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SAR EVALUATION REPORT

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

Date of Testing:
11/23/15 - 11/27/15
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1511191980-R1.ZNF

FCC ID: **ZNFL52VL**

APPLICANT: **LG ELECTRONICS MOBILECOMM U.S.A., INC.**

DUT Type: Portable Handset
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): LGL52VL, LG-L52VL, L52VL

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	0.50	0.49	0.49
PCE	PCS CDMA/EVDO	1851.25 - 1908.75 MHz	0.62	0.76	0.97
PCE	LTE Band 13	779.5 - 784.5 MHz	0.38	0.49	0.49
PCE	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	0.54	1.11	1.11
PCE	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	0.66	0.93	0.93
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.78	0.16	0.16
DSS/DTS	Bluetooth	2402 - 2480 MHz	N/A		
Simultaneous SAR per KDB 690783 D01v01r03:			1.44	1.38	1.27

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

Note: This revised Test Report (S/N: 0Y1511191980-R1.ZNF) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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

Randy Ortanez
President

ACCREDITED
TESTING CERT#2041.01

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

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

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 13	Data	779.5 - 784.5 MHz
LTE Band 4 (AWS)	Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Data	1850.7 - 1909.3 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
Bluetooth	Data	2402 - 2480 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 D01v05r02.

Mode / Band		Modulated Average (dBm)
Cell. CDMA/EVDO	Maximum	**24.4**
	Nominal	**23.9**
PCS CDMA/EVDO	Maximum	**24.7**
	Nominal	**24.2**

Mode / Band		Modulated Average (dBm)
LTE Band 13	Maximum	**23.7**
	Nominal	**23.2**
LTE Band 4 (AWS)	Maximum	**23.4**
	Nominal	**22.9**
LTE Band 2 (PCS)	Maximum	**23.7**
	Nominal	**23.2**

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	**15.5**
	Nominal	**14.5**
IEEE 802.11g (2.4 GHz)	Maximum	**11.5**
	Nominal	**10.5**
IEEE 802.11n (2.4 GHz)	Maximum	**10.5**
	Nominal	**9.5**
Bluetooth	Maximum	**11.0**
	Nominal	**7.0**
Bluetooth LE	Maximum	**3.0**
	Nominal	**-1.0**

1.3 DUT Antenna Locations

The overall dimensions of this device are ≥9 x 5 cm. The overall diagonal dimension of the device is ≤160 mm and the diagonal display is ≤150 mm. A diagram showing the location of the device antennas can be found in Appendix F.

Table 1-1
Device Edges/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 13	Yes	Yes	No	Yes	Yes	Yes
LTE Band 4 (AWS)	Yes	Yes	No	Yes	No	Yes
LTE Band 2 (PCS)	Yes	Yes	No	Yes	No	Yes
2.4 GHz WLAN	Yes	Yes	Yes	No	Yes	No

Note: Particular DUT edges were not required to be evaluated for wireless router SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v02 guidance, page 2. The distances between the transmit antennas and the edges of the device are included in the filing.

1.4 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v05r02, 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.

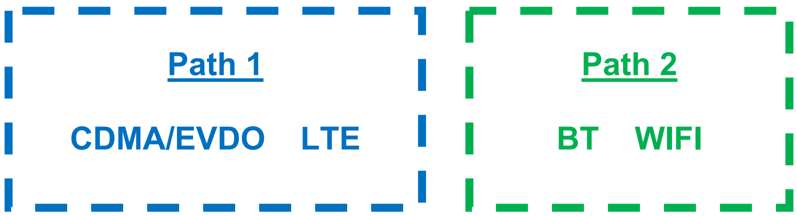

Figure 1-1
Simultaneous Transmission Paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v05r02 3) procedures.

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body-Worn Accessory	Wireless Router	Notes
1	1x CDMA voice + 2.4 GHz WI-FI	Yes	Yes	N/A	
2	1x CDMA voice + 2.4 GHz Bluetooth	N/A	Yes	N/A	
3	LTE + 2.4 GHz WI-FI	Yes*	Yes*	Yes	*-Pre-installed VOIP applications are considered.
4	LTE + 2.4 GHz Bluetooth	N/A	Yes*	N/A	*-Pre-installed VOIP applications are considered.
5	CDMA/EVDO data + 2.4 GHz WI-FI	Yes*	Yes*	Yes	*-Pre-installed VOIP applications are considered.
6	CDMA/EVDO data + 2.4 GHz Bluetooth	N/A	Yes*	N/A	*-Pre-installed VOIP applications are considered.

1. 2.4 GHz WLAN, and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously.
2. All licensed modes share the same antenna path and cannot transmit simultaneously.
3. Per the manufacturer, WIFI Direct is expected to be used in conjunction with a held-to-ear or body-worn accessory voice call. Simultaneous transmission scenarios involving WIFI direct are included in the above table.

1.5 Miscellaneous SAR Test Considerations

(A) WIFI/BT

Per FCC KDB 447498 D01v05r02, the 1g SAR exclusion threshold for distances <50mm is defined by the following equation:

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

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, body-worn Bluetooth SAR was not required; [(13/10)* √2.480] = 2.0< 3.0. Per KDB Publication 447498 D01v05r02, the maximum power of the channel was rounded to the nearest mW before calculation.

(B) Licensed Transmitter(s)

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth; and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02r03.

1.6 Power Reduction for SAR

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

1.7 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D01v03, D05v02r03, D06v02 (3G/4G and Hotspot)
- FCC KDB Publication 248227 D01v02r01 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r01 (SAR Measurements up to 6 GHz)

1.8 Device Serial Numbers

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

	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
Cell. CDMA/EVDO	02524	02516	02516
PCS CDMA/EVDO	02516	02516	02516
LTE Band 13	02516	02524	02524
LTE Band 4 (AWS)	02524	02516	02516
LTE Band 2 (PCS)	02516	02516	02516
2.4 GHz WLAN	02532	02532	02532

2 LTE INFORMATION

LTE Information			
FCC ID	**ZNFL52VL**		
Form Factor	Portable Handset		
Frequency Range of each LTE transmission band	LTE Band 13 (779.5 - 784.5 MHz)		
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)		
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)		
Channel Bandwidths	LTE Band 13: 5 MHz, 10 MHz		
	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 13: 5 MHz	779.5 (23205)	782 (23230)	784.5 (23255)
LTE Band 13: 10 MHz	N/A	782 (23230)	N/A
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)	1732.5 (20175)	1754.3 (20393)
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)	1732.5 (20175)	1753.5 (20385)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	1732.5 (20175)	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715 (20000)	1732.5 (20175)	1750 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	1732.5 (20175)	1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720 (20050)	1732.5 (20175)	1745 (20300)
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)	1880 (18900)	1909.3 (19193)
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	1880 (18900)	1908.5 (19185)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	1880 (18900)	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855 (18650)	1880 (18900)	1905 (19150)
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	1880 (18900)	1902.5 (19125)
LTE Band 2 (PCS): 20 MHz	1860 (18700)	1880 (18900)	1900 (19100)
UE Category	4		
Modulations Supported in UL	QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		

3 INTRODUCTION

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

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

3.1 SAR Definition

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

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

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

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

4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

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

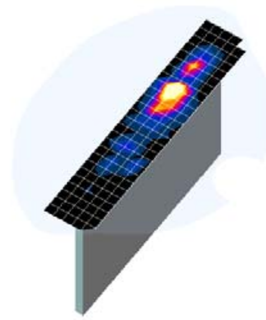

Figure 4-1 Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (See Table 4-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See Table 4-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):
   a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

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

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

*Also compliant to IEEE 1528-2013 Table 6

5 DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

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

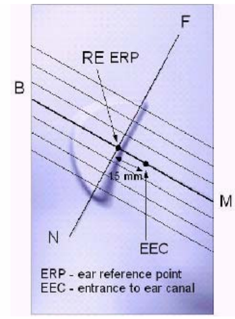

Figure 5-1
Close-Up Side view of ERP

5.2 HANDSET REFERENCE POINTS

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

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

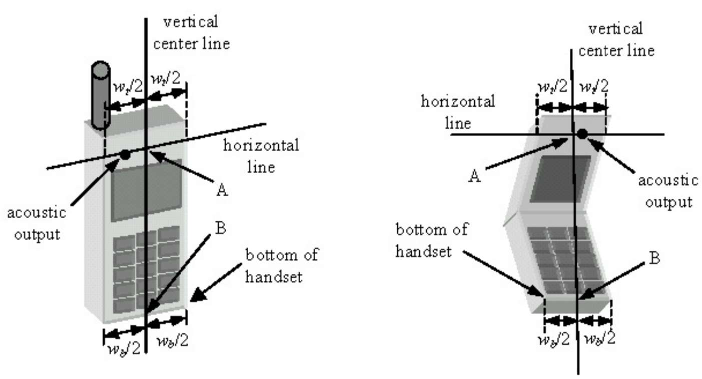

Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

6 TEST CONFIGURATION POSITIONS FOR HANDSETS

6.1 Device Holder

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

6.2 Positioning for Cheek

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

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

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

6.3 Positioning for Ear / 15º Tilt

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

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

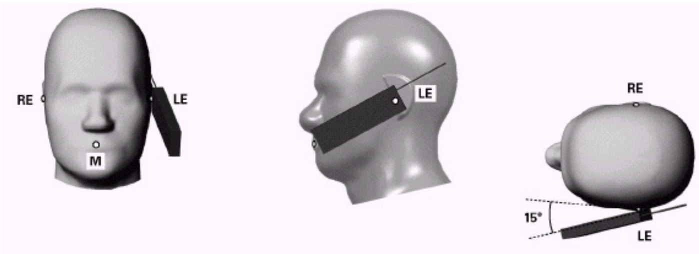

Figure 6-2 Front, Side and Top View of Ear/15º Tilt Position

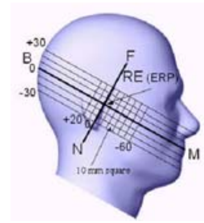

Figure 6-3
Side view w/ relevant markings

6.4 Body-Worn Accessory Configurations

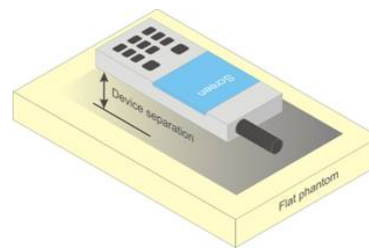

Figure 6-4
Sample Body-Worn Diagram

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 D04v01r02, 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 D01v05r02 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

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 the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D01v05r02 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D01v05r02, 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 D06v02 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v05r02 procedures. The “Portable Hotspot” feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

7 RF EXPOSURE LIMITS

7.1 Uncontrolled Environment

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

7.2 Controlled Environment

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

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

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

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

8 FCC MEASUREMENT PROCEDURES

Power measurements for licensed transmitters are performed using a base station simulator under digital average power.

8.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v05r02, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

8.2 3G SAR Test Reduction Procedure

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

8.3 Procedures Used to Establish RF Signal for SAR

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

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

8.4 SAR Measurement Conditions for CDMA2000

The following procedures were performed according to FCC KDB Publication 941225 D01v03 "3G SAR Measurement Procedures."

8.4.1 Output Power Verification

See 3GPP2 C.S0011/TIA-98-E as recommended by FCC KDB Publication 941225 D01v03 "3G SAR Measurement Procedures." 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 SCH_0 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.

Table 8-1
Parameters for Max. Power for RC1

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

Table 8-2
Parameters for Max. Power for RC3

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

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

8.4.2 Head SAR Measurements

SAR for next to the ear head exposure is measured in RC3 with the handset configured to transmit at fullrate in SO55. The 3G SAR test reduction procedure is applied to RC1 with RC3 as the primary mode; otherwise, SAR is required for the channel with maximum measured output in RC1 using the head exposure configuration that results in the highest reported SAR in RC3.

Head SAR is additionally evaluated using EVDO Rev. A to support compliance for VoIP operations. See Section 8.4.5 for EVDO Rev. A configuration parameters.

8.4.3 Body-worn SAR Measurements

SAR for body-worn 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. The 3G SAR test reduction procedure is applied to the multiple code channel configuration (FCH+SCHn), with FCH only as the primary mode. Otherwise, SAR is required for multiple code channel configuration (FCH + SCHn), with FCH at full rate and SCH0 enabled at 9600 bps, using the highest reported SAR configuration for FCH only. When multiple code channels are enabled, the transmitter output can shift by more than 0.5 dB and may lead to higher SAR drifts and SCH dropouts.

The 3G SAR test reduction procedure is applied to body-worn accessory SAR in RC1 with RC3 as the primary mode. Otherwise, SAR is required for RC1, with SO55 and full rate, using the highest reported SAR configuration for body-worn accessory exposure in RC3.

8.4.4 Body-worn SAR Measurements for EVDO Devices

For handsets with Ev-Do capabilities, the 3G SAR test reduction procedure is applied to Ev-Do Rev. 0 with 1x RTT RC3 as the primary mode to determine body-worn accessory test requirements. Otherwise, body-worn accessory SAR is required for Rev. 0, at 153.6 kbps, using the highest reported SAR configuration for body-worn accessory exposure in RC3.

The 3G SAR test reduction procedure is applied to Rev. A, with Rev. 0 as the primary mode to determine body-worn accessory SAR test requirements. When SAR is not required for Rev. 0, the 3G SAR test reduction is applied with 1x RTT RC3 as the primary mode.

When SAR is required for EVDO Rev. A, SAR is measured with a Reverse Data Channel payload size of 4096 bits and a Termination Target of 16 slots defined for Subtype 2 Physical Layer configurations, using the highest reported SAR configuration for body-worn accessory exposure in Rev. 0 or 1x RTT RC3, as appropriate.

8.4.5 Body SAR Measurements for EVDO Hotspot

Hotspot Body SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0. The 3G SAR test reduction procedure is applied to Rev. A, Subtype 2 Physical layer configuration, with Rev. 0 as the primary mode; otherwise, SAR is measured for Rev. A using the highest reported SAR configuration for body-worn accessory exposure 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.

For Ev-Do data devices that also support 1x RTT voice and/or data operations, the 3G SAR test reduction procedure is applied to 1x RTT RC3 and RC1 with Ev-Do Rev. 0 and Rev. A as the respective primary modes. Otherwise, the ‘Body-Worn Accessory SAR’ procedures in the ‘3GPP2 CDMA 2000 1x Handsets’ section are applied.

8.5 SAR Measurement Conditions for LTE

LTE modes are tested according to FCC KDB 941225 D05v02r03 publication. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 or Anritsu MT8820C simulators are used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

8.5.1 Spectrum Plots for RB Configurations

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

8.5.2 MPR

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

8.5.3 A-MPR

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

8.5.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r03:

a. Per Section 4.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
    i. The required channel and offset combination with the highest maximum output power is required for SAR.
    ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
    iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
b. Per Section 4.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 4.2.1.
c. Per Section 4.2.3, 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 4.2.4 and 4.3, 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 4.2.1 through 4.2.3 is less than or equal to ½ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is <1.45 W/kg.

8.6 SAR Testing with 802.11 Transmitters

The normal network operating configurations of 802.11 transmitters are not suitable for SAR measurements. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v02r01 for more details.

8.6.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters.

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

8.6.2 Initial Test Position Procedure

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

8.6.3 2.4 GHz SAR Test Requirements

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

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

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

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

8.6.4 OFDM Transmission Mode and SAR Test Channel Selection

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

8.6.5 Initial Test Configuration Procedure

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

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements (See Section 8.6.1).

9 RF CONDUCTED POWERS

9.1 CDMA Conducted Powers

Band	Channel	Rule Part	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	22H	824.7	24.35	24.30	24.38	24.36	24.40	24.40
	384	22H	836.52	24.30	24.28	24.35	24.31	24.33	24.35
	777	22H	848.31	24.33	24.25	24.33	24.33	24.35	24.31
PCS	25	24E	1851.25	24.55	24.51	24.52	24.51	24.55	24.58
	600	24E	1880	24.60	24.62	24.48	24.60	24.56	24.61
	1175	24E	1908.75	24.60	24.63	24.49	24.50	24.60	24.60

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

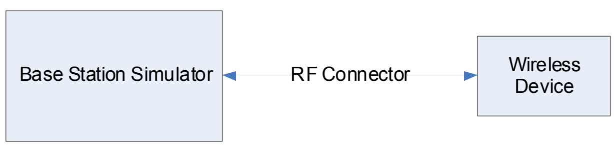

Figure 9-1
Power Measurement Setup

9.2 LTE Conducted Powers

9.2.1 LTE Band 13

Table 9-1
LTE Band 13 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	782.0	23230	10	QPSK	1	0	23.41	0	0
	782.0	23230	10	QPSK	1	25	23.30	0	0
	782.0	23230	10	QPSK	1	49	**23.63**	0	0
	782.0	23230	10	QPSK	25	0	**22.54**	0-1	1
	782.0	23230	10	QPSK	25	12	22.47	0-1	1
	782.0	23230	10	QPSK	25	25	22.54	0-1	1
	782.0	23230	10	QPSK	50	0	22.51	0-1	1
	782.0	23230	10	16QAM	1	0	22.67	0-1	1
	782.0	23230	10	16QAM	1	25	22.47	0-1	1
	782.0	23230	10	16QAM	1	49	22.49	0-1	1
	782.0	23230	10	16QAM	25	0	21.55	0-2	2
	782.0	23230	10	16QAM	25	12	21.32	0-2	2
	782.0	23230	10	16QAM	25	25	21.37	0-2	2
	782.0	23230	10	16QAM	50	0	21.41	0-2	2

Table 9-2
LTE Band 13 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]
Mid	782.0	23230	5	QPSK	1	0	23.10	0	0
	782.0	23230	5	QPSK	1	12	23.31	0	0
	782.0	23230	5	QPSK	1	24	23.30	0	0
	782.0	23230	5	QPSK	12	0	22.48	0-1	1
	782.0	23230	5	QPSK	12	6	22.49	0-1	1
	782.0	23230	5	QPSK	12	13	22.50	0-1	1
	782.0	23230	5	QPSK	25	0	22.52	0-1	1
	782.0	23230	5	16-QAM	1	0	22.10	0-1	1
	782.0	23230	5	16-QAM	1	12	21.87	0-1	1
	782.0	23230	5	16-QAM	1	24	22.02	0-1	1
	782.0	23230	5	16-QAM	12	0	21.41	0-2	2
	782.0	23230	5	16-QAM	12	6	21.32	0-2	2
	782.0	23230	5	16-QAM	12	13	21.43	0-2	2
	782.0	23230	5	16-QAM	25	0	21.69	0-2	2

Note: LTE Band 13 at 5 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

9.2.2 LTE Band 4 (AWS)

Table 9-3
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	23.23	0	0
	1732.5	20175	20	QPSK	1	50	**23.32**	0	0
	1732.5	20175	20	QPSK	1	99	23.17	0	0
	1732.5	20175	20	QPSK	50	0	**22.36**	0-1	1
	1732.5	20175	20	QPSK	50	25	22.34	0-1	1
	1732.5	20175	20	QPSK	50	50	22.26	0-1	1
	1732.5	20175	20	QPSK	100	0	22.27	0-1	1
	1732.5	20175	20	16QAM	1	0	22.02	0-1	1
	1732.5	20175	20	16QAM	1	50	22.06	0-1	1
	1732.5	20175	20	16QAM	1	99	21.97	0-1	1
	1732.5	20175	20	16QAM	50	0	21.26	0-2	2
	1732.5	20175	20	16QAM	50	25	21.32	0-2	2
	1732.5	20175	20	16QAM	50	50	21.21	0-2	2
	1732.5	20175	20	16QAM	100	0	21.35	0-2	2

Note: LTE Band 4 (AWS) at 20 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Table 9-4
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	23.00	0	0
	1717.5	20025	15	QPSK	1	36	22.80	0	0
	1717.5	20025	15	QPSK	1	74	23.05	0	0
	1717.5	20025	15	QPSK	36	0	22.14	0-1	1
	1717.5	20025	15	QPSK	36	18	22.14	0-1	1
	1717.5	20025	15	QPSK	36	37	22.25	0-1	1
	1717.5	20025	15	QPSK	75	0	22.21	0-1	1
	1717.5	20025	15	16QAM	1	0	21.82	0-1	1
	1717.5	20025	15	16QAM	1	36	21.88	0-1	1
	1717.5	20025	15	16QAM	1	74	22.02	0-1	1
	1717.5	20025	15	16QAM	36	0	21.17	0-2	2
	1717.5	20025	15	16QAM	36	18	21.14	0-2	2
	1717.5	20025	15	16QAM	36	37	21.34	0-2	2
	1717.5	20025	15	16QAM	75	0	21.22	0-2	2
Mid	1732.5	20175	15	QPSK	1	0	23.29	0	0
	1732.5	20175	15	QPSK	1	36	23.17	0	0
	1732.5	20175	15	QPSK	1	74	23.25	0	0
	1732.5	20175	15	QPSK	36	0	22.35	0-1	1
	1732.5	20175	15	QPSK	36	18	22.33	0-1	1
	1732.5	20175	15	QPSK	36	37	22.21	0-1	1
	1732.5	20175	15	QPSK	75	0	22.26	0-1	1
	1732.5	20175	15	16QAM	1	0	22.27	0-1	1
	1732.5	20175	15	16QAM	1	36	22.05	0-1	1
	1732.5	20175	15	16QAM	1	74	22.10	0-1	1
	1732.5	20175	15	16QAM	36	0	21.39	0-2	2
	1732.5	20175	15	16QAM	36	18	21.17	0-2	2
	1732.5	20175	15	16QAM	36	37	21.14	0-2	2
	1732.5	20175	15	16QAM	75	0	21.25	0-2	2
High	1747.5	20325	15	QPSK	1	0	23.25	0	0
	1747.5	20325	15	QPSK	1	36	23.09	0	0
	1747.5	20325	15	QPSK	1	74	23.15	0	0
	1747.5	20325	15	QPSK	36	0	22.26	0-1	1
	1747.5	20325	15	QPSK	36	18	22.12	0-1	1
	1747.5	20325	15	QPSK	36	37	22.12	0-1	1
	1747.5	20325	15	QPSK	75	0	22.11	0-1	1
	1747.5	20325	15	16QAM	1	0	22.00	0-1	1
	1747.5	20325	15	16QAM	1	36	21.77	0-1	1
	1747.5	20325	15	16QAM	1	74	21.84	0-1	1
	1747.5	20325	15	16QAM	36	0	21.14	0-2	2
	1747.5	20325	15	16QAM	36	18	21.10	0-2	2
	1747.5	20325	15	16QAM	36	37	21.00	0-2	2
	1747.5	20325	15	16QAM	75	0	21.17	0-2	2

Table 9-5
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	23.06	0	0
	1715	20000	10	QPSK	1	25	23.29	0	0
	1715	20000	10	QPSK	1	49	23.16	0	0
	1715	20000	10	QPSK	25	0	22.17	0-1	1
	1715	20000	10	QPSK	25	12	22.25	0-1	1
	1715	20000	10	QPSK	25	25	22.17	0-1	1
	1715	20000	10	QPSK	50	0	22.16	0-1	1
	1715	20000	10	16QAM	1	0	22.00	0-1	1
	1715	20000	10	16QAM	1	25	21.82	0-1	1
	1715	20000	10	16QAM	1	49	21.82	0-1	1
	1715	20000	10	16QAM	25	0	21.15	0-2	2
	1715	20000	10	16QAM	25	12	21.11	0-2	2
	1715	20000	10	16QAM	25	25	21.17	0-2	2
	1715	20000	10	16QAM	50	0	21.15	0-2	2
Mid	1732.5	20175	10	QPSK	1	0	23.13	0	0
	1732.5	20175	10	QPSK	1	25	23.39	0	0
	1732.5	20175	10	QPSK	1	49	23.27	0	0
	1732.5	20175	10	QPSK	25	0	22.32	0-1	1
	1732.5	20175	10	QPSK	25	12	22.39	0-1	1
	1732.5	20175	10	QPSK	25	25	22.24	0-1	1
	1732.5	20175	10	QPSK	50	0	22.31	0-1	1
	1732.5	20175	10	16QAM	1	0	22.28	0-1	1
	1732.5	20175	10	16QAM	1	25	22.10	0-1	1
	1732.5	20175	10	16QAM	1	49	21.99	0-1	1
	1732.5	20175	10	16QAM	25	0	21.35	0-2	2
	1732.5	20175	10	16QAM	25	12	21.24	0-2	2
	1732.5	20175	10	16QAM	25	25	21.23	0-2	2
	1732.5	20175	10	16QAM	50	0	21.35	0-2	2
High	1750	20350	10	QPSK	1	0	23.19	0	0
	1750	20350	10	QPSK	1	25	23.36	0	0
	1750	20350	10	QPSK	1	49	23.34	0	0
	1750	20350	10	QPSK	25	0	22.23	0-1	1
	1750	20350	10	QPSK	25	12	22.23	0-1	1
	1750	20350	10	QPSK	25	25	22.12	0-1	1
	1750	20350	10	QPSK	50	0	22.18	0-1	1
	1750	20350	10	16QAM	1	0	22.18	0-1	1
	1750	20350	10	16QAM	1	25	22.23	0-1	1
	1750	20350	10	16QAM	1	49	22.14	0-1	1
	1750	20350	10	16QAM	25	0	21.40	0-2	2
	1750	20350	10	16QAM	25	12	21.33	0-2	2
	1750	20350	10	16QAM	25	25	21.10	0-2	2
	1750	20350	10	16QAM	50	0	21.14	0-2	2

Table 9-6
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	22.88	0	0
	1712.5	19975	5	QPSK	1	12	22.99	0	0
	1712.5	19975	5	QPSK	1	24	22.81	0	0
	1712.5	19975	5	QPSK	12	0	22.15	0-1	1
	1712.5	19975	5	QPSK	12	6	22.05	0-1	1
	1712.5	19975	5	QPSK	12	13	22.09	0-1	1
	1712.5	19975	5	QPSK	25	0	22.09	0-1	1
	1712.5	19975	5	16-QAM	1	0	22.02	0-1	1
	1712.5	19975	5	16-QAM	1	12	21.98	0-1	1
	1712.5	19975	5	16-QAM	1	24	22.00	0-1	1
	1712.5	19975	5	16-QAM	12	0	20.87	0-2	2
	1712.5	19975	5	16-QAM	12	6	20.98	0-2	2
	1712.5	19975	5	16-QAM	12	13	20.95	0-2	2
	1712.5	19975	5	16-QAM	25	0	21.00	0-2	2
Mid	1732.5	20175	5	QPSK	1	0	23.08	0	0
	1732.5	20175	5	QPSK	1	12	23.30	0	0
	1732.5	20175	5	QPSK	1	24	23.13	0	0
	1732.5	20175	5	QPSK	12	0	22.28	0-1	1
	1732.5	20175	5	QPSK	12	6	22.25	0-1	1
	1732.5	20175	5	QPSK	12	13	22.21	0-1	1
	1732.5	20175	5	QPSK	25	0	22.32	0-1	1
	1732.5	20175	5	16-QAM	1	0	21.64	0-1	1
	1732.5	20175	5	16-QAM	1	12	21.80	0-1	1
	1732.5	20175	5	16-QAM	1	24	21.90	0-1	1
	1732.5	20175	5	16-QAM	12	0	20.94	0-2	2
	1732.5	20175	5	16-QAM	12	6	20.93	0-2	2
	1732.5	20175	5	16-QAM	12	13	20.95	0-2	2
	1732.5	20175	5	16-QAM	25	0	21.10	0-2	2
High	1752.5	20375	5	QPSK	1	0	23.07	0	0
	1752.5	20375	5	QPSK	1	12	23.09	0	0
	1752.5	20375	5	QPSK	1	24	23.01	0	0
	1752.5	20375	5	QPSK	12	0	22.12	0-1	1
	1752.5	20375	5	QPSK	12	6	22.12	0-1	1
	1752.5	20375	5	QPSK	12	13	22.16	0-1	1
	1752.5	20375	5	QPSK	25	0	22.06	0-1	1
	1752.5	20375	5	16-QAM	1	0	22.15	0-1	1
	1752.5	20375	5	16-QAM	1	12	21.82	0-1	1
	1752.5	20375	5	16-QAM	1	24	22.07	0-1	1
	1752.5	20375	5	16-QAM	12	0	21.04	0-2	2
	1752.5	20375	5	16-QAM	12	6	21.06	0-2	2
	1752.5	20375	5	16-QAM	12	13	21.07	0-2	2
	1752.5	20375	5	16-QAM	25	0	21.23	0-2	2

Table 9-7
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	22.92	0	0
	1711.5	19965	3	QPSK	1	7	23.16	0	0
	1711.5	19965	3	QPSK	1	14	22.90	0	0
	1711.5	19965	3	QPSK	8	0	22.00	0-1	1
	1711.5	19965	3	QPSK	8	4	21.99	0-1	1
	1711.5	19965	3	QPSK	8	7	21.97	0-1	1
	1711.5	19965	3	QPSK	15	0	21.99	0-1	1
	1711.5	19965	3	16-QAM	1	0	22.18	0-1	1
	1711.5	19965	3	16-QAM	1	7	22.35	0-1	1
	1711.5	19965	3	16-QAM	1	14	22.10	0-1	1
	1711.5	19965	3	16-QAM	8	0	21.02	0-2	2
	1711.5	19965	3	16-QAM	8	4	20.83	0-2	2
	1711.5	19965	3	16-QAM	8	7	20.77	0-2	2
	1711.5	19965	3	16-QAM	15	0	21.01	0-2	2
Mid	1732.5	20175	3	QPSK	1	0	23.21	0	0
	1732.5	20175	3	QPSK	1	7	23.39	0	0
	1732.5	20175	3	QPSK	1	14	23.38	0	0
	1732.5	20175	3	QPSK	8	0	22.34	0-1	1
	1732.5	20175	3	QPSK	8	4	22.25	0-1	1
	1732.5	20175	3	QPSK	8	7	22.19	0-1	1
	1732.5	20175	3	QPSK	15	0	22.28	0-1	1
	1732.5	20175	3	16-QAM	1	0	21.93	0-1	1
	1732.5	20175	3	16-QAM	1	7	21.94	0-1	1
	1732.5	20175	3	16-QAM	1	14	22.02	0-1	1
	1732.5	20175	3	16-QAM	8	0	21.10	0-2	2
	1732.5	20175	3	16-QAM	8	4	21.10	0-2	2
	1732.5	20175	3	16-QAM	8	7	21.01	0-2	2
	1732.5	20175	3	16-QAM	15	0	21.35	0-2	2
High	1753.5	20385	3	QPSK	1	0	23.35	0	0
	1753.5	20385	3	QPSK	1	7	23.35	0	0
	1753.5	20385	3	QPSK	1	14	23.29	0	0
	1753.5	20385	3	QPSK	8	0	22.24	0-1	1
	1753.5	20385	3	QPSK	8	4	22.22	0-1	1
	1753.5	20385	3	QPSK	8	7	22.11	0-1	1
	1753.5	20385	3	QPSK	15	0	22.14	0-1	1
	1753.5	20385	3	16-QAM	1	0	22.07	0-1	1
	1753.5	20385	3	16-QAM	1	7	22.19	0-1	1
	1753.5	20385	3	16-QAM	1	14	22.15	0-1	1
	1753.5	20385	3	16-QAM	8	0	21.16	0-2	2
	1753.5	20385	3	16-QAM	8	4	21.06	0-2	2
	1753.5	20385	3	16-QAM	8	7	21.06	0-2	2
	1753.5	20385	3	16-QAM	15	0	21.11	0-2	2

Table 9-8
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	22.79	0	0
	1710.7	19957	1.4	QPSK	1	2	22.88	0	0
	1710.7	19957	1.4	QPSK	1	5	22.78	0	0
	1710.7	19957	1.4	QPSK	3	0	22.98	0	0
	1710.7	19957	1.4	QPSK	3	2	23.12	0	0
	1710.7	19957	1.4	QPSK	3	3	23.06	0	0
	1710.7	19957	1.4	QPSK	6	0	22.04	0-1	1
	1710.7	19957	1.4	16-QAM	1	0	22.25	0-1	1
	1710.7	19957	1.4	16-QAM	1	2	22.28	0-1	1
	1710.7	19957	1.4	16-QAM	1	5	22.18	0-1	1
	1710.7	19957	1.4	16-QAM	3	0	21.44	0-1	1
	1710.7	19957	1.4	16-QAM	3	2	21.67	0-1	1
	1710.7	19957	1.4	16-QAM	3	3	21.52	0-1	1
	1710.7	19957	1.4	16-QAM	6	0	20.76	0-2	2
Mid	1732.5	20175	1.4	QPSK	1	0	23.11	0	0
	1732.5	20175	1.4	QPSK	1	2	23.34	0	0
	1732.5	20175	1.4	QPSK	1	5	23.33	0	0
	1732.5	20175	1.4	QPSK	3	0	23.19	0	0
	1732.5	20175	1.4	QPSK	3	2	23.28	0	0
	1732.5	20175	1.4	QPSK	3	3	23.19	0	0
	1732.5	20175	1.4	QPSK	6	0	22.26	0-1	1
	1732.5	20175	1.4	16-QAM	1	0	22.13	0-1	1
	1732.5	20175	1.4	16-QAM	1	2	22.26	0-1	1
	1732.5	20175	1.4	16-QAM	1	5	22.19	0-1	1
	1732.5	20175	1.4	16-QAM	3	0	21.94	0-1	1
	1732.5	20175	1.4	16-QAM	3	2	21.83	0-1	1
	1732.5	20175	1.4	16-QAM	3	3	21.67	0-1	1
	1732.5	20175	1.4	16-QAM	6	0	21.22	0-2	2
High	1754.3	20393	1.4	QPSK	1	0	23.22	0	0
	1754.3	20393	1.4	QPSK	1	2	23.13	0	0
	1754.3	20393	1.4	QPSK	1	5	23.13	0	0
	1754.3	20393	1.4	QPSK	3	0	23.10	0	0
	1754.3	20393	1.4	QPSK	3	2	23.19	0	0
	1754.3	20393	1.4	QPSK	3	3	23.11	0	0
	1754.3	20393	1.4	QPSK	6	0	22.02	0-1	1
	1754.3	20393	1.4	16-QAM	1	0	22.26	0-1	1
	1754.3	20393	1.4	16-QAM	1	2	22.32	0-1	1
	1754.3	20393	1.4	16-QAM	1	5	22.30	0-1	1
	1754.3	20393	1.4	16-QAM	3	0	21.94	0-1	1
	1754.3	20393	1.4	16-QAM	3	2	21.96	0-1	1
	1754.3	20393	1.4	16-QAM	3	3	22.04	0-1	1
	1754.3	20393	1.4	16-QAM	6	0	21.06	0-2	2

9.2.3 LTE Band 2 (PCS)

Table 9-9
LTE Band 2 (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	18700	20	QPSK	1	0	23.30	0	0
	1860	18700	20	QPSK	1	50	23.51	0	0
	1860	18700	20	QPSK	1	99	23.48	0	0
	1860	18700	20	QPSK	50	0	22.36	0-1	1
	1860	18700	20	QPSK	50	25	22.25	0-1	1
	1860	18700	20	QPSK	50	50	22.35	0-1	1
	1860	18700	20	QPSK	100	0	22.19	0-1	1
	1860	18700	20	16QAM	1	0	22.43	0-1	1
	1860	18700	20	16QAM	1	50	22.63	0-1	1
	1860	18700	20	16QAM	1	99	22.69	0-1	1
	1860	18700	20	16QAM	50	0	21.31	0-2	2
	1860	18700	20	16QAM	50	25	21.20	0-2	2
	1860	18700	20	16QAM	50	50	21.27	0-2	2
	1860	18700	20	16QAM	100	0	21.14	0-2	2
Mid	1880.0	18900	20	QPSK	1	0	23.43	0	0
	1880.0	18900	20	QPSK	1	50	23.39	0	0
	1880.0	18900	20	QPSK	1	99	**23.68**	0	0
	1880.0	18900	20	QPSK	50	0	22.51	0-1	1
	1880.0	18900	20	QPSK	50	25	22.41	0-1	1
	1880.0	18900	20	QPSK	50	50	22.38	0-1	1
	1880.0	18900	20	QPSK	100	0	22.40	0-1	1
	1880.0	18900	20	16QAM	1	0	22.13	0-1	1
	1880.0	18900	20	16QAM	1	50	22.57	0-1	1
	1880.0	18900	20	16QAM	1	99	22.70	0-1	1
	1880.0	18900	20	16QAM	50	0	21.47	0-2	2
	1880.0	18900	20	16QAM	50	25	21.29	0-2	2
	1880.0	18900	20	16QAM	50	50	21.34	0-2	2
	1880.0	18900	20	16QAM	100	0	21.37	0-2	2
High	1900	19100	20	QPSK	1	0	23.54	0	0
	1900	19100	20	QPSK	1	50	23.57	0	0
	1900	19100	20	QPSK	1	99	23.36	0	0
	1900	19100	20	QPSK	50	0	**22.53**	0-1	1
	1900	19100	20	QPSK	50	25	22.44	0-1	1
	1900	19100	20	QPSK	50	50	22.34	0-1	1
	1900	19100	20	QPSK	100	0	22.39	0-1	1
	1900	19100	20	16QAM	1	0	22.28	0-1	1
	1900	19100	20	16QAM	1	50	22.51	0-1	1
	1900	19100	20	16QAM	1	99	22.52	0-1	1
	1900	19100	20	16QAM	50	0	21.37	0-2	2
	1900	19100	20	16QAM	50	25	21.29	0-2	2
	1900	19100	20	16QAM	50	50	21.31	0-2	2
	1900	19100	20	16QAM	100	0	21.47	0-2	2

Table 9-10
LTE Band 2 (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	18675	15	QPSK	1	0	23.25	0	0
	1857.5	18675	15	QPSK	1	36	23.15	0	0
	1857.5	18675	15	QPSK	1	74	23.18	0	0
	1857.5	18675	15	QPSK	36	0	22.30	0-1	1
	1857.5	18675	15	QPSK	36	18	22.21	0-1	1
	1857.5	18675	15	QPSK	36	37	22.21	0-1	1
	1857.5	18675	15	QPSK	75	0	22.19	0-1	1
	1857.5	18675	15	16QAM	1	0	22.65	0-1	1
	1857.5	18675	15	16QAM	1	36	22.64	0-1	1
	1857.5	18675	15	16QAM	1	74	22.30	0-1	1
	1857.5	18675	15	16QAM	36	0	21.30	0-2	2
	1857.5	18675	15	16QAM	36	18	21.22	0-2	2
	1857.5	18675	15	16QAM	36	37	21.24	0-2	2
	1857.5	18675	15	16QAM	75	0	21.11	0-2	2
Mid	1880.0	18900	15	QPSK	1	0	23.44	0	0
	1880.0	18900	15	QPSK	1	36	23.39	0	0
	1880.0	18900	15	QPSK	1	74	23.50	0	0
	1880.0	18900	15	QPSK	36	0	22.44	0-1	1
	1880.0	18900	15	QPSK	36	18	22.42	0-1	1
	1880.0	18900	15	QPSK	36	37	22.48	0-1	1
	1880.0	18900	15	QPSK	75	0	22.40	0-1	1
	1880.0	18900	15	16QAM	1	0	22.61	0-1	1
	1880.0	18900	15	16QAM	1	36	22.40	0-1	1
	1880.0	18900	15	16QAM	1	74	22.55	0-1	1
	1880.0	18900	15	16QAM	36	0	21.26	0-2	2
	1880.0	18900	15	16QAM	36	18	21.23	0-2	2
	1880.0	18900	15	16QAM	36	37	21.13	0-2	2
	1880.0	18900	15	16QAM	75	0	21.22	0-2	2
High	1902.5	19125	15	QPSK	1	0	23.60	0	0
	1902.5	19125	15	QPSK	1	36	23.12	0	0
	1902.5	19125	15	QPSK	1	74	23.40	0	0
	1902.5	19125	15	QPSK	36	0	22.50	0-1	1
	1902.5	19125	15	QPSK	36	18	22.24	0-1	1
	1902.5	19125	15	QPSK	36	37	22.30	0-1	1
	1902.5	19125	15	QPSK	75	0	22.34	0-1	1
	1902.5	19125	15	16QAM	1	0	22.58	0-1	1
	1902.5	19125	15	16QAM	1	36	22.31	0-1	1
	1902.5	19125	15	16QAM	1	74	22.42	0-1	1
	1902.5	19125	15	16QAM	36	0	21.31	0-2	2
	1902.5	19125	15	16QAM	36	18	21.25	0-2	2
	1902.5	19125	15	16QAM	36	37	21.31	0-2	2
	1902.5	19125	15	16QAM	75	0	21.26	0-2	2

Table 9-11
LTE Band 2 (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	18650	10	QPSK	1	0	23.13	0	0
	1855	18650	10	QPSK	1	25	23.52	0	0
	1855	18650	10	QPSK	1	49	23.29	0	0
	1855	18650	10	QPSK	25	0	22.27	0-1	1
	1855	18650	10	QPSK	25	12	22.21	0-1	1
	1855	18650	10	QPSK	25	25	22.22	0-1	1
	1855	18650	10	QPSK	50	0	22.30	0-1	1
	1855	18650	10	16QAM	1	0	22.11	0-1	1
	1855	18650	10	16QAM	1	25	22.67	0-1	1
	1855	18650	10	16QAM	1	49	22.58	0-1	1
	1855	18650	10	16QAM	25	0	21.18	0-2	2
	1855	18650	10	16QAM	25	12	21.12	0-2	2
	1855	18650	10	16QAM	25	25	21.13	0-2	2
	1855	18650	10	16QAM	50	0	21.22	0-2	2
Mid	1880.0	18900	10	QPSK	1	0	23.53	0	0
	1880.0	18900	10	QPSK	1	25	23.54	0	0
	1880.0	18900	10	QPSK	1	49	23.67	0	0
	1880.0	18900	10	QPSK	25	0	22.45	0-1	1
	1880.0	18900	10	QPSK	25	12	22.55	0-1	1
	1880.0	18900	10	QPSK	25	25	22.49	0-1	1
	1880.0	18900	10	QPSK	50	0	22.44	0-1	1
	1880.0	18900	10	16QAM	1	0	21.91	0-1	1
	1880.0	18900	10	16QAM	1	25	22.34	0-1	1
	1880.0	18900	10	16QAM	1	49	22.05	0-1	1
	1880.0	18900	10	16QAM	25	0	21.45	0-2	2
	1880.0	18900	10	16QAM	25	12	21.63	0-2	2
	1880.0	18900	10	16QAM	25	25	21.59	0-2	2
	1880.0	18900	10	16QAM	50	0	21.41	0-2	2
High	1905	19150	10	QPSK	1	0	23.62	0	0
	1905	19150	10	QPSK	1	25	23.61	0	0
	1905	19150	10	QPSK	1	49	23.50	0	0
	1905	19150	10	QPSK	25	0	22.28	0-1	1
	1905	19150	10	QPSK	25	12	22.39	0-1	1
	1905	19150	10	QPSK	25	25	22.31	0-1	1
	1905	19150	10	QPSK	50	0	22.33	0-1	1
	1905	19150	10	16QAM	1	0	22.32	0-1	1
	1905	19150	10	16QAM	1	25	22.62	0-1	1
	1905	19150	10	16QAM	1	49	22.48	0-1	1
	1905	19150	10	16QAM	25	0	21.36	0-2	2
	1905	19150	10	16QAM	25	12	21.38	0-2	2
	1905	19150	10	16QAM	25	25	21.42	0-2	2
	1905	19150	10	16QAM	50	0	21.28	0-2	2

Table 9-12
LTE Band 2 (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	18625	5	QPSK	1	0	23.30	0	0
	1852.5	18625	5	QPSK	1	12	23.30	0	0
	1852.5	18625	5	QPSK	1	24	23.16	0	0
	1852.5	18625	5	QPSK	12	0	22.19	0-1	1
	1852.5	18625	5	QPSK	12	6	22.23	0-1	1
	1852.5	18625	5	QPSK	12	13	22.16	0-1	1
	1852.5	18625	5	QPSK	25	0	22.16	0-1	1
	1852.5	18625	5	16-QAM	1	0	21.89	0-1	1
	1852.5	18625	5	16-QAM	1	12	22.56	0-1	1
	1852.5	18625	5	16-QAM	1	24	22.35	0-1	1
	1852.5	18625	5	16-QAM	12	0	21.11	0-2	2
	1852.5	18625	5	16-QAM	12	6	20.90	0-2	2
	1852.5	18625	5	16-QAM	12	13	20.83	0-2	2
	1852.5	18625	5	16-QAM	25	0	21.08	0-2	2
Mid	1880.0	18900	5	QPSK	1	0	23.18	0	0
	1880.0	18900	5	QPSK	1	12	23.10	0	0
	1880.0	18900	5	QPSK	1	24	23.28	0	0
	1880.0	18900	5	QPSK	12	0	22.30	0-1	1
	1880.0	18900	5	QPSK	12	6	22.28	0-1	1
	1880.0	18900	5	QPSK	12	13	22.41	0-1	1
	1880.0	18900	5	QPSK	25	0	22.36	0-1	1
	1880.0	18900	5	16-QAM	1	0	22.02	0-1	1
	1880.0	18900	5	16-QAM	1	12	22.10	0-1	1
	1880.0	18900	5	16-QAM	1	24	22.34	0-1	1
	1880.0	18900	5	16-QAM	12	0	21.28	0-2	2
	1880.0	18900	5	16-QAM	12	6	21.26	0-2	2
	1880.0	18900	5	16-QAM	12	13	21.39	0-2	2
	1880.0	18900	5	16-QAM	25	0	21.37	0-2	2
High	1907.5	19175	5	QPSK	1	0	23.57	0	0
	1907.5	19175	5	QPSK	1	12	23.36	0	0
	1907.5	19175	5	QPSK	1	24	23.33	0	0
	1907.5	19175	5	QPSK	12	0	22.27	0-1	1
	1907.5	19175	5	QPSK	12	6	22.30	0-1	1
	1907.5	19175	5	QPSK	12	13	22.36	0-1	1
	1907.5	19175	5	QPSK	25	0	22.27	0-1	1
	1907.5	19175	5	16-QAM	1	0	21.92	0-1	1
	1907.5	19175	5	16-QAM	1	12	22.24	0-1	1
	1907.5	19175	5	16-QAM	1	24	22.29	0-1	1
	1907.5	19175	5	16-QAM	12	0	21.21	0-2	2
	1907.5	19175	5	16-QAM	12	6	21.16	0-2	2
	1907.5	19175	5	16-QAM	12	13	21.10	0-2	2
	1907.5	19175	5	16-QAM	25	0	21.25	0-2	2

Table 9-13
LTE Band 2 (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	18615	3	QPSK	1	0	23.15	0	0
	1851.5	18615	3	QPSK	1	7	23.48	0	0
	1851.5	18615	3	QPSK	1	14	22.81	0	0
	1851.5	18615	3	QPSK	8	0	22.19	0-1	1
	1851.5	18615	3	QPSK	8	4	22.19	0-1	1
	1851.5	18615	3	QPSK	8	7	22.26	0-1	1
	1851.5	18615	3	QPSK	15	0	22.18	0-1	1
	1851.5	18615	3	16-QAM	1	0	22.50	0-1	1
	1851.5	18615	3	16-QAM	1	7	22.52	0-1	1
	1851.5	18615	3	16-QAM	1	14	22.53	0-1	1
	1851.5	18615	3	16-QAM	8	0	21.35	0-2	2
	1851.5	18615	3	16-QAM	8	4	21.37	0-2	2
	1851.5	18615	3	16-QAM	8	7	21.32	0-2	2
	1851.5	18615	3	16-QAM	15	0	21.21	0-2	2
Mid	1880.0	18900	3	QPSK	1	0	23.14	0	0
	1880.0	18900	3	QPSK	1	7	23.31	0	0
	1880.0	18900	3	QPSK	1	14	23.43	0	0
	1880.0	18900	3	QPSK	8	0	22.31	0-1	1
	1880.0	18900	3	QPSK	8	4	22.32	0-1	1
	1880.0	18900	3	QPSK	8	7	22.36	0-1	1
	1880.0	18900	3	QPSK	15	0	22.39	0-1	1
	1880.0	18900	3	16-QAM	1	0	22.15	0-1	1
	1880.0	18900	3	16-QAM	1	7	21.85	0-1	1
	1880.0	18900	3	16-QAM	1	14	21.95	0-1	1
	1880.0	18900	3	16-QAM	8	0	21.38	0-2	2
	1880.0	18900	3	16-QAM	8	4	21.34	0-2	2
	1880.0	18900	3	16-QAM	8	7	21.38	0-2	2
	1880.0	18900	3	16-QAM	15	0	21.32	0-2	2
High	1908.5	19185	3	QPSK	1	0	23.47	0	0
	1908.5	19185	3	QPSK	1	7	23.48	0	0
	1908.5	19185	3	QPSK	1	14	23.45	0	0
	1908.5	19185	3	QPSK	8	0	22.19	0-1	1
	1908.5	19185	3	QPSK	8	4	22.22	0-1	1
	1908.5	19185	3	QPSK	8	7	22.25	0-1	1
	1908.5	19185	3	QPSK	15	0	22.24	0-1	1
	1908.5	19185	3	16-QAM	1	0	22.39	0-1	1
	1908.5	19185	3	16-QAM	1	7	22.28	0-1	1
	1908.5	19185	3	16-QAM	1	14	22.32	0-1	1
	1908.5	19185	3	16-QAM	8	0	21.21	0-2	2
	1908.5	19185	3	16-QAM	8	4	21.26	0-2	2
	1908.5	19185	3	16-QAM	8	7	21.30	0-2	2
	1908.5	19185	3	16-QAM	15	0	21.12	0-2	2

Table 9-14
LTE Band 2 (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	18607	1.4	QPSK	1	0	23.29	0	0
	1850.7	18607	1.4	QPSK	1	2	23.33	0	0
	1850.7	18607	1.4	QPSK	1	5	23.35	0	0
	1850.7	18607	1.4	QPSK	3	0	23.11	0	0
	1850.7	18607	1.4	QPSK	3	2	23.20	0	0
	1850.7	18607	1.4	QPSK	3	3	23.17	0	0
	1850.7	18607	1.4	QPSK	6	0	22.20	0-1	1
	1850.7	18607	1.4	16-QAM	1	0	22.61	0-1	1
	1850.7	18607	1.4	16-QAM	1	2	22.62	0-1	1
	1850.7	18607	1.4	16-QAM	1	5	22.56	0-1	1
	1850.7	18607	1.4	16-QAM	3	0	22.14	0-1	1
	1850.7	18607	1.4	16-QAM	3	2	22.21	0-1	1
	1850.7	18607	1.4	16-QAM	3	3	21.92	0-1	1
	1850.7	18607	1.4	16-QAM	6	0	20.90	0-2	2
Mid	1880.0	18900	1.4	QPSK	1	0	23.70	0	0
	1880.0	18900	1.4	QPSK	1	2	23.28	0	0
	1880.0	18900	1.4	QPSK	1	5	23.30	0	0
	1880.0	18900	1.4	QPSK	3	0	23.34	0	0
	1880.0	18900	1.4	QPSK	3	2	23.34	0	0
	1880.0	18900	1.4	QPSK	3	3	23.30	0	0
	1880.0	18900	1.4	QPSK	6	0	22.42	0-1	1
	1880.0	18900	1.4	16-QAM	1	0	22.55	0-1	1
	1880.0	18900	1.4	16-QAM	1	2	22.61	0-1	1
	1880.0	18900	1.4	16-QAM	1	5	22.53	0-1	1
	1880.0	18900	1.4	16-QAM	3	0	22.26	0-1	1
	1880.0	18900	1.4	16-QAM	3	2	22.23	0-1	1
	1880.0	18900	1.4	16-QAM	3	3	22.15	0-1	1
	1880.0	18900	1.4	16-QAM	6	0	21.34	0-2	2
High	1909.3	19193	1.4	QPSK	1	0	23.21	0	0
	1909.3	19193	1.4	QPSK	1	2	23.31	0	0
	1909.3	19193	1.4	QPSK	1	5	23.27	0	0
	1909.3	19193	1.4	QPSK	3	0	23.27	0	0
	1909.3	19193	1.4	QPSK	3	2	23.33	0	0
	1909.3	19193	1.4	QPSK	3	3	23.35	0	0
	1909.3	19193	1.4	QPSK	6	0	22.29	0-1	1
	1909.3	19193	1.4	16-QAM	1	0	22.61	0-1	1
	1909.3	19193	1.4	16-QAM	1	2	22.55	0-1	1
	1909.3	19193	1.4	16-QAM	1	5	22.63	0-1	1
	1909.3	19193	1.4	16-QAM	3	0	22.41	0-1	1
	1909.3	19193	1.4	16-QAM	3	2	22.41	0-1	1
	1909.3	19193	1.4	16-QAM	3	3	22.45	0-1	1
	1909.3	19193	1.4	16-QAM	6	0	21.28	0-2	2

9.3 WLAN Conducted Powers

Table 9-15
2.4 GHz Average RF Power

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11b	802.11g
2412	1	15.15	11.16
2437	**6**	**15.46**	11.38
2462	11	15.30	11.37

Justification for test configurations for WLAN per KDB Publication 248227 D01v02r01:

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

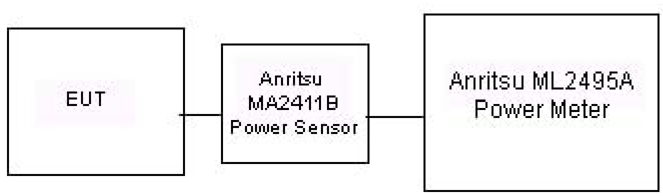

Figure 9-2
Power Measurement Setup for Bandwidths

10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C°)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
11/27/2015	750H	19.6	725	0.883	42.335	0.891	42.071	-0.90%	0.63%
			740	0.897	42.135	0.893	41.994	0.45%	0.34%
			755	0.911	41.987	0.894	41.916	1.90%	0.17%
			770	0.926	41.858	0.895	41.838	3.46%	0.05%
			785	0.940	41.689	0.896	41.760	4.91%	-0.17%
11/23/2015	835H	21.1	820	0.918	42.247	0.899	41.578	2.11%	1.61%
			835	0.935	42.065	0.900	41.500	3.89%	1.36%
			850	0.951	41.879	0.916	41.500	3.82%	0.91%
11/23/2015	1750H	20.8	1710	1.285	39.721	1.348	40.142	-4.67%	-1.05%
			1750	1.331	39.496	1.371	40.079	-2.92%	-1.45%
			1790	1.366	39.382	1.394	40.016	-2.01%	-1.58%
11/23/2015	1900H	22.7	1850	1.382	38.507	1.400	40.000	-1.29%	-3.73%
			1880	1.410	38.299	1.400	40.000	0.71%	-4.25%
			1910	1.443	38.179	1.400	40.000	3.07%	-4.55%
11/23/2015	2450H	23.7	2400	1.819	39.524	1.756	39.289	3.59%	0.60%
			2450	1.879	39.335	1.800	39.200	4.39%	0.34%
			2500	1.939	39.118	1.855	39.136	4.53%	-0.05%
11/23/2015	750B	23.7	725	0.933	53.961	0.961	55.629	-2.91%	-3.00%
			740	0.945	53.763	0.963	55.570	-1.87%	-3.25%
			755	0.958	53.520	0.964	55.512	-0.62%	-3.59%
			770	0.972	53.311	0.965	55.453	0.73%	-3.86%
			785	0.986	53.157	0.966	55.395	2.07%	-4.04%
11/24/2015	835B	20.3	820	0.974	54.187	0.969	55.258	0.52%	-1.94%
			835	0.989	54.008	0.970	55.200	1.96%	-2.16%
			850	1.004	53.823	0.988	55.154	1.62%	-2.41%
11/23/2015	1750B	20.5	1710	1.450	51.502	1.463	53.537	-0.89%	-3.80%
			1750	1.495	51.318	1.488	53.432	0.47%	-3.96%
			1790	1.541	51.150	1.514	53.326	1.78%	-4.08%
11/23/2015	1900B	22.8	1850	1.491	51.375	1.520	53.300	-1.91%	-3.61%
			1880	1.519	51.265	1.520	53.300	-0.07%	-3.82%
			1910	1.560	51.185	1.520	53.300	2.63%	-3.97%
11/27/2015	1900B	22.2	1850	1.524	55.768	1.520	53.300	0.26%	4.63%
			1880	1.560	55.694	1.520	53.300	2.63%	4.49%
			1910	1.593	55.577	1.520	53.300	4.80%	4.27%
11/23/2015	2450B	23.0	2400	1.906	51.571	1.902	52.767	0.21%	-2.27%
			2450	1.975	51.385	1.950	52.700	1.28%	-2.50%
			2500	2.045	51.189	2.021	52.636	1.19%	-2.75%

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 D01v01r04 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

10.2 Test System Verification

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

Table 10-2
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	$Deviation_{1g}$ (%)
I	750	HEAD	11/27/2015	23.3	21.0	0.200	1003	3333	1.610	8.090	8.050	-0.49%
A	835	HEAD	11/23/2015	21.9	21.1	0.200	4d132	3332	1.940	9.250	9.700	4.86%
J	1750	HEAD	11/23/2015	20.3	20.8	0.100	1051	3319	3.460	36.200	34.600	-4.42%
B	1900	HEAD	11/23/2015	23.4	22.7	0.100	5d148	3287	4.100	40.600	41.000	0.99%
E	2450	HEAD	11/23/2015	21.7	21.8	0.100	797	3351	5.220	52.700	52.200	-0.95%
I	750	BODY	11/23/2015	22.0	23.7	0.200	1003	3333	1.740	8.460	8.700	2.84%
E	835	BODY	11/24/2015	21.5	20.0	0.200	4d119	3351	1.740	9.200	8.700	-5.43%
K	1750	BODY	11/23/2015	20.8	20.5	0.100	1051	3022	3.820	37.100	38.200	2.96%
C	1900	BODY	11/23/2015	23.4	22.8	0.100	5d148	3288	4.020	40.200	40.200	0.00%
E	1900	BODY	11/27/2015	21.9	21.5	0.100	5d141	3351	4.200	40.000	42.000	5.00%
H	2450	BODY	11/23/2015	21.9	22.0	0.100	719	3263	5.530	51.900	55.300	6.55%

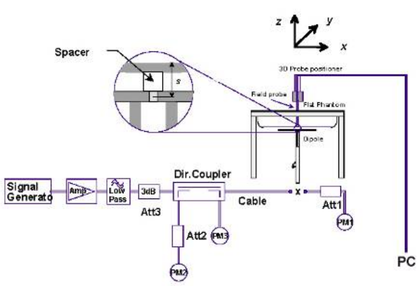

Figure 10-1
System Verification Setup Diagram

Figure 10-2
System Verification Setup Photo

11 SAR DATA SUMMARY

11.1 Standalone Head SAR Data

Table 11-1
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	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.52	384	Cell. CDMA	RC3 / SO55	24.4	24.28	-0.02	Right	Cheek	02524	1:1	0.486	1.028	0.500	A1
836.52	384	Cell. CDMA	RC3 / SO55	24.4	24.28	0.02	Right	Tilt	02524	1:1	0.232	1.028	0.238	
836.52	384	Cell. CDMA	RC3 / SO55	24.4	24.28	0.04	Left	Cheek	02524	1:1	0.431	1.028	0.443	
836.52	384	Cell. CDMA	RC3 / SO55	24.4	24.28	-0.02	Left	Tilt	02524	1:1	0.241	1.028	0.248	
836.52	384	Cell. CDMA	EVDO Rev. A	24.4	24.35	0.06	Right	Cheek	02524	1:1	0.460	1.012	0.466	
836.52	384	Cell. CDMA	EVDO Rev. A	24.4	24.35	-0.02	Right	Tilt	02524	1:1	0.196	1.012	0.198	
836.52	384	Cell. CDMA	EVDO Rev. A	24.4	24.35	0.01	Left	Cheek	02524	1:1	0.413	1.012	0.418	
836.52	384	Cell. CDMA	EVDO Rev. A	24.4	24.35	0.05	Left	Tilt	02524	1:1	0.216	1.012	0.219	
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	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.62	-0.03	Right	Cheek	02516	1:1	0.445	1.019	0.453	
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.62	0.09	Right	Tilt	02516	1:1	0.295	1.019	0.301	
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.62	0.04	Left	Cheek	02516	1:1	0.607	1.019	0.619	
1880.00	600	PCS CDMA	RC3 / SO55	24.7	24.62	0.01	Left	Tilt	02516	1:1	0.435	1.019	0.443	
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.61	-0.09	Right	Cheek	02516	1:1	0.468	1.021	0.478	
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.61	0.10	Right	Tilt	02516	1:1	0.291	1.021	0.297	
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.61	0.02	Left	Cheek	02516	1:1	0.609	1.021	0.622	A2
1880.00	600	PCS CDMA	EVDO Rev. A	24.7	24.61	-0.01	Left	Tilt	02516	1:1	0.437	1.021	0.446	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 11-3
LTE Band 13 Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
782.00	23230	Mid	LTE Band 13	10	23.7	23.63	0.05	0	Right	Cheek	QPSK	1	49	02516	1:1	0.371	1.016	0.377	A3
782.00	23230	Mid	LTE Band 13	10	22.7	22.54	0.00	1	Right	Cheek	QPSK	25	0	02516	1:1	0.279	1.038	0.290	
782.00	23230	Mid	LTE Band 13	10	23.7	23.63	-0.06	0	Right	Tilt	QPSK	1	49	02516	1:1	0.224	1.016	0.228	
782.00	23230	Mid	LTE Band 13	10	22.7	22.54	0.03	1	Right	Tilt	QPSK	25	0	02516	1:1	0.188	1.038	0.195	
782.00	23230	Mid	LTE Band 13	10	23.7	23.63	-0.13	0	Left	Cheek	QPSK	1	49	02516	1:1	0.306	1.016	0.311	
782.00	23230	Mid	LTE Band 13	10	22.7	22.54	0.09	1	Left	Cheek	QPSK	25	0	02516	1:1	0.261	1.038	0.271	
782.00	23230	Mid	LTE Band 13	10	23.7	23.63	0.06	0	Left	Tilt	QPSK	1	49	02516	1:1	0.220	1.016	0.224	
782.00	23230	Mid	LTE Band 13	10	22.7	22.54	-0.01	1	Left	Tilt	QPSK	25	0	02516	1:1	0.184	1.038	0.191	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

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

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.4	23.32	-0.13	0	Right	Cheek	QPSK	1	50	02524	1:1	0.323	1.019	0.329	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.4	22.36	-0.17	1	Right	Cheek	QPSK	50	0	02524	1:1	0.249	1.009	0.251	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.4	23.32	-0.11	0	Right	Tilt	QPSK	1	50	02524	1:1	0.329	1.019	0.335	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.4	22.36	0.03	1	Right	Tilt	QPSK	50	0	02524	1:1	0.285	1.009	0.288	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.4	23.32	0.08	0	Left	Cheek	QPSK	1	50	02524	1:1	0.534	1.019	0.544	A4
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.4	22.36	0.11	1	Left	Cheek	QPSK	50	0	02524	1:1	0.416	1.009	0.420	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.4	23.32	-0.05	0	Left	Tilt	QPSK	1	50	02524	1:1	0.361	1.019	0.368	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.4	22.36	-0.01	1	Left	Tilt	QPSK	50	0	02524	1:1	0.297	1.009	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										

Table 11-5
LTE Band 2 (PCS) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.68	0.18	0	Right	Cheek	QPSK	1	99	02516	1:1	0.471	1.005	0.473	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.7	22.53	-0.14	1	Right	Cheek	QPSK	50	0	02516	1:1	0.367	1.040	0.382	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.68	-0.11	0	Right	Tilt	QPSK	1	99	02516	1:1	0.289	1.005	0.290	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.7	22.53	-0.09	1	Right	Tilt	QPSK	50	0	02516	1:1	0.226	1.040	0.235	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.68	-0.10	0	Left	Cheek	QPSK	1	99	02516	1:1	0.657	1.005	0.660	A5
1900.00	19100	High	LTE Band 2 (PCS)	20	22.7	22.53	0.02	1	Left	Cheek	QPSK	50	0	02516	1:1	0.495	1.040	0.515	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.68	0.04	0	Left	Tilt	QPSK	1	99	02516	1:1	0.359	1.005	0.361	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.7	22.53	-0.01	1	Left	Tilt	QPSK	50	0	02516	1:1	0.304	1.040	0.316	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

Table 11-6
DTS Head SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
2437	6	802.11b	DSSS	22	15.5	15.46	-	Right	Cheek	02532	1	98.6	0.377	-	1.009	1.014	-	
2437	6	802.11b	DSSS	22	15.5	15.46	-	Right	Tilt	02532	1	98.6	0.227	-	1.009	1.014	-	
2437	6	802.11b	DSSS	22	15.5	15.46	0.12	Left	Cheek	02532	1	98.6	0.874	0.758	1.009	1.014	0.776	A6
2437	6	802.11b	DSSS	22	15.5	15.46	-0.04	Left	Tilt	02532	1	98.6	0.446	0.429	1.009	1.014	0.439	
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 11-7
CDMA Body-Worn 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	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.52	384	Cell. CDMA	TDSO / SO32	24.4	24.31	-0.18	10 mm	02516	1:1	back	0.483	1.021	0.493	A7
1880.00	600	PCS CDMA	TDSO / SO32	24.7	24.60	-0.06	10 mm	02516	1:1	back	0.738	1.023	0.755	A9
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 11-8
LTE Body-Worn SAR

MEASUREMENT RESULTS																		
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
782.00	23230	Mid	LTE Band 13	10	23.7	23.63	0.07	0	02524	QPSK	1	49	10 mm	back	1:1	0.480	1.016	0.488	A11
782.00	23230	Mid	LTE Band 13	10	22.7	22.54	0.06	1	02524	QPSK	25	0	10 mm	back	1:1	0.400	1.038	0.415	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.4	23.32	0.13	0	02516	QPSK	1	50	10 mm	back	1:1	1.090	1.019	1.111	A12
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.4	22.36	0.02	1	02516	QPSK	50	0	10 mm	back	1:1	0.898	1.009	0.906	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.4	22.27	-0.01	1	02516	QPSK	100	0	10 mm	back	1:1	0.852	1.030	0.878	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.4	23.32	0.16	0	02516	QPSK	1	50	10 mm	back	1:1	1.030	1.019	1.050	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.7	23.51	0.08	0	02516	QPSK	1	50	10 mm	back	1:1	0.891	1.045	0.931	A13
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.68	-0.02	0	02516	QPSK	1	99	10 mm	back	1:1	0.840	1.005	0.844	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.7	23.57	-0.03	0	02516	QPSK	1	50	10 mm	back	1:1	0.753	1.030	0.776	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.7	22.53	0.02	1	02516	QPSK	50	0	10 mm	back	1:1	0.610	1.040	0.634	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.7	22.40	0.04	1	02516	QPSK	100	0	10 mm	back	1:1	0.678	1.072	0.727	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram										

Note: Blue entry represents variability measurement.

Table 11-9
DTS Body-Worn SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
2437	6	802.11b	DSSS	22	15.5	15.46	-0.08	10 mm	02532	1	back	98.6	0.171	0.156	1.009	1.014	0.159	A14
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram										

11.3 Standalone Wireless Router SAR Data

Table 11-10
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	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.52	384	Cell. CDMA	EVDO Rev. 0	24.4	24.33	0.12	10 mm	02516	1:1	back	0.477	1.016	0.485	A8
836.52	384	Cell. CDMA	EVDO Rev. 0	24.4	24.33	-0.02	10 mm	02516	1:1	front	0.431	1.016	0.438	
836.52	384	Cell. CDMA	EVDO Rev. 0	24.4	24.33	0.12	10 mm	02516	1:1	bottom	0.254	1.016	0.258	
836.52	384	Cell. CDMA	EVDO Rev. 0	24.4	24.33	0.09	10 mm	02516	1:1	right	0.388	1.016	0.394	
836.52	384	Cell. CDMA	EVDO Rev. 0	24.4	24.33	0.01	10 mm	02516	1:1	left	0.262	1.016	0.266	
1851.25	25	PCS CDMA	EVDO Rev. 0	24.7	24.55	0.01	10 mm	02516	1:1	back	0.931	1.035	0.964	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.56	-0.04	10 mm	02516	1:1	back	0.841	1.033	0.869	
1908.75	1175	PCS CDMA	EVDO Rev. 0	24.7	24.60	-0.01	10 mm	02516	1:1	back	0.804	1.023	0.822	
1851.25	25	PCS CDMA	EVDO Rev. 0	24.7	24.55	-0.01	10 mm	02516	1:1	front	0.934	1.035	0.967	A10
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.56	-0.03	10 mm	02516	1:1	front	0.838	1.033	0.866	
1908.75	1175	PCS CDMA	EVDO Rev. 0	24.7	24.60	0.01	10 mm	02516	1:1	front	0.791	1.023	0.809	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.56	-0.01	10 mm	02516	1:1	bottom	0.478	1.033	0.494	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.7	24.56	0.03	10 mm	02516	1:1	left	0.559	1.033	0.577	
1851.25	25	PCS CDMA	EVDO Rev. 0	24.7	24.55	-0.03	10 mm	02516	1:1	front	0.881	1.035	0.912	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram						

Note: Blue entry represents variability measurement.

Table 11-11
LTE Band 13 Hotspot SAR

FREQUENCY MHz	Ch.		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) (W/kg)	Scaling Factor	Reported SAR (1g) (W/kg)	Plot #
782.00	23230	Mid	LTE Band 13	10	23.7	23.63	0.07	0	02524	QPSK	1	49	10 mm	back	1:1	0.480	1.016	0.488	A11
782.00	23230	Mid	LTE Band 13	10	22.7	22.54	0.06	1	02524	QPSK	25	0	10 mm	back	1:1	0.400	1.038	0.415	
782.00	23230	Mid	LTE Band 13	10	23.7	23.63	-0.01	0	02524	QPSK	1	49	10 mm	front	1:1	0.401	1.016	0.407	
782.00	23230	Mid	LTE Band 13	10	22.7	22.54	0.06	1	02524	QPSK	25	0	10 mm	front	1:1	0.320	1.038	0.332	
782.00	23230	Mid	LTE Band 13	10	23.7	23.63	-0.06	0	02524	QPSK	1	49	10 mm	bottom	1:1	0.201	1.016	0.204	
782.00	23230	Mid	LTE Band 13	10	22.7	22.54	0.17	1	02524	QPSK	25	0	10 mm	bottom	1:1	0.151	1.038	0.157	
782.00	23230	Mid	LTE Band 13	10	23.7	23.63	0.00	0	02524	QPSK	1	49	10 mm	right	1:1	0.303	1.016	0.308	
782.00	23230	Mid	LTE Band 13	10	22.7	22.54	0.04	1	02524	QPSK	25	0	10 mm	right	1:1	0.254	1.038	0.264	
782.00	23230	Mid	LTE Band 13	10	23.7	23.63	-0.14	0	02524	QPSK	1	49	10 mm	left	1:1	0.259	1.016	0.263	
782.00	23230	Mid	LTE Band 13	10	22.7	22.54	0.03	1	02524	QPSK	25	0	10 mm	left	1:1	0.224	1.038	0.233	

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
LTE Band 4 (AWS) Hotspot SAR

FREQUENCY MHz	Ch.		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) (W/kg)	Scaling Factor	Reported SAR (1g) (W/kg)	Plot #
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.4	23.32	0.13	0	02516	QPSK	1	50	10 mm	back	1:1	1.090	1.019	1.111	A12
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.4	22.36	0.02	1	02516	QPSK	50	0	10 mm	back	1:1	0.898	1.009	0.906	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.4	22.27	-0.01	1	02516	QPSK	100	0	10 mm	back	1:1	0.852	1.030	0.878	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.4	23.32	-0.01	0	02516	QPSK	1	50	10 mm	front	1:1	0.870	1.019	0.887	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.4	22.36	-0.05	1	02516	QPSK	50	0	10 mm	front	1:1	0.712	1.009	0.718	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.4	22.27	-0.07	1	02516	QPSK	100	0	10 mm	front	1:1	0.677	1.030	0.697	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.4	23.32	-0.04	0	02516	QPSK	1	50	10 mm	bottom	1:1	0.536	1.019	0.546	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.4	22.36	-0.01	1	02516	QPSK	50	0	10 mm	bottom	1:1	0.444	1.009	0.448	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.4	23.32	-0.10	0	02516	QPSK	1	50	10 mm	left	1:1	0.329	1.019	0.335	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.4	22.36	-0.02	1	02516	QPSK	50	0	10 mm	left	1:1	0.250	1.009	0.252	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.4	23.32	0.16	0	02516	QPSK	1	50	10 mm	back	1:1	1.030	1.019	1.050	

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

Note: Blue entry represents variability measurement.

Table 11-13
LTE Band 2 (PCS) Hotspot SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.7	23.51	0.08	0	02516	QPSK	1	50	10 mm	back	1:1	0.891	1.045	0.931	A13
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.68	-0.02	0	02516	QPSK	1	99	10 mm	back	1:1	0.840	1.005	0.844	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.7	23.57	-0.03	0	02516	QPSK	1	50	10 mm	back	1:1	0.753	1.030	0.776	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.7	22.53	0.02	1	02516	QPSK	50	0	10 mm	back	1:1	0.610	1.040	0.634	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.7	22.40	0.04	1	02516	QPSK	100	0	10 mm	back	1:1	0.678	1.072	0.727	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.7	23.51	0.00	0	02516	QPSK	1	50	10 mm	front	1:1	0.821	1.045	0.858	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.68	-0.12	0	02516	QPSK	1	99	10 mm	front	1:1	0.855	1.005	0.859	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.7	23.57	0.13	0	02516	QPSK	1	50	10 mm	front	1:1	0.766	1.030	0.789	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.7	22.53	0.11	1	02516	QPSK	50	0	10 mm	front	1:1	0.595	1.040	0.619	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.7	22.40	0.00	1	02516	QPSK	100	0	10 mm	front	1:1	0.619	1.072	0.664	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.68	0.00	0	02516	QPSK	1	99	10 mm	bottom	1:1	0.488	1.005	0.490	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.7	22.53	-0.04	1	02516	QPSK	50	0	10 mm	bottom	1:1	0.404	1.040	0.420	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.68	-0.18	0	02516	QPSK	1	99	10 mm	left	1:1	0.516	1.005	0.519	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.7	22.53	0.00	1	02516	QPSK	50	0	10 mm	left	1:1	0.405	1.040	0.421	
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
WLAN Hotspot SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
2437	6	802.11b	DSSS	22	15.5	15.46	-0.08	10 mm	02532	1	back	98.6	0.171	0.156	1.009	1.014	0.159	A14
2437	6	802.11b	DSSS	22	15.5	15.46	-	10 mm	02532	1	front	98.6	0.116	-	1.009	1.014	-	
2437	6	802.11b	DSSS	22	15.5	15.46	-	10 mm	02532	1	top	98.6	0.076	-	1.009	1.014	-	
2437	6	802.11b	DSSS	22	15.5	15.46	-	10 mm	02532	1	right	98.6	0.093	-	1.009	1.014	-	
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 D01v05r02.
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 D01v05r02.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01r02, body-worn SAR was evaluated without a headset connected to the device. Since the standalone reported body-worn SAR was ≤ 1.2 W/kg, no additional body-worn SAR evaluations using a headset cable were required.
8. Per FCC KDB 865664 D01v01r04, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 13 for variability analysis.

9. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v02, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.6 for more details).

CDMA Notes:

1. Head SAR for CDMA2000 mode was tested under RC3/SO55 per FCC KDB Publication 941225 D01v03.
2. Body-Worn SAR was tested with 1x RTT with TDSO / SO32 FCH Only. EVDO Rev0 and RevA and TDSO / SO32 FCH+SCH SAR tests were not required per the 3G SAR Test Reduction Procedure in FCC KDB Publication 941225 D01v03.
3. CDMA Wireless Router SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0 according to KDB 941225 D01v03 procedures for data devices. Wireless Router SAR tests for Subtype 2 of Rev.A and 1x RTT configurations were not required per the 3G SAR Test Reduction Policy in KDB Publication 941225 D01v03.
4. Head SAR was additionally evaluated using EVDO Rev. A to determine compliance for VoIP operations.
5. Per FCC KDB Publication 447498 D01v05r02, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r03. The general test procedures used for testing can be found in Section 8.5.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

WLAN Notes:

1. For held-to-ear and hotspot operations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r01 for 2.4 GHz WIFI operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 8.6.3 for more information. When the maximum reported 1g averaged SAR is ≤0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
3. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated EMC test reports.

12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05r02 are applicable to devices with built-in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

12.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05r02 IV.C.1.iii and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1-g or 10-g SAR.

When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05r02 4.3.2 2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

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

Table 12-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2480	11.00	10	0.273

Note: Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. Per KDB Publication 447498 D01v05r02, the maximum power of the channel was rounded to the nearest mW before calculation.

12.3 Head SAR Simultaneous Transmission Analysis

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

Exposure Condition	Mode	CDMA/LTE SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Cell. CDMA/EVDO	0.500	0.776	1.276
	PCS CDMA/EVDO	0.622	0.776	1.398
	LTE Band 13	0.377	0.776	1.153
	LTE Band 4 (AWS)	0.544	0.776	1.320
	LTE Band 2 (PCS)	0.660	0.776	**1.436**

12.4 Body-Worn Simultaneous Transmission Analysis

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

Exposure Condition	Mode	CDMA/LTE SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	Cell. CDMA	0.493	0.159	0.652
	PCS CDMA	0.755	0.159	0.914
	LTE Band 13	0.488	0.159	0.647
	LTE Band 4 (AWS)	1.111	0.159	1.270
	LTE Band 2 (PCS)	0.931	0.159	1.090

Table 12-4
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 1.0 cm)

Exposure Condition	Mode	CDMA/LTE SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	Cell. CDMA	0.493	0.273	0.766
	PCS CDMA	0.755	0.273	1.028
	LTE Band 13	0.488	0.273	0.761
	LTE Band 4 (AWS)	1.111	0.273	**1.384**
	LTE Band 2 (PCS)	0.931	0.273	1.204

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.

12.5 Hotspot SAR Simultaneous Transmission Analysis

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

Exposure Condition	Mode	CDMA/LTE SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	Cell. EVDO	0.485	0.159	0.644
	PCS EVDO	0.967	0.159	1.126
	LTE Band 13	0.488	0.159	0.647
	LTE Band 4 (AWS)	1.111	0.159	**1.270**
	LTE Band 2 (PCS)	0.931	0.159	1.090

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 D01v05r02 and IEEE 1528-2013 Section 6.3.4.1.2.

13 SAR MEASUREMENT VARIABILITY

13.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

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

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

Table 13-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS													
Band	FREQUENCY		Mode	Service	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)	
1750	1732.50	20175	LTE Band 4 (AWS), 20 MHz Bandwidth	QPSK, 1 RB, 50 RB Offset	back	10 mm	1.090	1.030	1.06	N/A	N/A	N/A	N/A
1900	1851.25	25	PCS CDMA	EVDO Rev. 0	front	10 mm	0.934	0.881	1.06	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram							

13.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2003 was not required.

14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753E	(30kHz-6GHz) Network Analyzer	12/30/2014	Annual	12/30/2015	JP38020182
Agilent	8648D	(9kHz-4GHz) Signal Generator	3/15/2015	Annual	3/15/2016	3629U00687
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8753ES	S-Parameter Network Analyzer	3/12/2015	Annual	3/12/2016	MY40000670
Agilent	8753ES	Network Analyzer	3/20/2015	Annual	3/20/2016	MY40001472
Agilent	E4432B	ESG-D Series Signal Generator	3/16/2015	Annual	3/16/2016	US40053896
Agilent	E4438C	ESG Vector Signal Generator	3/13/2015	Annual	3/13/2016	MY42082385
Agilent	E8257D	(250kHz-20GHz) Signal Generator	3/15/2015	Annual	3/15/2016	MY45470194
Agilent	N5182A	MXG Vector Signal Generator	3/16/2015	Annual	3/16/2016	MY47420800
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433972
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433974
Anritsu	MA24106A	USB Power Sensor	3/2/2015	Annual	3/2/2016	1344555
Anritsu	MA24106A	USB Power Sensor	3/2/2015	Annual	3/2/2016	1344556
Anritsu	MA2411B	Pulse Power Sensor	3/13/2015	Annual	3/13/2016	1207470
Anritsu	MA2411B	Pulse Power Sensor	8/3/2015	Annual	8/3/2016	1126066
Anritsu	MA2481A	Power Sensor	3/10/2015	Annual	3/10/2016	5605
Anritsu	MA2481A	Power Sensor	3/10/2015	Annual	3/10/2016	2400
Anritsu	ML2495A	Power Meter	10/16/2015	Biennial	10/16/2017	941001
Anritsu	ML2438A	Power Meter	3/13/2015	Annual	3/13/2016	1190013
Anritsu	ML2438A	Power Meter	3/13/2015	Annual	3/13/2016	1070030
Anritsu	ML2496A	Power Meter	3/13/2015	Annual	3/13/2016	1351001
Anritsu	ML2496A	Power Meter	3/13/2015	Annual	3/13/2016	1306009
Anritsu	MT8820C	Radio Communication Analyzer	6/12/2015	Annual	6/12/2016	6201240328
Anritsu	MT8820C	Radio Communication Analyzer	7/24/2015	Annual	7/24/2016	6200901190
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
Control Company	4040	Digital Thermometer	3/15/2015	Biennial	3/15/2017	150194929
Control Company	4353	Long Stem Thermometer	1/22/2015	Biennial	1/22/2017	150053059
Control Company	4353	Long Stem Thermometer	1/22/2015	Biennial	1/22/2017	150053077
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	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
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264162
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	NC-100	Torque Wrench	5/21/2015	Biennial	5/21/2017	N/A
Pasternack	NC-100	Torque Wrench	5/21/2015	Biennial	5/21/2017	N/A
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMW500	Radio Communication Tester	4/8/2015	Annual	4/8/2016	140148
Rohde & Schwarz	CMW500	Radio Communication Tester	4/22/2015	Annual	4/22/2016	101699
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/12/2015	Annual	5/12/2016	1070
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	7/14/2015	Annual	7/14/2016	1039
SPEAG	D750V3	750 MHz SAR Dipole	1/16/2015	Annual	1/16/2016	1003
SPEAG	D835V2	835 MHz SAR Dipole	4/13/2015	Annual	4/13/2016	4d119
SPEAG	D835V2	835 MHz SAR Dipole	1/16/2015	Annual	1/16/2016	4d132
SPEAG	D1750V2	1750 MHz SAR Dipole	4/15/2015	Annual	4/15/2016	1051
SPEAG	D1900V2	1900 MHz SAR Dipole	2/18/2015	Annual	2/18/2016	5d148
SPEAG	D1900V2	1900 MHz SAR Dipole	4/14/2015	Annual	4/14/2016	5d141
SPEAG	D2450V2	2450 MHz SAR Dipole	10/21/2015	Annual	10/21/2016	797
SPEAG	D2450V2	2450 MHz SAR Dipole	8/20/2015	Annual	8/20/2016	719
SPEAG	ES3DV3	SAR Probe	9/18/2015	Annual	9/18/2016	3332
SPEAG	ES3DV3	SAR Probe	3/19/2015	Annual	3/19/2016	3319
SPEAG	ES3DV3	SAR Probe	10/29/2015	Annual	10/29/2016	3287
SPEAG	ES3DV3	SAR Probe	10/29/2015	Annual	10/29/2016	3333
SPEAG	ES3DV2	SAR Probe	8/26/2015	Annual	8/26/2016	3022
SPEAG	ES3DV3	SAR Probe	6/22/2015	Annual	6/22/2016	3351
SPEAG	ES3DV3	SAR Probe	9/18/2015	Annual	9/18/2016	3288
SPEAG	ES3DV3	SAR Probe	5/20/2015	Annual	5/20/2016	3263
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/16/2015	Annual	9/16/2016	1323
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/13/2015	Annual	3/13/2016	1368
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/27/2015	Annual	10/27/2016	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/24/2015	Annual	8/24/2016	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/18/2015	Annual	2/18/2016	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/18/2015	Annual	9/18/2016	1364
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/17/2015	Annual	6/17/2016	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/20/2015	Annual	10/20/2016	1408

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

15 MEASUREMENT UNCERTAINTIES

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

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

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: ZNFL52VL; Type: Portable Handset; Serial: 02524

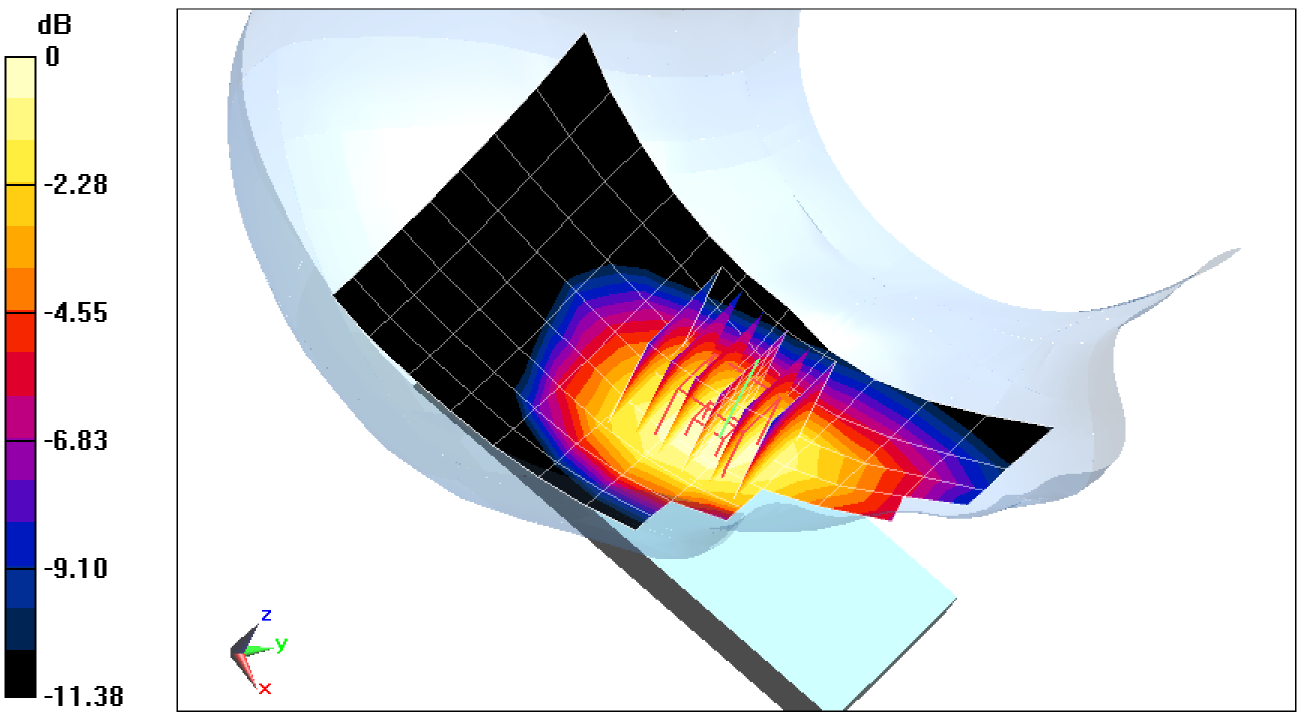
Communication System: UID 0, CDMA; Frequency: 836.52 MHz; Duty Cycle: 1:1
Medium: 835 Head, Medium parameters used (interpolated):
f = 836.52 MHz; σ = 0.937 S/m; ε_r = 42.046; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 11-23-2015; Ambient Temp: 21.9°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3332; ConvF(6.23, 6.23, 6.23); Calibrated: 9/18/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/16/2015
Phantom: SAM Main ; Type: QD000P40CC; Serial: TP 1114
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=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.28 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.598 W/kg
SAR(1 g) = 0.486 W/kg



0 dB = 0.527 W/kg = -2.78 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02516

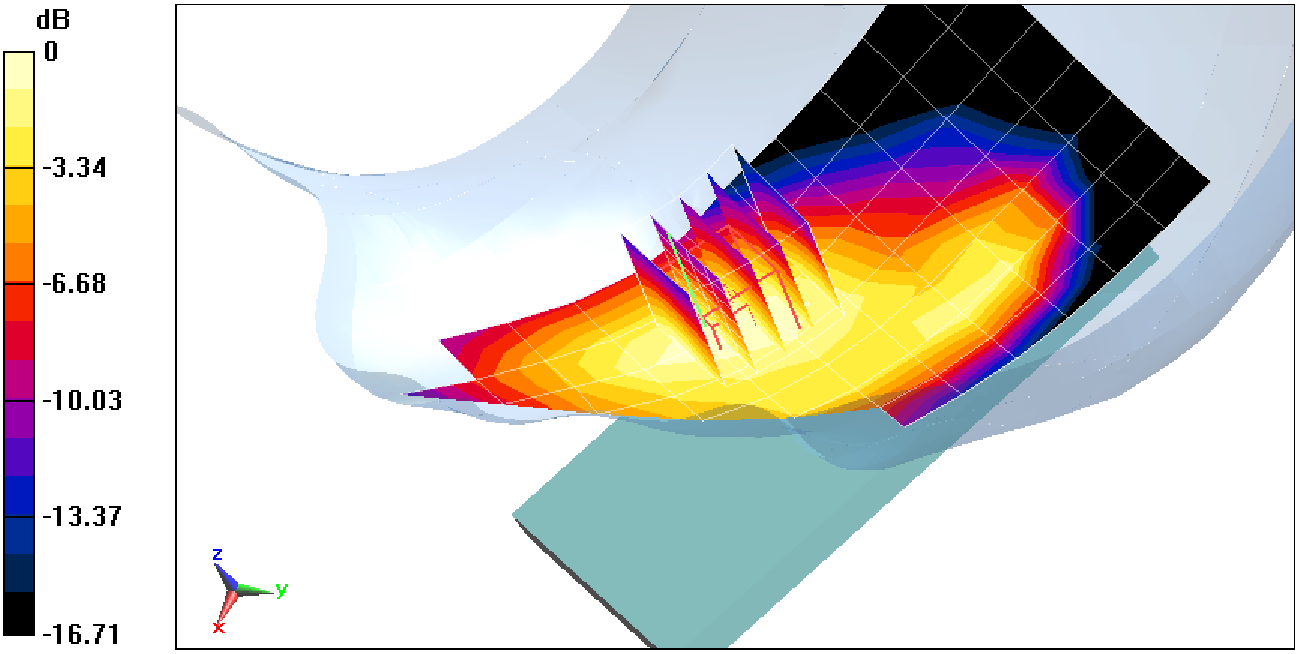
Communication System: UID 0, PCS CDMA; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Head, Medium parameters used:
f = 1880 MHz; σ = 1.41 S/m; ε_r = 38.299; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 11-23-2015; Ambient Temp: 23.4°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3287; ConvF(5.08, 5.08, 5.08); Calibrated: 10/29/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 10/20/2015
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: PCS EVDO Rev A, Left Head, Cheek, Mid.ch

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.61 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.940 W/kg
SAR(1 g) = 0.609 W/kg



0 dB = 0.699 W/kg = -1.56 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02516

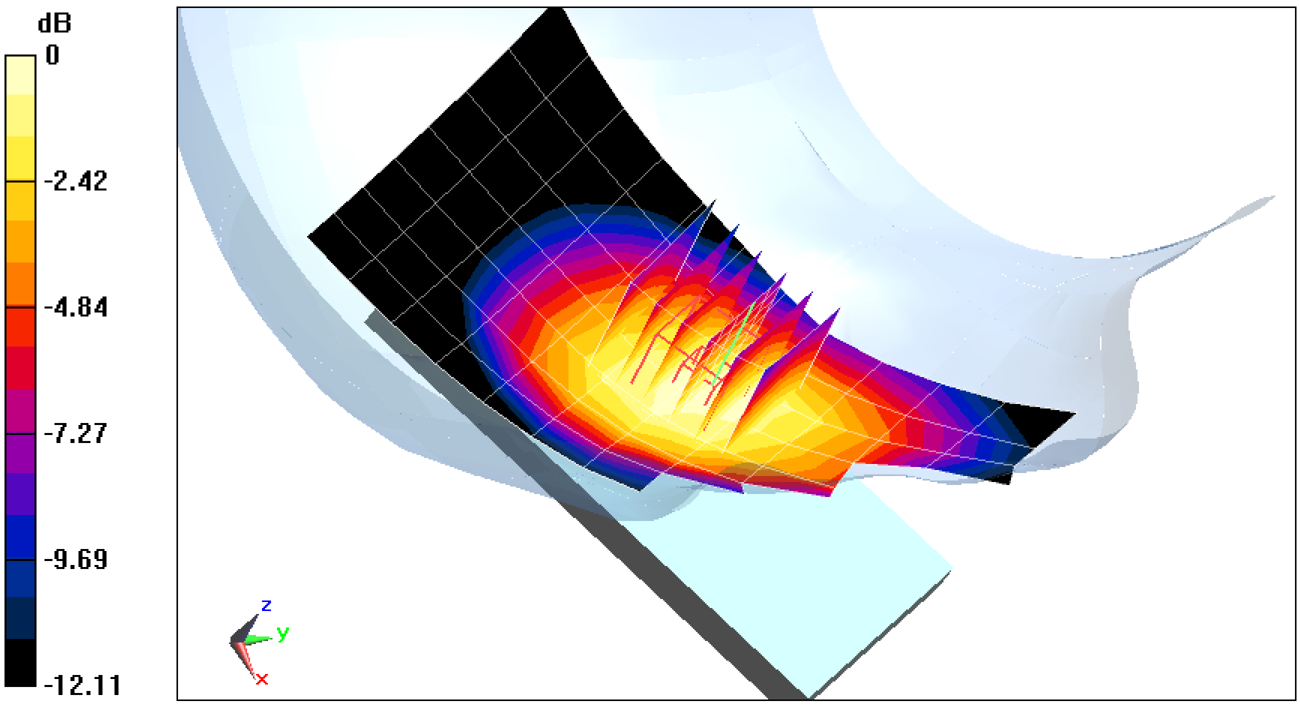
Communication System: UID 0, LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1
Medium: 750 Head, Medium parameters used (interpolated):
f = 782 MHz; σ = 0.937 S/m; ε_r = 41.723; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 11-27-2015; Ambient Temp: 23.3°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3333; ConvF(6.46, 6.46, 6.46); Calibrated: 10/29/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 10/27/2015
Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 13, Right Head, Cheek, Mid.ch, 10 MHz Bandwidth, QPSK, 1 RB, 49 RB Offset

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.29 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 0.484 W/kg
SAR(1 g) = 0.371 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02524

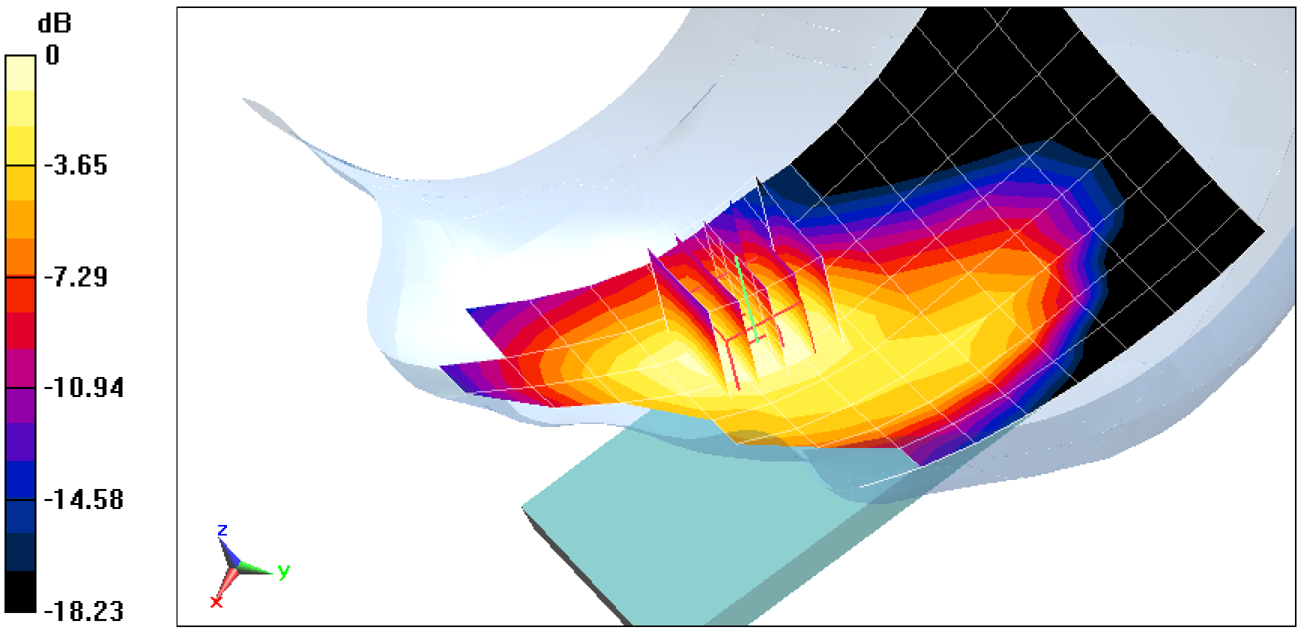
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Head, Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.311 S/m; ε_r = 39.594; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 11-23-2015; Ambient Temp: 20.3°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3319; ConvF(5.29, 5.29, 5.29); Calibrated: 3/19/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 3/13/2015
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: LTE Band 4 (AWS), Left Head, Cheek, Mid.ch, 20 MHz Bandwidth, QPSK, 1 RB, 50 RB Offset

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.75 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 0.80 W/kg
SAR(1 g) = 0.534 W/kg



0 dB = 0.629 W/kg = -2.01 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02516

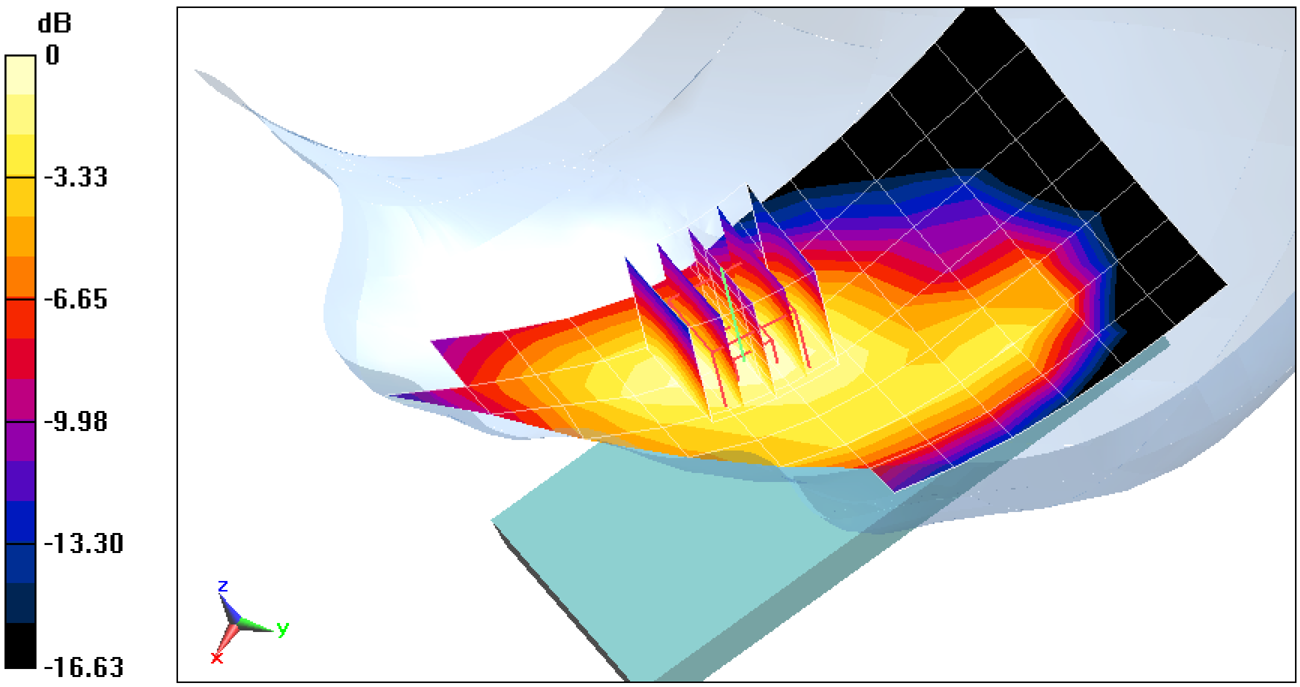
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Head, Medium parameters used:
f = 1880 MHz; $\sigma = 1.41$ S/m; $\varepsilon_r = 38.299$; $\rho = 1000$ kg/m^3
Phantom section: Left Section

Test Date: 11-23-2015; Ambient Temp: 23.4°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3287; ConvF(5.08, 5.08, 5.08); Calibrated: 10/29/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 10/20/2015
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 2 (PCS), Left Head, Cheek, Mid.ch, 20 MHz Bandwidth, QPSK, 1 RB, 99 RB Offset

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.85 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 1.01 W/kg
SAR(1 g) = 0.657 W/kg



0 dB = 0.789 W/kg = -1.03 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02532

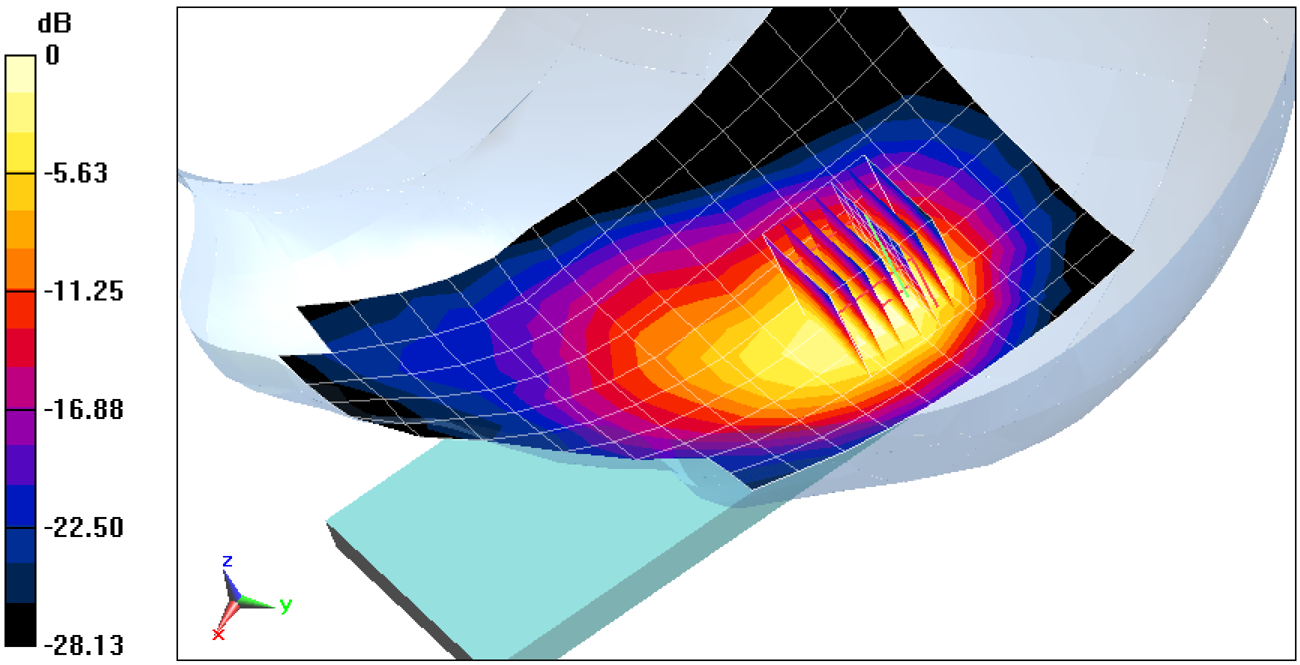
Communication System: UID 0, IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: 2400 Head, Medium parameters used (interpolated):
f = 2437 MHz; σ = 1.863 S/m; ε_r = 39.384; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 11-23-2015; Ambient Temp: 21.7°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3351; ConvF(4.46, 4.46, 4.46); Calibrated: 6/22/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2015
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11b, 22 MHz Bandwidth, Left Head, Cheek, Ch 06, 1 Mbps

Area Scan (11x18x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.16 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 1.76 W/kg
SAR(1 g) = 0.758 W/kg



0 dB = 1.01 W/kg = 0.04 dBW/kg

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02516

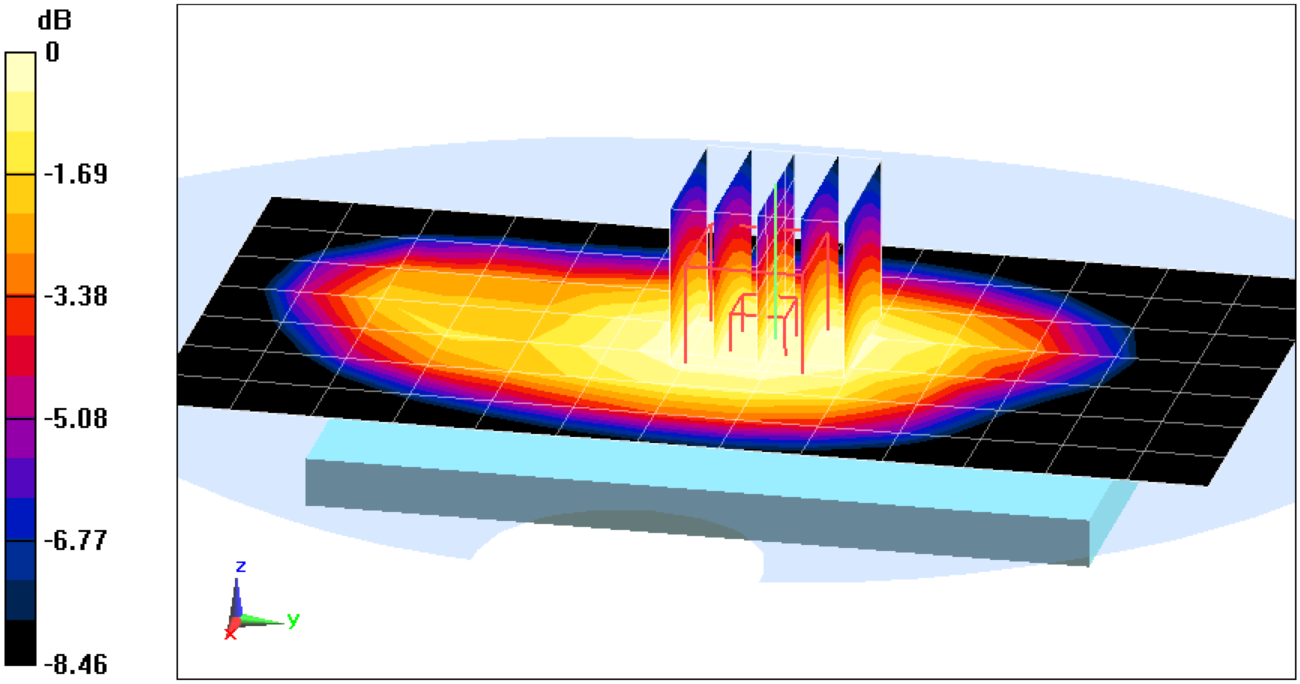
Communication System: UID 0, CDMA; Frequency: 836.52 MHz; Duty Cycle: 1:1
Medium: 835 Body, Medium parameters used (interpolated):
f = 836.52 MHz; σ = 0.991 S/m; ε_r = 53.989; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-24-2015; Ambient Temp: 21.5°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3351; ConvF(6.11, 6.11, 6.11); Calibrated: 6/22/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2015
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.98 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 0.599 W/kg
SAR(1 g) = 0.483 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02516

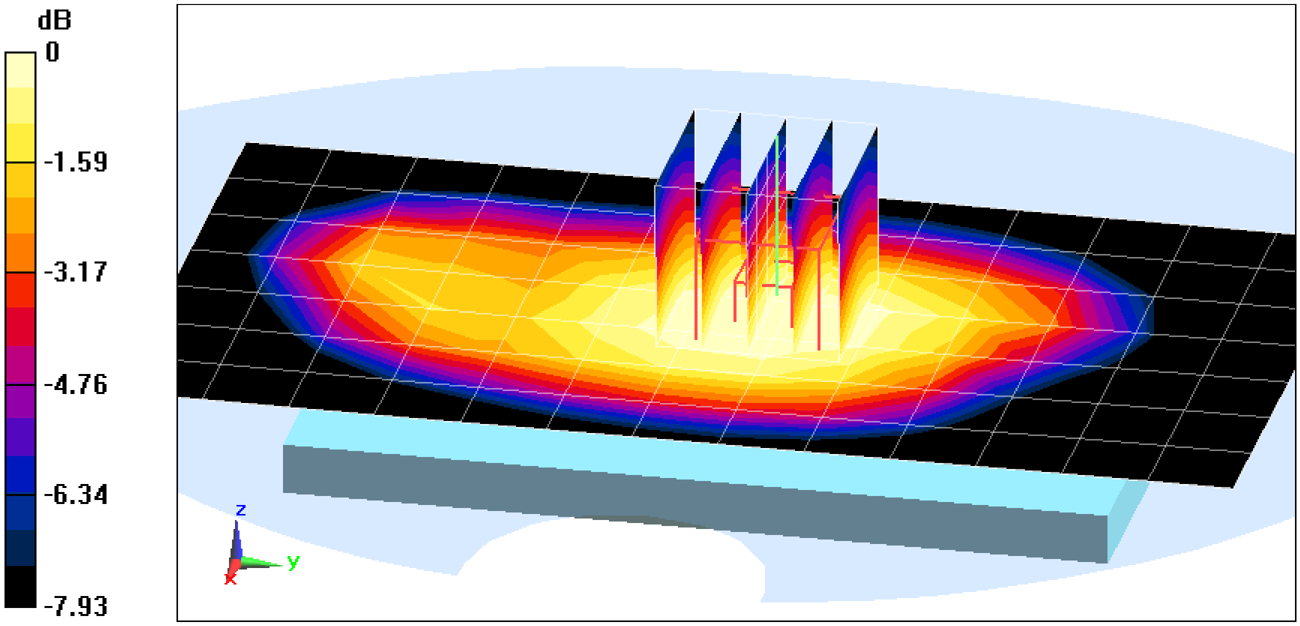
Communication System: UID 0, CDMA; Frequency: 836.52 MHz; Duty Cycle: 1:1
Medium: 835 Body, Medium parameters used (interpolated):
f = 836.52 MHz; σ = 0.991 S/m; ε_r = 53.989; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-24-2015; Ambient Temp: 21.5°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3351; ConvF(6.11, 6.11, 6.11); Calibrated: 6/22/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2015
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.16 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 0.592 W/kg
SAR(1 g) = 0.477 W/kg



0 dB = 0.519 W/kg = -2.85 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02516

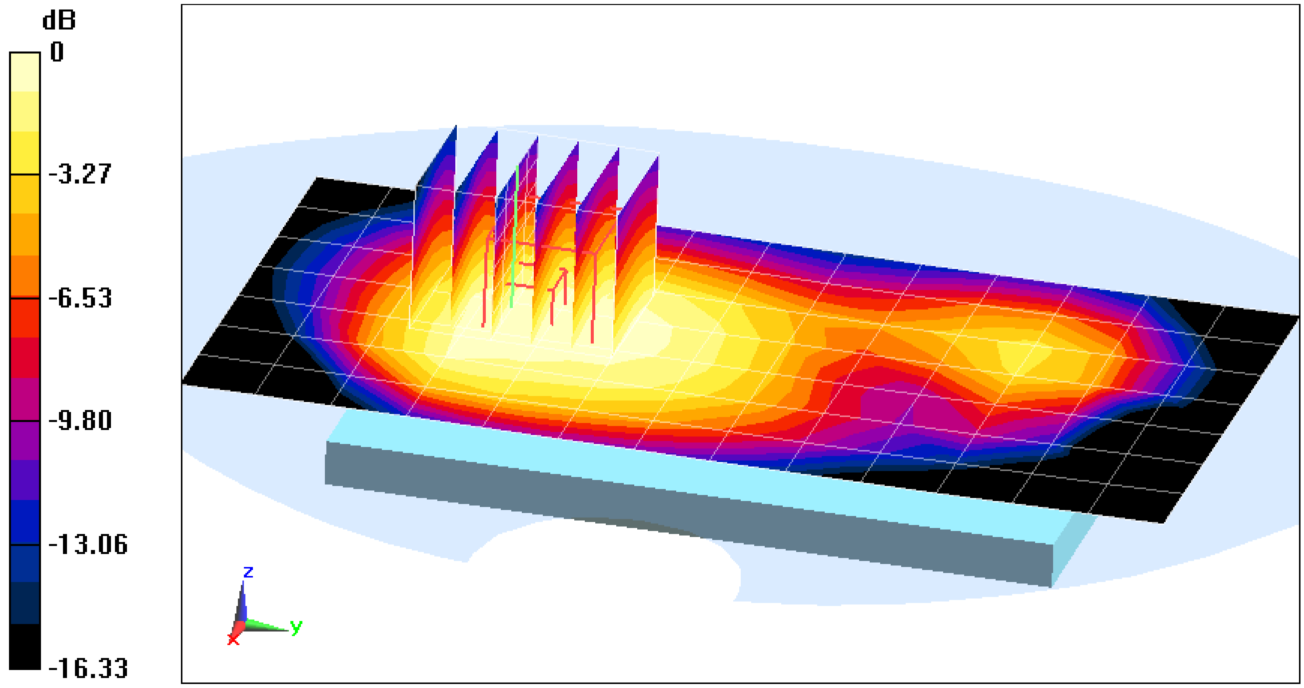
Communication System: UID 0, CDMA; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used:
f = 1880 MHz; σ = 1.519 S/m; ε_r = 51.265; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-23-2015; Ambient Temp: 23.4°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3288; ConvF(4.81, 4.81, 4.81); Calibrated: 9/18/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2015
Phantom: Main TWIN SAM; Type: QD000P40CC; Serial: TP-1406
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 (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.08 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 1.12 W/kg
SAR(1 g) = 0.738 W/kg



0 dB = 0.851 W/kg = -0.70 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02516

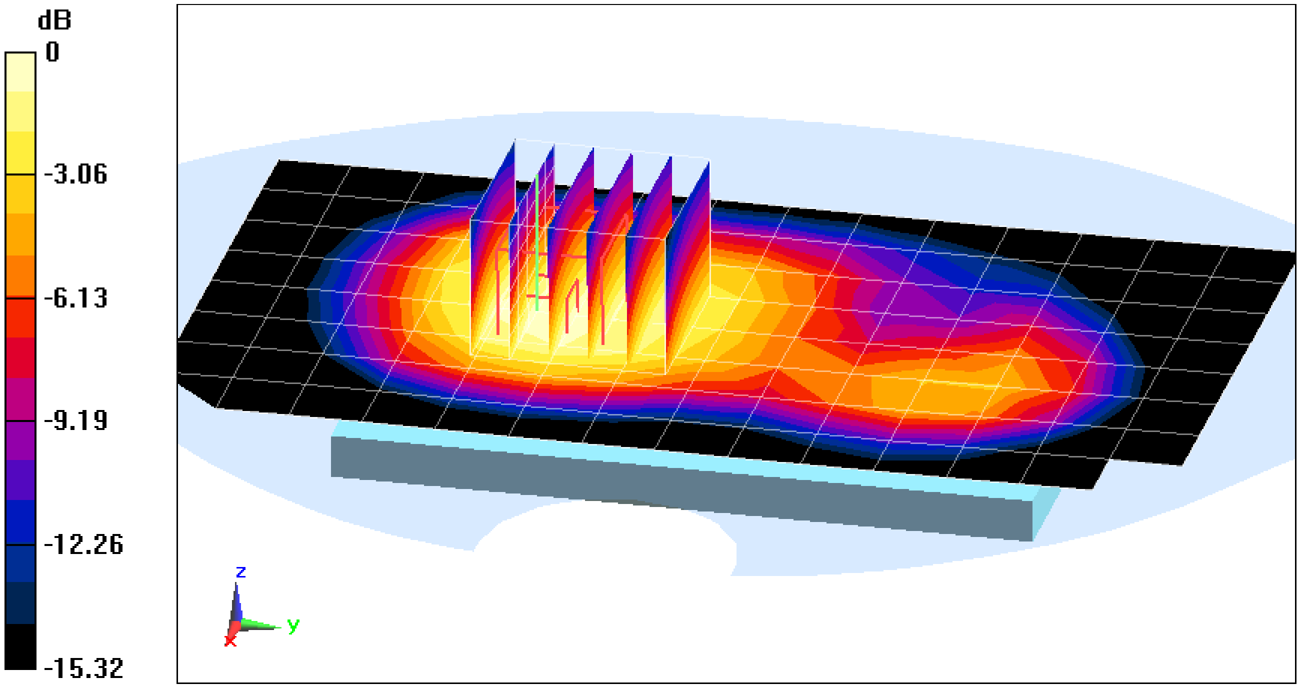
Communication System: UID 0, CDMA; Frequency: 1851.25 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used (interpolated):
$f = 1851.25$ MHz; $\sigma = 1.492$ S/m; $\varepsilon_r = 51.37$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-23-2015; Ambient Temp: 23.4°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3288; ConvF(4.81, 4.81, 4.81); Calibrated: 9/18/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2015
Phantom: Main TWIN SAM; Type: QD000P40CC; Serial: TP-1406
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: PCS EVDO, Body SAR, Front side, Low.ch

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.93 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.41 W/kg
SAR(1 g) = 0.934 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02524

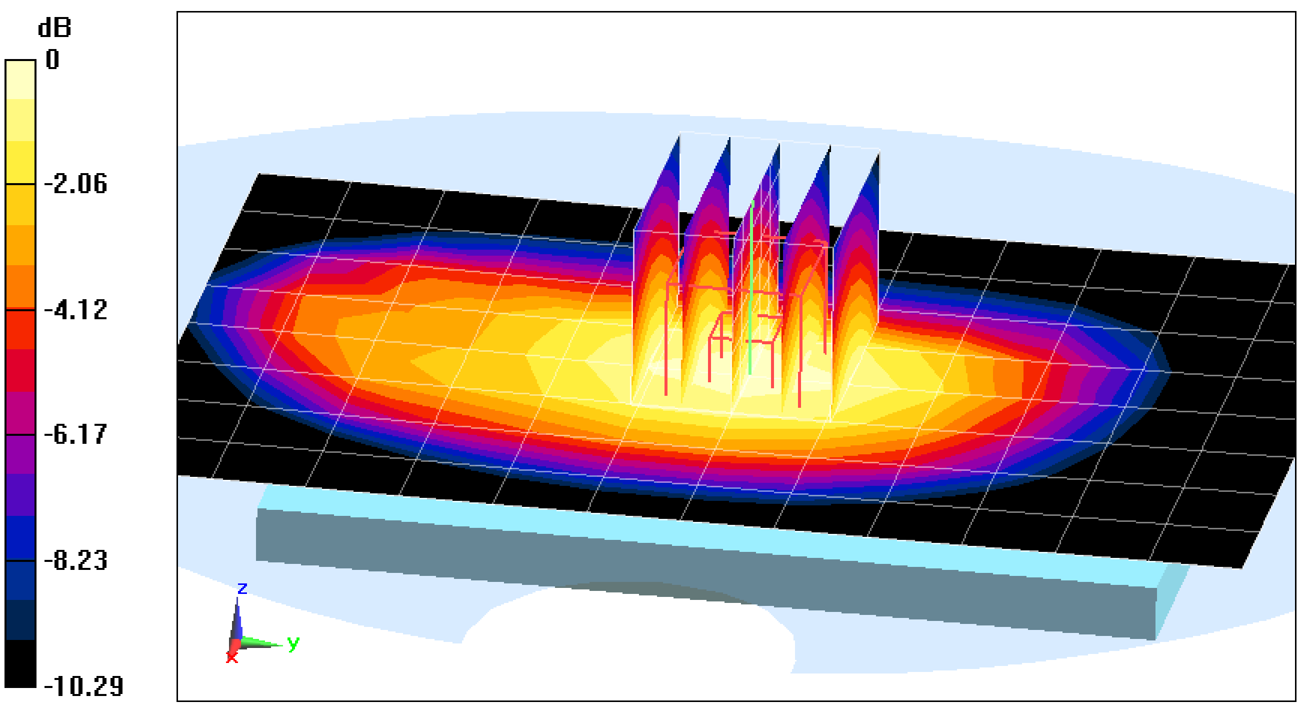
Communication System: UID 0, LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1
Medium: 750 Body, Medium parameters used (interpolated):
f = 782 MHz; σ = 0.983 S/m; ε_r = 53.188; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-23-2015; Ambient Temp: 22.0°C; Tissue Temp: 23.7°C

Probe: ES3DV3 - SN3333; ConvF(6.31, 6.31, 6.31); Calibrated: 10/29/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 10/27/2015
Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 13, Body SAR, Back side, Mid.ch, 10 MHz Bandwidth, QPSK, 1 RB, 49 RB Offset

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.71 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.603 W/kg
SAR(1 g) = 0.480 W/kg



0 dB = 0.532 W/kg = -2.74 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02516

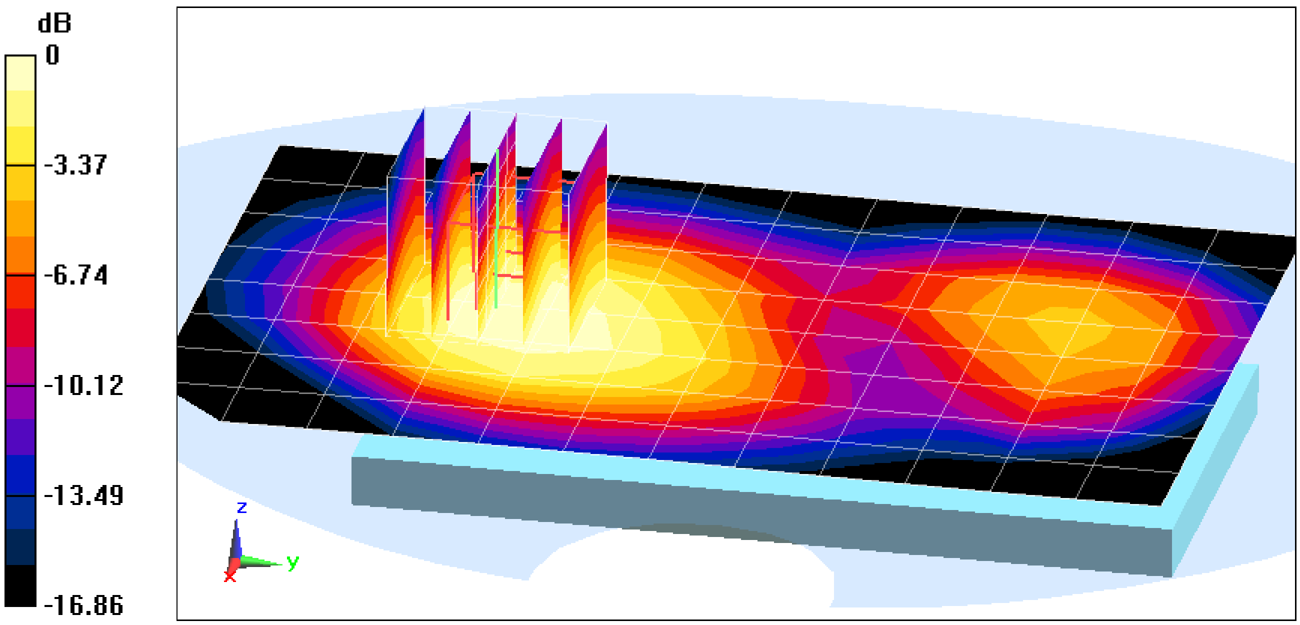
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Body, Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.475 S/m; ε_r = 51.398; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-23-2015; Ambient Temp: 20.8°C; Tissue Temp: 20.5°C

Probe: ES3DV2 - SN3022; ConvF(4.79, 4.79, 4.79); Calibrated: 8/26/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/18/2015
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 4 (AWS), Body SAR, Back side, Mid.ch, 20 MHz Bandwidth, QPSK, 1 RB, 50 RB Offset

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.15 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 1.65 W/kg
SAR(1 g) = 1.09 W/kg



0 dB = 1.26 W/kg = 1.00 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02516

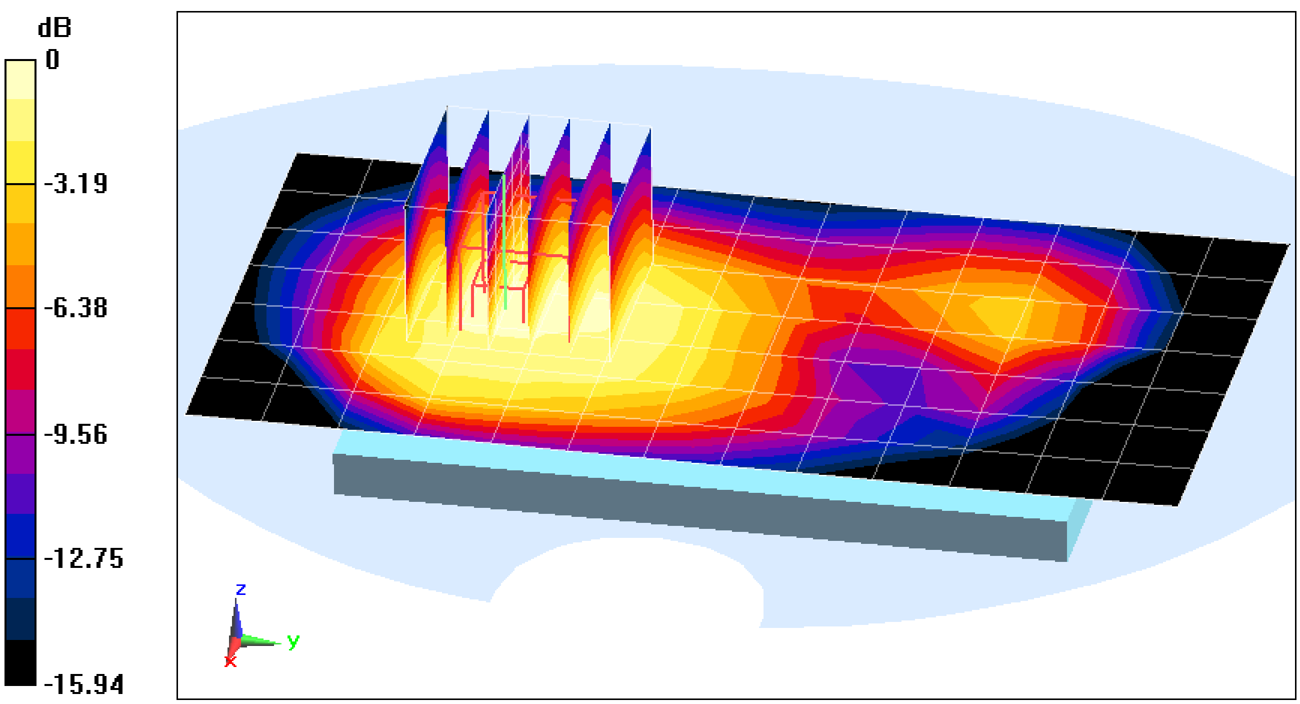
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1860 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used (interpolated):
f = 1860 MHz; σ = 1.5 S/m; ε_r = 51.338; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-23-2015; Ambient Temp: 23.4°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3288; ConvF(4.81, 4.81, 4.81); Calibrated: 9/18/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2015
Phantom: Main TWIN SAM; Type: QD000P40CC; Serial: TP-1406
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 2 (PCS), Body SAR, Back side, Low.ch, 20 MHz Bandwidth, QPSK, 1 RB, 50 RB Offset

Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.45 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 1.35 W/kg
SAR(1 g) = 0.891 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: ZNFL52VL; Type: Portable Handset; Serial: 02532

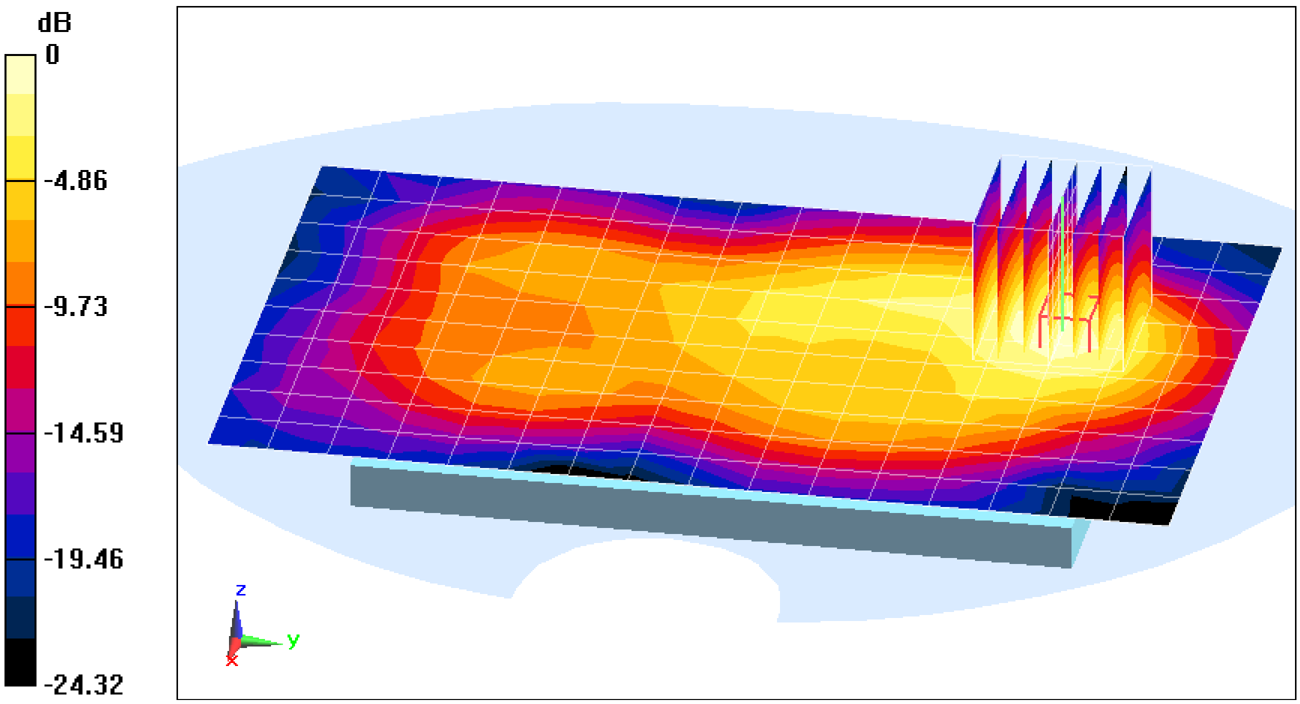
Communication System: UID 0, IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: 2400 Body, Medium parameters used (interpolated):
f = 2437 MHz; σ = 1.957 S/m; ε_r = 51.433; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-23-2015; Ambient Temp: 21.9°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3263; ConvF(4.28, 4.28, 4.28); Calibrated: 5/20/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 6/17/2015
Phantom: SAM with CRP v5.0 (Right); Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: IEEE 802.11b, 22 MHz Bandwidth, Body SAR, Ch 06,
1 Mbps, Back Side**

Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.259 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.324 W/kg
SAR(1 g) = 0.156 W/kg



0 dB = 0.193 W/kg = -7.14 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1003

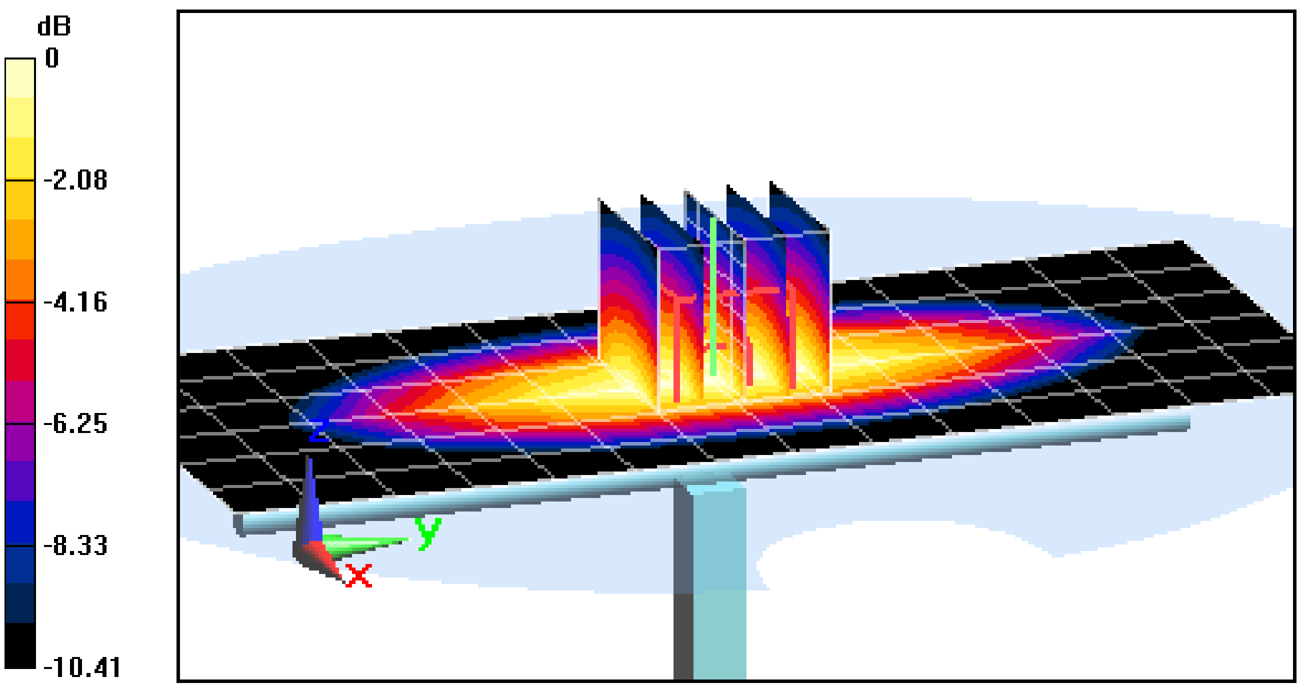
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium: 750 Head Medium parameters used (interpolated):
f = 750 MHz; σ = 0.906 S/m; ε_r = 42.036; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-27-2015; Ambient Temp: 23.3°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3333; ConvF(6.46, 6.46, 6.46); Calibrated: 10/29/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 10/27/2015
Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

750 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.39 W/kg
SAR(1 g) = 1.61 W/kg
Deviation(1 g) = -0.49 %



0 dB = 1.89 W/kg = 2.76 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

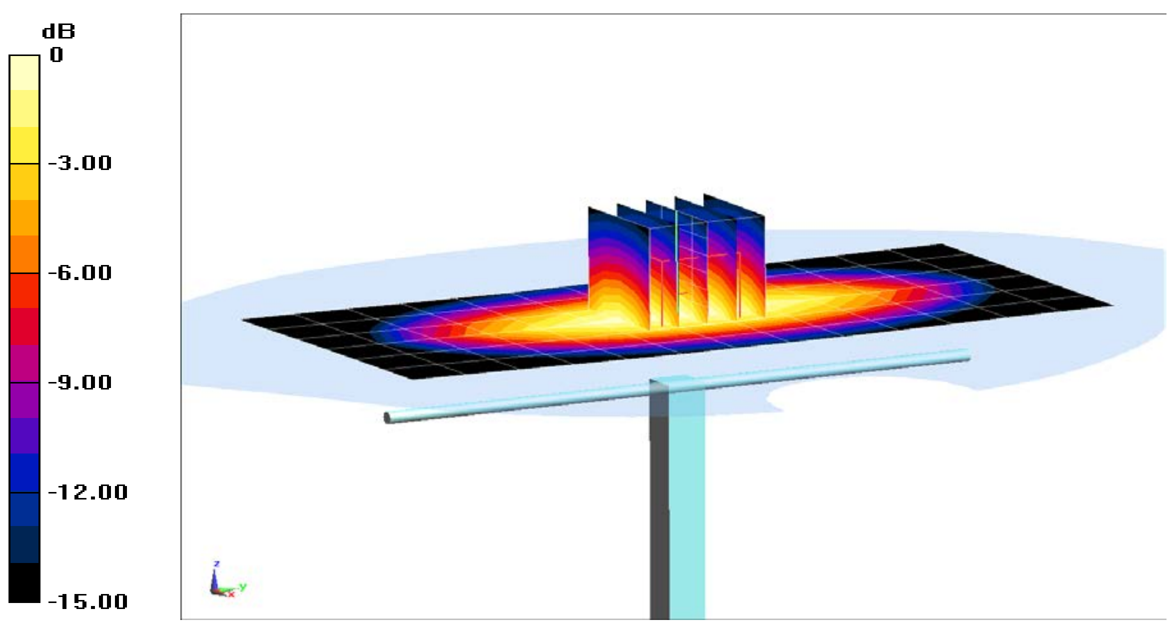
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Head Medium parameters used:
f = 835 MHz; σ = 0.935 S/m; ε_r = 42.065; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-23-2015; Ambient Temp: 21.9°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3332; ConvF(6.23, 6.23, 6.23); Calibrated: 9/18/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/16/2015
Phantom: SAM Main ; Type: QD000P40CC; Serial: TP 1114
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

835 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.91 W/kg
SAR(1 g) = 1.94 W/kg
Deviation(1 g) = 4.86 %



0 dB = 2.24 W/kg = 3.50 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

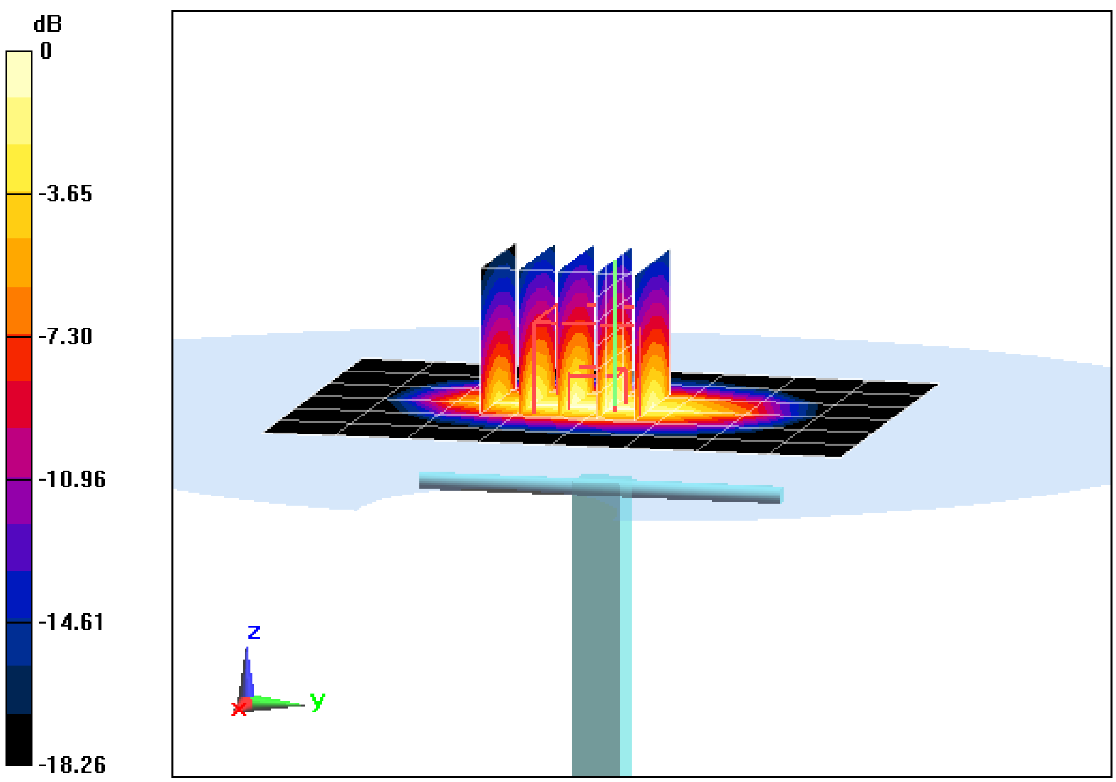
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Head, Medium parameters used:
f = 1750 MHz; σ = 1.331 S/m; ε_r = 39.496; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-23-2015; Ambient Temp: 20.3°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3319; ConvF(5.29, 5.29, 5.29); Calibrated: 3/19/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 3/13/2015
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)

1750 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 6.28 W/kg
SAR(1 g) = 3.46 W/kg
Deviation(1 g) = -4.42 %



0 dB = 4.32 W/kg = 6.35 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

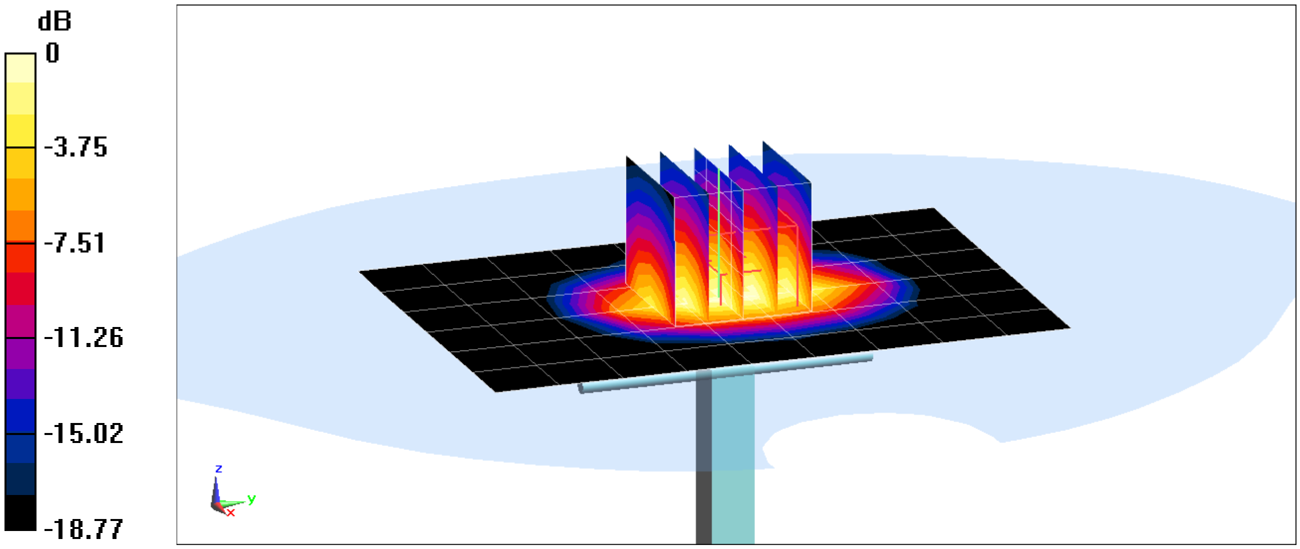
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Head; Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.432 S/m; ε_r = 38.219; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-23-2015; Ambient Temp: 23.4°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3287; ConvF(5.08, 5.08, 5.08); Calibrated: 10/29/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 10/20/2015
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)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.56 W/kg
SAR(1 g) = 4.10 W/kg
Deviation(1 g) = 0.99 %



0 dB = 5.14 W/kg = 7.11 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

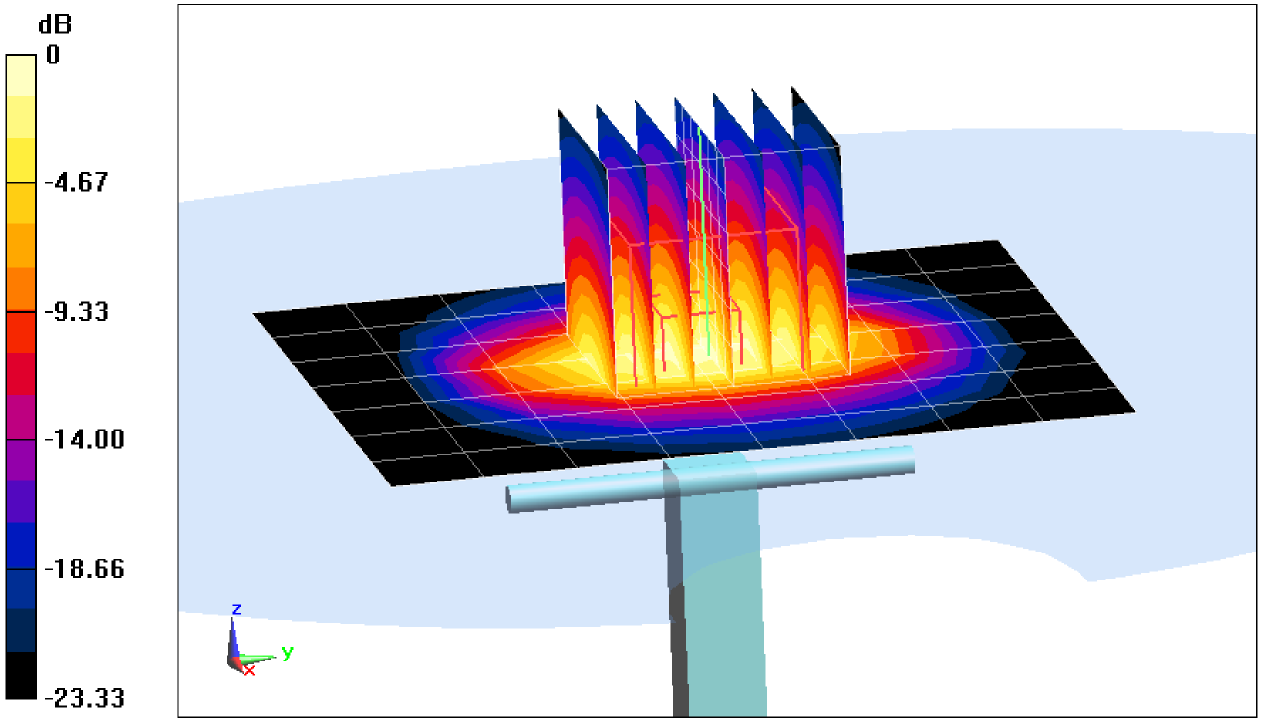
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2400 Head Medium parameters used:
f = 2450 MHz; σ = 1.879 S/m; ε_r = 39.335; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-23-2015; Ambient Temp: 21.7°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3351; ConvF(4.46, 4.46, 4.46); Calibrated: 6/22/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2015
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 11.2 W/kg
SAR(1 g) = 5.22 W/kg
Deviation(1 g) = -0.95 %



0 dB = 6.92 W/kg = 8.40 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1003

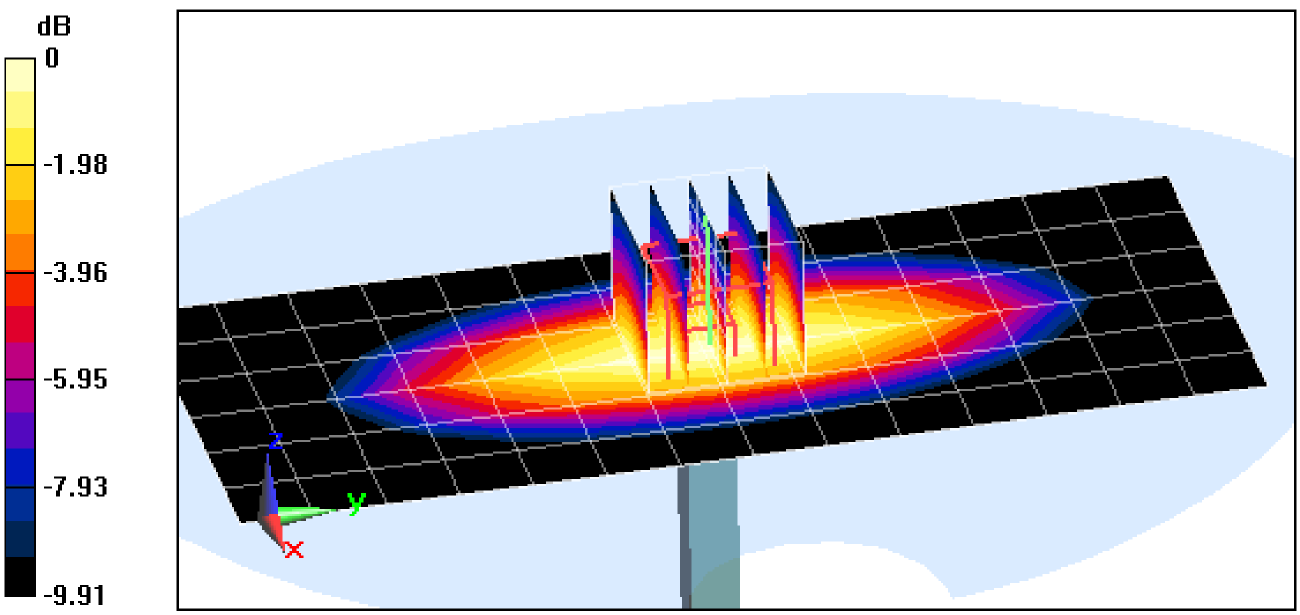
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium: 750 Body Medium parameters used (interpolated):
f = 750 MHz; $\sigma = 0.954$ S/m; $\varepsilon_r = 53.601$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-23-2015; Ambient Temp: 22.0°C; Tissue Temp: 23.7°C

Probe: ES3DV3 - SN3333; ConvF(6.31, 6.31, 6.31); Calibrated: 10/29/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 10/27/2015
Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

750 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.53 W/kg
SAR(1 g) = 1.74 W/kg
Deviation(1 g) = 2.84 %



0 dB = 2.02 W/kg = 3.05 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

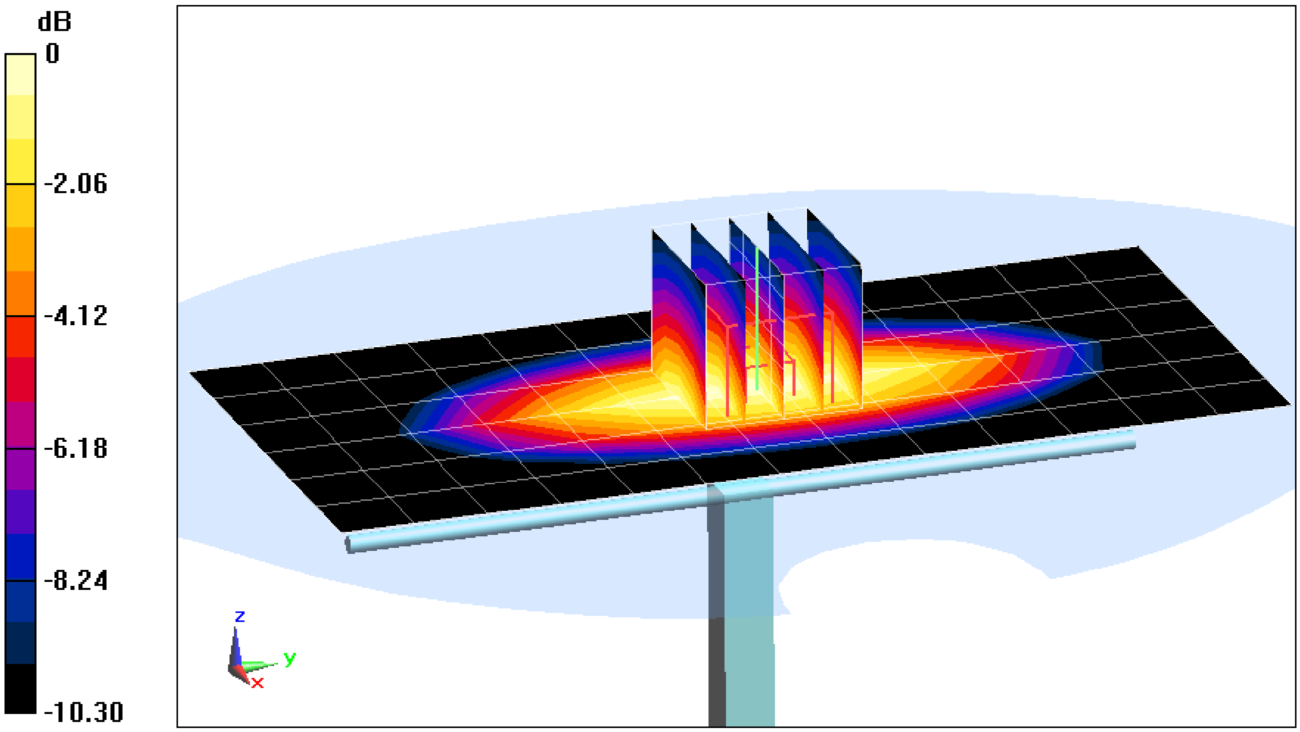
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Body Medium parameters used:
f = 835 MHz; σ = 0.989 S/m; ε_r = 54.008; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 11-24-2015; Ambient Temp: 21.5°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3351; ConvF(6.11, 6.11, 6.11); Calibrated: 6/22/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2015
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

835 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.52 W/kg
SAR(1 g) = 1.74 W/kg
Deviation(1 g) = -5.43 %



0 dB = 2.03 W/kg = 3.07 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

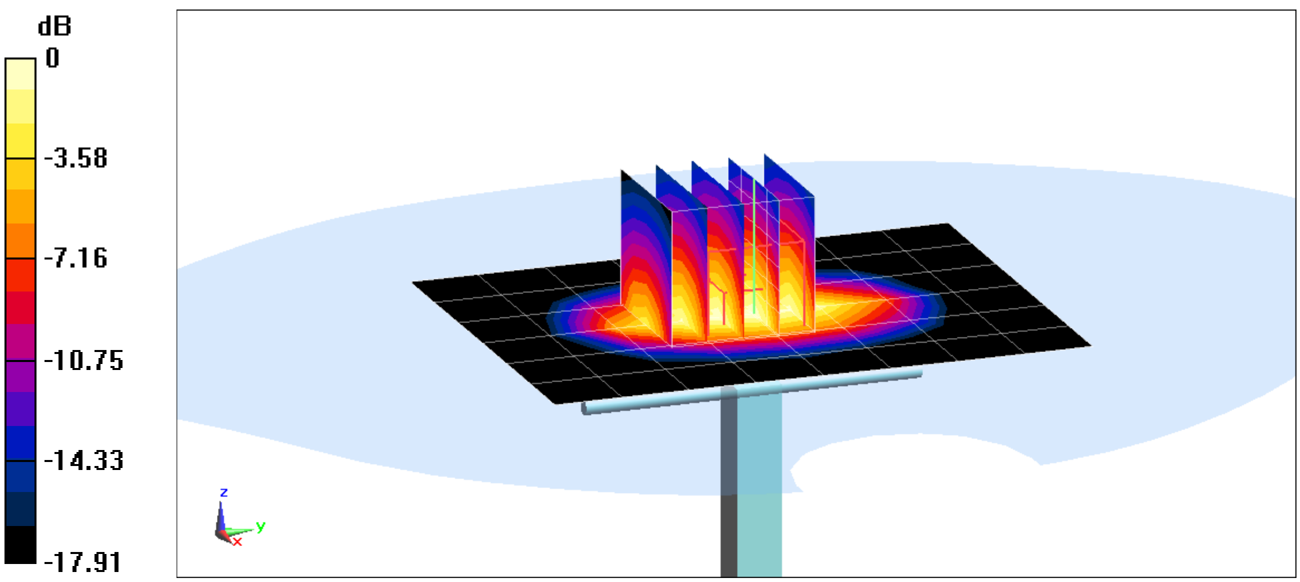
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used:
$f = 1750$ MHz; $\sigma = 1.495$ S/m; $\varepsilon_r = 51.318$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-23-2015; Ambient Temp: 20.8°C; Tissue Temp: 20.5°C

Probe: ES3DV2 - SN3022; ConvF(4.79, 4.79, 4.79); Calibrated: 8/26/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/18/2015
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 6.79 W/kg
SAR(1 g) = 3.82 W/kg
Deviation(1 g) = 2.96 %



0 dB = 4.77 W/kg = 6.79 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

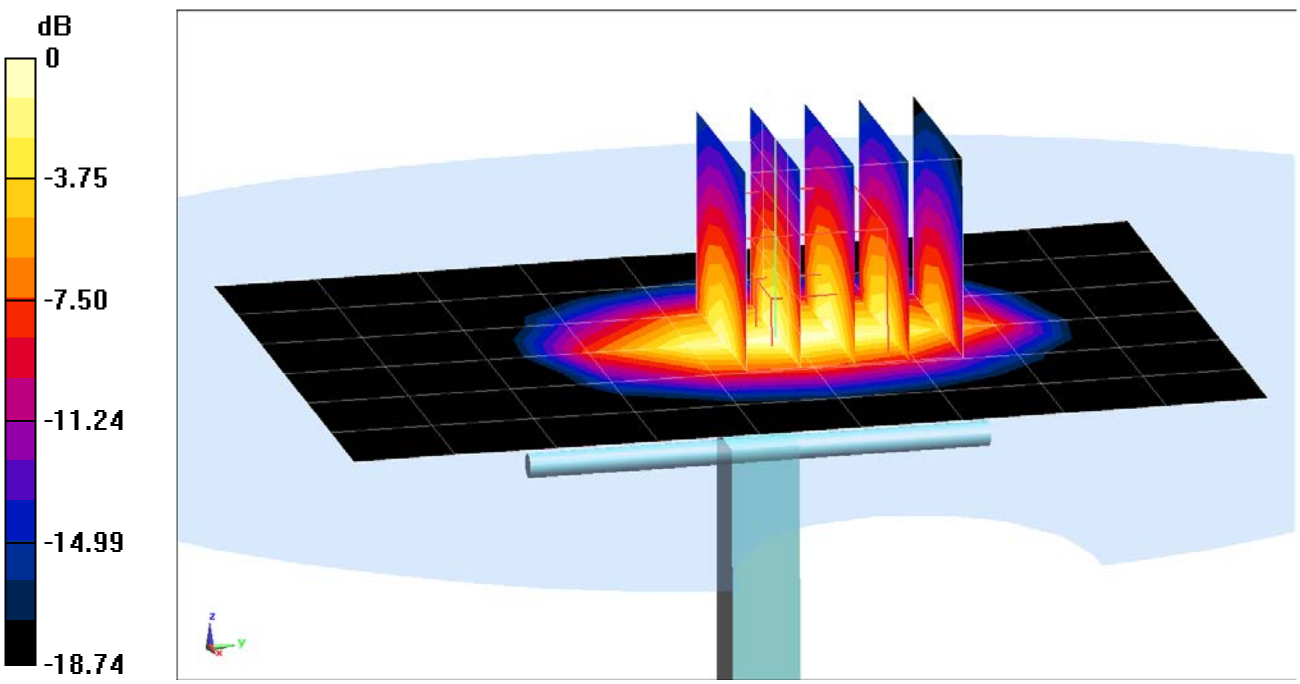
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.546 S/m; ε_r = 51.212; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-23-2015; Ambient Temp: 23.4°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3288; ConvF(4.81, 4.81, 4.81); Calibrated: 9/18/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2015
Phantom: Main TWIN SAM; Type: QD000P40CC; Serial: TP-1406
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.14 W/kg
SAR(1 g) = 4.02 W/kg
Deviation(1 g) = 0.00 %



0 dB = 5.07 W/kg = 7.05 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

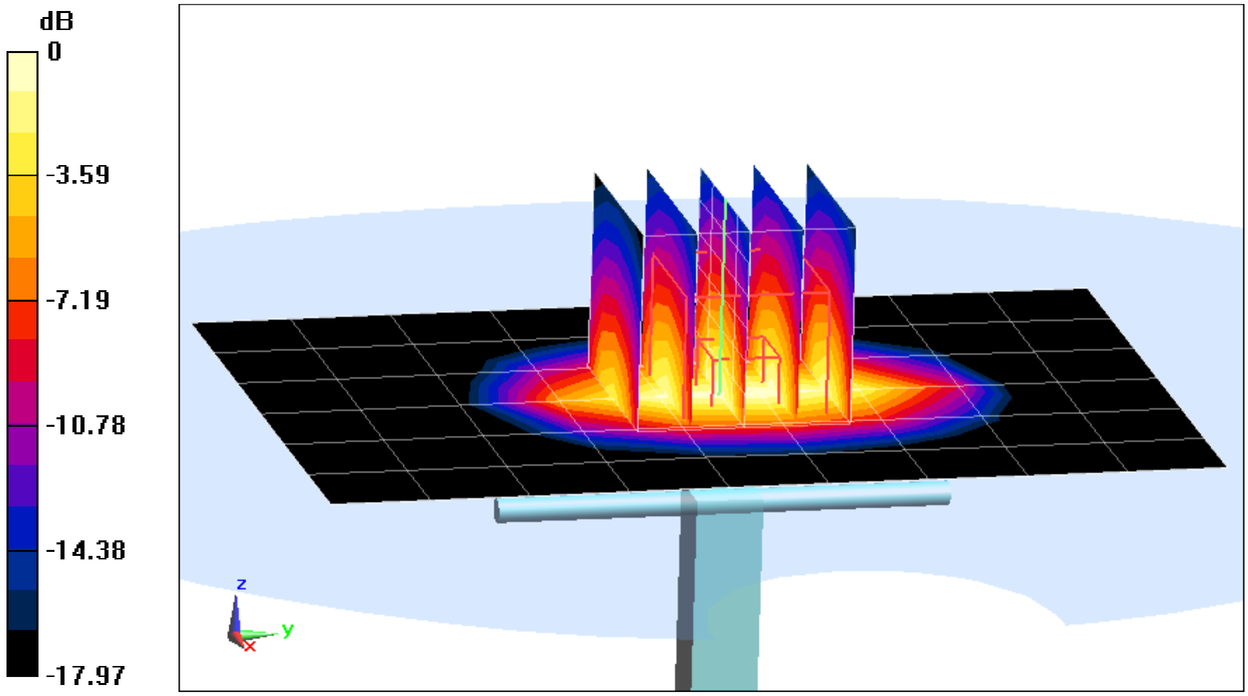
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.582 S/m; ε_r = 55.616; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-27-2015; Ambient Temp: 21.9°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3351; ConvF(4.68, 4.68, 4.68); Calibrated: 6/22/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2015
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.43 W/kg
SAR(1 g) = 4.20 W/kg
Deviation(1 g) = 5.00 %



0 dB = 5.26 W/kg = 7.21 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

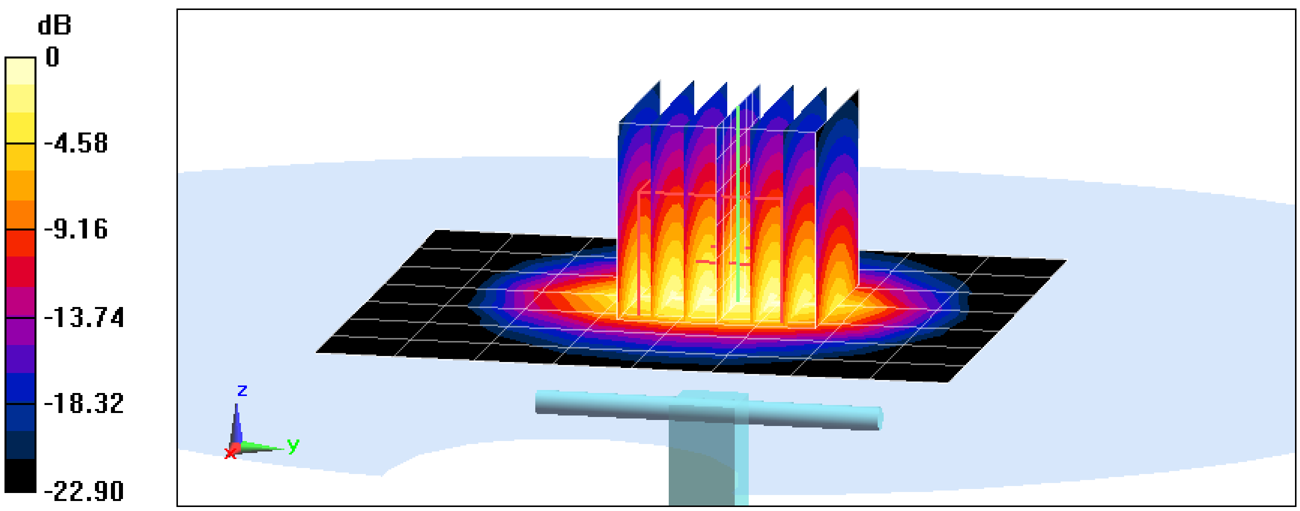
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2400 Body Medium parameters used:
f = 2450 MHz; σ = 1.975 S/m; ε_r = 51.385; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-23-2015; Ambient Temp: 21.9°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3263; ConvF(4.28, 4.28, 4.28); Calibrated: 5/20/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 6/17/2015
Phantom: SAM with CRP v5.0 (Right); Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 12.0 W/kg
SAR(1 g) = 5.53 W/kg
Deviation(1 g) = 6.55 %



0 dB = 7.27 W/kg = 8.62 dBW/kg

APPENDIX C: PROBE CALIBRATION

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

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

Accreditation No.: **SCS 0108**

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

Client **PC Test**

Certificate No: **D750V3-1003_Jan15**

CALIBRATION CERTIFICATE

Object	D750V3 - SN: 1003
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	January 16, 2015

CC
2/3/15

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: January 19, 2015

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 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 ± 0.2) °C	41.7 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.09 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.32 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	56.0 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.46 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.58 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.7 Ω - 1.4 jΩ
Return Loss	- 28.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.3 Ω - 3.8 jΩ
Return Loss	- 27.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.043 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 21, 2009

DASY5 Validation Report for Head TSL

Date: 16.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1003

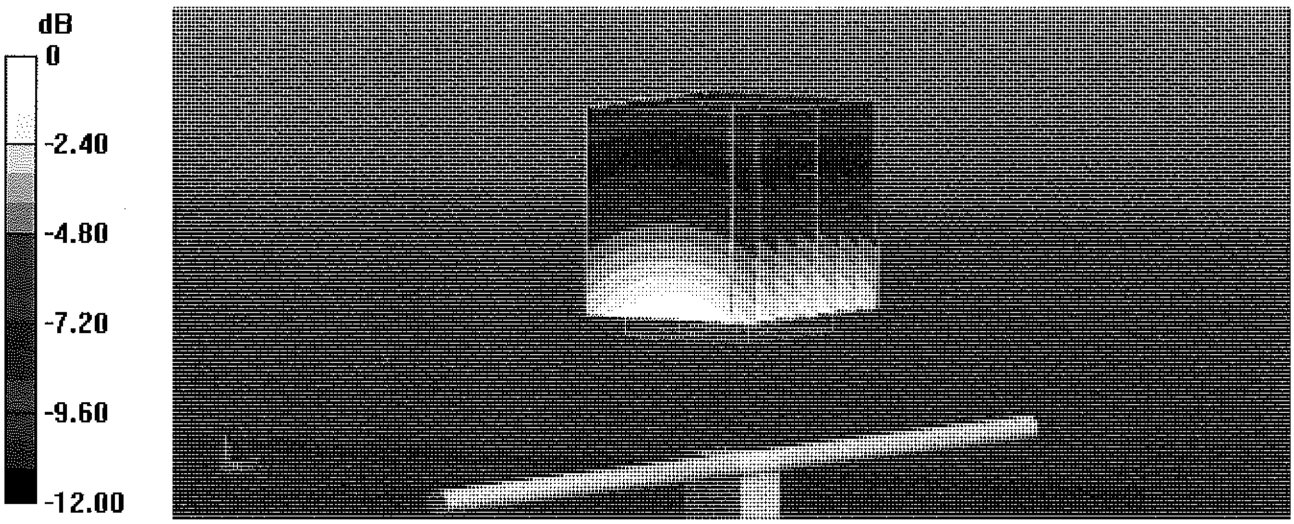
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.91 S/m; ε_r = 41.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.44, 6.44, 6.44); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

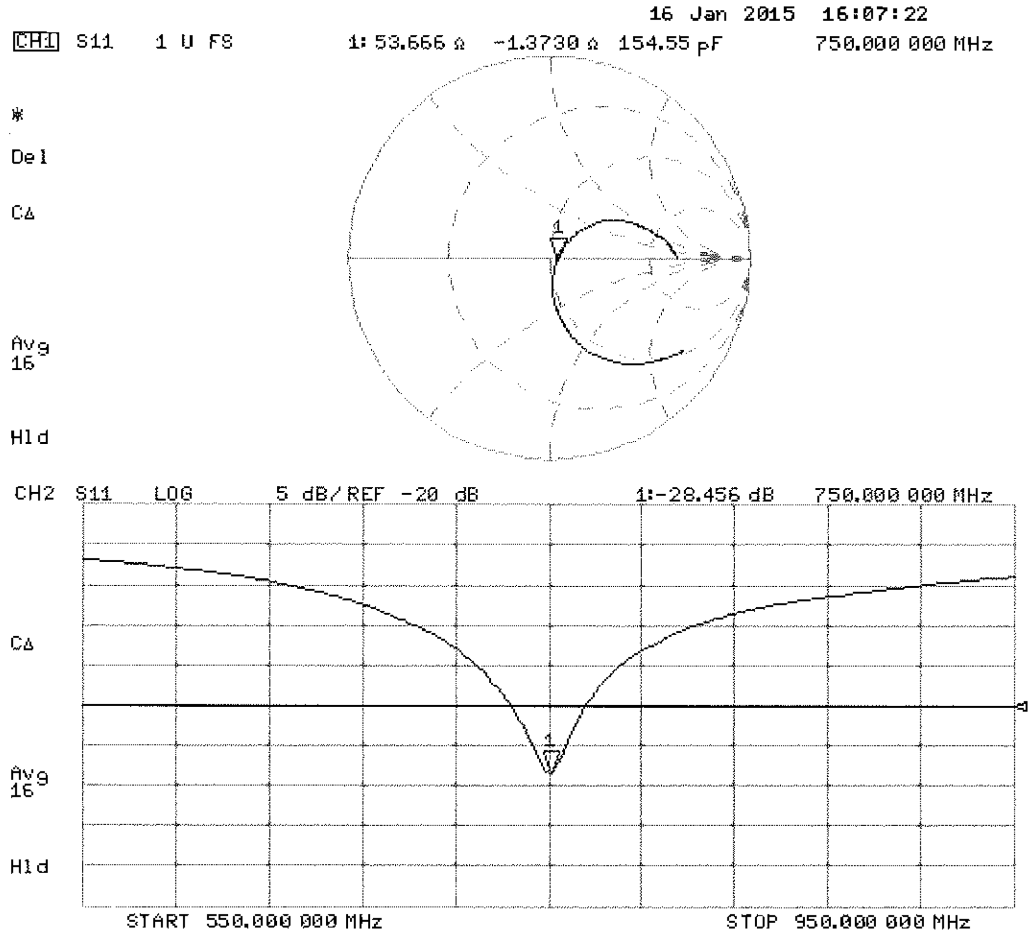
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 53.08 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.05 W/kg
SAR(1 g) = 2.06 W/kg; SAR(10 g) = 1.35 W/kg
Maximum value of SAR (measured) = 2.41 W/kg



0 dB = 2.41 W/kg = 3.82 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 16.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1003

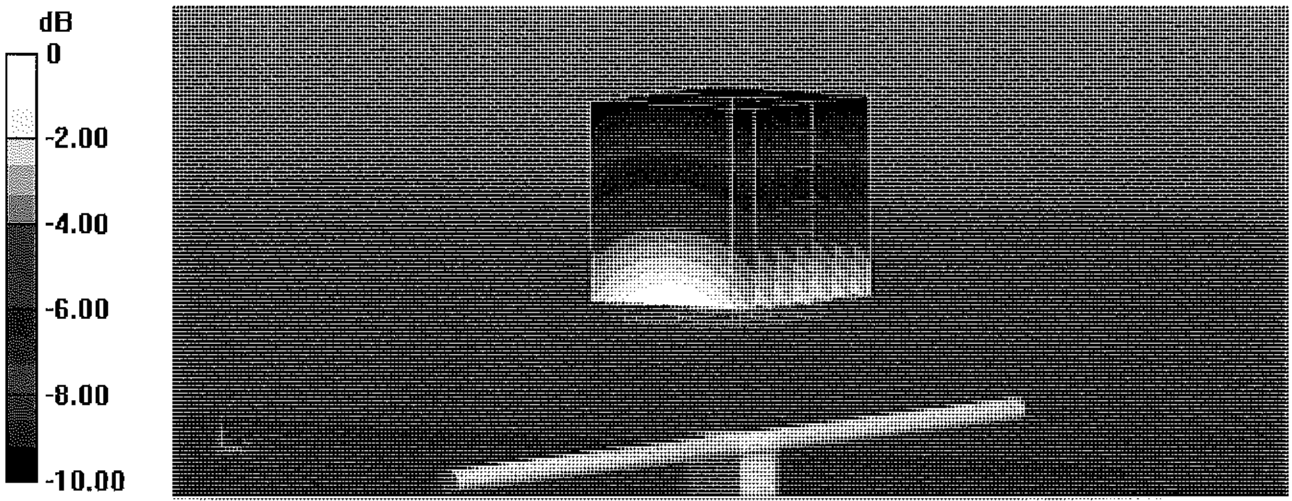
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.99 S/m; ε_r = 56; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.21, 6.21, 6.21); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

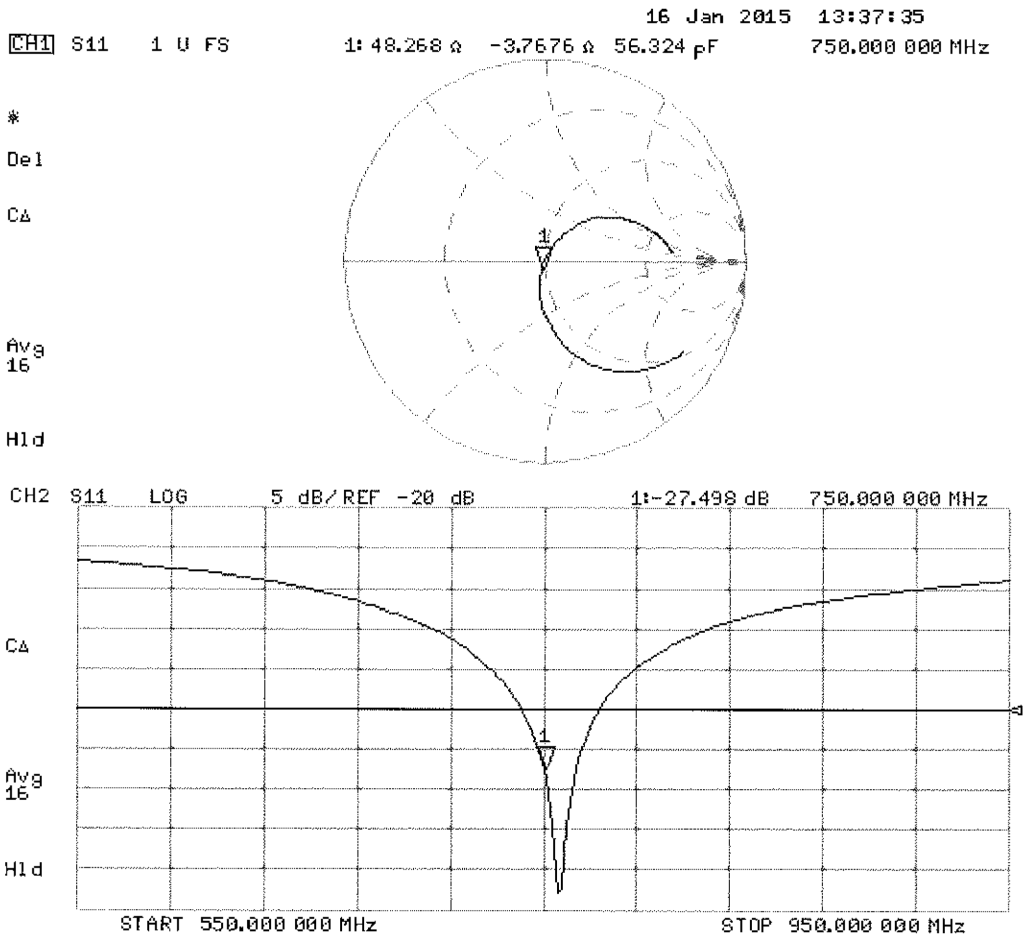
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.21 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.16 W/kg
SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.42 W/kg
Maximum value of SAR (measured) = 2.52 W/kg



0 dB = 2.52 W/kg = 4.01 dBW/kg

Impedance Measurement Plot for Body TSL



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

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Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D835V2-4d132_Jan15

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d132
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	January 16, 2015

CC 2/3/15

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: January 19, 2015

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

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

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.25 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.04 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.8 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.35 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.14 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.53 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.98 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.8 Ω - 2.3 jΩ
Return Loss	- 30.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.5 Ω - 4.3 jΩ
Return Loss	- 25.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.385 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 22, 2011

DASY5 Validation Report for Head TSL

Date: 16.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

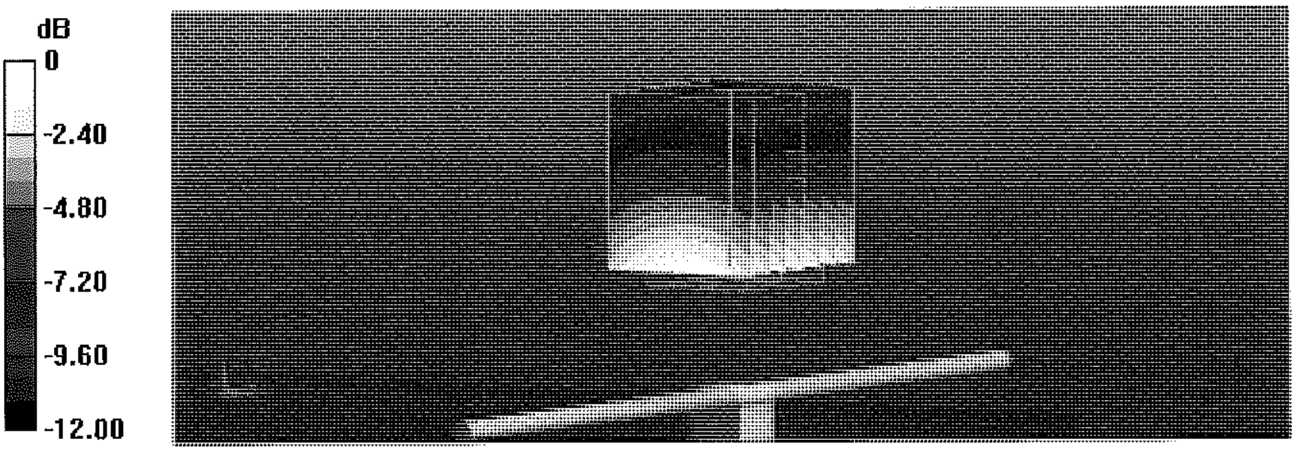
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.93 S/m; ε_r = 41.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.2, 6.2, 6.2); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

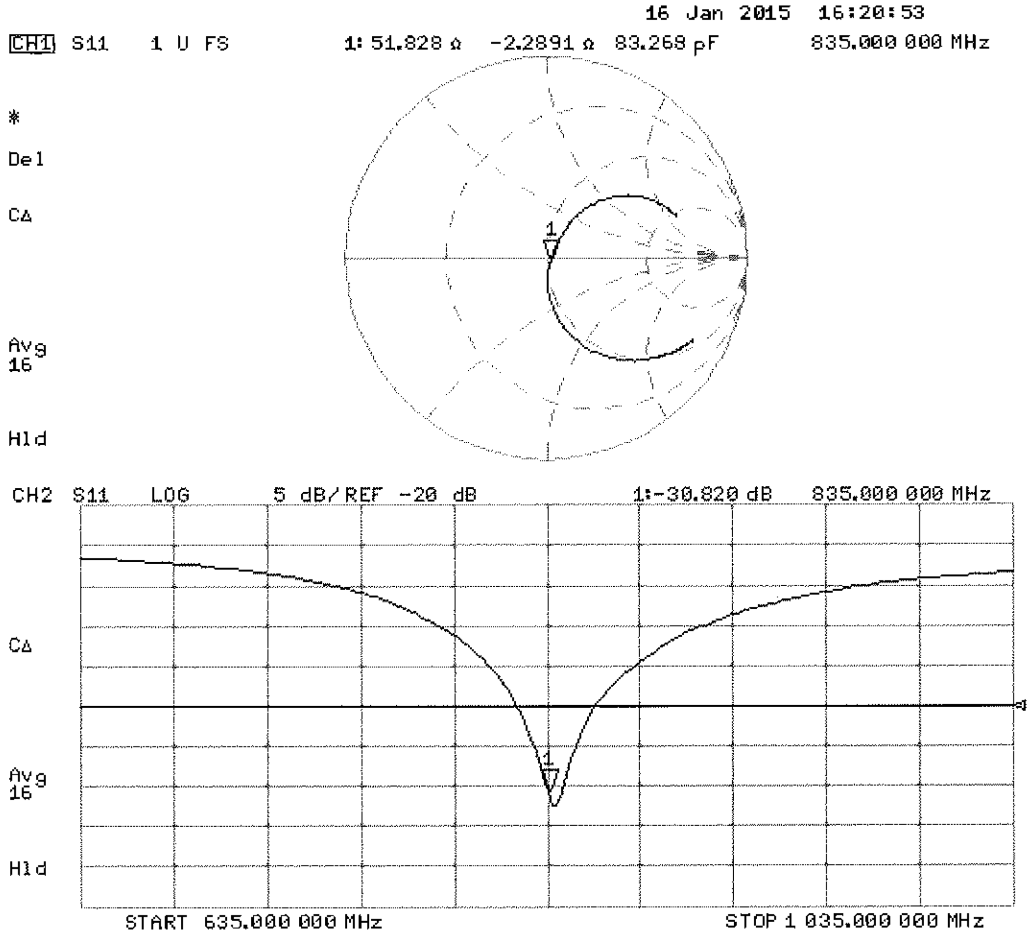
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.27 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.51 W/kg
SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.54 W/kg
Maximum value of SAR (measured) = 2.77 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 16.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

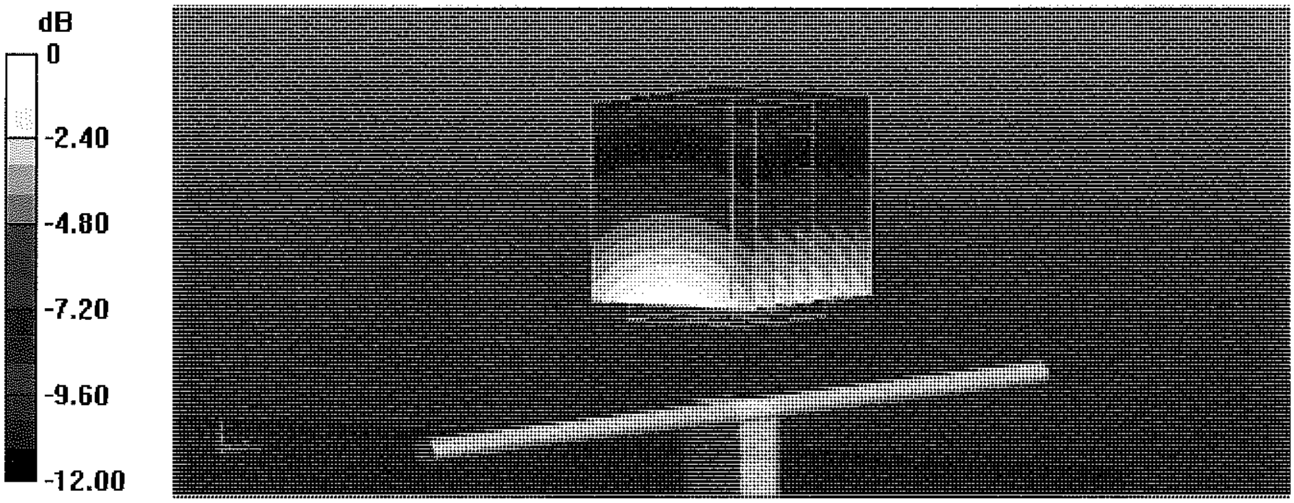
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.01 S/m; ε_r = 55.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.17, 6.17, 6.17); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

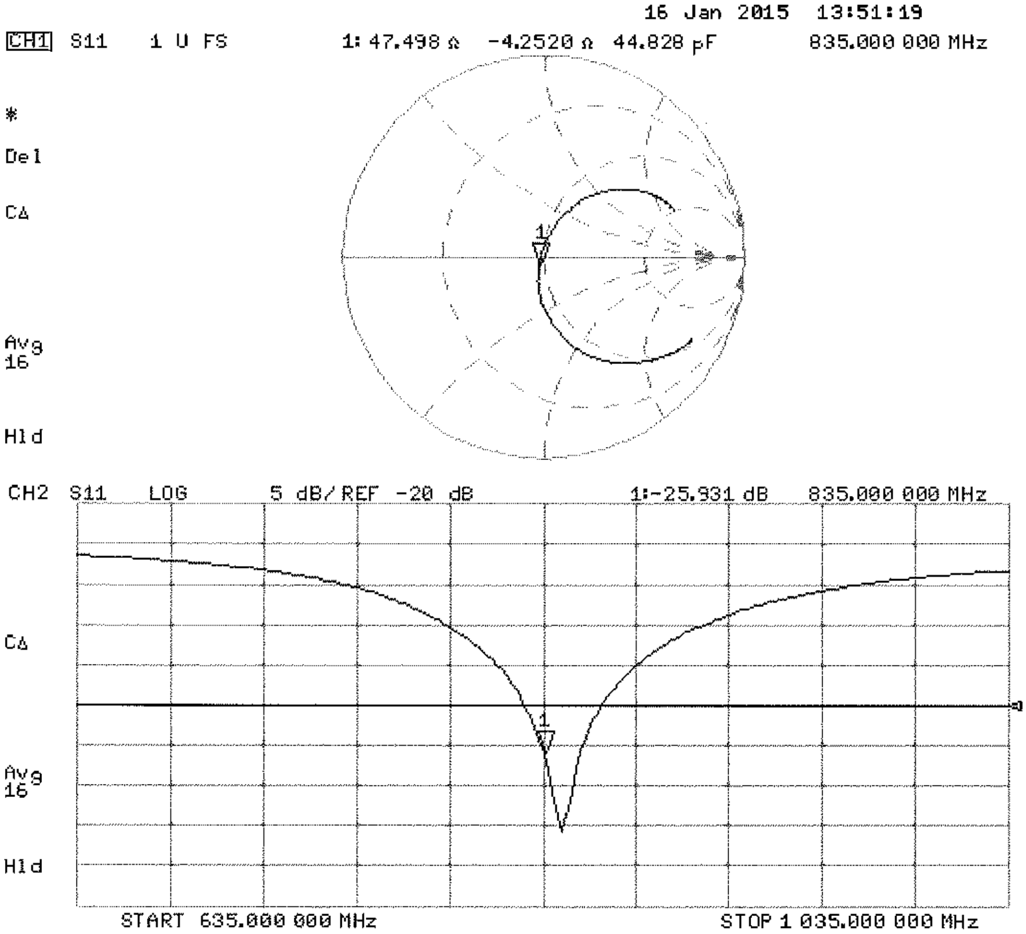
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.27 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 3.47 W/kg
SAR(1 g) = 2.35 W/kg; SAR(10 g) = 1.53 W/kg
Maximum value of SAR (measured) = 2.75 W/kg



0 dB = 2.75 W/kg = 4.39 dBW/kg

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
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Accreditation No.: SCS 0108

Client PC Test

Certificate No: D1750V2-1051_Apr15

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 15, 2015

PM ✓ 4/29/15

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: April 15, 2015

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.35 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**36.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.2 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.5 ± 6 %	1.48 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.32 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**37.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.01 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.0 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.3 Ω - 0.2 jΩ
Return Loss	- 37.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.9 Ω + 0.3 jΩ
Return Loss	- 29.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.221 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: 15.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

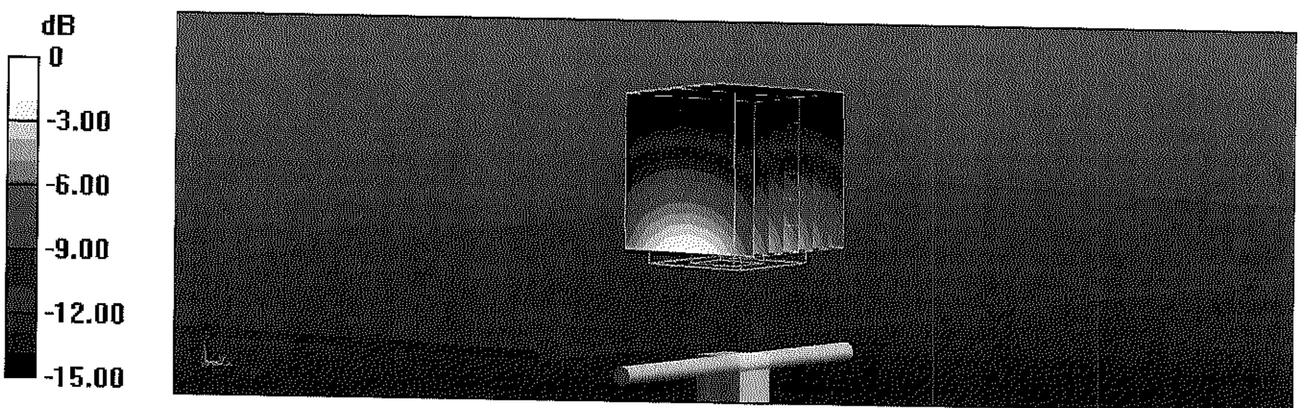
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.35 S/m; ε_r = 38.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.2, 5.2, 5.2); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

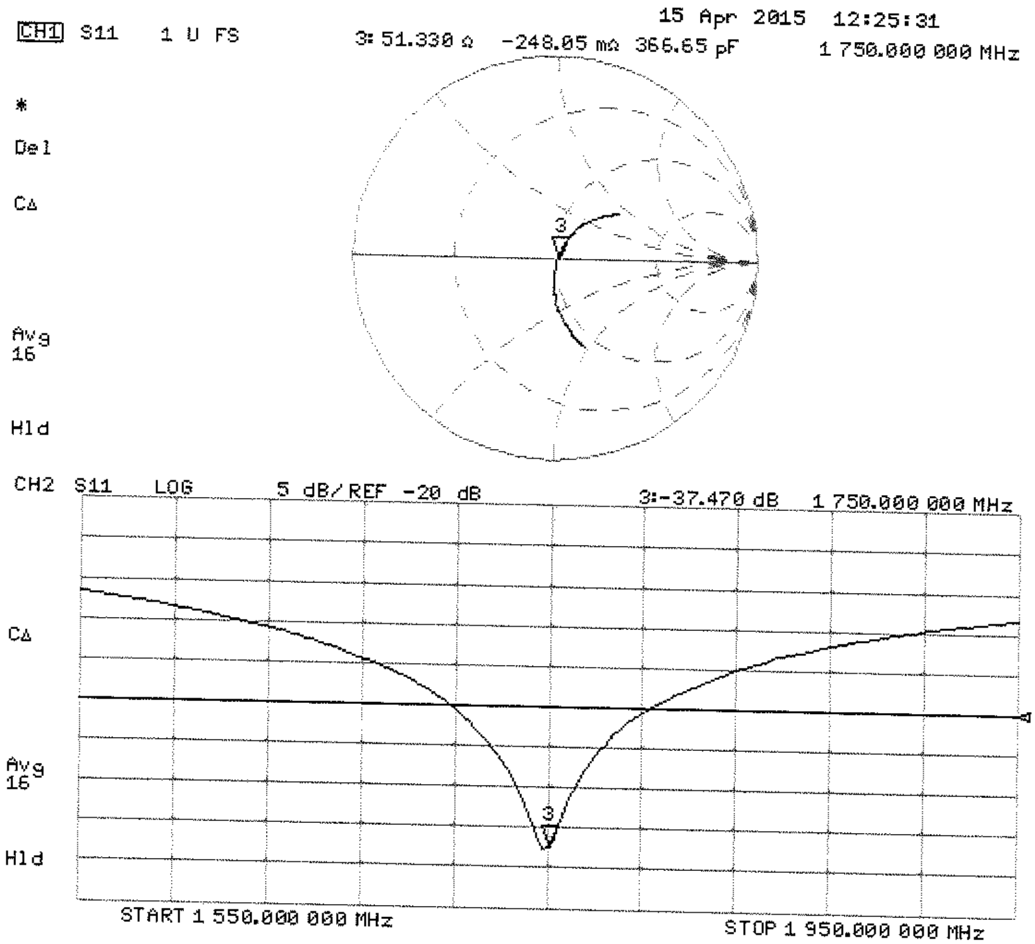
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.99 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 16.3 W/kg
SAR(1 g) = 9.04 W/kg; SAR(10 g) = 4.8 W/kg
Maximum value of SAR (measured) = 11.5 W/kg



0 dB = 11.5 W/kg = 10.61 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 15.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

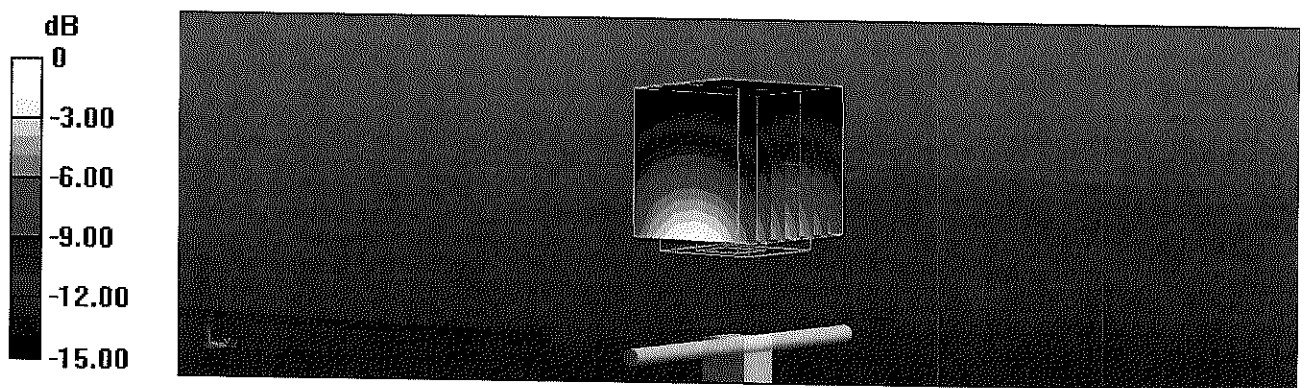
DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1051

Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.48 S/m; ε_r = 51.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

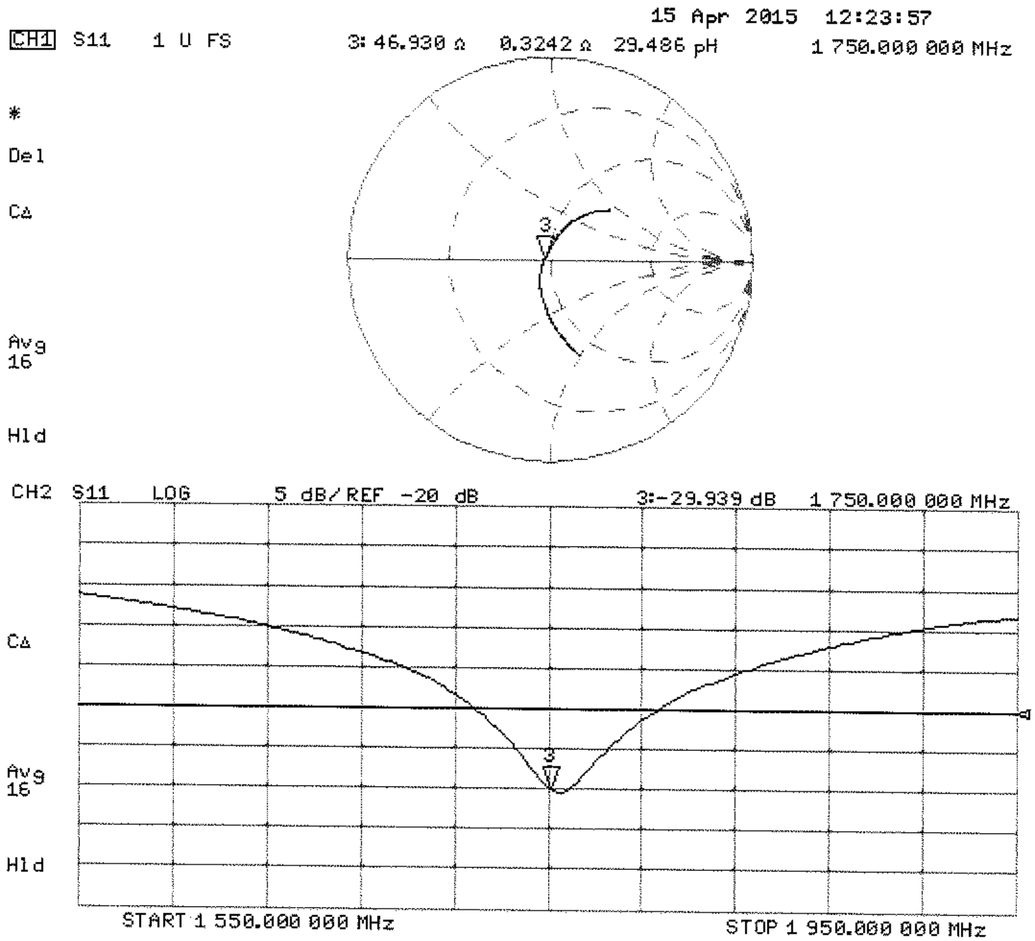
- Probe: ES3DV3 - SN3205; ConvF(4.88, 4.88, 4.88); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 92.87 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 16.0 W/kg
SAR(1 g) = 9.32 W/kg; SAR(10 g) = 5.01 W/kg
Maximum value of SAR (measured) = 11.7 W/kg



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

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D1900V2-5d148_Feb15

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 18, 2015

QC ✓ 3/6/15

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: February 18, 2015

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Accreditation No.: SCS 0108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.1 ± 6 %	1.42 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.3 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.1 ± 6 %	1.53 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**40.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.4 Ω + 6.2 jΩ
Return Loss	- 23.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.2 Ω + 6.6 jΩ
Return Loss	- 23.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.198 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: 18.02.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

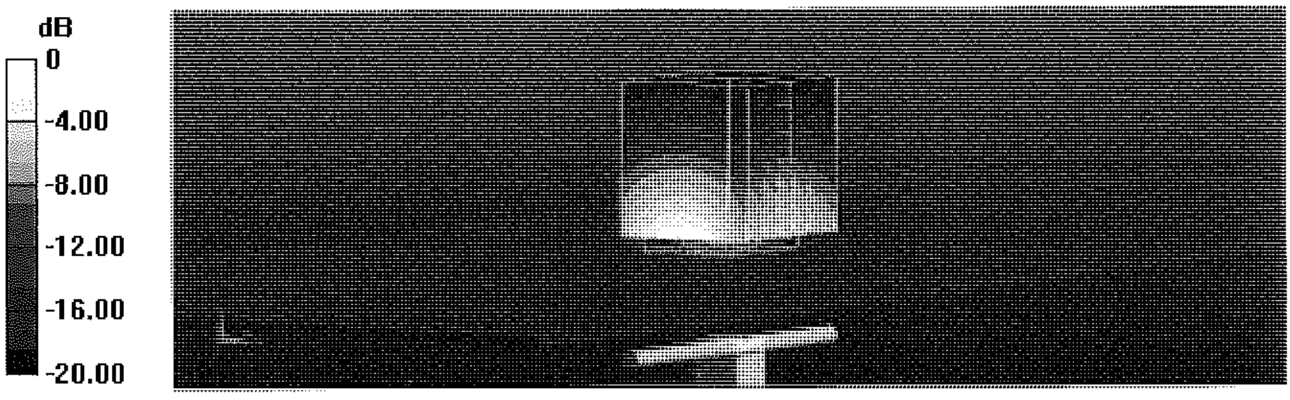
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.42 S/m; ε_r = 39.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5, 5, 5); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

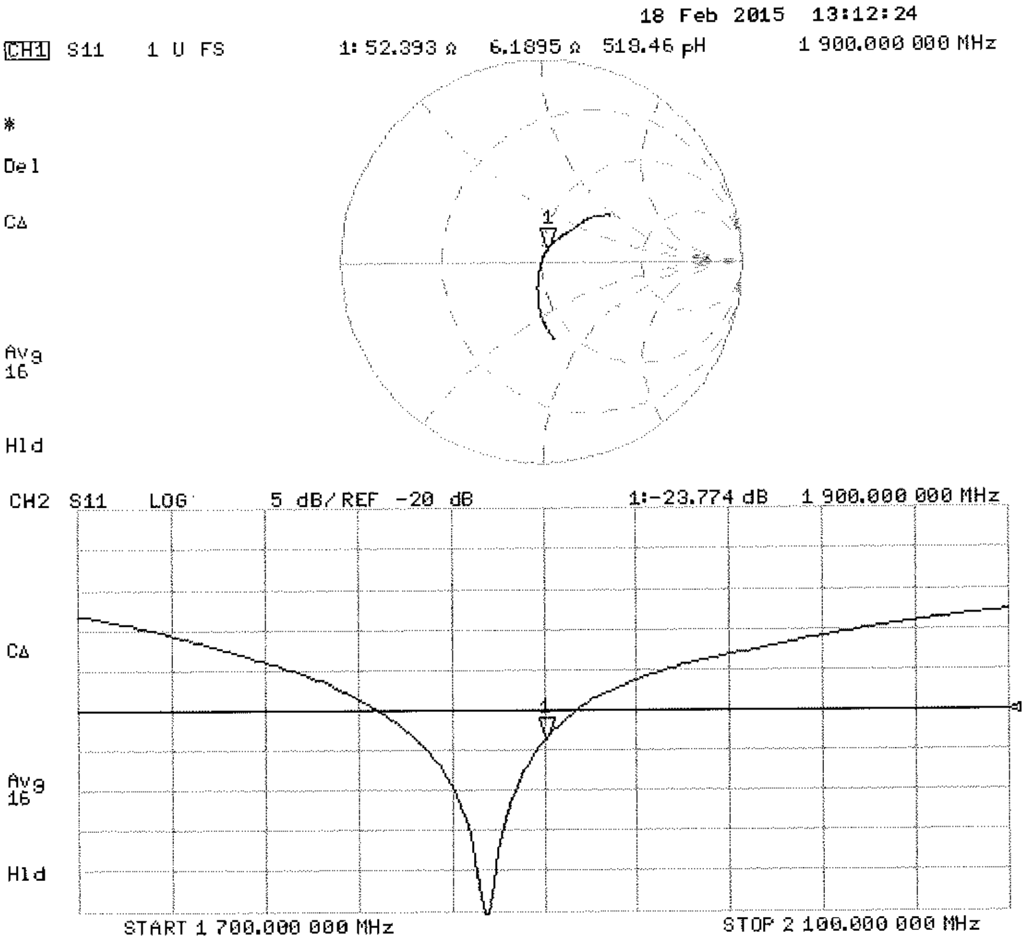
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.30 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 18.8 W/kg
SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.37 W/kg
Maximum value of SAR (measured) = 13.0 W/kg

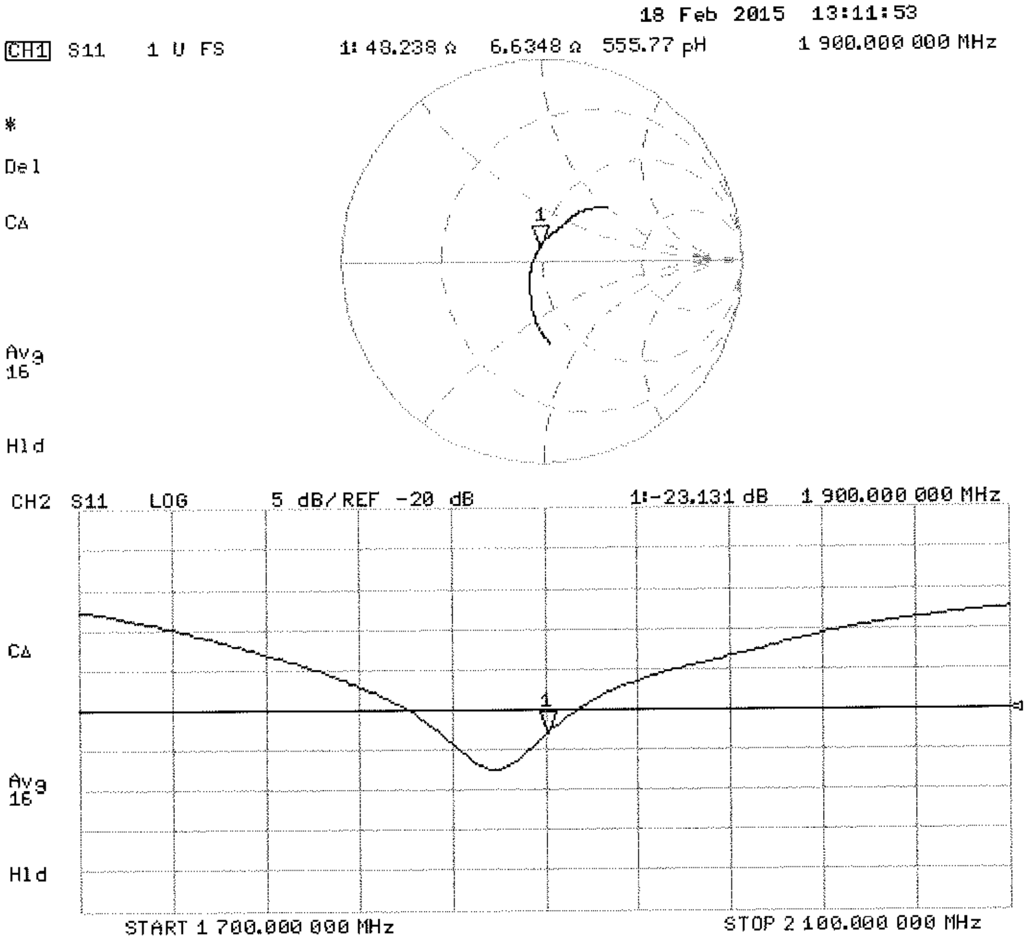


0 dB = 13.0 W/kg = 11.14 dBW/kg

Impedance Measurement Plot for Head TSL



Impedance Measurement Plot for Body TSL



DASY5 Validation Report for Body TSL

Date: 18.02.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

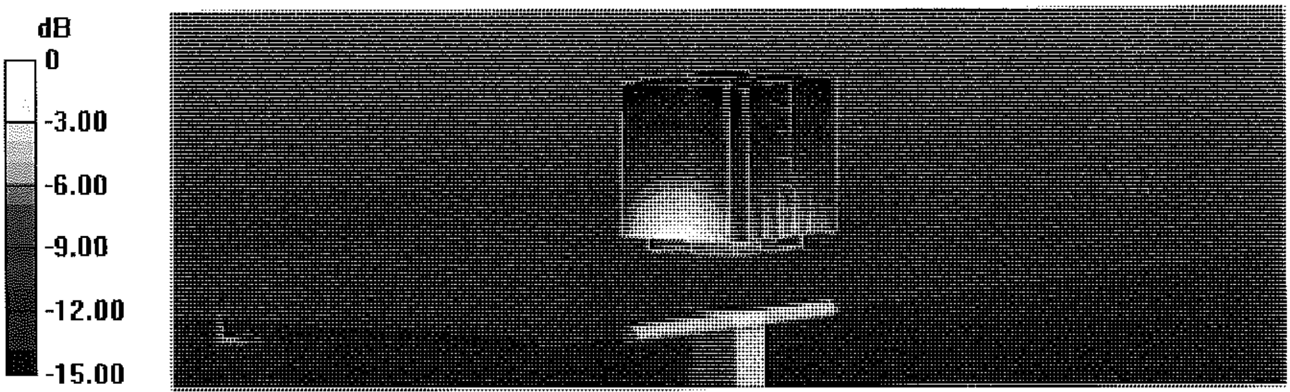
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.53 S/m; ε_r = 53.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.79 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 17.2 W/kg
SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.4 W/kg
Maximum value of SAR (measured) = 12.7 W/kg



0 dB = 12.7 W/kg = 11.04 dBW/kg

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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2450V2-797_Oct15**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 797
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	October 21, 2015

BN ✓ 11/03/15

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	US37292783	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	MY41092317	07-Oct-15 (No. 217-02223)	Oct-16
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 7349	30-Dec-14 (No. EX3-7349_Dec14)	Dec-15
DAE4	SN: 601	17-Aug-15 (No. DAE4-601_Aug15)	Aug-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100972	15-Jun-15 (in house check Jun-15)	In house check: Jun-18
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

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

Issued: October 22, 2015

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.0 ± 6 %	1.84 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.4 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.8 ± 6 %	1.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.2 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.1 Ω + 6.0 jΩ
Return Loss	- 21.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.8 Ω + 9.3 jΩ
Return Loss	- 20.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 24, 2006

DASY5 Validation Report for Head TSL

Date: 21.10.2015

Test Laboratory: SPEAG, Zurich, Switzerland

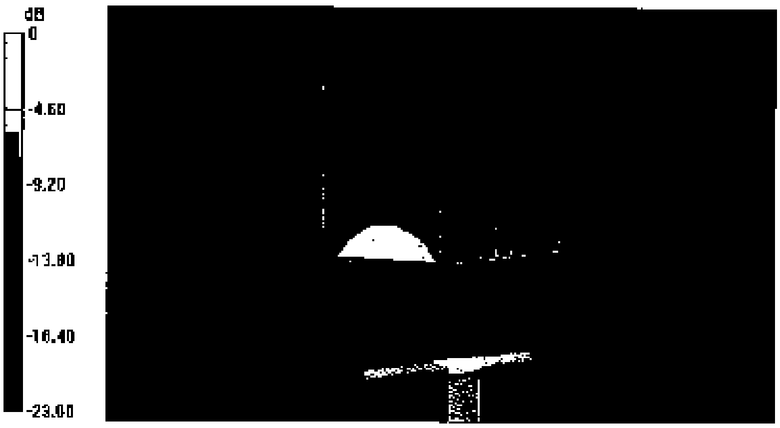
DUT: Dipole 2450 MHz ; Type: D2450V2; Serial: D2450V2 - SN: 797

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.84 S/m; ε_r = 38; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

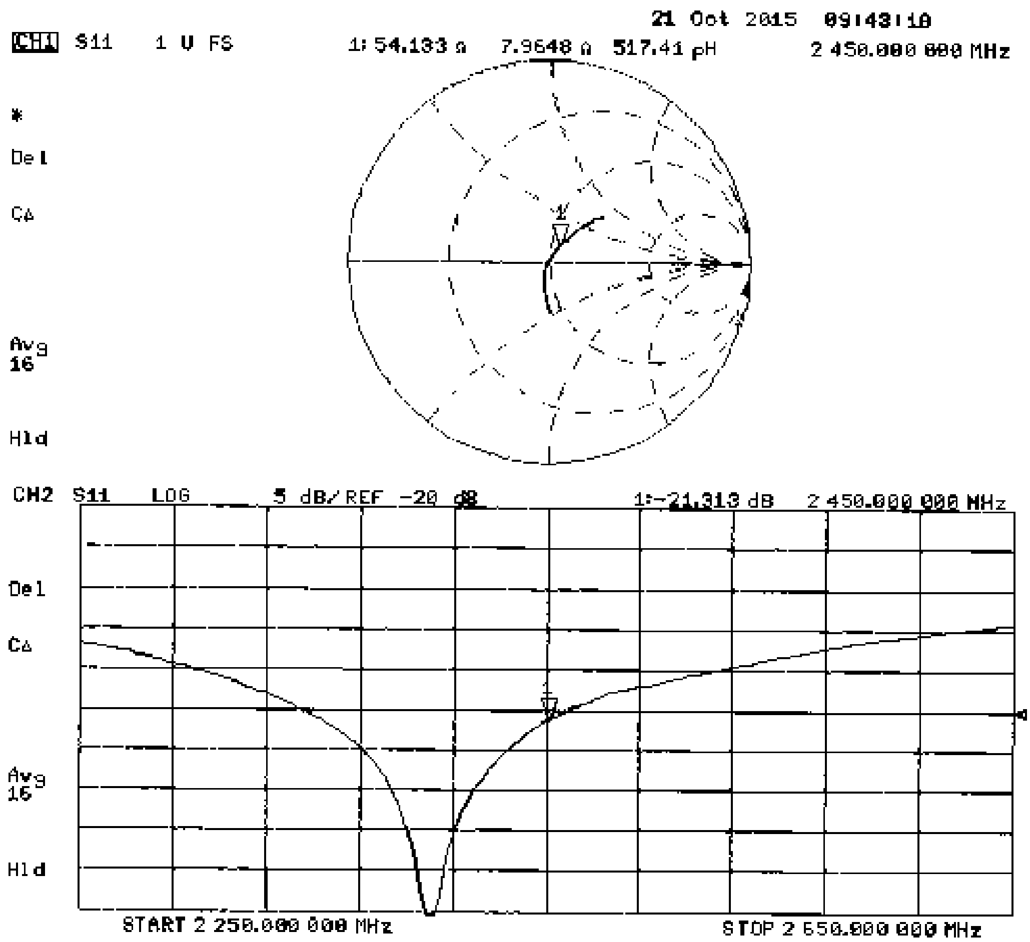
- Probe: EX3DV4 - SN7349; ConvF(7.67, 7.67, 7.67); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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 = 114.6 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 27.8 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.17 W/kg
Maximum value of SAR (measured) = 22.3 W/kg



0 dB = 22.3 W/kg = 13.48 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 21.10.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.99 S/m; ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

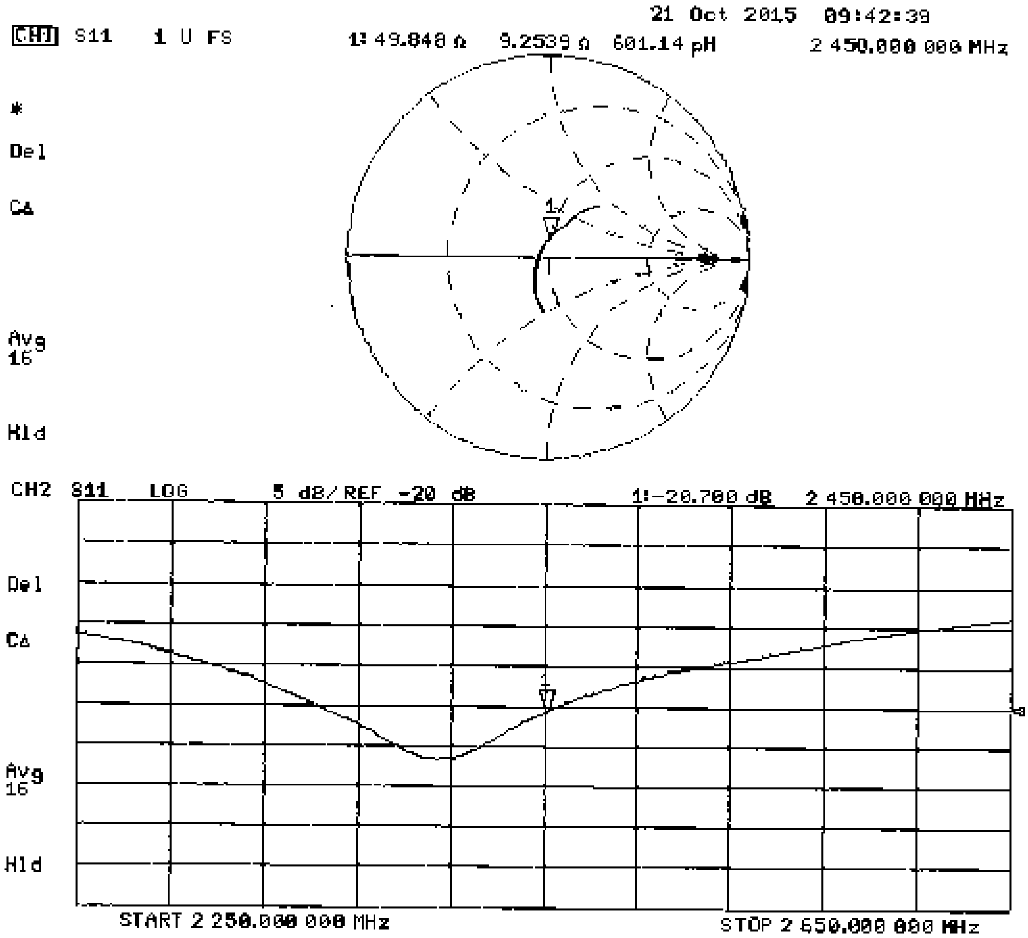
DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.53, 7.53, 7.53); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- 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 = 108.1 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 25.8 W/kg
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.08 W/kg
Maximum value of SAR (measured) = 21.2 W/kg

0 dB = 21.2 W/kg = 13.26 dBW/kg

Impedance Measurement Plot for Body TSL



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

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

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

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: D835V2-4d119_Apr15

CALIBRATION CERTIFICATE

Object	D835V2 - SN:4d119
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 13, 2015

RN ✓ 4/29/15

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Israe Elnaouq	Laboratory Technician	Israe Elnaouq
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: April 13, 2015

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.9 ± 6 %	0.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.38 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.11 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.4 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

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

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.55 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.06 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.2 Ω - 2.2 jΩ
Return Loss	- 33.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.7 Ω - 4.9 jΩ
Return Loss	- 25.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.386 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 29, 2010

DASY5 Validation Report for Head TSL

Date: 13.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

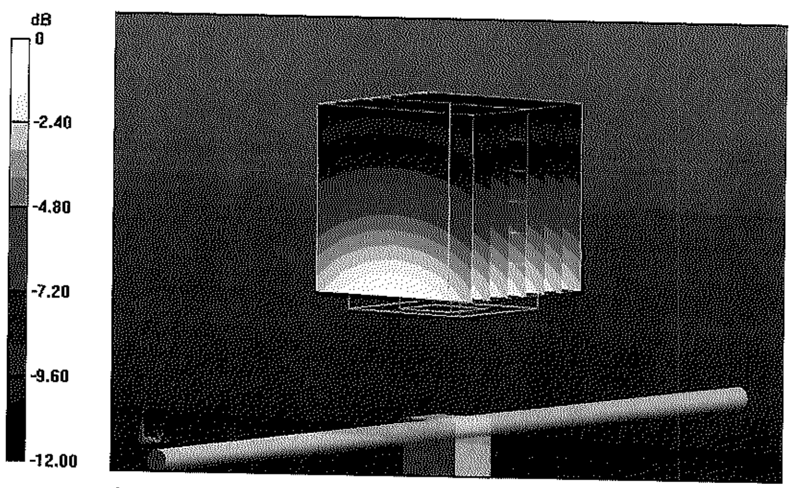
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d119

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 40.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

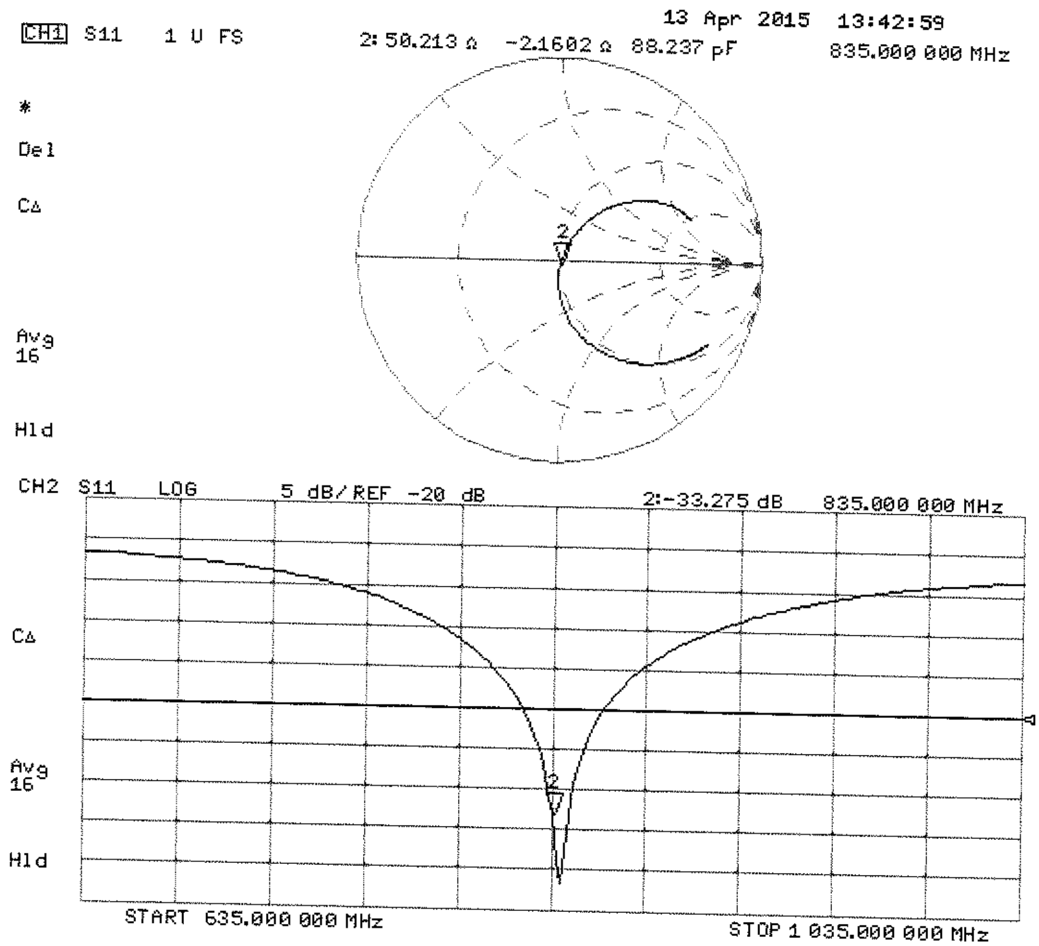
- Probe: ES3DV3 - SN3205; ConvF(6.2, 6.2, 6.2); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.77 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.64 W/kg
SAR(1 g) = 2.43 W/kg; SAR(10 g) = 1.57 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 Head TSL



DASY5 Validation Report for Body TSL

Date: 13.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

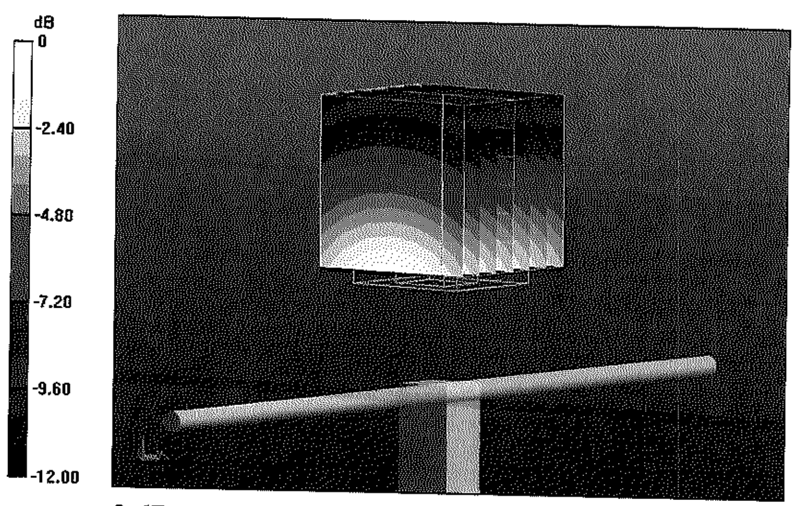
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d119

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma = 1.01$ S/m; $\varepsilon_r = 55.4$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

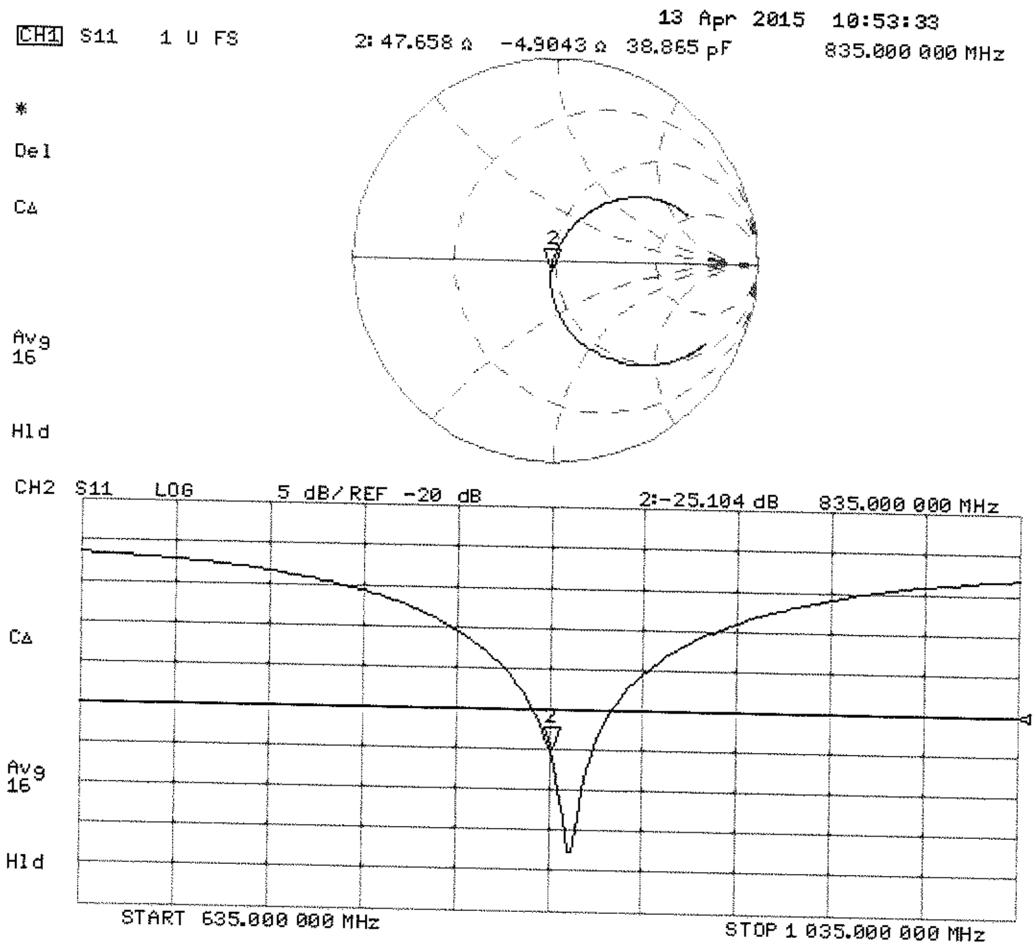
- Probe: ES3DV3 - SN3205; ConvF(6.17, 6.17, 6.17); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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 = 54.44 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 3.52 W/kg
SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.55 W/kg
Maximum value of SAR (measured) = 2.77 W/kg



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

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
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S Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D1900V2-5d141_Apr15

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 14, 2015

PM ✓ 4/29/15

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: April 14, 2015

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.6 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**39.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.9 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.8 ± 6 %	1.50 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**40.0 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.29 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.2 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.0 Ω + 4.6 jΩ
Return Loss	- 25.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.2 Ω + 5.6 jΩ
Return Loss	- 24.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.198 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

Date: 14.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

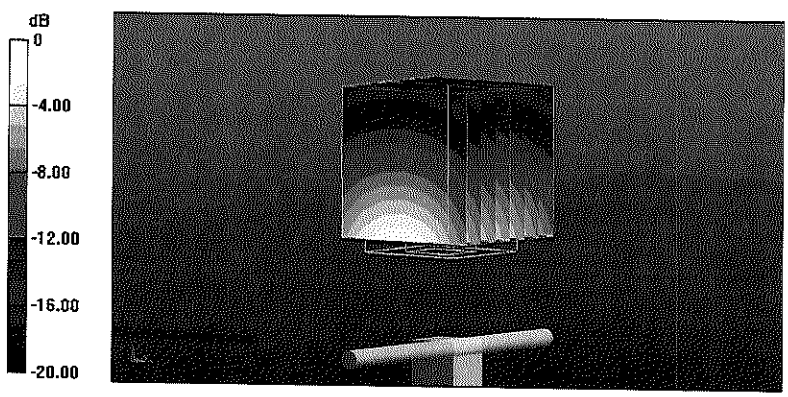
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.37 S/m; ε_r = 38.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5, 5, 5); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

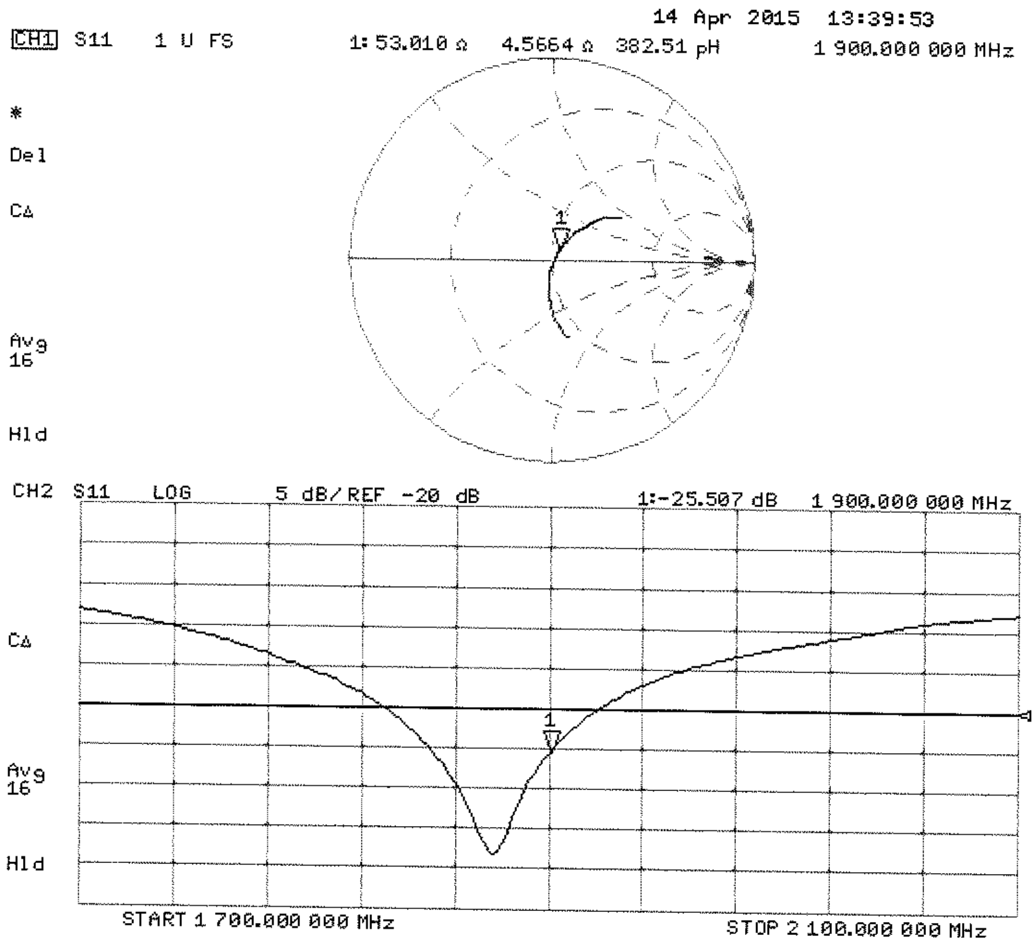
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.18 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 9.93 W/kg; SAR(10 g) = 5.2 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



DASY5 Validation Report for Body TSL

Date: 14.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

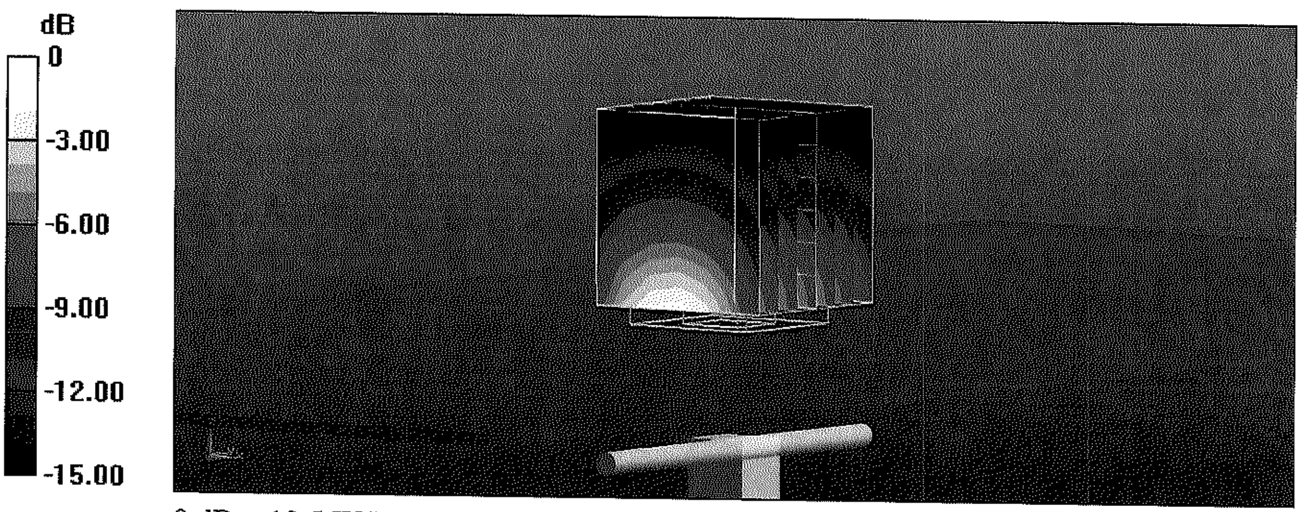
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d141

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.5 S/m; ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

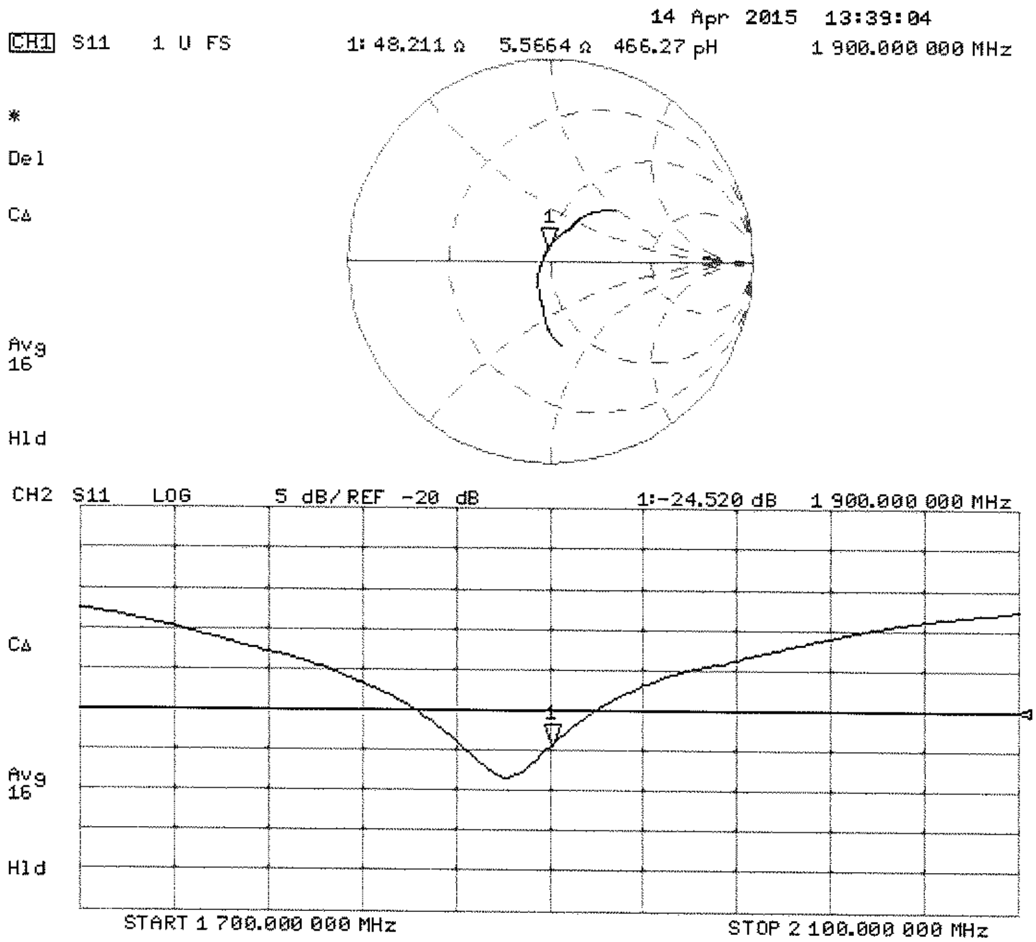
- Probe: ES3DV3 - SN3205; ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.73 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 16.9 W/kg
SAR(1 g) = 9.94 W/kg; SAR(10 g) = 5.29 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 Body TSL



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

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S Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D2450V2-719_Aug15

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 20, 2015

BN ✓
9/3/15

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	17-Aug-15 (No. DAE4-601_Aug15)	Aug-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: August 21, 2015

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.2 ± 6 %	1.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**54.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.48 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.7 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.2 ± 6 %	2.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.3 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.5 Ω + 5.3 jΩ
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.1 Ω + 6.5 jΩ
Return Loss	- 23.7 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: 20.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

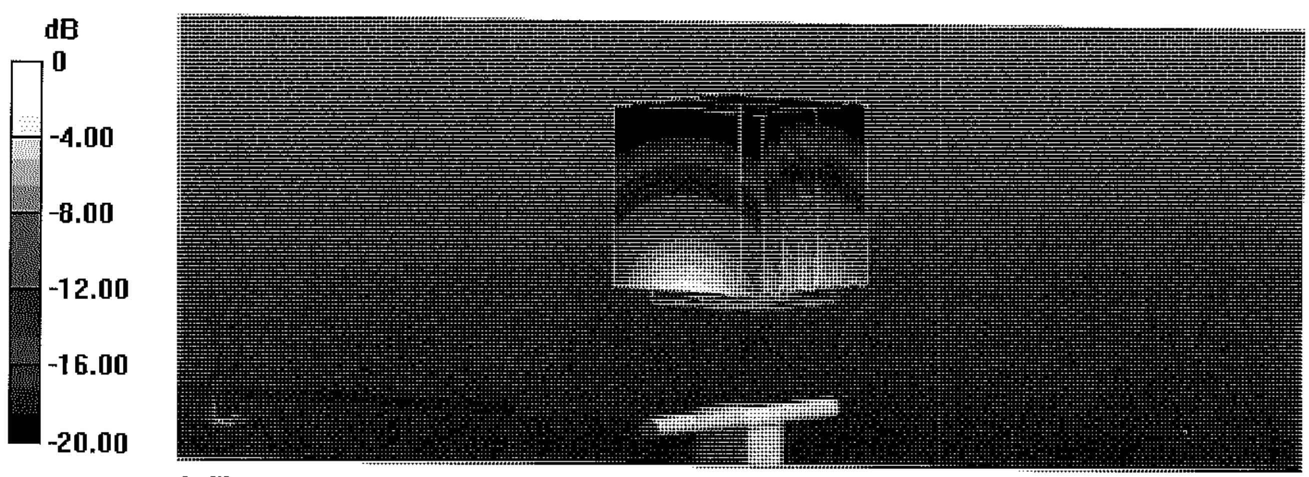
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 719

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.87 S/m; ε_r = 39.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

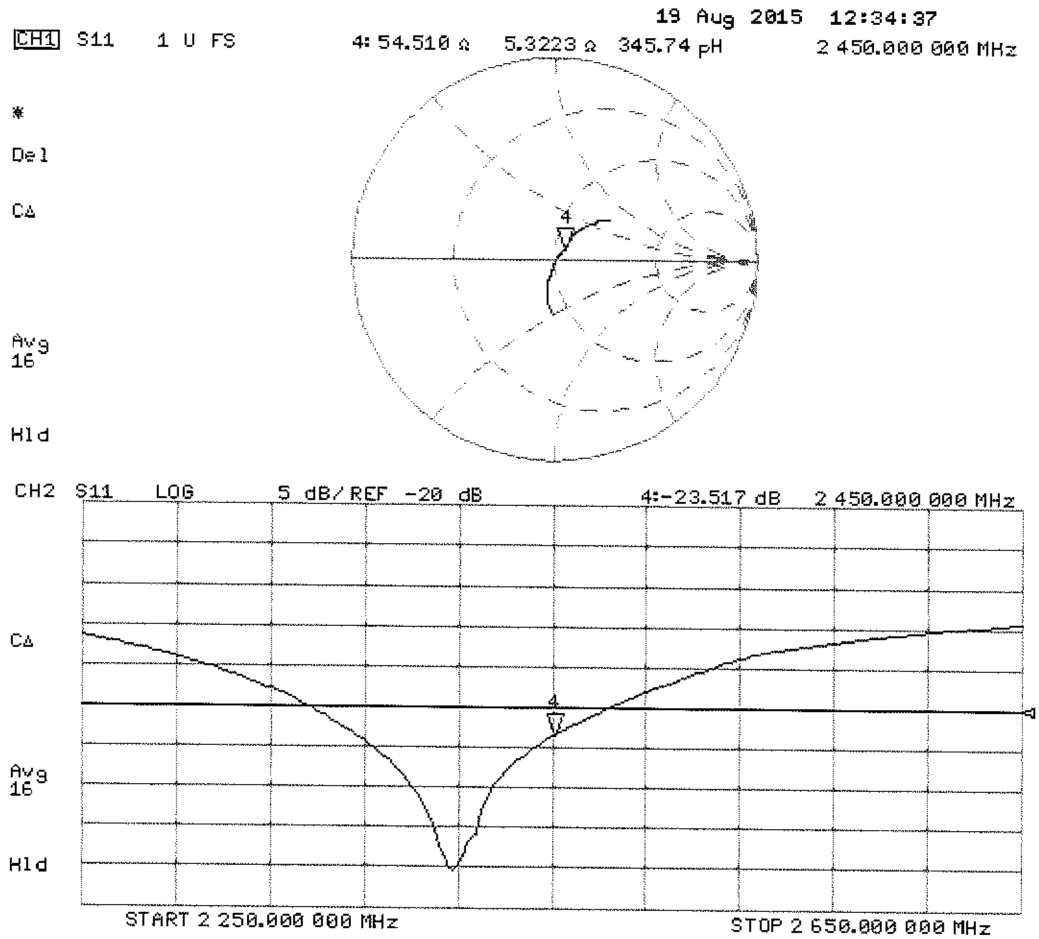
- Probe: ES3DV3 - SN3205; ConvF(4.54, 4.54, 4.54); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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 = 102.2 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 28.1 W/kg
SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.48 W/kg
Maximum value of SAR (measured) = 18.2 W/kg



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

Impedance Measurement Plot for Head TSL



Date: 19.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

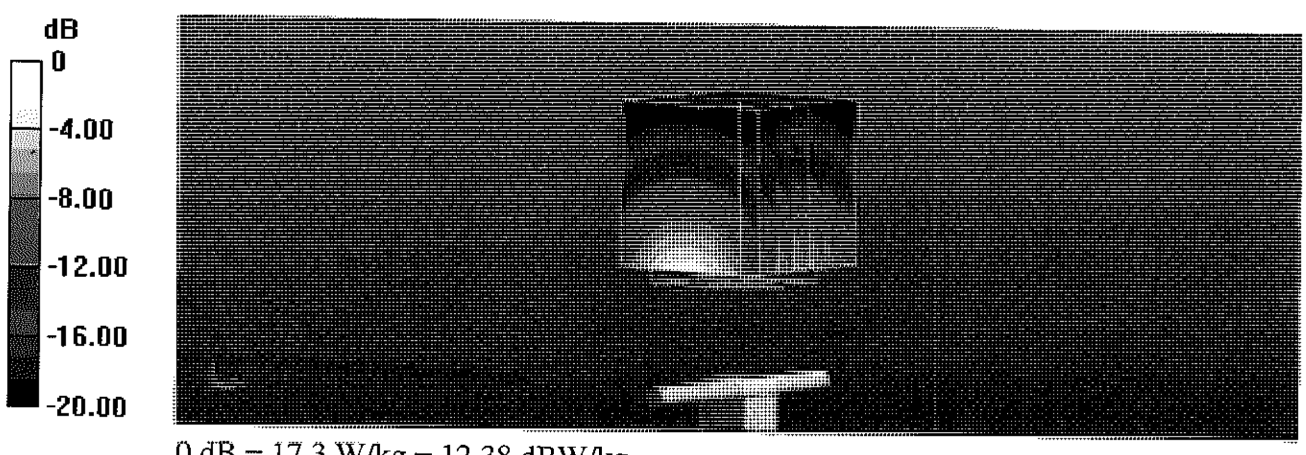
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2 S/m; ε_r = 53.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.32, 4.32, 4.32); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.73 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 26.9 W/kg
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.11 W/kg
Maximum value of SAR (measured) = 17.3 W/kg



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

Impedance Measurement Plot for Body TSL