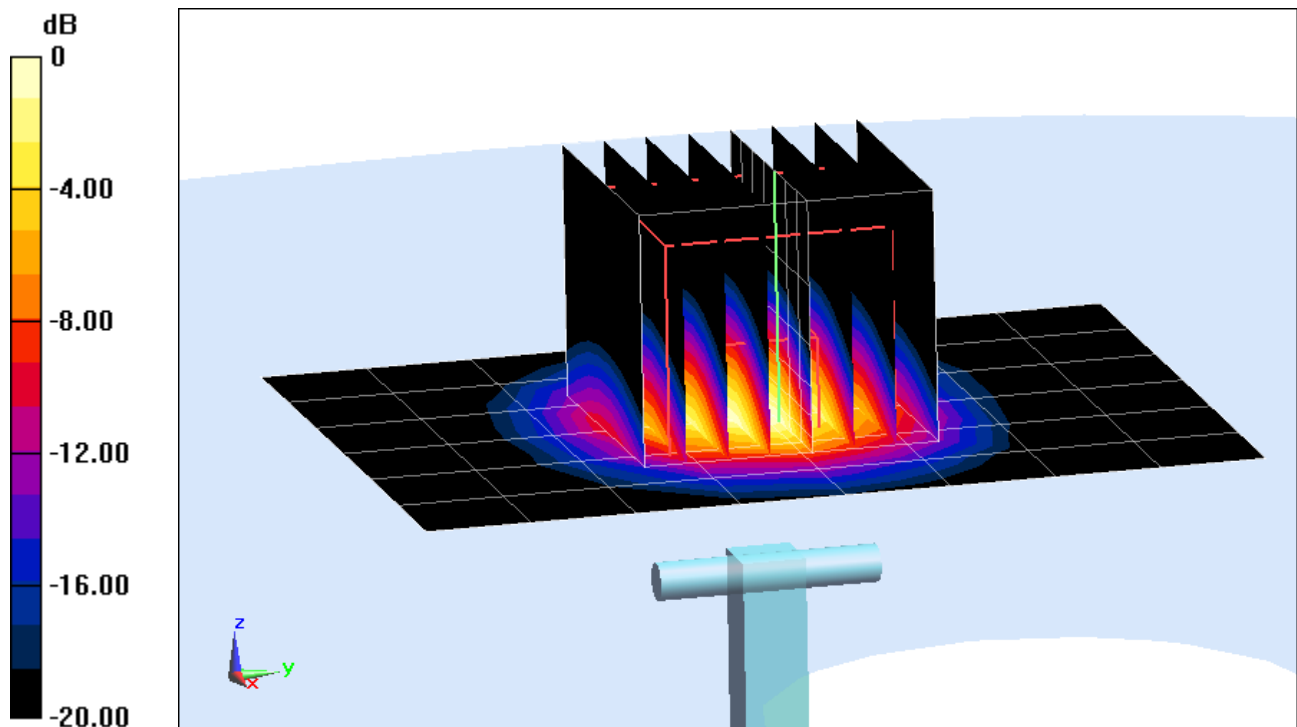
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 31.5 W/kg

SAR(1 g) = 7.8 W/kg

Deviation = 5.41%



0 dB = 18.2 W/kg = 12.60 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5GHz Body Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 5.452 \text{ S/m}$; $\epsilon_r = 48.044$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-20-2015; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3949; ConvF(4.47, 4.47, 4.47); Calibrated: 8/21/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 10/31/2014

Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357

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

5300 MHz System Verification

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

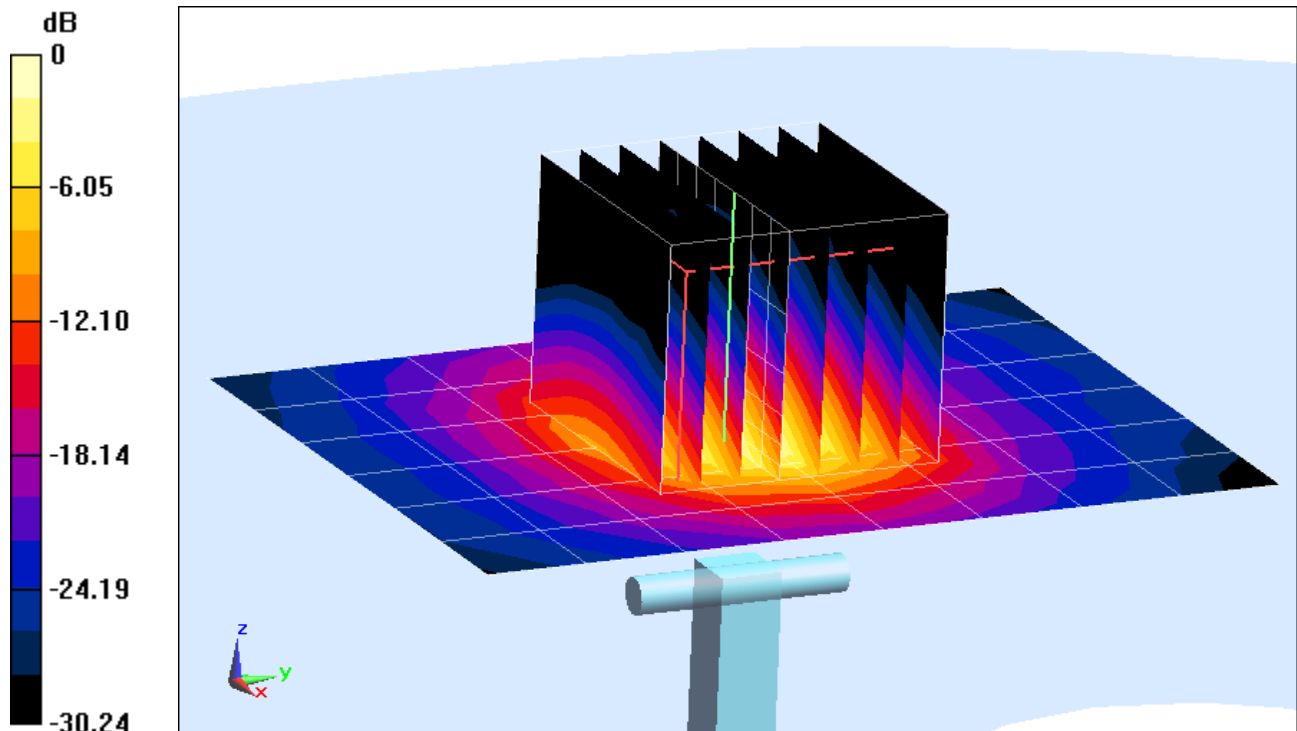
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 33.5 W/kg

SAR(1 g) = 8.01 W/kg

Deviation = 5.67%



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

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5500 MHz; Duty Cycle: 1:1

Medium: 5GHz Body Medium parameters used:

$f = 5500 \text{ MHz}$; $\sigma = 5.772 \text{ S/m}$; $\epsilon_r = 47.649$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-20-2015; Ambient Temp: 22.9°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3949; ConvF(4.16, 4.16, 4.16); Calibrated: 8/21/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 10/31/2014

Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357

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

5500 MHz System Verification

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

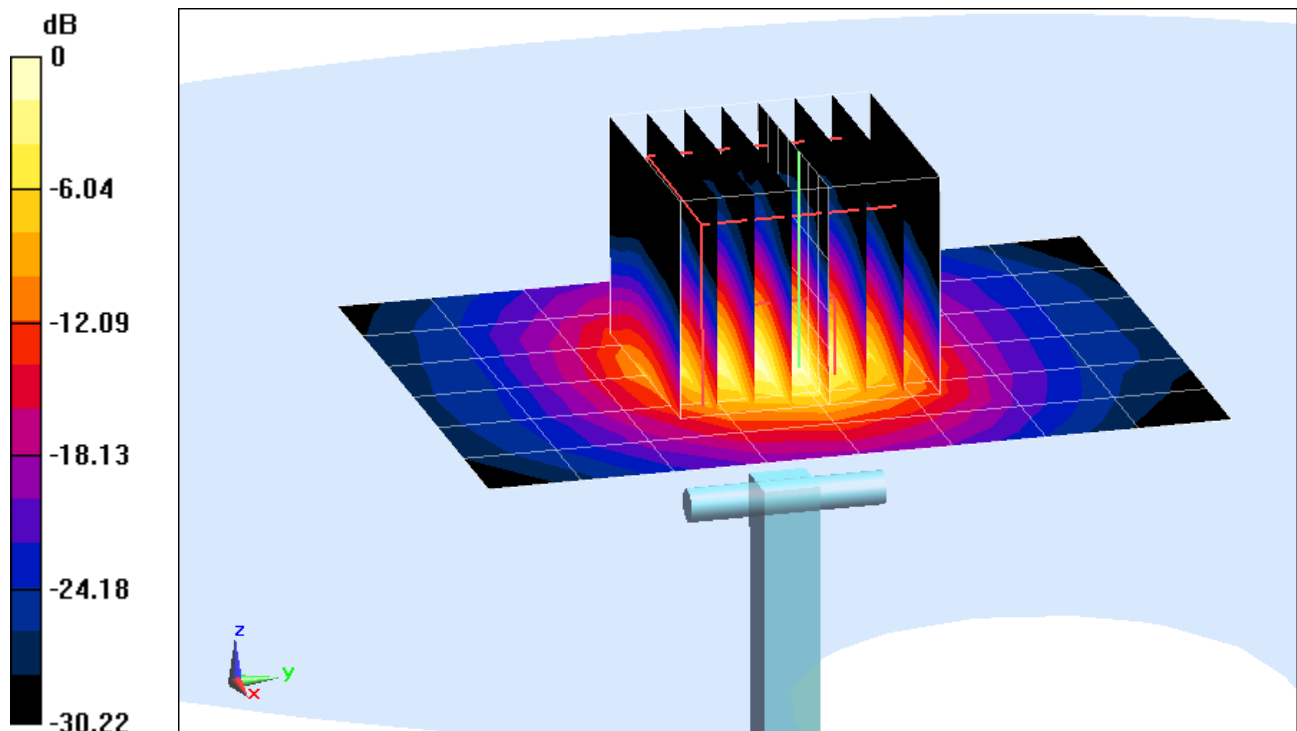
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 36.6 W/kg

SAR(1 g) = 8.51 W/kg

Deviation = 7.45%



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

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5GHz Body Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.928 \text{ S/m}$; $\epsilon_r = 47.449$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-20-2015; Ambient Temp: 22.9°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3949; ConvF(3.97, 3.97, 3.97); Calibrated: 8/21/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 10/31/2014

Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357

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

5600 MHz System Verification

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

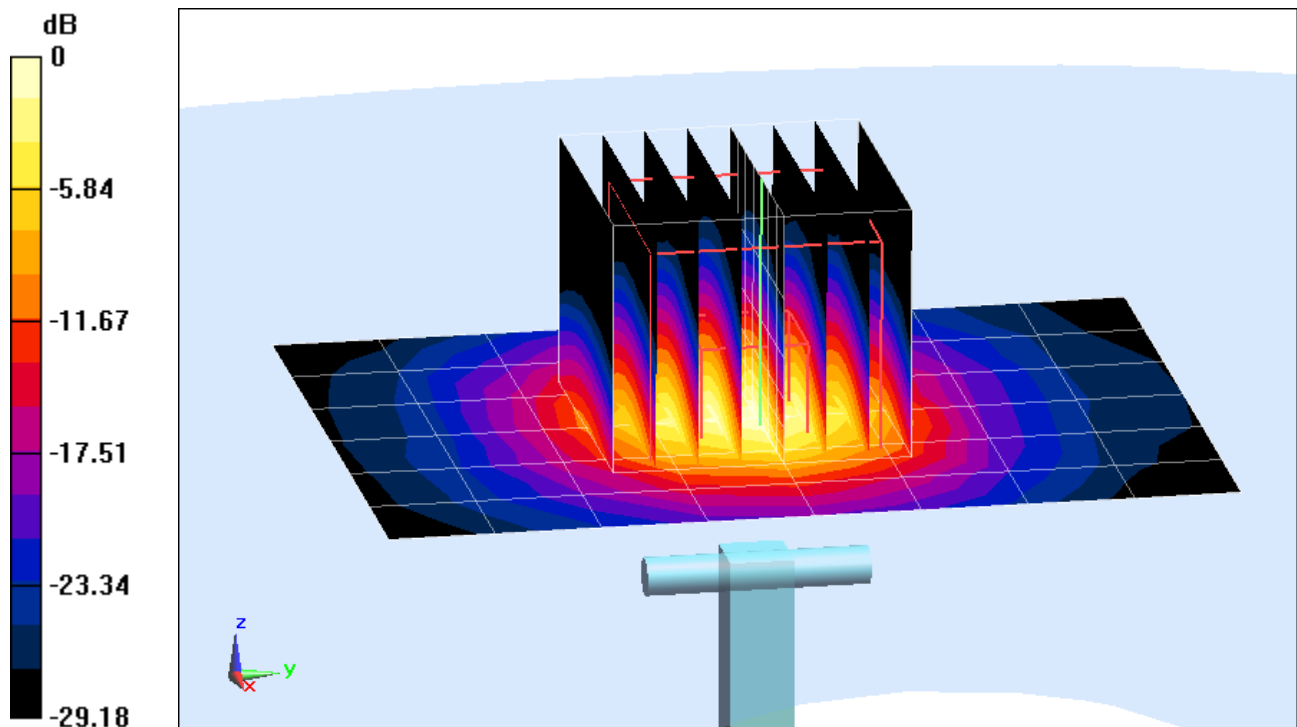
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 38.5 W/kg

SAR(1 g) = 8.64 W/kg

Deviation = 8.82%



0 dB = 21.8 W/kg = 13.38 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5GHz Body Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 6.22 \text{ S/m}$; $\epsilon_r = 46.948$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-20-2015; Ambient Temp: 22.9°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN3949; ConvF(4.27, 4.27, 4.27); Calibrated: 8/21/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 10/31/2014

Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357

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

5800 MHz System Verification

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

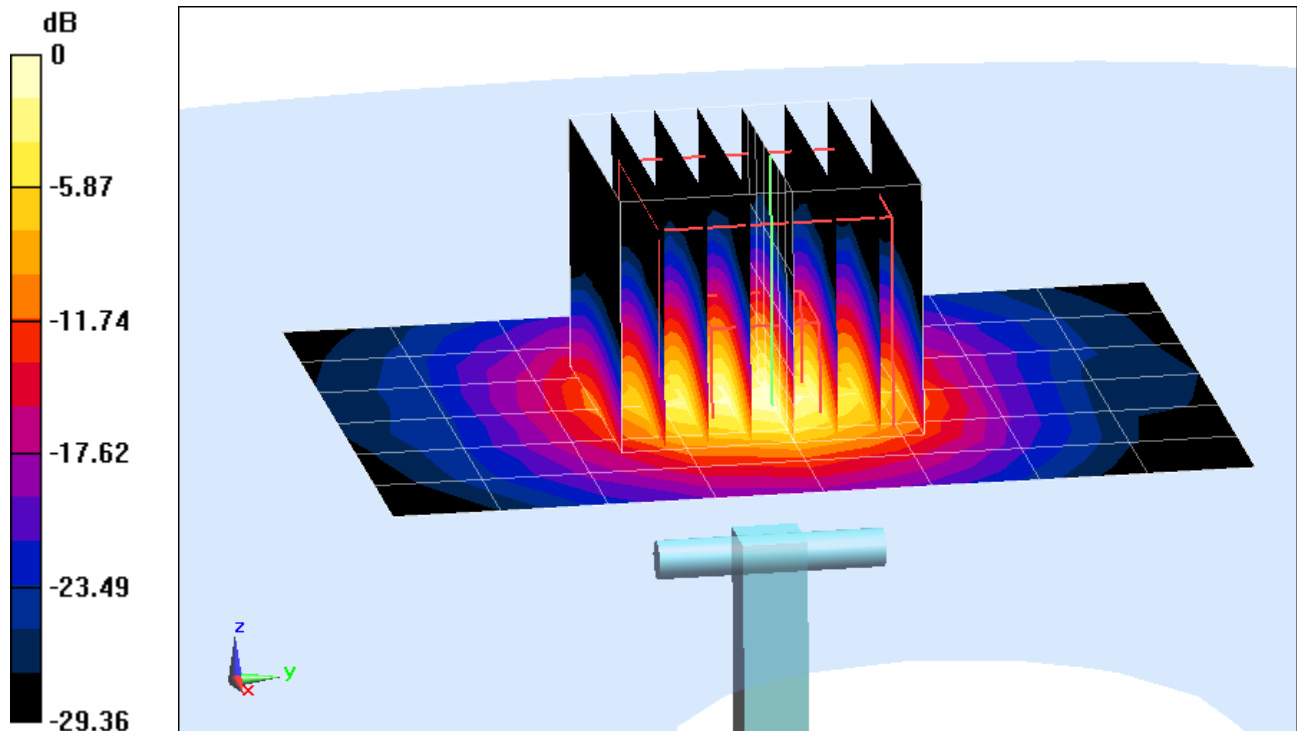
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 37.1 W/kg

SAR(1 g) = 7.81 W/kg

Deviation = 4.97%



0 dB = 19.9 W/kg = 12.99 dBW/kg

APPENDIX C: PROBE CALIBRATION



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Client **PC Test**

Certificate No: **D750V3-1046_Feb14**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1046**

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

CC✓
3/6/14

Calibration date: **February 27, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Jeton Kastrati** Function: **Laboratory Technician** Signature:

Approved by: **Katja Pokovic** Technical Manager

Issued: February 27, 2014

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.7 $\pm$ 6 %	0.90 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.27 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.42 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.2 $\pm$ 6 %	0.98 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.18 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.54 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.63 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$56.4 \Omega + 2.1 j\Omega$
Return Loss	- 24.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.8 \Omega - 2.0 j\Omega$
Return Loss	- 33.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.032 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 02, 2011

DASY5 Validation Report for Head TSL

Date: 21.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1046

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750$ MHz; $\sigma = 0.9$ S/m; $\epsilon_r = 40.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.37, 6.37, 6.37); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

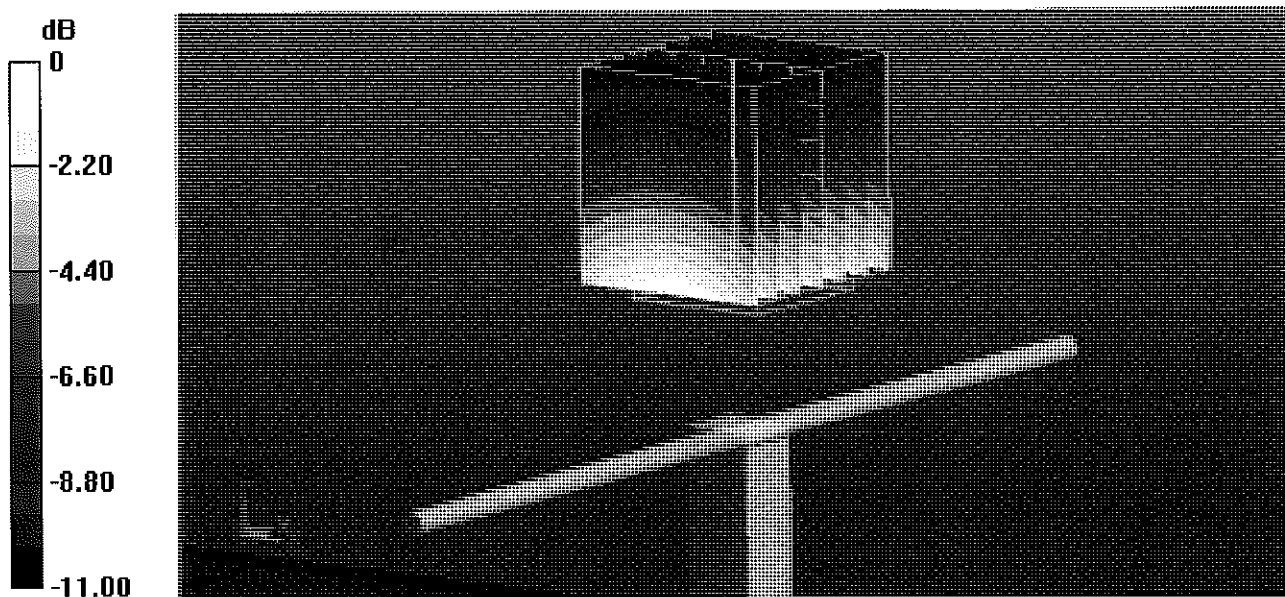
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.936 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.17 W/kg

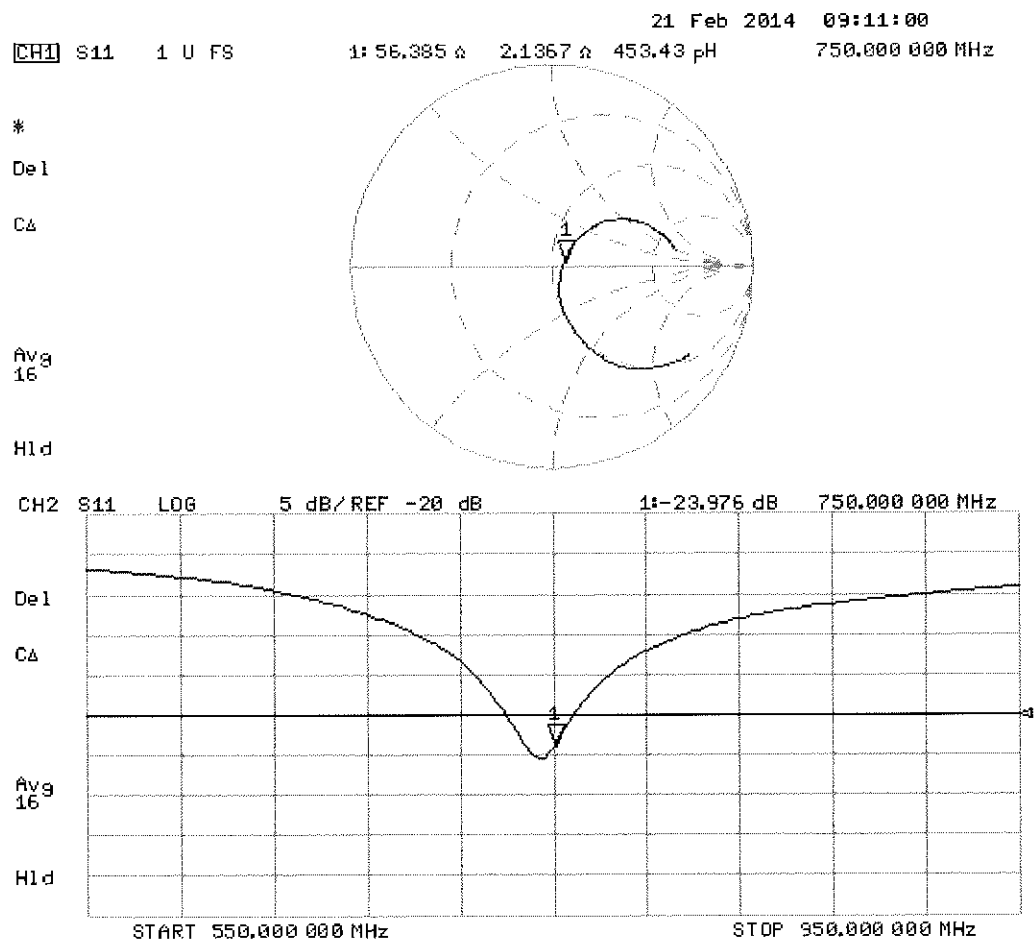
SAR(1 g) = 2.1 W/kg; SAR(10 g) = 1.37 W/kg

Maximum value of SAR (measured) = 2.46 W/kg



0 dB = 2.46 W/kg = 3.91 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 27.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1046

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.98 \text{ S/m}$; $\epsilon_r = 54.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.13, 6.13, 6.13); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

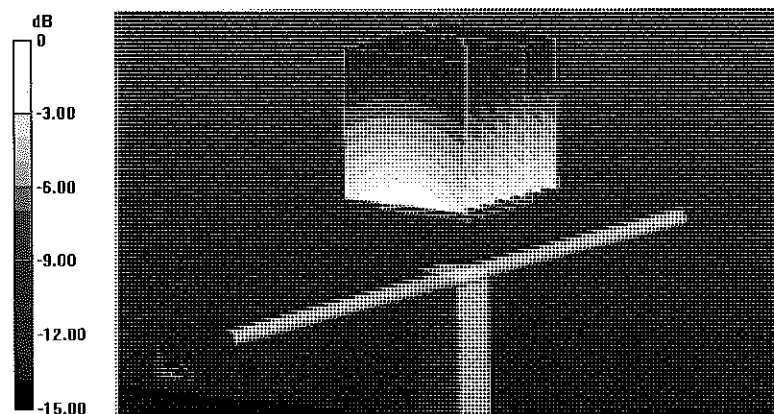
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 52.721 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.20 W/kg

SAR(1 g) = 2.18 W/kg; SAR(10 g) = 1.43 W/kg

Maximum value of SAR (measured) = 2.54 W/kg



0 dB = 2.54 W/kg = 4.05 dBW/kg

Impedance Measurement Plot for Body TSL

27 Feb 2014 10:22:29
CH1 S11 1 U FS 1: 50.007 Ω -1.9805 Ω 107.15 pF 750.000 000 MHz

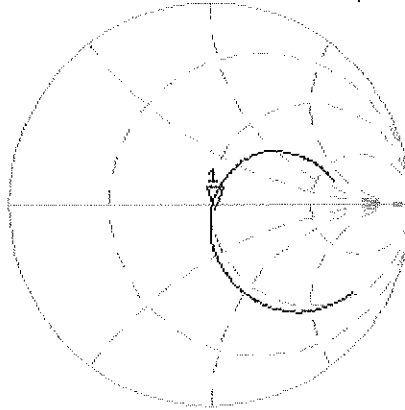
*

De1

Cor

Avg
16

H1d

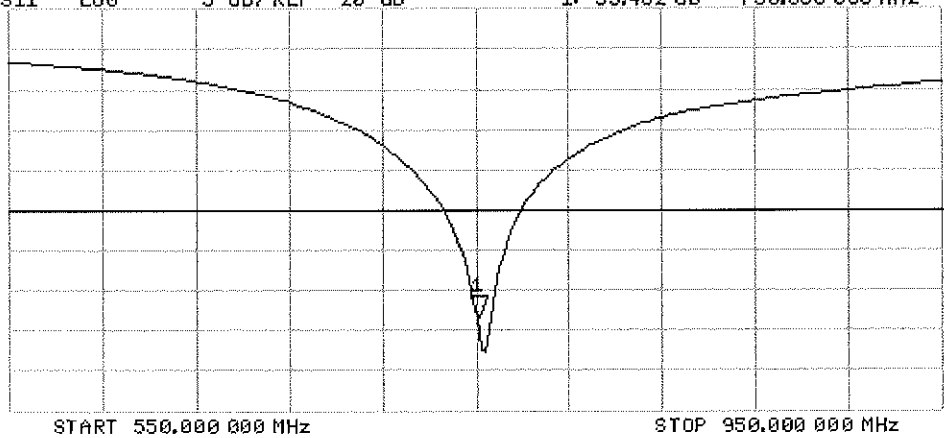


CH2 S11 LOG 5 dB/REF -20 dB 1: -33.462 dB 750.000 000 MHz

Cor

Avg
16

H1d





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d119_Apr14**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d119**

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

OCV
 4/25/14

Calibration date: **April 07, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
D4E4	SN: 601	25-Apr-13 (No. D4E4-601_Apr13)	Apr-14

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

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

Issued: April 9, 2014

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.6 $\pm$ 6 %	0.94 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.22 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.97 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.6 $\pm$ 6 %	1.02 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.34 W/kg $\pm$ 17.0 % (k=2)

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.2 Ω - 1.6 j Ω
Return Loss	- 34.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.3 Ω - 4.5 j Ω
Return Loss	- 24.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.386 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 29, 2010

DASY5 Validation Report for Head TSL

Date: 07.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.94$ S/m; $\epsilon_r = 41.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.22, 6.22, 6.22); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

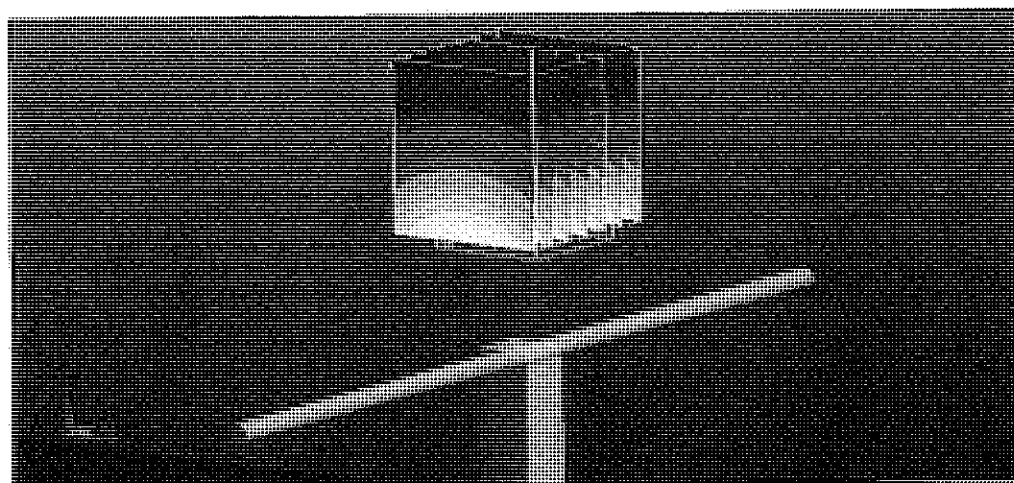
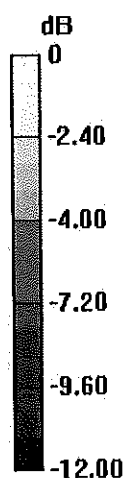
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.289 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.59 W/kg

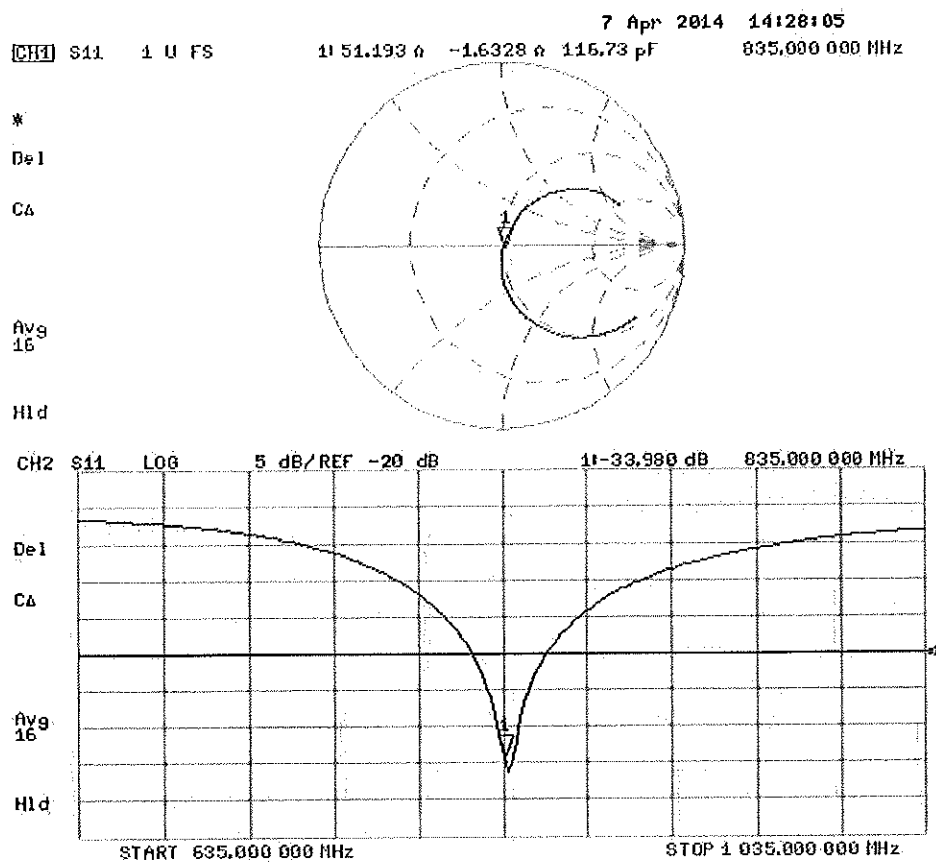
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.53 W/kg

Maximum value of SAR (measured) = 2.80 W/kg



0 dB = 2.80 W/kg = 4.47 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.02 \text{ S/m}$; $\epsilon_r = 53.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

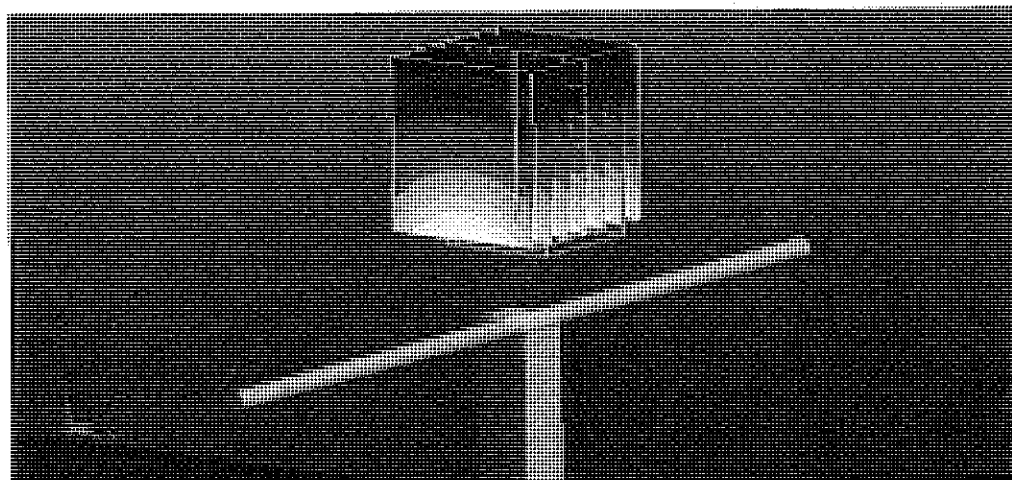
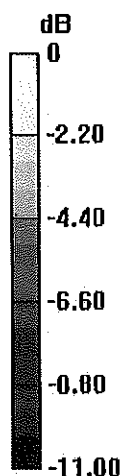
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 54.594 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.61 W/kg

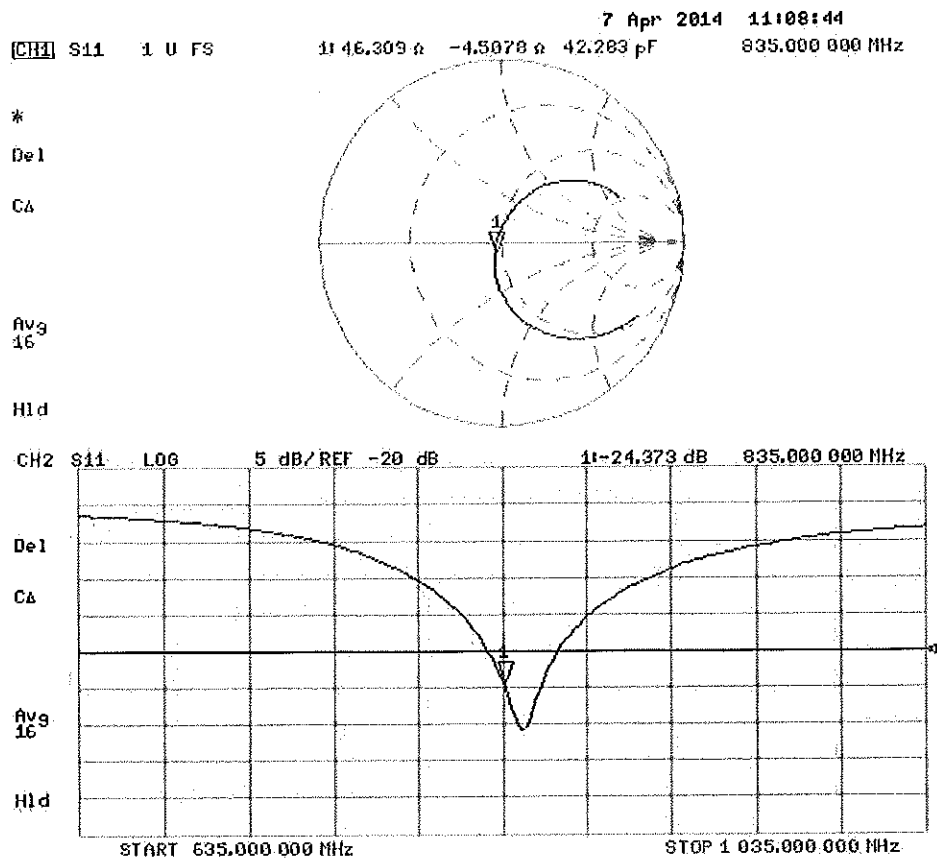
SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.85 W/kg



0 dB = 2.85 W/kg = 4.55 dBW/kg

Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d133_Jul14**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d133**

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

CC
W/CM

Calibration date: **July 24, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

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

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8763E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Name** **Function**
Jeton Kastrali **Laboratory Technician**

Signature

Approved by: **Name** **Technical Manager**
Katja Pokovic

Issued: July 24, 2014

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

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

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.20 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.96 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.8 $\pm$ 6 %	1.02 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.35 W/kg $\pm$ 17.0 % (k=2)

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

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.395 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 22, 2011

DASY5 Validation Report for Head TSL

Date: 24.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.94 \text{ S/m}$; $\epsilon_r = 41.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.22, 6.22, 6.22); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

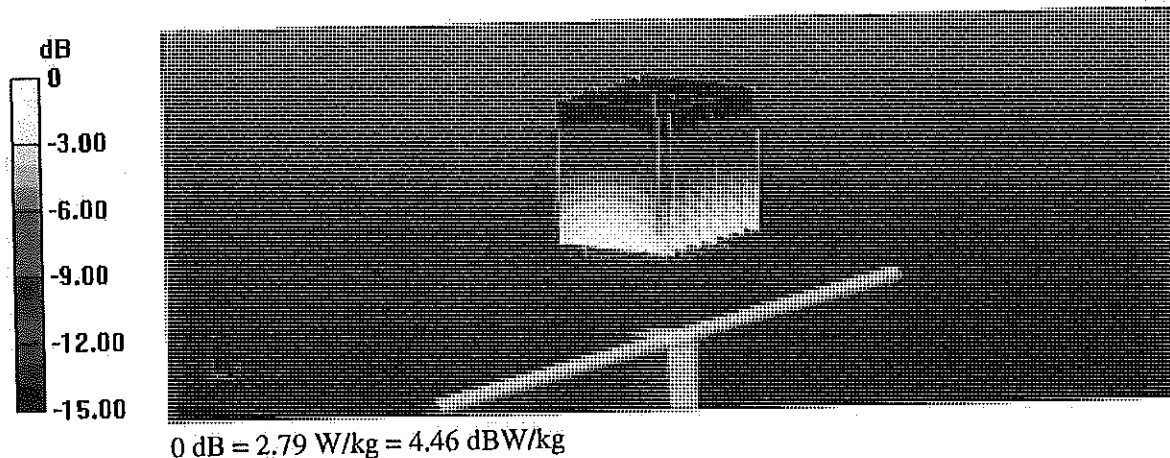
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 56.07 V/m; Power Drift = 0.03 dB

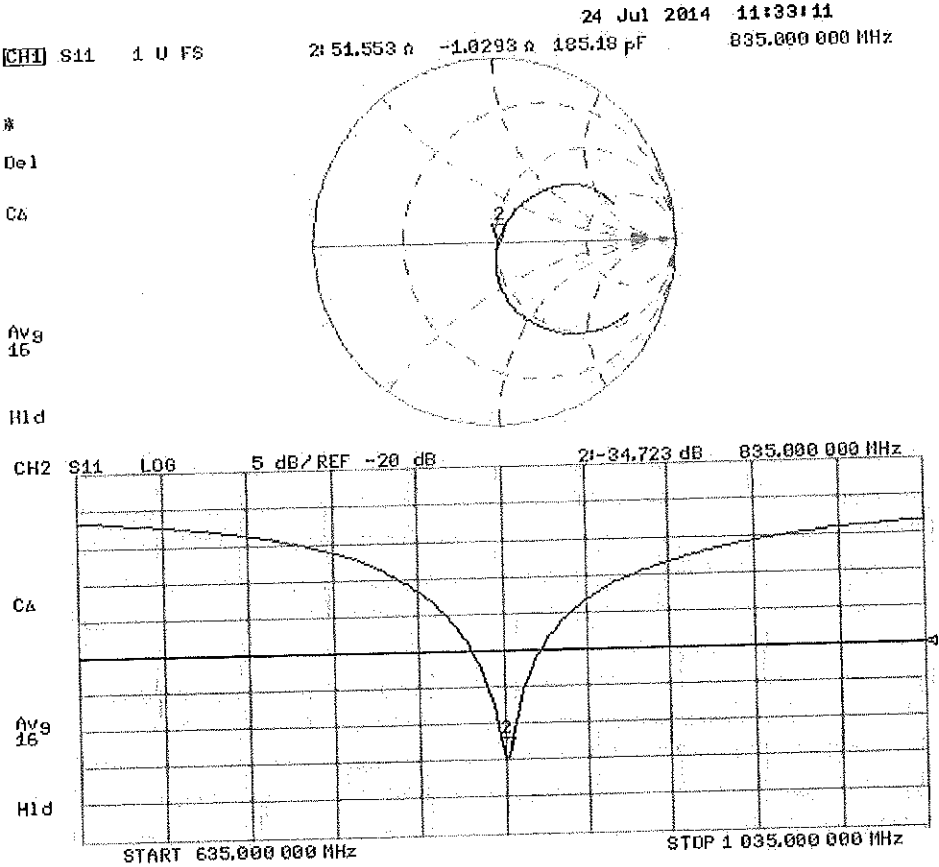
Peak SAR (extrapolated) = 3.58 W/kg

SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.53 W/kg

Maximum value of SAR (measured) = 2.79 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 17.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 1.02$ S/m; $\epsilon_r = 53.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

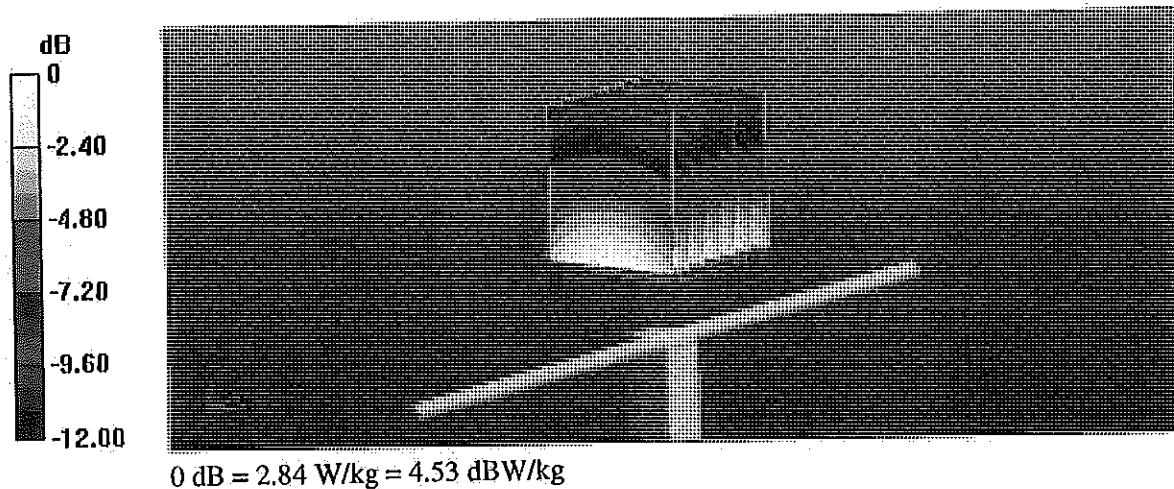
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.61 V/m; Power Drift = -0.01 dB

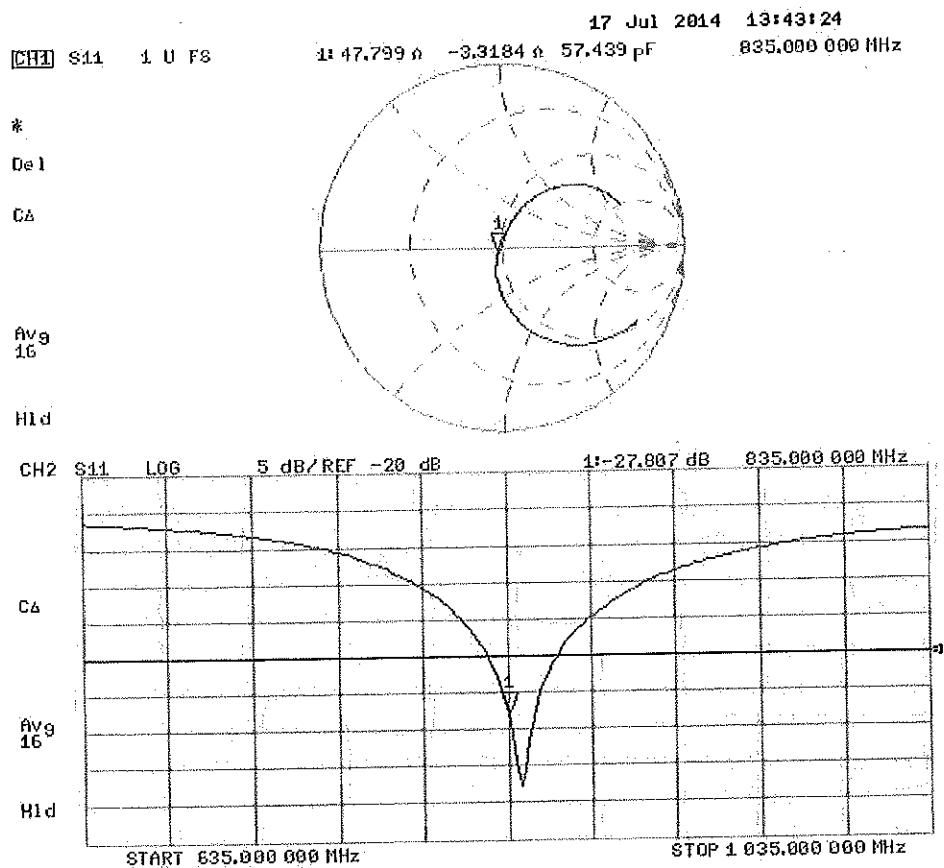
Peak SAR (extrapolated) = 3.59 W/kg

SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.84 W/kg



Impedance Measurement Plot for Body TSL



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



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S Servizio svizzero di taratura
S Swiss Calibration Service

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1750V2-1051_Apr14**

CALIBRATION CERTIFICATE

Object **D1750V2 - SN: 1051**

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

Calibration date: **April 10, 2014**

✓
KOK
5/7/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: April 10, 2014

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.1 $\pm$ 6 %	1.35 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.2 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.79 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.2 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.0 $\pm$ 6 %	1.48 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.4 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.04 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.1 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$50.7 \Omega + 0.4 j\Omega$
Return Loss	- 41.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$46.8 \Omega + 0.8 j\Omega$
Return Loss	- 29,3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.222 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	February 19, 2010

DASY5 Validation Report for Head TSL

Date: 10.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1051

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.35$ S/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.23, 5.23, 5.23); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: I001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

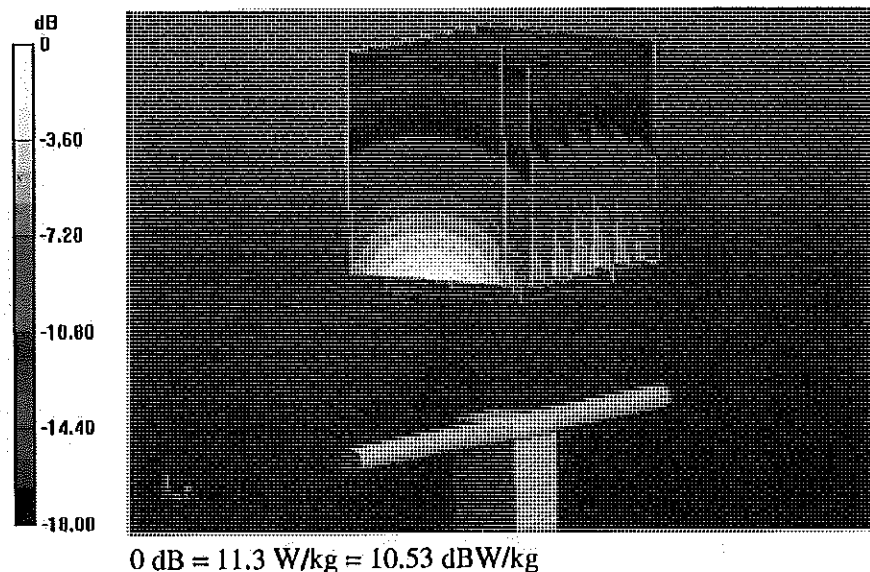
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.631 V/m; Power Drift = 0.00 dB

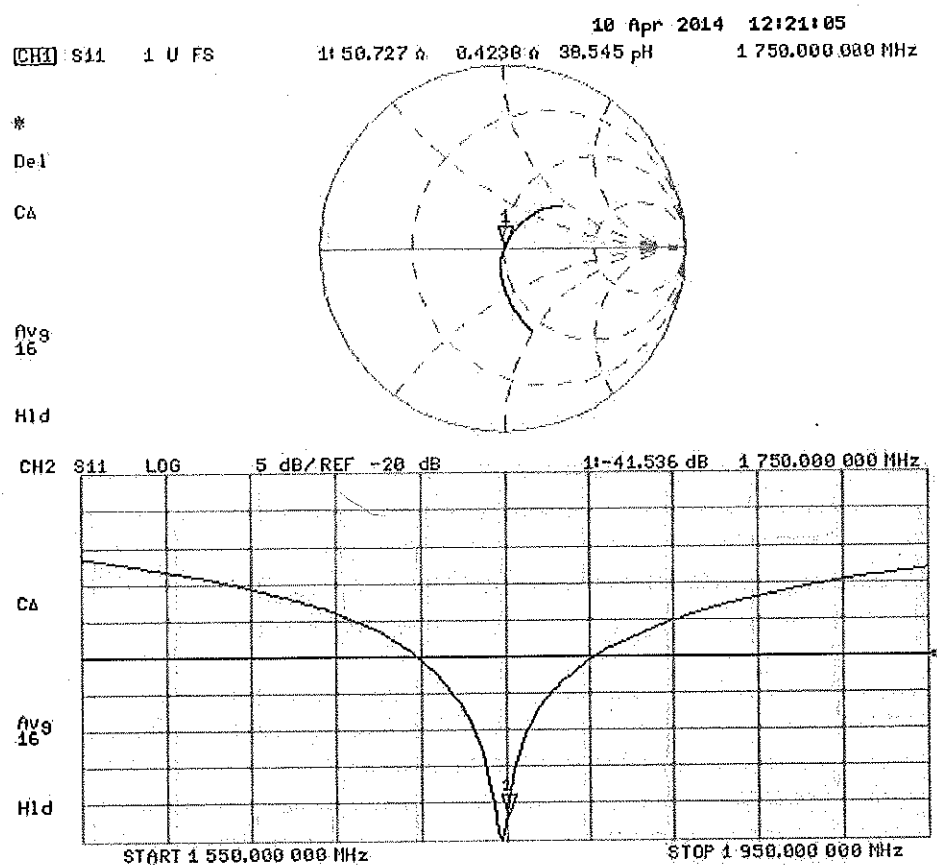
Peak SAR (extrapolated) = 16.2 W/kg

SAR(1 g) = 9.02 W/kg; SAR(10 g) = 4.79 W/kg

Maximum value of SAR (measured) = 11.3 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 10.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1051

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.48$ S/m; $\epsilon_r = 52$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.89, 4.89, 4.89); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

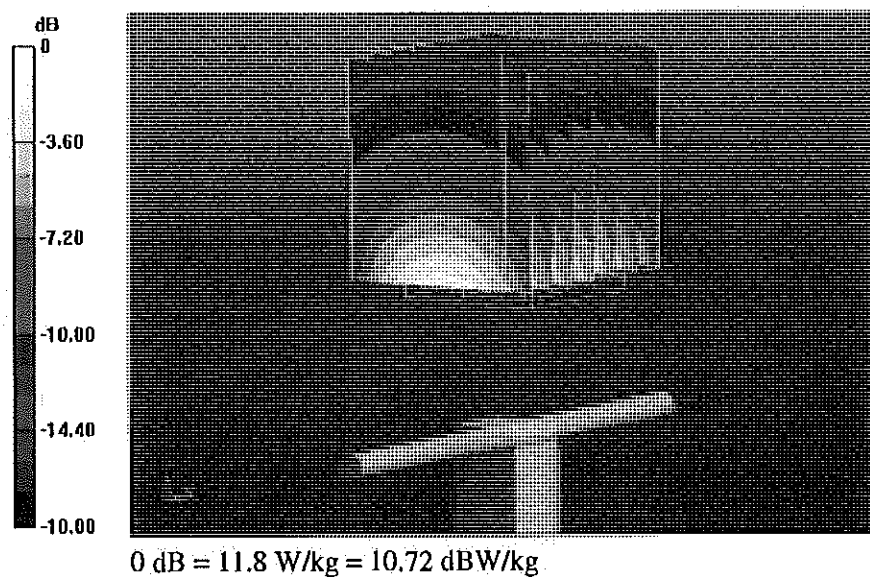
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.321 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 16.1 W/kg

SAR(1 g) = 9.37 W/kg; SAR(10 g) = 5.04 W/kg

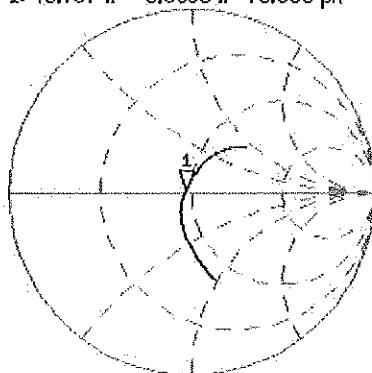
Maximum value of SAR (measured) = 11.8 W/kg



Impedance Measurement Plot for Body TSL

10 Apr 2014 12:20:40
 [CH1] S11 1 U FS 1: 46.787 Ω 0.8086 Ω 73.538 pH 1 750.000 000 MHz

*
 Del
 CA



Av9
 16

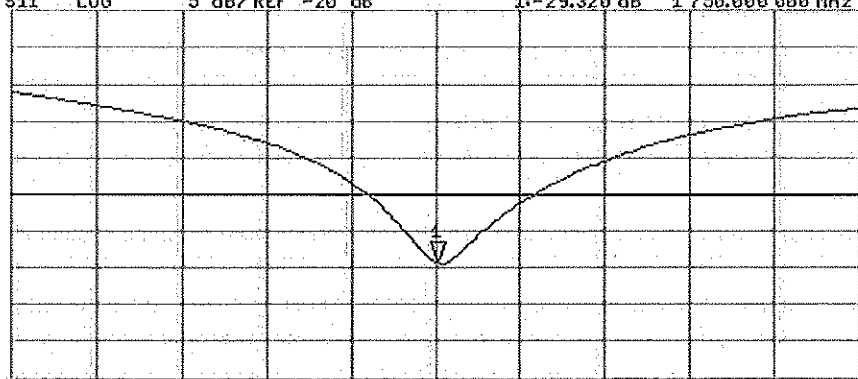
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -29.320 dB 1 750.000 000 MHz

CA

Av9
 16

H1d



START 1.550.000 000 MHz

STOP 1.950.000 000 MHz



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d141_Apr14**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d141**

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

Calibration date: **April 09, 2014**

✓
Kok
5/7/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292763	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 801	25-Apr-13 (No. DAE4-801_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Claudio Leubler** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: April 9, 2014

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.1 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.91 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.1 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.8 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.4 $\pm$ 6 %	1.52 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.8 \Omega + 5.5 j\Omega$
Return Loss	- 24.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.8 \Omega + 6.3 j\Omega$
Return Loss	- 23.7 dB

General Antenna Parameters and Design

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

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 09.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.36$ S/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

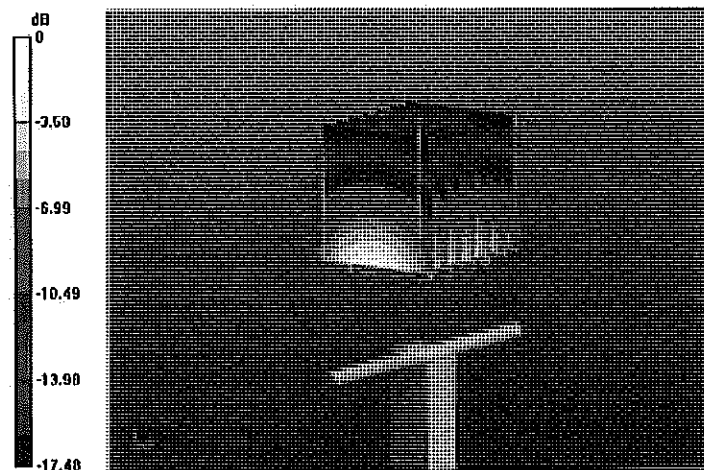
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.080 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 18.2 W/kg

SAR(1 g) = 9.91 W/kg; SAR(10 g) = 5.17 W/kg

Maximum value of SAR (measured) = 12.5 W/kg

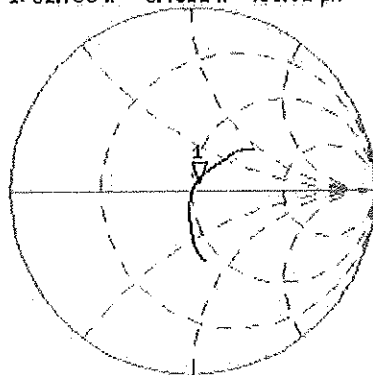


0 dB = 12.5 W/kg = 10.97 dBW/kg

Impedance Measurement Plot for Head TSL

9 Apr 2014 11:03:32
 CH1 S11 1 U FS 1 52.760 n 5.4512 n 456.62 pF 1 900.000 000 MHz

*
 Del
 CA



AVG
 16

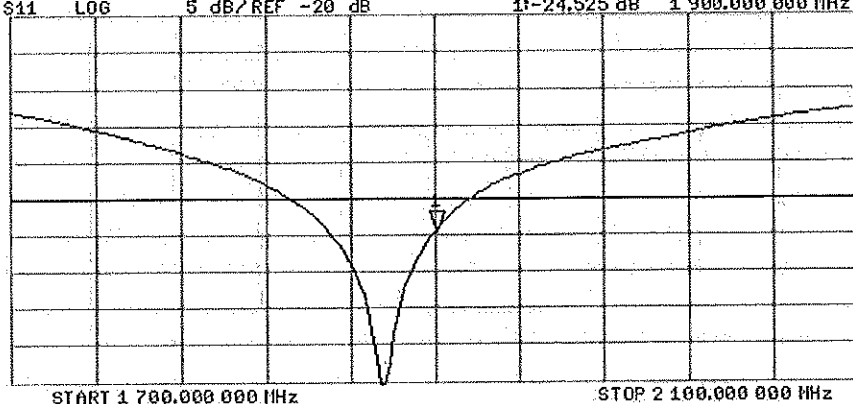
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1 24.525 dB 1 900.000 000 MHz

CA

AVG
 16

H1d



DASY5 Validation Report for Body TSL

Date: 09.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.52$ S/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

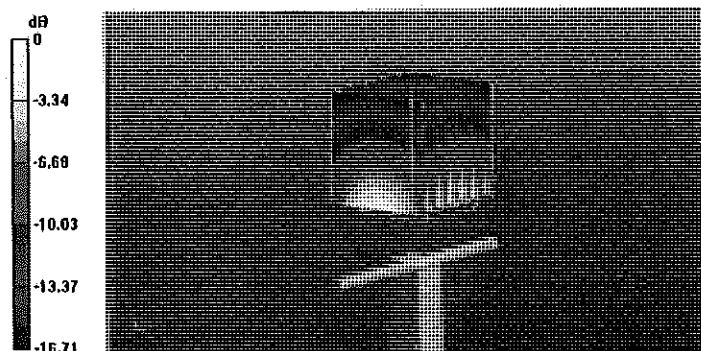
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.820 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 17.9 W/kg

SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.41 W/kg

Maximum value of SAR (measured) = 12.9 W/kg



0 dB = 12.9 W/kg = 11.11 dBW/kg

Impedance Measurement Plot for Body TSL

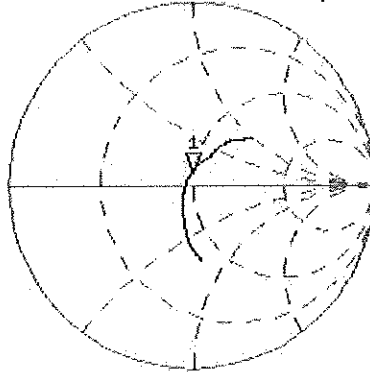
9 Apr 2014 11:02:32
[CH1] S11 1 U FS 1: 48.752 Ω 6.3320 Ω 530.41 μ H 1 900.000 000 MHz

*
Del

CA

Avg
16

↑

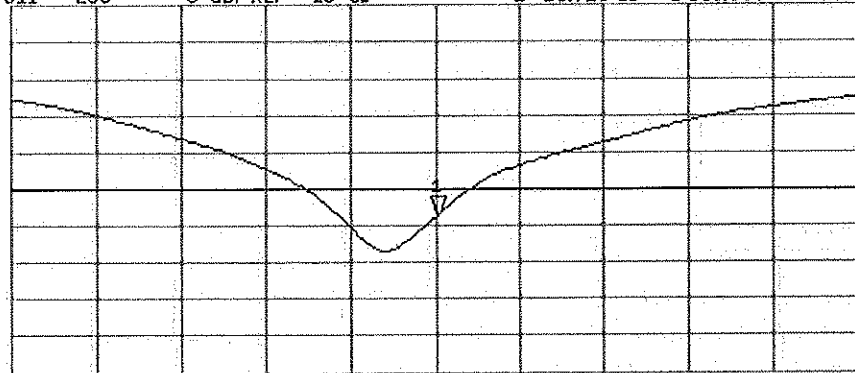


CH2 S11 LOG 5 dB/REF -20 dB 1: -23.715 dB 1 900.000 000 MHz

CA

Avg
16

↑



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz



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Accreditation No.: **SCS 108**

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 Multilateral Agreement for the recognition of calibration certificates

Client **PC Test**

Certificate No: **D1900V2-5d148_Feb14**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d148**

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

Calibration date: **February 27, 2014**

CCV
3/4/2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Jeton Kastrati** Name **Laboratory Technician** Function **Signature**

Approved by: **Katja Pokovic** Technical Manager

Issued: February 27, 2014

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



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Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.9 $\pm$ 6 %	1.39 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.7 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.2 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.8 $\pm$ 6 %	1.49 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.73 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.3 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.7 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.5 \Omega + 5.5 j\Omega$
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.0 \Omega + 6.7 j\Omega$
Return Loss	- 23.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 27.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d148

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.39$ S/m; $\epsilon_r = 38.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

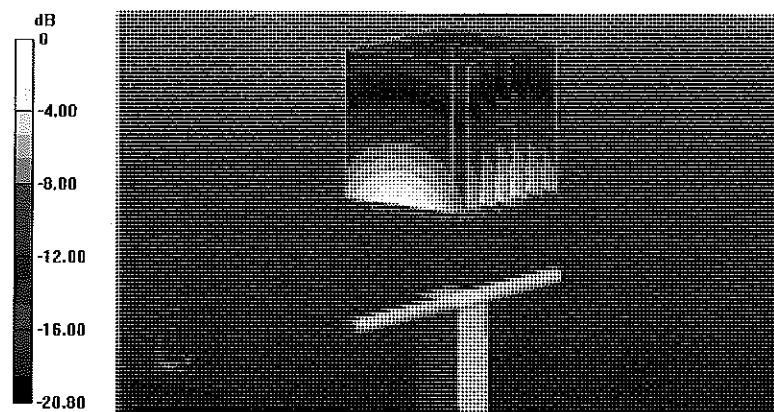
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.796 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 18.9 W/kg

SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.31 W/kg

Maximum value of SAR (measured) = 12.8 W/kg

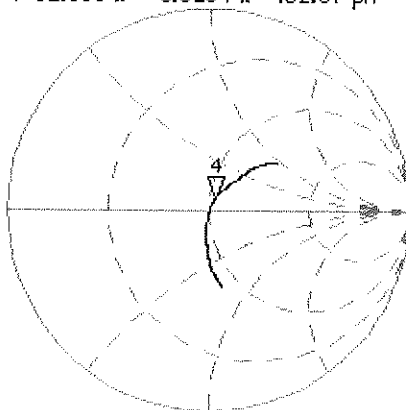


0 dB = 12.8 W/kg = 11.07 dBW/kg

Impedance Measurement Plot for Head TSL

27 Feb 2014 09:42:31
 [CH1] S11 1 U FS 4: 52.533 Δ 5.5234 Δ 462.67 pH 1 900.000 000 MHz

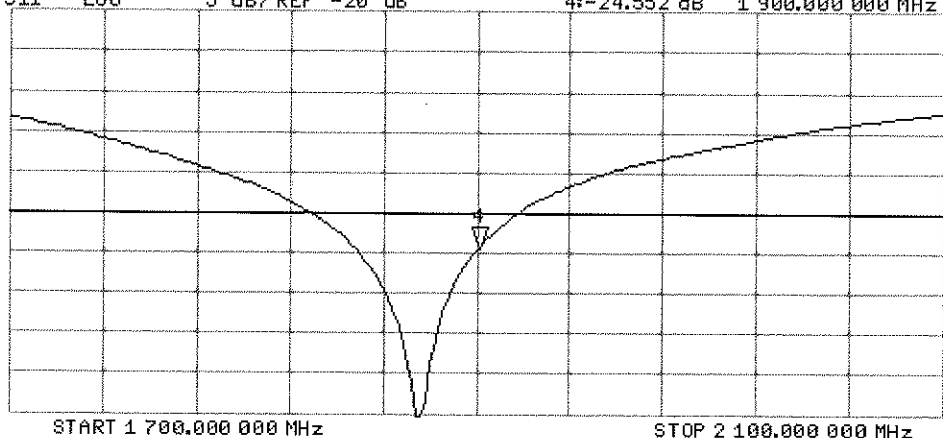
*
 De1
 CA



Avg
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 4:-24.552 dB 1 900.000 000 MHz

CA
 Avg
 16
 H1d



DASY5 Validation Report for Body TSL

Date: 27.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d148

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.49$ S/m; $\epsilon_r = 52.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

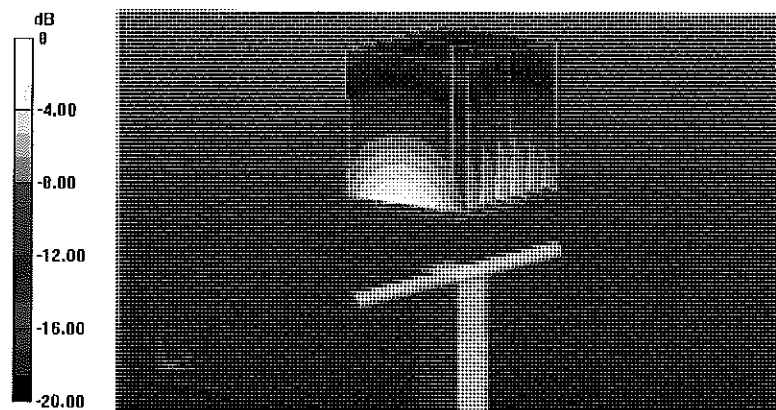
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.520 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 9.73 W/kg; SAR(10 g) = 5.15 W/kg

Maximum value of SAR (measured) = 12.2 W/kg

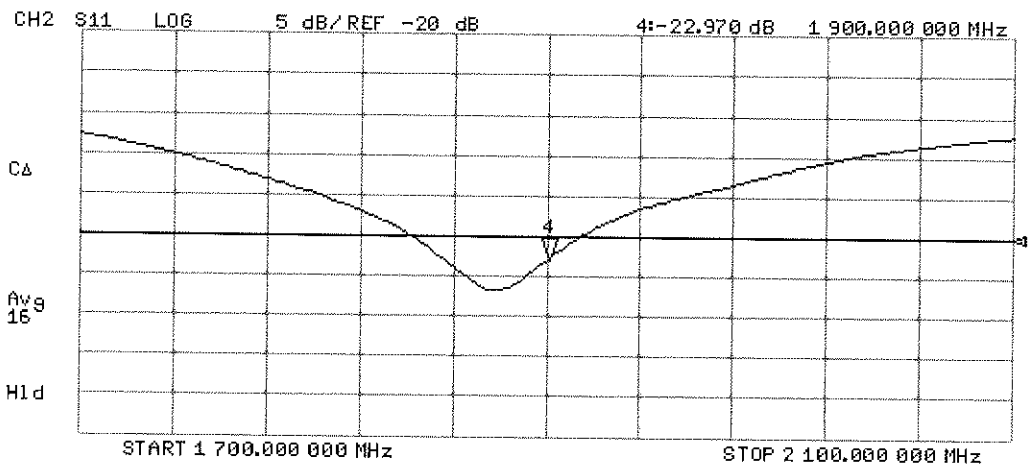
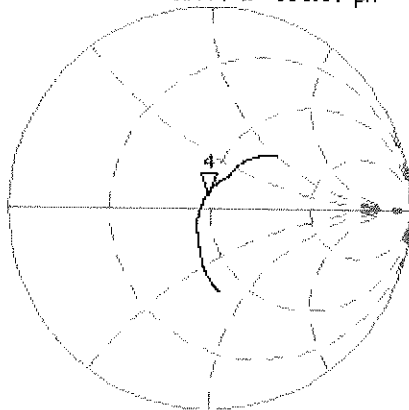


0 dB = 12.2 W/kg = 10.86 dBW/kg

Impedance Measurement Plot for Body TSL

CH1 S11 1 U FS 4: 47.971 Ω 6.6777 Ω 559.37 pF 1 900.000 000 MHz 27 Feb 2014 09:42:04

*
De1
CA
Avg
16
H1d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D2450V2-719_Aug14**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 719**

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

Calibration date: **August 11, 2014**

✓ KOK
9/8/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Michael Weber** Function: **Laboratory Technician**

Signature

M. Weber

Approved by: **Katja Pokovic** Technical Manager

Katja Pokovic

Issued: August 12, 2014

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Accreditation No.: **SCS 108**

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.0 $\pm$ 6 %	1.82 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.1 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.2 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

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

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.8 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.0 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$54.9 \Omega + 3.0 j\Omega$
Return Loss	- 25.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.9 \Omega + 5.8 j\Omega$
Return Loss	- 24.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 11.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.82$ S/m; $\epsilon_r = 38$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

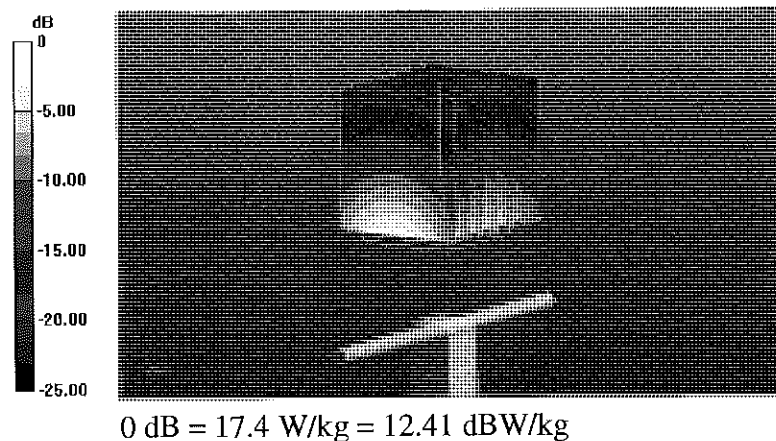
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.6 V/m; Power Drift = 0.03 dB

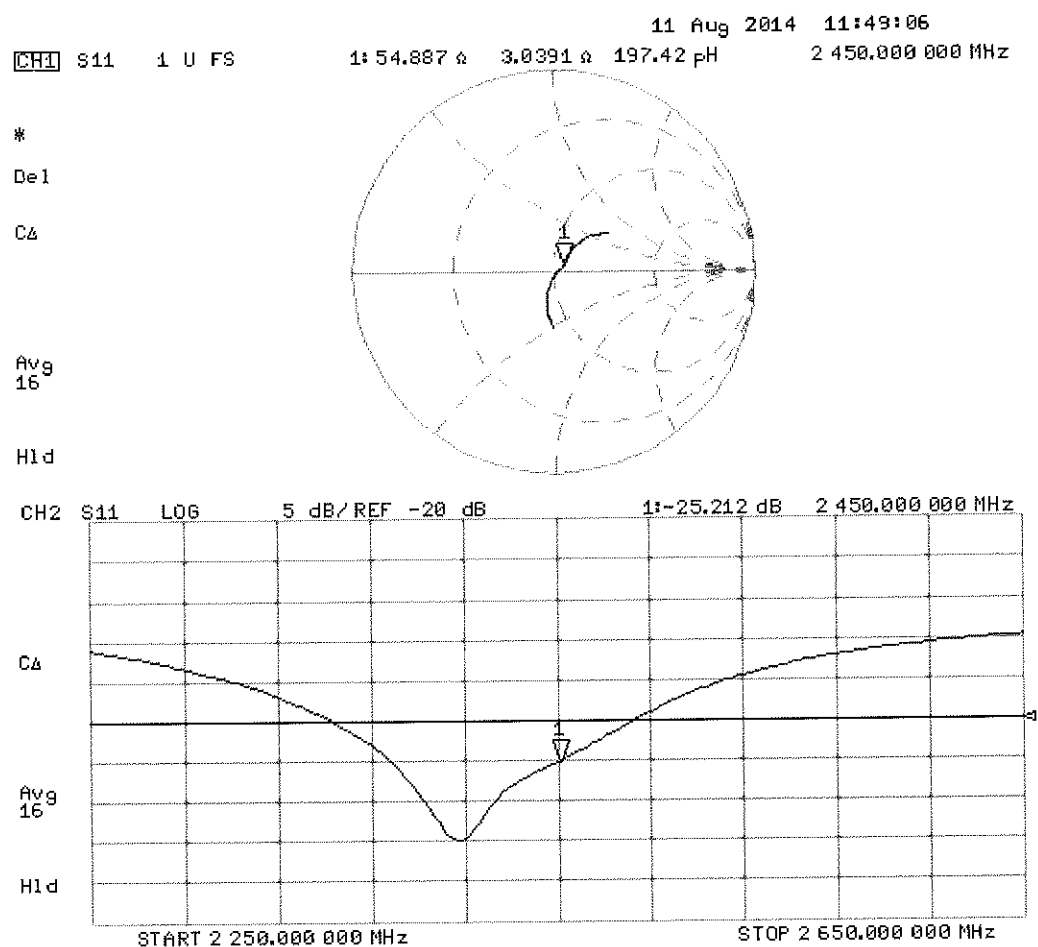
Peak SAR (extrapolated) = 27.5 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.09 W/kg

Maximum value of SAR (measured) = 17.4 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.02$ S/m; $\epsilon_r = 50.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

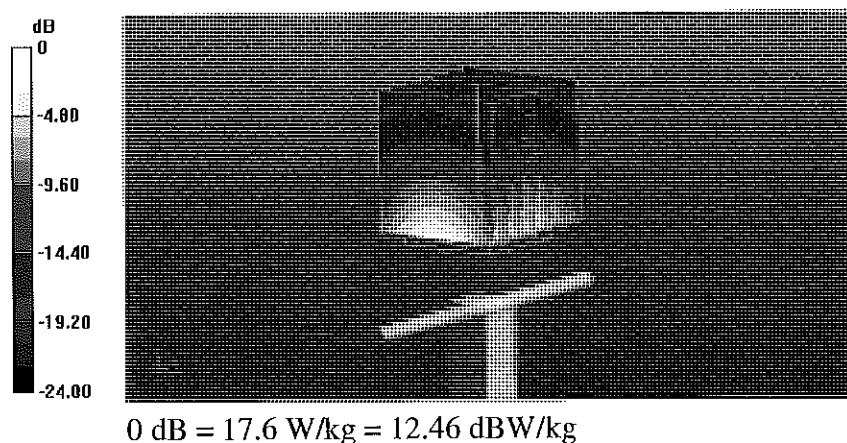
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.08 V/m; Power Drift = -0.01 dB

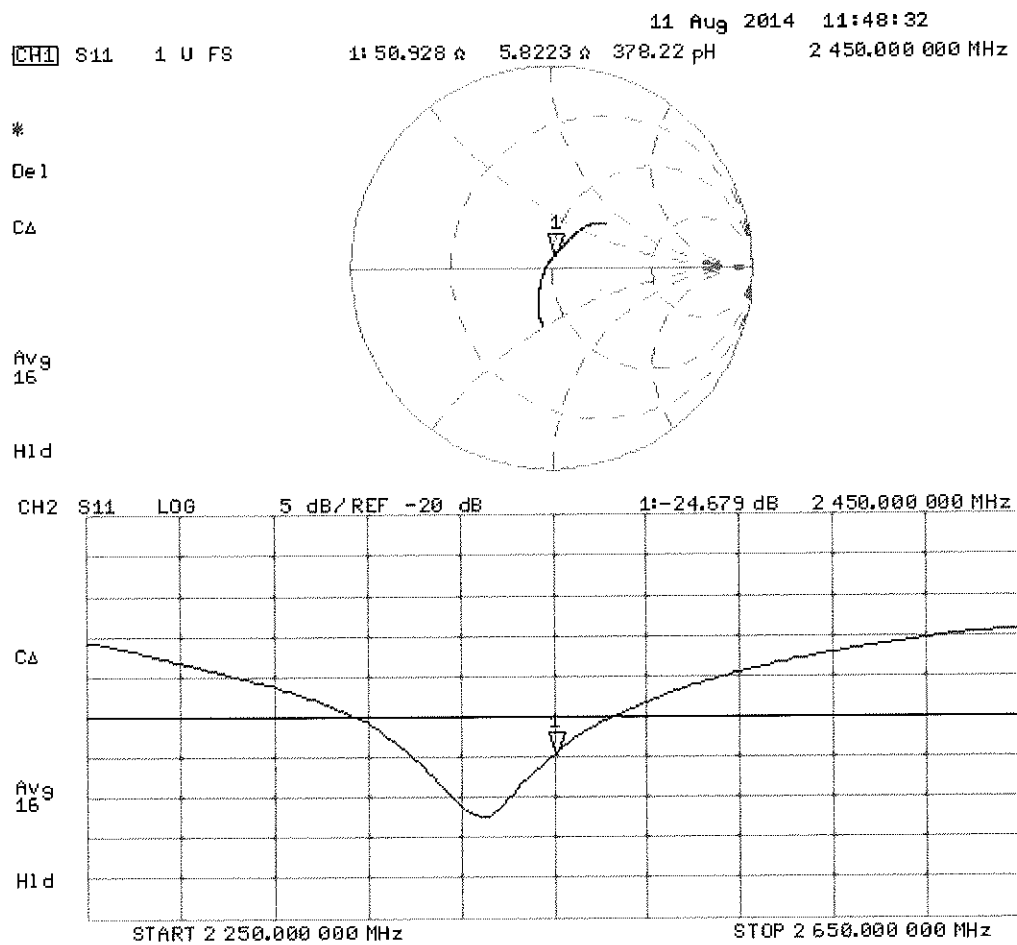
Peak SAR (extrapolated) = 27.9 W/kg

SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.1 W/kg

Maximum value of SAR (measured) = 17.6 W/kg



Impedance Measurement Plot for Body TSL





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Client **PC Test**

Certificate No: **D5GHzV2-1120_Feb14**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1120**

Calibration procedure(s) **QA CAL-22.v2**
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: **February 26, 2014**

CC✓
3/16/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	30-Dec-13 (No. EX3-3503_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Claudio Leubler** Function: **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: February 27, 2014

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

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

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.5 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.4 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.1 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.5 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.7 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.3 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5500 MHz

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

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

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5600 MHz

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

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

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

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

SAR result with Body TSL at 5800 MHz

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

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

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	$54.0\ \Omega - 5.6\ j\Omega$
Return Loss	- 23.6 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	$51.1\ \Omega + 1.6\ j\Omega$
Return Loss	- 34.6 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	$51.1\ \Omega - 2.3\ j\Omega$
Return Loss	- 31.9 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	$58.4\ \Omega - 0.2\ j\Omega$
Return Loss	- 22.2 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	$52.9\ \Omega + 2.8\ j\Omega$
Return Loss	- 28.2 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	$52.3\ \Omega - 5.9\ j\Omega$
Return Loss	- 24.2 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	$51.1\ \Omega + 1.2\ j\Omega$
Return Loss	- 35.8 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	$50.5\ \Omega - 2.6\ j\Omega$
Return Loss	- 31.6 dB

Antenna Parameters with Body TSL at 5600 MHz

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

Antenna Parameters with Body TSL at 5800 MHz

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

General Antenna Parameters and Design

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

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 08, 2011

DASY5 Validation Report for Head TSL

Date: 26.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.52$ S/m; $\epsilon_r = 37.1$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5300$ MHz; $\sigma = 4.63$ S/m; $\epsilon_r = 36.9$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5500$ MHz; $\sigma = 4.84$ S/m; $\epsilon_r = 36.7$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5600$ MHz; $\sigma = 4.95$ S/m; $\epsilon_r = 36.6$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5800$ MHz; $\sigma = 5.16$ S/m; $\epsilon_r = 36.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 62.794 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 28.6 W/kg

SAR(1 g) = 7.87 W/kg; SAR(10 g) = 2.24 W/kg

Maximum value of SAR (measured) = 18.0 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.390 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 31.5 W/kg

SAR(1 g) = 8.3 W/kg; SAR(10 g) = 2.37 W/kg

Maximum value of SAR (measured) = 19.2 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.321 V/m; Power Drift = 0.08 dB

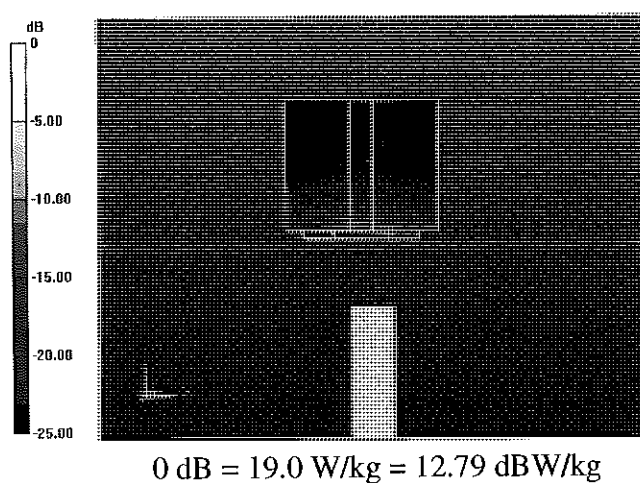
Peak SAR (extrapolated) = 33.6 W/kg

SAR(1 g) = 8.45 W/kg; SAR(10 g) = 2.4 W/kg

Maximum value of SAR (measured) = 20.0 W/kg

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

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



Impedance Measurement Plot for Head TSL

26 Feb 2014 10:12:36

[CH1] S11 1 U FS 1: 53.980 Ω -5.5879 Ω 5.4773 pF 5 200.000 000 MHz

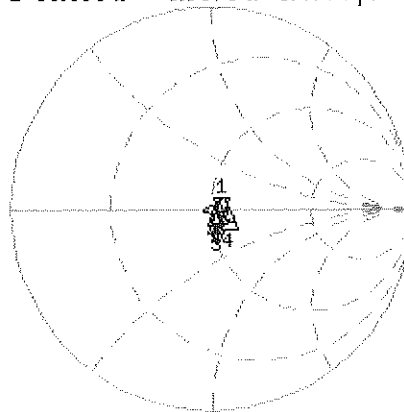
*

Del

Cor

Avg
16

H1d



CH1 Markers

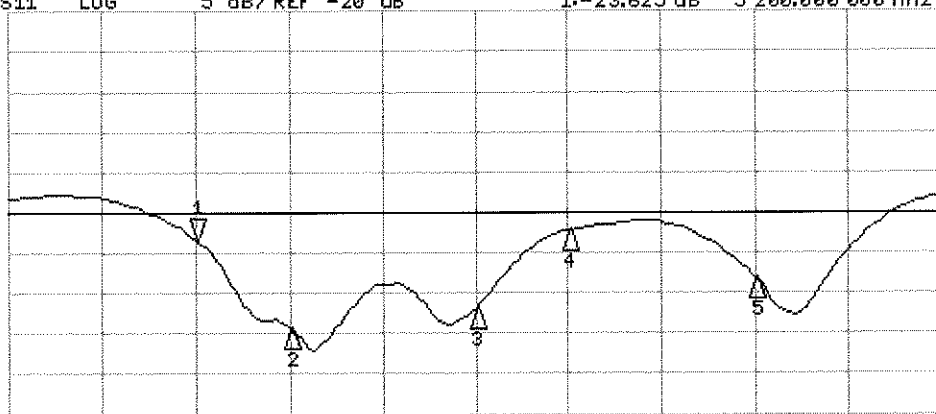
2: 51.086 Ω
1.5508 Ω
5.30000 GHz
3: 51.148 Ω
-2.3066 Ω
5.50000 GHz
4: 50.436 Ω
-158.20 m Ω
5.60000 GHz
5: 52.877 Ω
2.8086 Ω
5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -23.625 dB 5 200.000 000 MHz

Cor

Avg
16

H1d



CH2 Markers

2: -34.550 dB
5.30000 GHz
3: -31.869 dB
5.50000 GHz
4: -22.182 dB
5.60000 GHz
5: -28.164 dB
5.80000 GHz

START 5 000.000 000 MHz

STOP 6 000.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 25.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.4$ S/m; $\epsilon_r = 47.8$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5300$ MHz; $\sigma = 5.53$ S/m; $\epsilon_r = 47.6$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5500$ MHz; $\sigma = 5.8$ S/m; $\epsilon_r = 47.3$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5600$ MHz; $\sigma = 5.94$ S/m; $\epsilon_r = 47.1$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5800$ MHz; $\sigma = 6.21$ S/m; $\epsilon_r = 46.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

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

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.562 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 29.5 W/kg

SAR(1 g) = 7.43 W/kg; SAR(10 g) = 2.08 W/kg

Maximum value of SAR (measured) = 17.7 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.903 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.14 W/kg

Maximum value of SAR (measured) = 18.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.015 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 34.5 W/kg

SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.21 W/kg

Maximum value of SAR (measured) = 19.5 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.626 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 35.6 W/kg

SAR(1 g) = 7.98 W/kg; SAR(10 g) = 2.21 W/kg

Maximum value of SAR (measured) = 19.8 W/kg

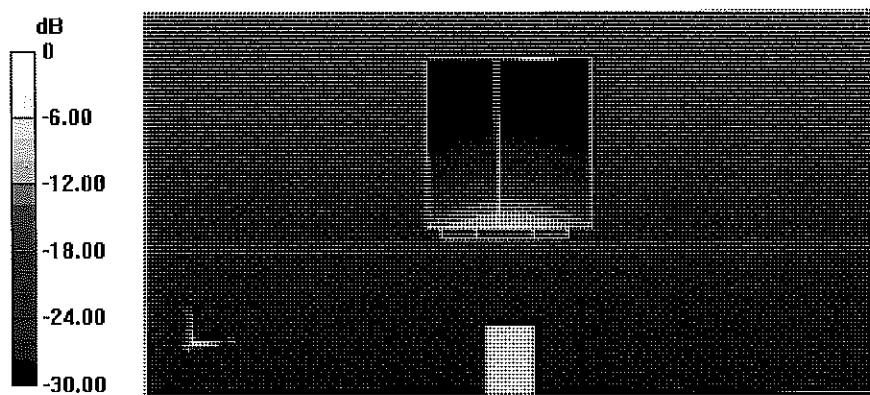
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 55.428 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 34.9 W/kg

SAR(1 g) = 7.47 W/kg; SAR(10 g) = 2.07 W/kg

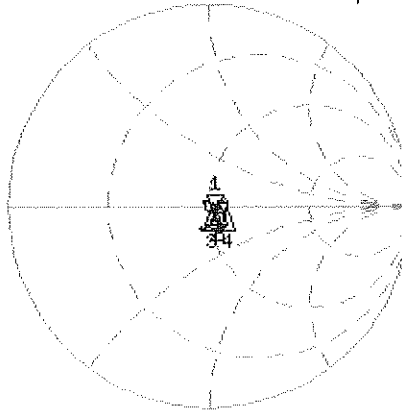
Maximum value of SAR (measured) = 18.8 W/kg



Impedance Measurement Plot for Body TSL

25 Feb 2014 15:49:48
 [CH1] S11 1 U FS 1: 52.344 Ω -5.8965 Ω 5.1907 pF 5 200.000 000 MHz

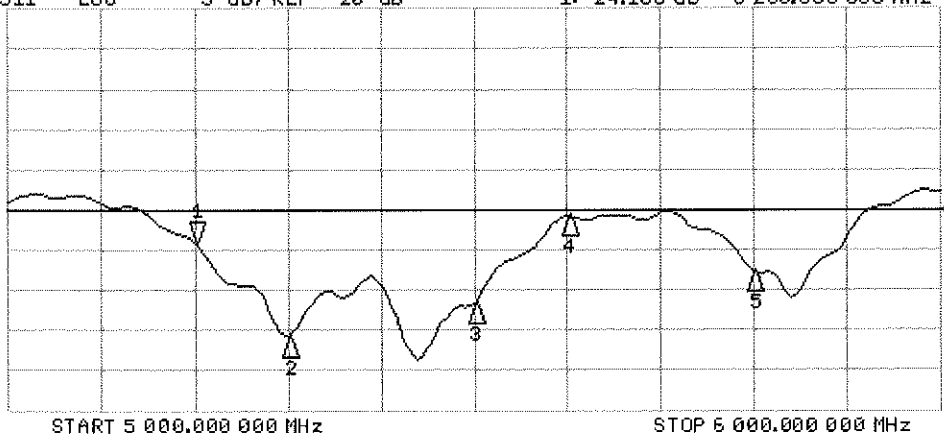
*
 Del
 Cor
 Avg
 16
 H1d



CH1 Markers
 2: 51.105 Ω
 1.1973 Ω
 5.30000 GHz
 3: 50.543 Ω
 -2.5781 Ω
 5.50000 GHz
 4: 59.457 Ω
 -2.9082 Ω
 5.60000 GHz
 5: 54.162 Ω
 1.1016 Ω
 5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -24.165 dB 5 200.000 000 MHz

Cor
 Avg
 16
 H1d



CH2 Markers
 2: -35.830 dB
 5.30000 GHz
 3: -31.626 dB
 5.50000 GHz
 4: -20.878 dB
 5.60000 GHz
 5: -27.672 dB
 5.80000 GHz

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



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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: **ES3-3022_Aug14/2**

CALIBRATION CERTIFICATE (Replacement of No: ES3-3022_Aug14)

Object **ES3DV2 - SN:3022**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes**

CC
D/M/Y

Calibration date: **August 19, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature 
Approved by:	Katja Pokovic	Technical Manager	
Issued: November 3, 2014			

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV2

SN:3022

Manufactured: April 15, 2003
Calibrated: August 19, 2014

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$) ^A	1.00	1.04	0.96	$\pm 10.1 \%$
DCP (mV) ^B	103.0	96.3	101.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	181.8	$\pm 2.7 \%$
		Y	0.0	0.0	1.0		183.0	
		Z	0.0	0.0	1.0		192.3	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	2.51	63.1	12.7	10.00	42.6	$\pm 1.9 \%$
		Y	2.62	63.1	12.9		42.7	
		Z	3.12	65.7	13.6		40.4	
10011- CAB	UMTS-FDD (WCDMA)	X	3.33	67.8	19.2	2.91	145.9	$\pm 0.9 \%$
		Y	3.13	64.9	16.9		147.4	
		Z	3.20	66.4	18.2		139.6	
10012- CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.05	70.1	19.8	1.87	147.2	$\pm 0.9 \%$
		Y	2.62	65.1	16.2		147.4	
		Z	2.85	68.2	18.4		141.7	
10013- CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.10	70.9	23.6	9.46	143.9	$\pm 3.0 \%$
		Y	11.04	70.2	22.9		144.2	
		Z	10.77	70.2	23.1		134.7	
10021- DAB	GSM-FDD (TDMA, GMSK)	X	19.66	99.7	28.6	9.39	126.0	$\pm 1.9 \%$
		Y	11.04	89.6	25.5		138.9	
		Z	10.45	88.8	24.9		137.5	
10023- DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	20.19	99.6	28.5	9.57	142.0	$\pm 2.5 \%$
		Y	10.53	88.4	25.0		145.5	
		Z	15.52	96.5	27.8		147.6	
10024- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	31.93	99.6	25.2	6.56	149.5	$\pm 1.9 \%$
		Y	12.70	87.9	22.2		148.0	
		Z	27.00	99.8	25.7		135.3	
10027- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	38.32	99.8	23.8	4.80	148.1	$\pm 2.2 \%$
		Y	9.80	83.2	19.3		138.8	
		Z	31.96	99.9	24.2		128.9	
10028- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	40.03	99.5	22.8	3.55	130.5	$\pm 2.2 \%$
		Y	40.27	99.6	23.0		148.1	
		Z	43.09	99.7	22.5		140.1	
10032- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	38.93	99.4	20.4	1.16	146.7	$\pm 1.9 \%$
		Y	32.83	92.5	17.9		139.2	
		Z	31.94	99.5	20.8		133.1	
10039- CAB	CDMA2000 (1xRTT, RC1)	X	4.66	66.8	19.3	4.57	144.5	$\pm 1.2 \%$
		Y	4.56	65.3	17.9		137.2	
		Z	4.52	66.1	18.7		131.7	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.82	66.0	18.7	3.97	140.3	±0.9 %
		Y	3.77	64.5	17.3		133.6	
		Z	3.79	65.7	18.4		128.2	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.40	66.2	18.5	3.98	130.9	±1.2 %
		Y	4.39	65.0	17.4		131.1	
		Z	4.47	66.3	18.4		140.0	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.30	67.3	19.8	5.67	137.4	±1.7 %
		Y	6.25	66.3	18.9		135.9	
		Z	6.36	67.4	19.7		147.5	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.14	66.8	19.6	5.80	134.6	±1.7 %
		Y	6.17	66.1	18.9		133.9	
		Z	6.24	67.0	19.7		144.5	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 6 MHz, QPSK)	X	5.82	66.3	19.4	5.75	131.2	±1.7 %
		Y	5.82	65.4	18.6		130.3	
		Z	5.91	66.5	19.4		140.4	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.00	68.5	21.2	8.10	124.3	±2.5 %
		Y	9.89	67.9	20.6		124.0	
		Z	10.05	68.6	21.2		133.2	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.01	68.6	21.2	8.07	125.8	±2.5 %
		Y	9.91	67.9	20.7		125.8	
		Z	10.09	68.8	21.3		134.7	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.69	75.5	26.4	9.28	144.7	±3.3 %
		Y	9.09	72.7	24.6		143.2	
		Z	8.54	72.0	24.5		124.8	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.82	66.2	19.4	5.75	131.3	±1.9 %
		Y	6.06	66.3	19.1		149.2	
		Z	5.91	66.5	19.4		140.7	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.27	66.9	19.7	5.82	136.5	±1.4 %
		Y	6.19	65.8	18.7		128.4	
		Z	6.33	67.0	19.6		145.4	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.81	66.4	19.7	5.73	134.8	±1.7 %
		Y	4.92	66.1	19.1		149.9	
		Z	4.78	66.4	19.6		141.2	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	7.83	76.6	27.2	9.21	131.4	±3.5 %
		Y	7.54	74.5	25.8		147.8	
		Z	7.71	76.7	27.4		145.3	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.90	66.9	20.0	5.72	147.6	±1.4 %
		Y	4.90	66.0	19.1		148.0	
		Z	4.78	66.4	19.6		141.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.90	66.9	20.0	5.72	148.1	±1.4 %
		Y	4.89	65.9	19.0		146.9	
		Z	4.80	66.5	19.7		142.1	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.80	68.7	21.4	8.09	135.1	±2.7 %
		Y	9.78	68.2	20.9		135.5	
		Z	9.70	68.5	21.2		130.2	

10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.79	68.7	21.4	8.10	136.4	±2.7 %
		Y	9.81	68.3	20.9		138.0	
		Z	9.72	68.6	21.3		132.8	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.68	68.6	21.3	8.03	136.0	±2.7 %
		Y	9.74	68.3	21.0		137.4	
		Z	9.62	68.5	21.2		132.6	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.20	69.1	21.5	8.06	143.4	±2.5 %
		Y	9.91	60.0	20.7		125.8	
		Z	10.27	69.4	21.6		148.4	
10225-CAB	UMTS-FDD (HSPA+)	X	6.87	66.9	19.6	5.97	139.5	±1.9 %
		Y	7.04	66.9	19.3		149.3	
		Z	6.89	67.0	19.5		143.5	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	7.66	75.9	26.9	9.21	126.1	±3.0 %
		Y	7.17	73.1	25.1		132.1	
		Z	7.18	74.6	26.3		128.0	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	8.58	73.1	25.3	9.24	127.6	±3.3 %
		Y	8.22	71.0	23.7		126.9	
		Z	8.83	74.3	26.0		149.8	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.69	75.5	26.5	9.30	143.8	±3.3 %
		Y	8.88	72.0	24.2		135.2	
		Z	8.83	72.9	25.1		131.3	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.87	67.0	19.2	4.87	141.2	±1.4 %
		Y	5.77	65.8	18.1		136.0	
		Z	5.71	66.3	18.6		132.7	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.44	67.2	19.2	3.96	147.3	±0.9 %
		Y	4.29	65.3	17.6		139.2	
		Z	4.31	66.3	18.5		139.6	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.60	67.1	19.1	3.46	137.8	±0.7 %
		Y	3.44	64.8	17.2		129.6	
		Z	3.48	66.2	18.4		130.5	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.50	66.9	18.9	3.39	139.5	±0.7 %
		Y	3.38	64.8	17.2		132.0	
		Z	3.48	66.5	18.5		133.1	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.12	66.7	19.6	5.81	133.3	±1.9 %
		Y	6.35	66.7	19.3		149.3	
		Z	6.17	66.8	19.5		132.7	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.72	67.4	20.0	6.06	138.7	±1.7 %
		Y	6.63	66.3	19.1		131.4	
		Z	6.72	67.3	19.9		138.7	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.90	69.9	19.8	1.71	146.4	±0.5 %
		Y	2.54	65.2	16.5		139.3	
		Z	2.75	68.1	18.5		146.4	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.12	69.3	21.9	8.36	142.9	±3.0 %
		Y	10.01	68.5	21.3		135.2	
		Z	10.11	69.3	21.9		141.7	

10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.59	68.2	19.0	3.76	126.7	±0.7 %
		Y	4.59	67.2	18.0		142.4	
		Z	4.64	68.5	19.0		143.0	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.64	68.8	19.3	3.77	147.1	±0.9 %
		Y	4.47	67.1	17.9		139.6	
		Z	4.54	68.4	18.9		147.2	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.66	69.0	19.4	1.54	145.8	±0.5 %
		Y	2.40	64.8	16.2		140.0	
		Z	2.62	67.8	18.4		147.2	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.97	69.1	21.7	8.23	142.0	±3.0 %
		Y	10.08	68.9	21.4		145.8	
		Z	10.01	69.2	21.8		143.3	

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

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

[^] Numerical linearization parameter: uncertainty not required.

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

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^g (mm)	Unct. (k=2)
750	41.9	0.89	6.39	6.39	6.39	0.20	2.24	± 12.0 %
835	41.5	0.90	6.18	6.18	6.18	0.23	1.98	± 12.0 %
1750	40.1	1.37	5.04	5.04	5.04	0.51	1.35	± 12.0 %
1900	40.0	1.40	4.85	4.85	4.85	0.38	1.66	± 12.0 %
2450	39.2	1.80	4.31	4.31	4.31	0.66	1.28	± 12.0 %
2600	39.0	1.96	4.13	4.13	4.13	0.76	1.28	± 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: ES3DV2 - SN:3022

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^f	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^g (mm)	Unct. (k=2)
450	56.7	0.94	6.78	6.78	6.78	0.12	1.30	± 13.3 %
600	56.1	0.95	6.72	6.72	6.72	0.05	1.20	± 13.3 %
750	55.5	0.96	6.02	6.02	6.02	0.23	2.05	± 12.0 %
835	55.2	0.97	5.98	5.98	5.98	0.29	1.85	± 12.0 %
1750	53.4	1.49	4.70	4.70	4.70	0.66	1.25	± 12.0 %
1900	53.3	1.52	4.49	4.49	4.49	0.33	2.02	± 12.0 %
2450	52.7	1.95	4.05	4.05	4.05	0.80	1.01	± 12.0 %
2600	52.5	2.16	3.94	3.94	3.94	0.68	1.03	± 12.0 %

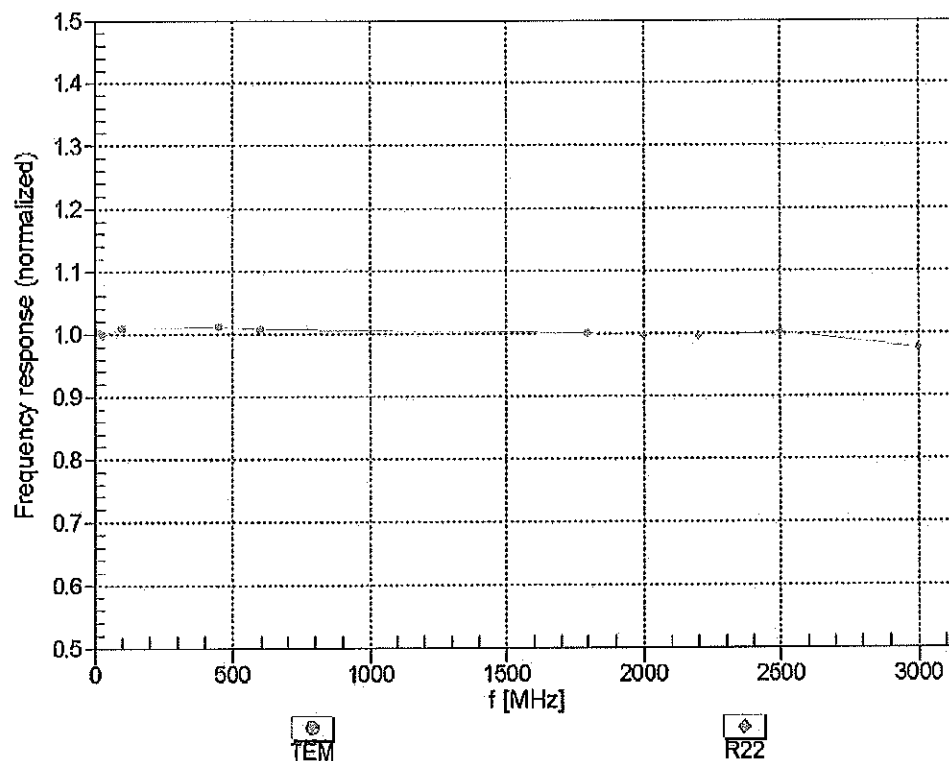
^c Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is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

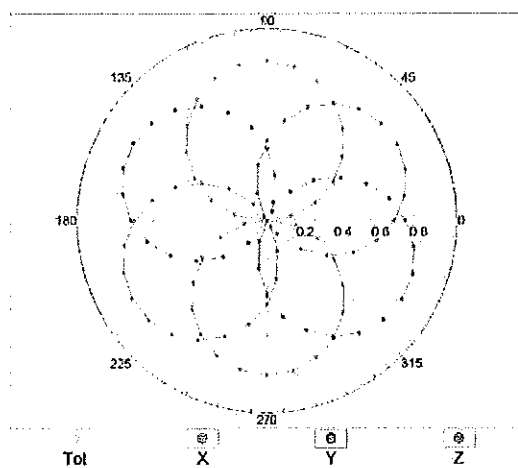
(TEM-Cell:ifi110 EXX, Waveguide: R22)



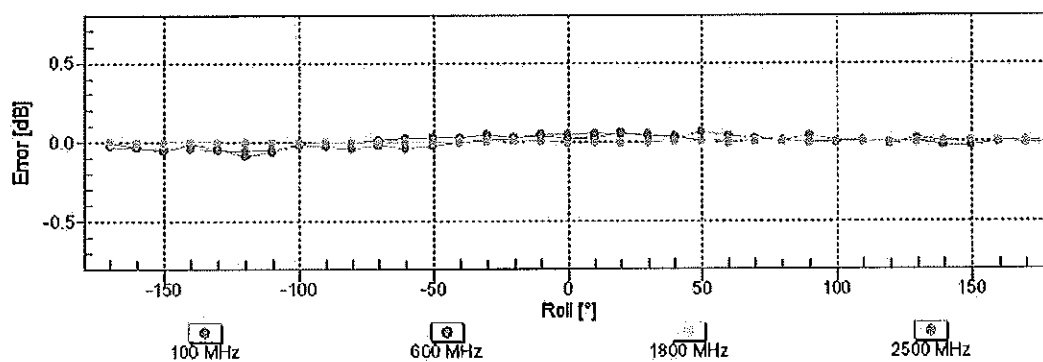
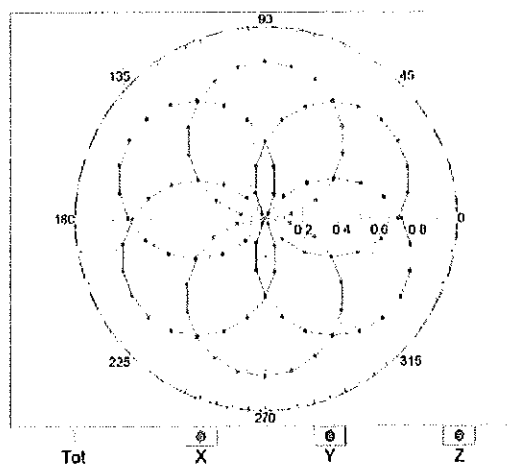
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

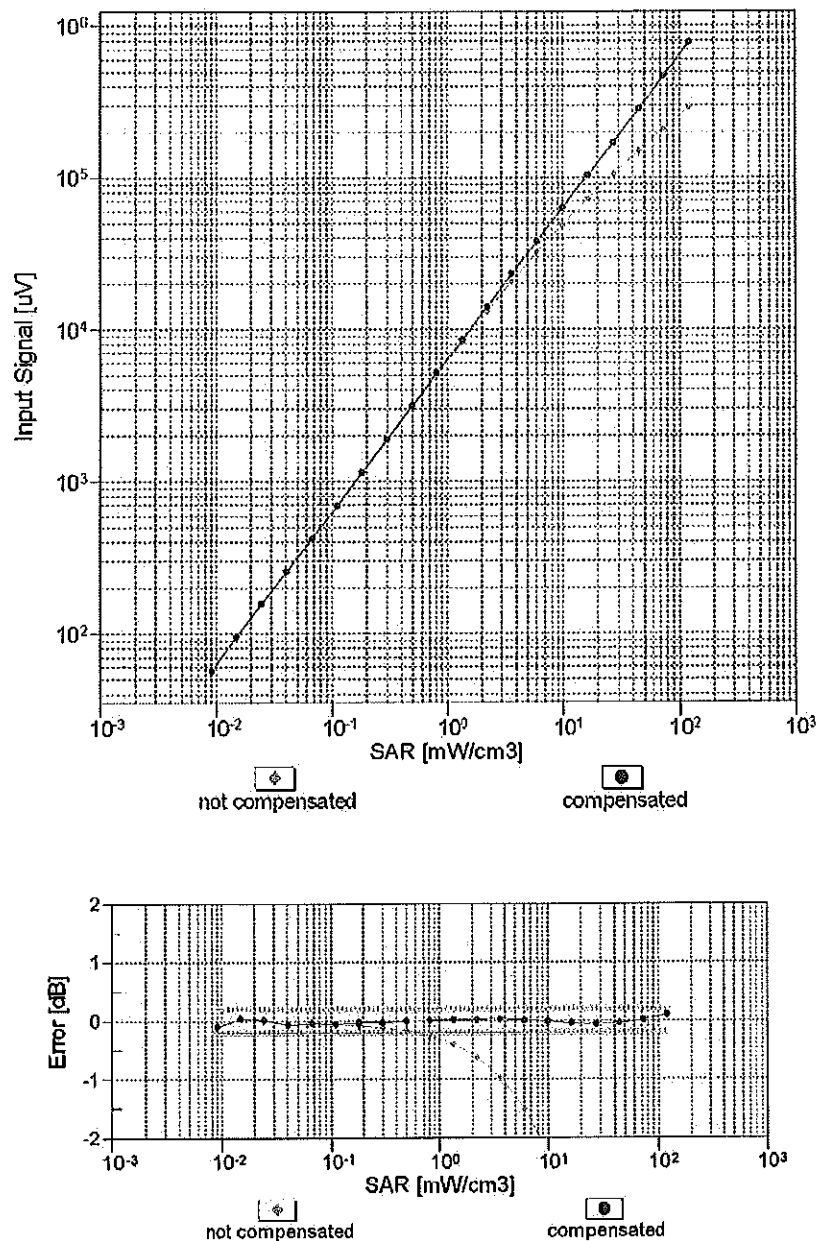


f=1800 MHz,R22



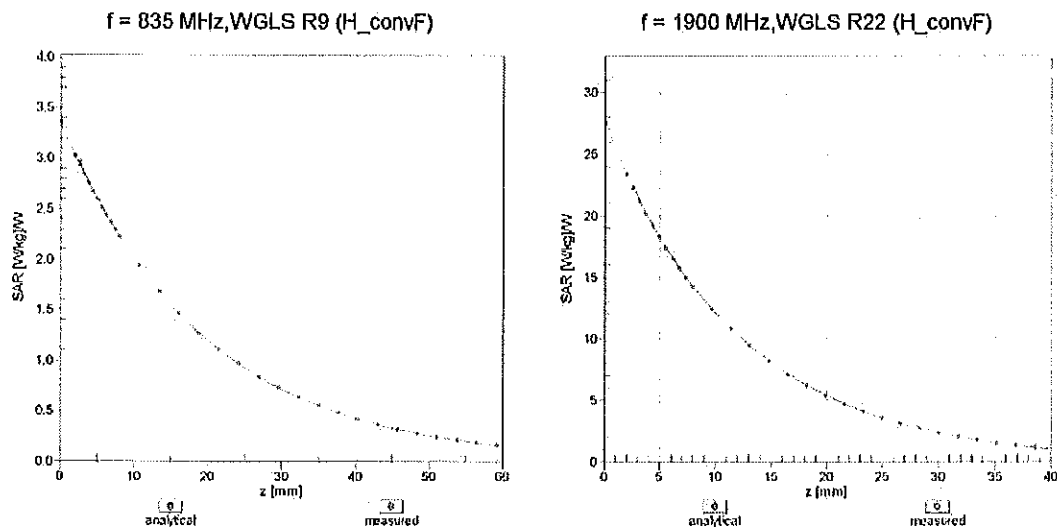
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f_{\text{eval}} = 1900 \text{ MHz}$)



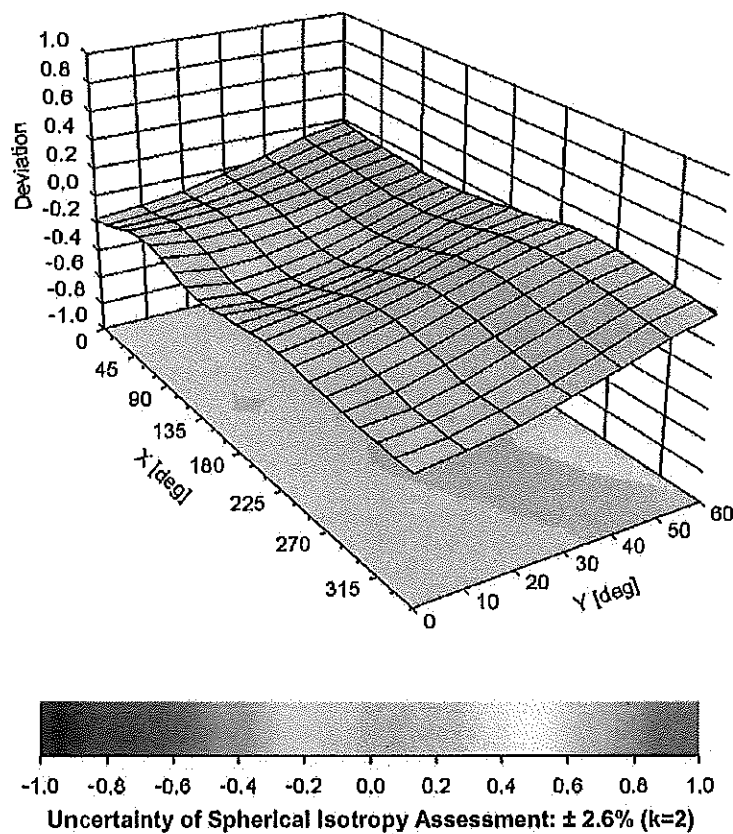
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



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

Sensor Arrangement	Triangular
Connector Angle (°)	-80.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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Accreditation No.: **SCS 108**

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 Multilateral Agreement for the recognition of calibration certificates

Client **PC Test**

Certificate No: **ES3-3209_Mar14**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3209**

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

CCV
 3/27/14

Calibration date: **March 19, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: March 20, 2014

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



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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3209

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

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

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

Basic Calibration Parameters

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

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^F (k=2)
0	CW	X	0.0	0.0	1.0	0.00	188.4	$\pm 3.8 \%$
		Y	0.0	0.0	1.0		180.7	
		Z	0.0	0.0	1.0		200.1	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	2.80	64.7	12.3	10.00	43.2	$\pm 1.4 \%$
		Y	3.12	65.6	13.1		41.9	
		Z	2.67	64.0	11.7		39.4	
10011-CAB	UMTS-FDD (WCDMA)	X	3.39	67.7	19.0	2.91	149.2	$\pm 0.5 \%$
		Y	3.38	67.7	19.0		146.1	
		Z	3.35	67.6	18.7		136.1	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.01	69.8	19.4	1.87	149.4	$\pm 0.7 \%$
		Y	3.06	70.1	19.6		147.1	
		Z	2.98	69.7	19.2		136.4	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	5.47	79.6	20.4	9.39	146.9	$\pm 1.7 \%$
		Y	7.76	84.9	22.9		134.2	
		Z	4.34	75.3	18.5		134.2	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	6.66	82.9	21.6	9.57	139.8	$\pm 2.5 \%$
		Y	9.36	88.2	24.2		131.5	
		Z	4.67	76.1	18.8		144.8	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	5.89	79.1	17.9	6.56	141.2	$\pm 1.9 \%$
		Y	27.58	99.6	24.8		145.8	
		Z	5.42	77.8	17.4		129.3	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	9.68	85.3	19.0	4.80	136.9	$\pm 2.2 \%$
		Y	36.47	100.0	23.3		139.2	
		Z	31.63	96.5	21.4		149.2	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	40.09	99.7	21.7	3.55	125.9	$\pm 1.9 \%$
		Y	47.92	99.6	21.7		127.6	
		Z	61.98	99.9	20.8		136.2	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	99.32	95.7	16.5	1.16	145.1	$\pm 1.7 \%$
		Y	55.30	99.5	19.3		145.6	
		Z	0.54	60.4	5.7		132.7	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.77	67.1	19.2	4.57	145.6	$\pm 0.9 \%$
		Y	4.85	67.5	19.5		147.8	
		Z	4.67	66.7	18.9		133.4	

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

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

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

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

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

^B Numerical linearization parameter: uncertainty not required.

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

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

Calibration Parameter Determined in Head Tissue Simulating Media

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

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

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

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.16	6.16	6.16	0.26	2.23	± 12.0 %
835	55.2	0.97	6.14	6.14	6.14	0.80	1.13	± 12.0 %
1750	53.4	1.49	4.85	4.85	4.85	0.59	1.42	± 12.0 %
1900	53.3	1.52	4.68	4.68	4.68	0.52	1.59	± 12.0 %
2450	52.7	1.95	4.20	4.20	4.20	0.73	1.08	± 12.0 %
2600	52.5	2.16	4.04	4.04	4.04	0.80	1.00	± 12.0 %

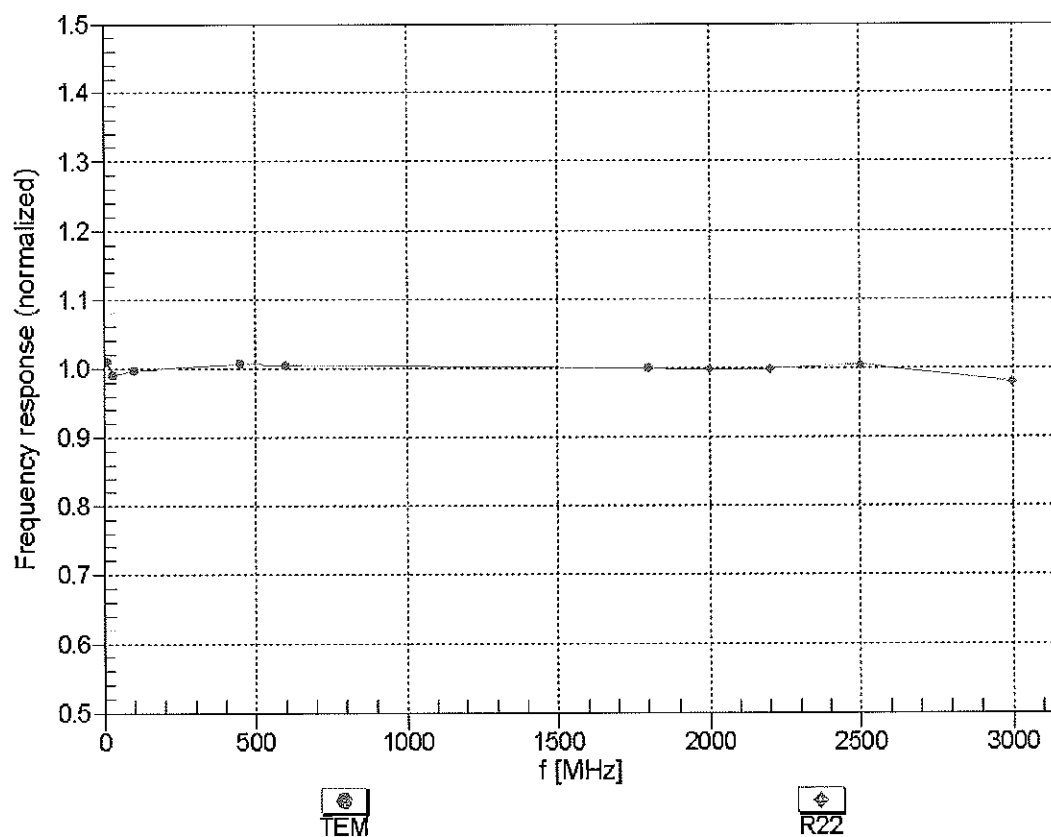
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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

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

Frequency Response of E-Field

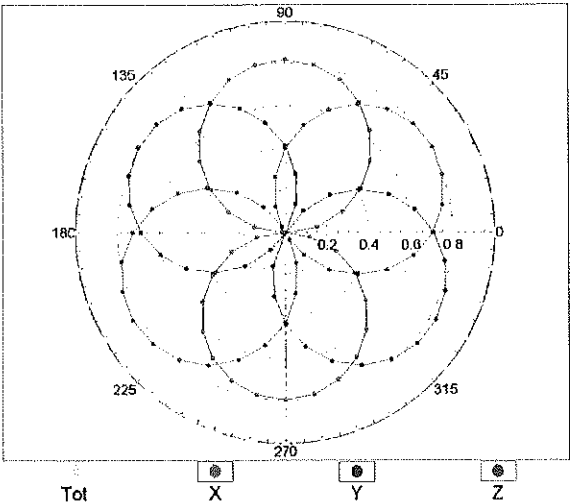
(TEM-Cell:ifi110 EXX, Waveguide: R22)



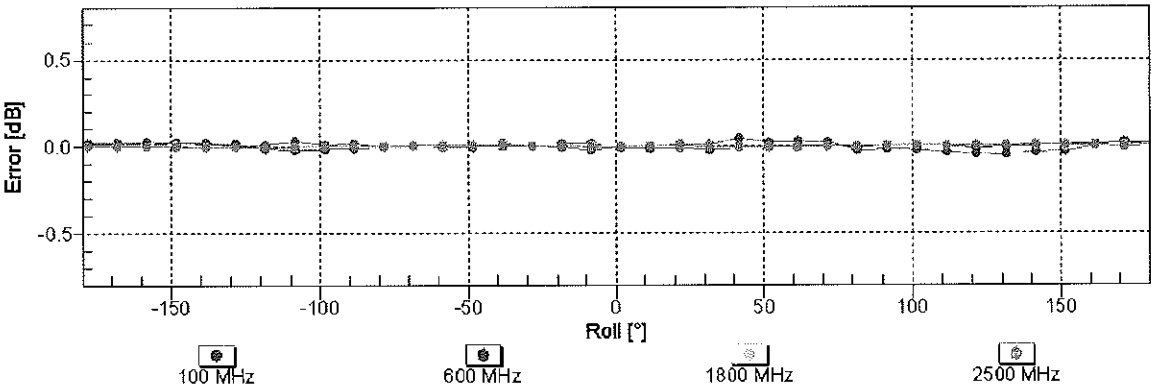
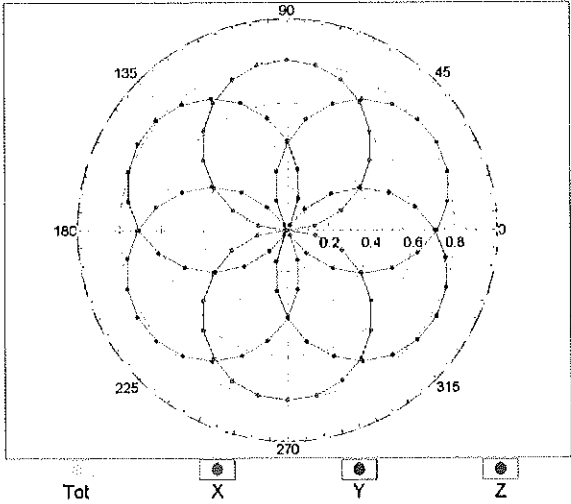
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

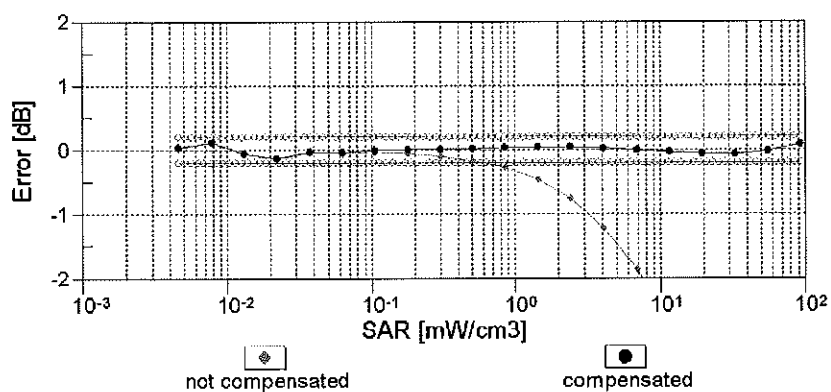
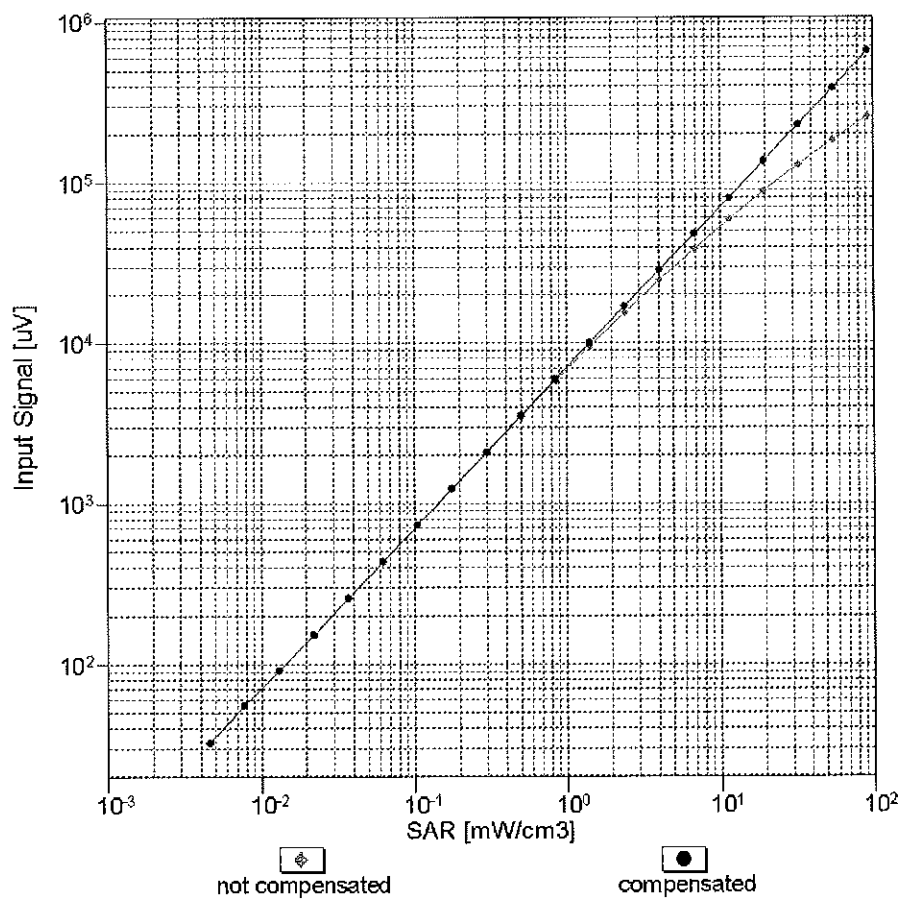


f=1800 MHz,R22



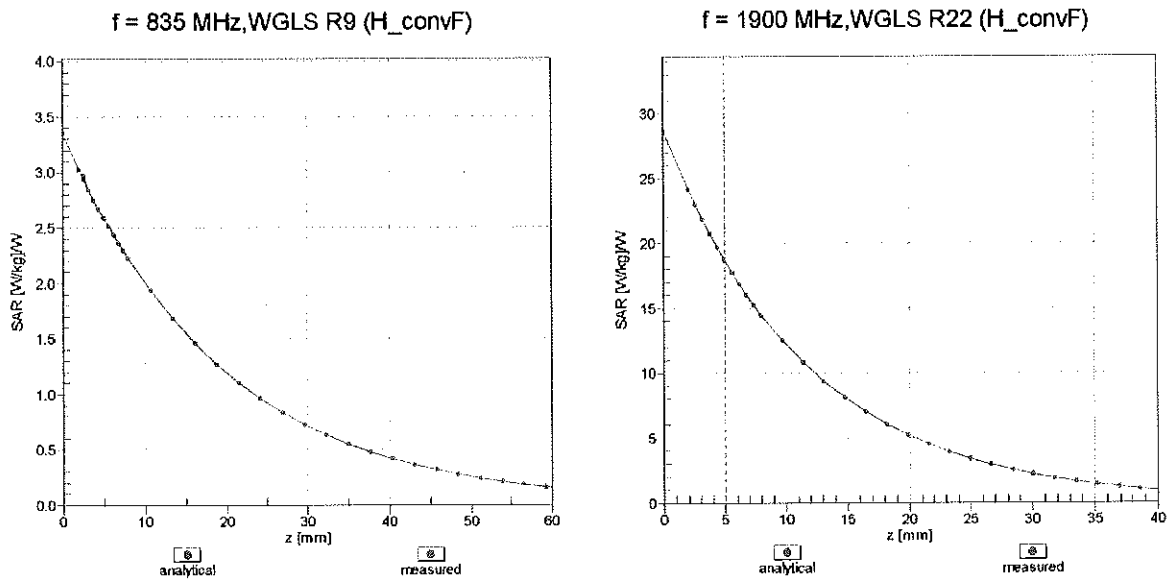
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f_{\text{eval}} = 1900 \text{ MHz}$)



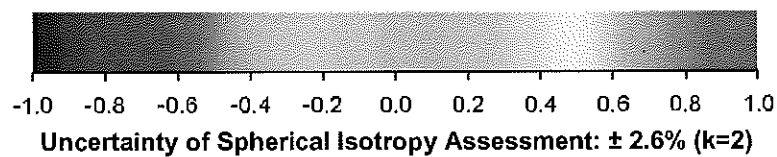
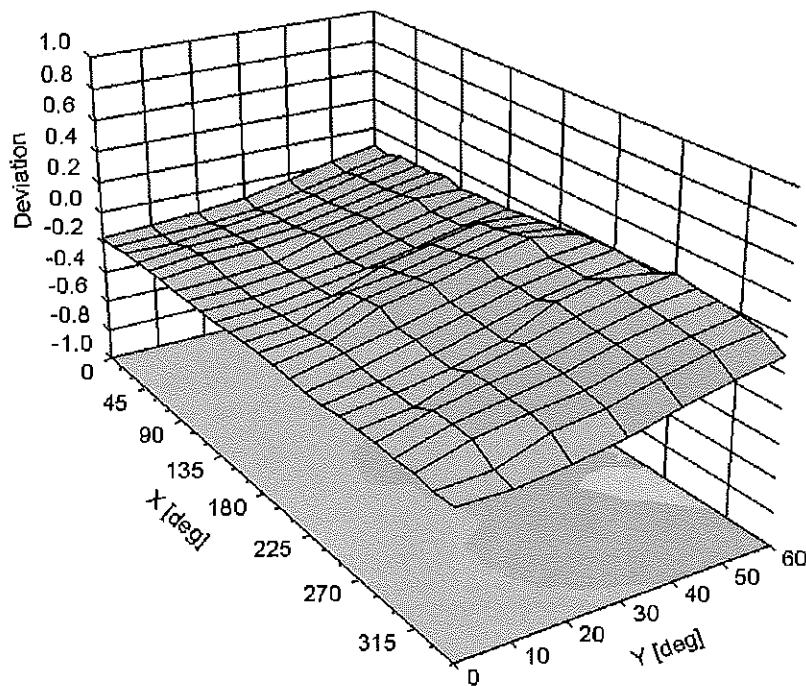
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



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

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

Other Probe Parameters

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



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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3258_Feb14**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3258**

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

CCV
 3/6/14

Calibration date: **February 25, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: February 27, 2014

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



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Accreditation No.: **SCS 108**

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3258

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

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

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

Basic Calibration Parameters

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

Modulation Calibration Parameters

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

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

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

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

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

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

^B Numerical linearization parameter: uncertainty not required.

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

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

Calibration Parameter Determined in Head Tissue Simulating Media

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

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

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

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

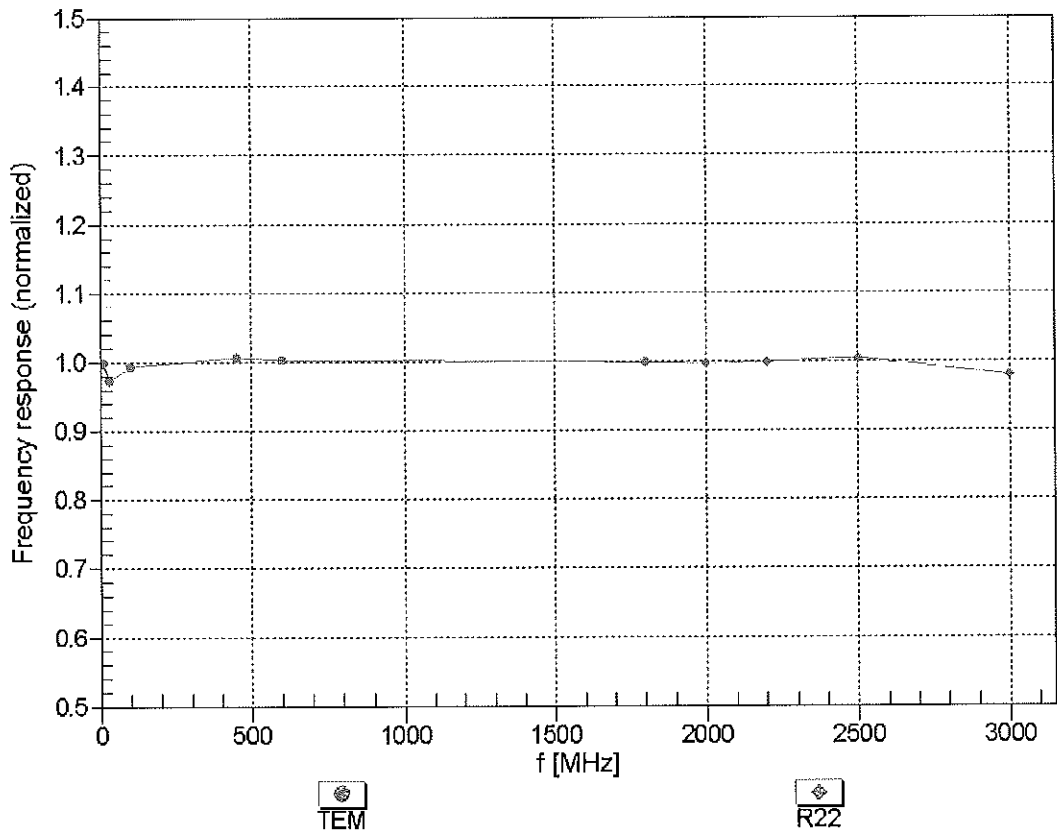
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.15	6.15	6.15	0.61	1.32	± 12.0 %
835	55.2	0.97	6.11	6.11	6.11	0.80	1.15	± 12.0 %
1750	53.4	1.49	4.83	4.83	4.83	0.47	1.74	± 12.0 %
1900	53.3	1.52	4.61	4.61	4.61	0.55	1.59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

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

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

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

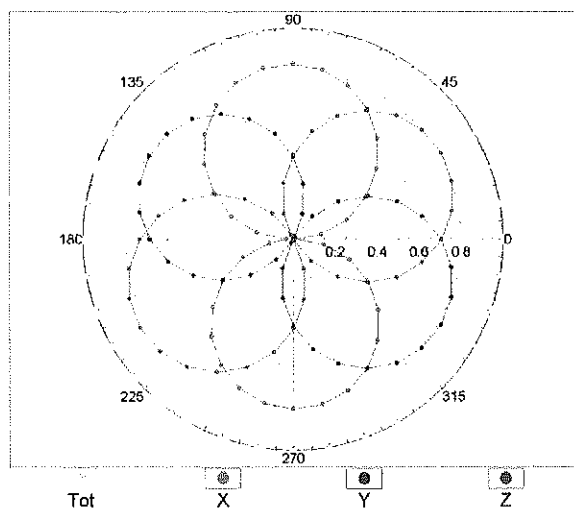
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



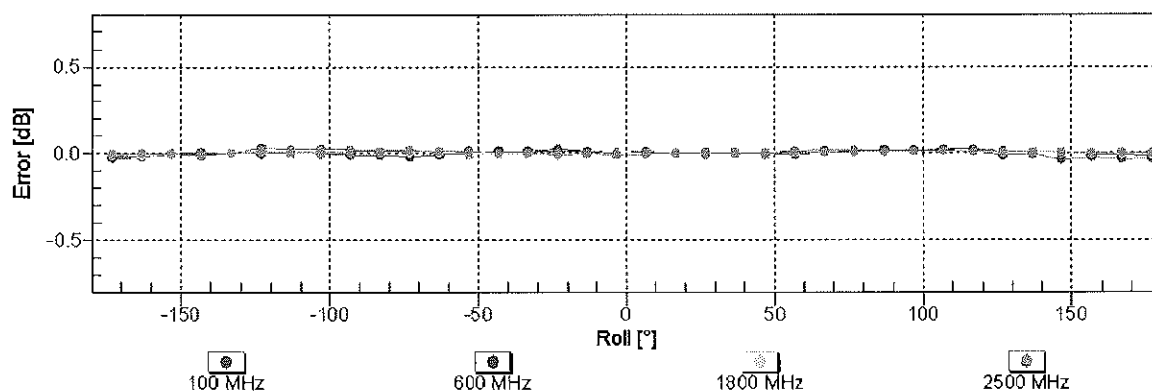
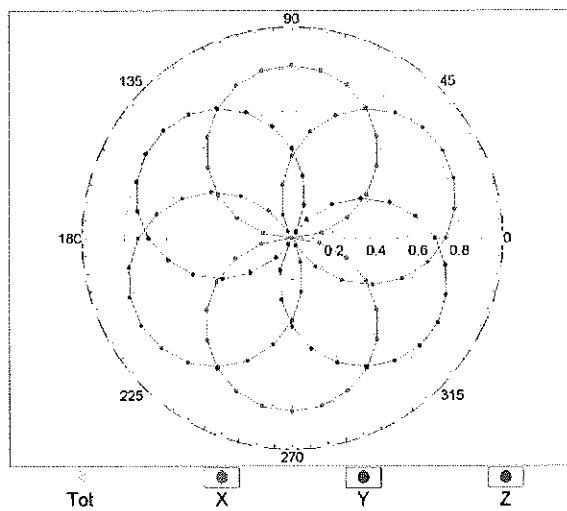
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM



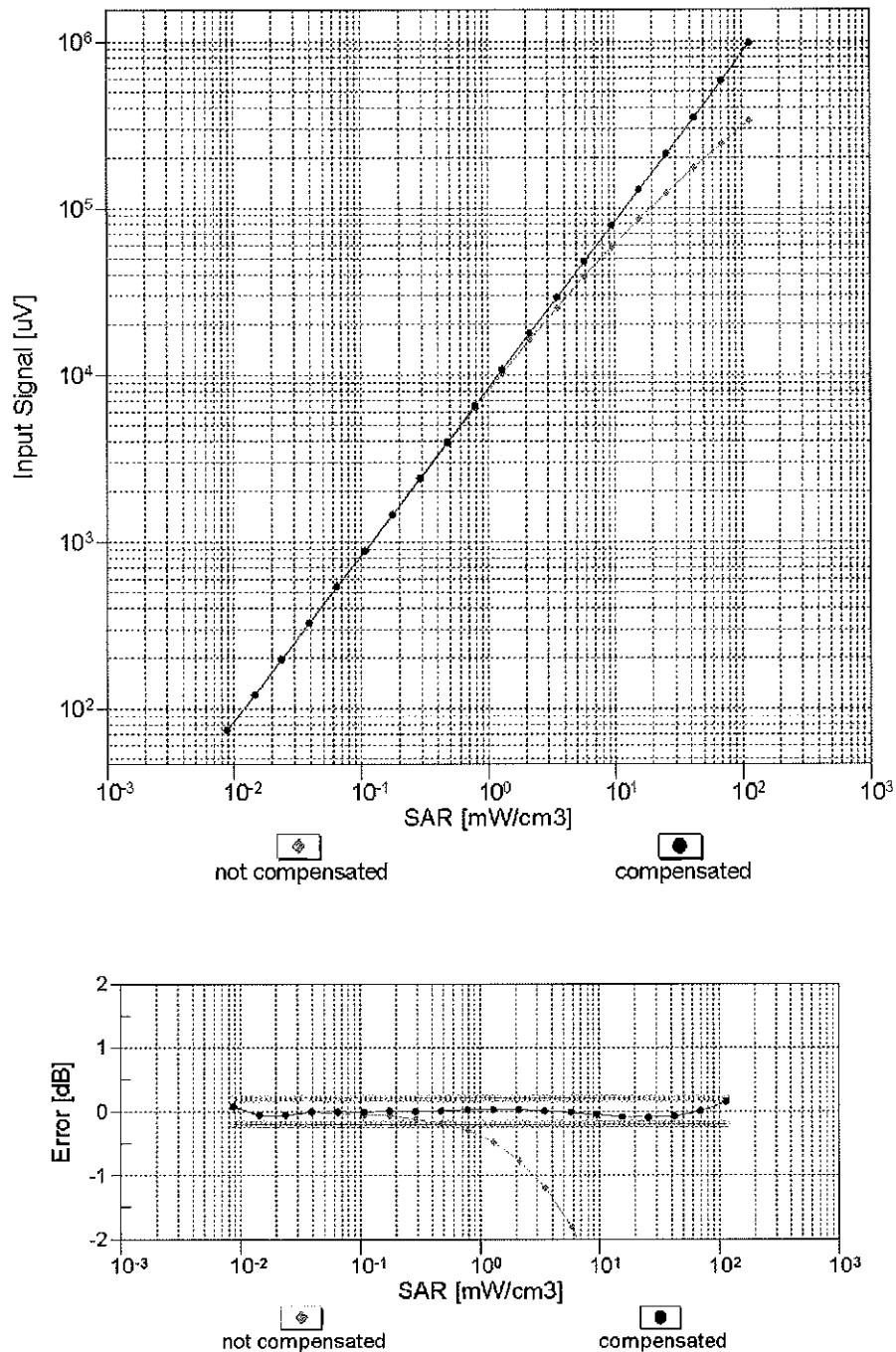
f=1800 MHz,R22



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

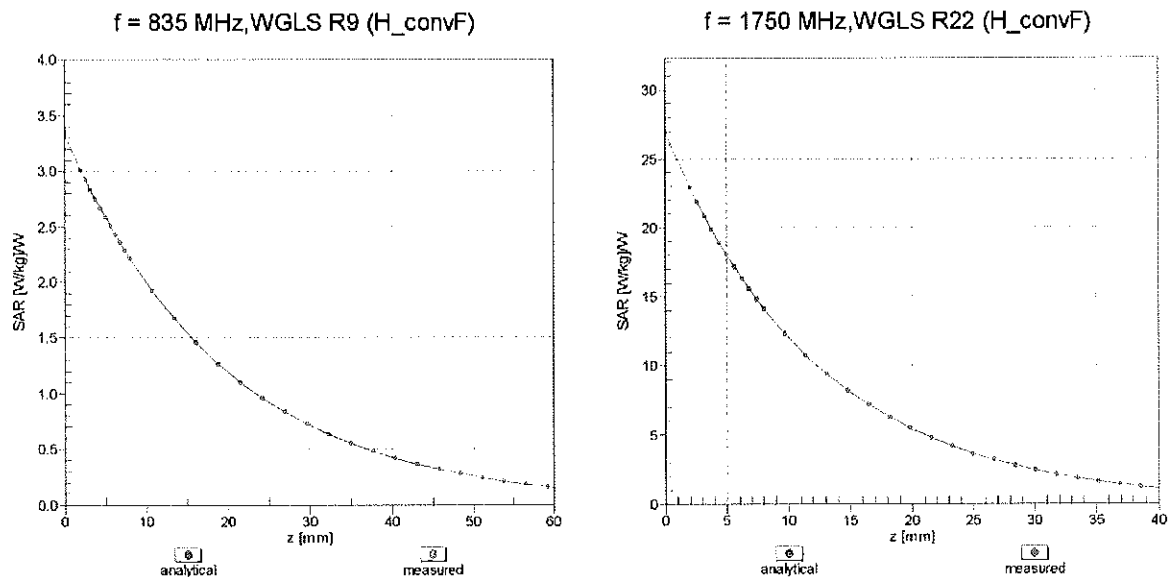
Dynamic Range f(SAR_{head})

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



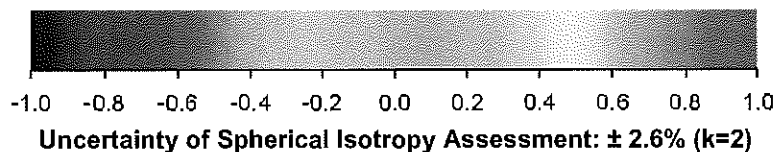
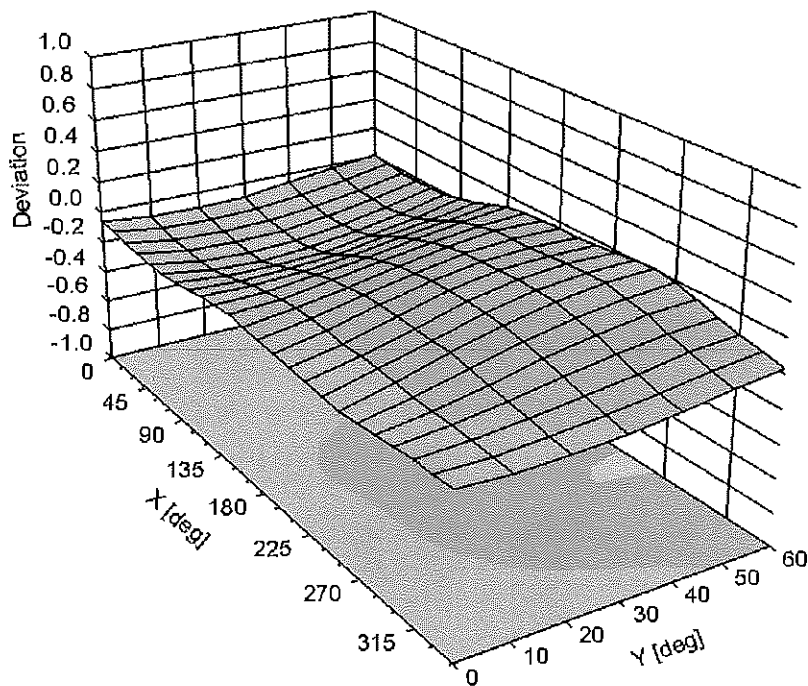
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), $f = 900 \text{ MHz}$



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

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