



SAR EVALUATION REPORT

Applicant Name:
Samsung Electronics Co., Ltd.
416, Maetan 3-dong, Yeongtong-gu, Suwon-si
Gyeonggi-do, 443-742
Republic of Korea

Date of Testing:
08/21/12 - 08/23/12
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1208171174-R1.A3L

FCC ID: A3LSPHL710

APPLICANT: SAMSUNG ELECTRONICS CO., LTD.

EUT Type: Portable Handset
Application Type: Class II Permissive Change
FCC Rule Part(s): CFR §2.1093
Model(s): SCH-L710
Test Device Serial No.: Pre-Production [S/N: 1009-1, FJ-220-A]
Permissive Change(s): Adding LTE Band 2 and disabling BC10 CDMA
Date of Original Certification: June 1, 2012

Band & Mode	Tx Frequency	Conducted Power [dBm]	SAR		
			1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Hotspot (W/kg)
LTE Band 2 (PCS)	1852.5 - 1907.5 MHz	23.43	0.20	0.90	0.90
Simultaneous SAR per KDB 690783 D01:			0.53	1.40	1.40

Note: Powers in the above table represent output powers for the SAR test configurations and may not represent the highest output powers for all configurations for each mode.

The table above shows LTE Band 2 (PCS) SAR Test Data evaluated for current Test report. Please see RF Exposure Technical Report S/N 0Y1203290373.A3L for SAR Test Data filed for original compliance evaluation.

This revised Test Report (S/N: 0Y1208171174-R1.A3L) supersedes and replaces the previously issued test report on the same subject EUT for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001), IEEE 1528-2003 and in applicable Industry Canada Radio Standards Specifications (RSS); for North American frequency bands only.

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

PCTEST certifies that no party to this application has been subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.


Randy Ortanez
President



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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Tx Frequency
Cell. CDMA/EVDO - FCC Rule Part 22H	824.70 - 848.31 MHz
PCS CDMA/EVDO - FCC Rule Part 24E	1851.25 - 1908.75 MHz
LTE Band 25 - FCC Rule Part 24E	1852.5 - 1912.5 MHz
LTE Band 2 - FCC Rule Part 24E	1852.5 - 1907.5 MHz
2.4 GHz WLAN - FCC Rule Part 15C	2412 - 2462 MHz
5.8 GHz WLAN - FCC Rule Part 15C	5745 - 5825 MHz
5.2 GHz WLAN - FCC Rule Part 15E	5180 - 5240 MHz
5.3 GHz WLAN - FCC Rule Part 15E	5260 - 5320 MHz
5.5 GHz WLAN - FCC Rule Part 15E	5500 - 5700 MHz
Bluetooth - FCC Rule Part 15C	2402 - 2480 MHz
NFC - FCC Rule Part 15C	13.56 MHz

1.2 Near Field Communication (NFC) Antenna

This EUT has NFC operations. The NFC antenna is integrated into the standard battery and will be the only battery available from the manufacturer for this model. Therefore all SAR tests were performed with the standard battery which already integrates the NFC antenna. The device restricts the battery used to battery model: EB-L1G6LLA.

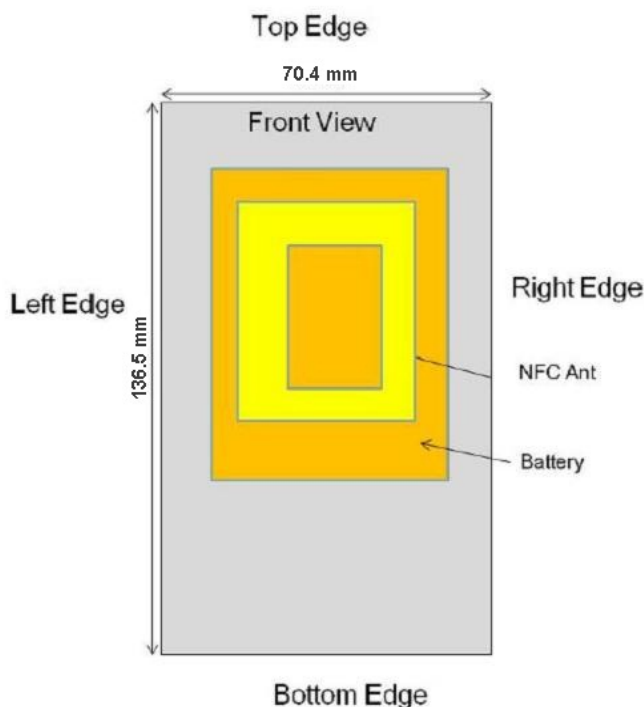


Figure 1-1
NFC Antenna Locations

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1.3 EUT Antenna Locations

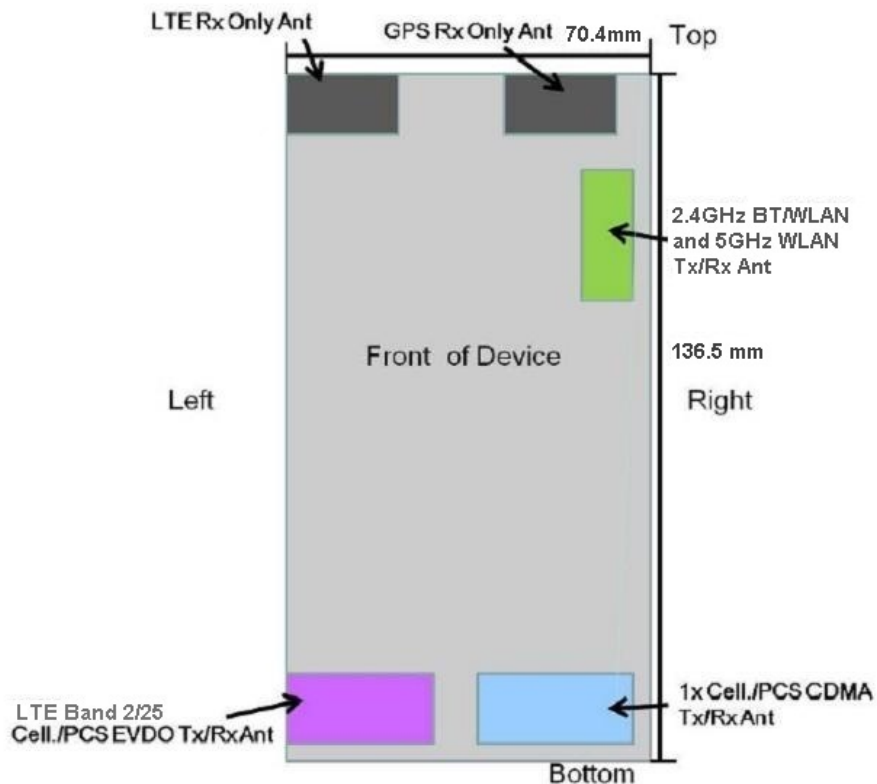


Figure 1-2
EUT Antenna Locations

Table 1-1
Mobile Hotspot Sides for LTE Band 2 SAR Testing

Mobile Hotspot Sides for SAR Testing						
Mode	Back	Front	Top	Bottom	Right	Left
LTE Band 2 (PCS)	Yes	Yes	No	Yes	No	Yes

Note: Particular EUT edges were not required to be evaluated for Wireless Router SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06 guidance, page 2. The antenna document shows the distances between the transmit antennas and the edges of the device.

1.4 Power Reduction for SAR

This device uses power reduction mechanisms for EVDO and LTE during SVDO (Voice + EVDO) and SVLTE (Voice + LTE) operations for SAR compliance. Please see RF Exposure Technical Report S/N 0Y1203290373.A3L filed with original compliance for SVDO power reduction mechanism. Please see Section 11 for more details on SVLTE power reduction.

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1.5 SAR Test Exclusions Applied

There were no changes to hardware during this permissive change. Therefore, CDMA, EVDO, WLAN, and LTE Band 25 data from original application (RF Exposure Technical Report S/N 0Y1203290373.A3L) were not additionally evaluated for current application.

1.6 Simultaneous Transmission Capabilities

According to KDB 648474, 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 EUT are shown in Figure 1-3 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.

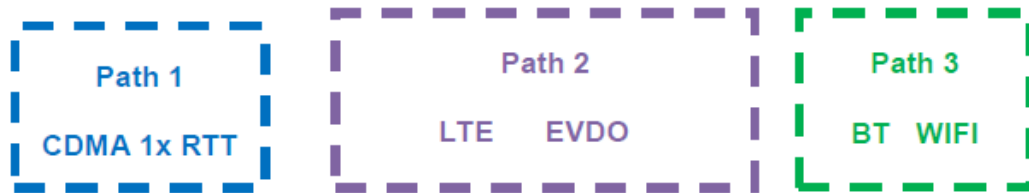


Figure 1-3
EUT Antenna Locations

This device requires a simultaneous transmission analysis for LTE related scenarios according to KDB 447498 3) procedures. Please see RF Exposure Technical Report S/N 0Y1203290373.A3L filed with original compliance for device simultaneous transmission analysis for other modes/bands.

Table 1-2
Simultaneous Transmission Scenarios

Simultaneous Transmit Configurations	Power Reduction	Head	Body-Worn Accessory	Hot Spot	Note
		IEEE 1528, Supp C	Supplement C	FCC KDB 941225 D06 edges/sides	
BC0/BC1 850/1900 MHz 1x-RTT CDMA Voice + LTE B2 Data	LTE	√	√	-	SVLTE
BC0/BC1 850/1900 MHz 1x-RTT CDMA Voice + LTE B25 Data		√	√	-	SVLTE
BC0/BC1 850/1900 MHz 1x-RTT CDMA Voice + EVDO BC0 Data	EVDO	√	√	-	
BC0/BC1 850/1900 MHz 1x-RTT CDMA Voice + EVDO BC1 Data		√	√	-	
BC0/BC1 850/1900 MHz 1x-RTT CDMA Voice + 2.4 GHz WIFI	None	√	√	-	
BC0/BC1 850/1900 MHz 1x-RTT CDMA Voice + 5 GHz WIFI		√	√	-	
BC0/BC1 850/1900 MHz 1x-RTT CDMA Voice + LTE B2 Data + 2.4 GHz WIFI	LTE	√	√	√	SVLTE + WIFI Hotspot
BC0/BC1 850/1900 MHz 1x-RTT CDMA Voice + LTE B25 Data + 2.4 GHz WIFI		√	√	√	SVLTE + WIFI Hotspot
BC0/BC1 850/1900 MHz 1x-RTT CDMA Voice + EVDO BC0 Data + 2.4 GHz WIFI	EVDO	√	√	√	1X CDMA / EVDO +WIFI Hotspot
BC0/BC1 850/1900 MHz 1x-RTT CDMA Voice + EVDO BC1 Data + 2.4 GHz WIFI		√	√	√	1X CDMA / EVDO +WIFI Hotspot
BC0/BC1 850/1900 MHz 1x-RTT CDMA Data + 2.4 GHz WIFI	None	-	-	√	1X CDMA / EVDO +WIFI Hotspot
BC0/BC1 850/1900 MHz EVDO Data + 2.4 GHz WIFI		-	-	√	1X CDMA / EVDO +WIFI Hotspot
LTE B2 Data + 2.4 GHz WIFI		√	√	√	LTE+WIFI Hotspot
LTE B25 Data + 2.4 GHz WIFI		√	√	√	LTE+WIFI Hotspot

1.7 Guidance Applied

- FCC OET Bulletin 65 Supplement C [June 2001]
- IEEE 1528-2003
- FCC KDB 941225 (4G and Hotspot)
- FCC KDB 648474 (Simultaneous)

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LTE CHECKLIST PER KDB 941225 D05

KDB 941225 Pub LTE Information				
KDB 941225 Section	FCC ID	A3LSPHL710		
	Form Factor	Portable Handset		
1)	Frequency Range of each LTE transmission band	LTE Band 2: 1852.5 ~ 1907.5 MHz LTE Band 25: 1852.5 ~ 1912.5 MHz		
2)	Channel Bandwidths	LTE Band 2: 5MHz BW LTE Band 25: 5MHz BW		
3)	Channel Numbers and Frequencies (MHz)	Low	Mid	High
	Band2, 5MHz BW	18625 (1852.5MHz)	18900 (1880MHz)	19175 (1907.5MHz)
	Band25, 5MHz BW	26065 (1852.5MHz)	26365 (1882.5MHz)	26665 (1912.5MHz)
4)(a)	UE Category	3		
(b)	Modulations Supported in UL	QPSK, 16QAM		
	LTE Transmitter and Antenna Implementation	CDMA and LTE/EVDO operate on separate transmission paths		
5)	Description of LTE Tx and Ant. Implementation	1 Main TX/RX Ant, 1 RX Diversity Ant		
6)	LTE Voice available?	No		
	Hotspot with LTE+WIFI	Yes		
	Hotspot with LTE+WIFI active with 1XVoice sessions?	Yes		
7)	LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	See Section 10 and Section 11.3		
	A-MPR (Additional MPR) disabled for SAR Testing?	Yes		
8)	Conducted power Table provided for 1RB (low and high offset), 50% RB (centered), 100% RB	Yes		
9-10)	Non-LTE US Wireless Operating Modes/Band	RF Output Power [dBm]	RF Exposure Configurations	
	Cell. CDMA/EVDO - FCC Rule Part 22H	See RF Exposure Technical Report S/N 0Y1203290373.A3L		
	PCS CDMA/EVDO - FCC Rule Part 24E			
	Bluetooth - FCC Rule Part 15			
	2.4 GHz WLAN - FCC Rule Part 15			
	5 GHz WLAN - FCC Rule Part 15			
11)	Simultaneous Tx Conditions (Voice and Data Configurations)	See Section 1.5		
12)	Power Reduction used for SAR Compliance?	Yes		
13)	Describe Power Reduction (LTE Modes)	See Section 11		
14)	SAR Test Plan	See Section 11		
15)	SAR test data	See Section 13		

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3 INTRODUCTION

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 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 [24]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

3.1 SAR Definition

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

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

- σ = conductivity of the tissue-simulating material (S/m)
- ρ = mass density of the tissue-simulating material (kg/m³)
- E = Total RMS electric field strength (V/m)

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

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4 SAR MEASUREMENT SETUP

4.1 Automated SAR Measurement System

Measurements are performed using the DASY automated dosimetric SAR assessment system. The DASY is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of a high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the SAM phantom containing the head or body equivalent material. The robot is a six-axis industrial robot, performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). See www.speag.com for more information about the specification of the SAR assessment system.



Figure 4-1
SAR Measurement System



Figure 4-2
Near-Field Probe

Table 4-1
Composition of the Tissue Equivalent Matter

Frequency (MHz)	1900	1900
Tissue	Head	Body
Ingredients (% by weight)		
DGBE	44.92	29.44
NaCl	0.18	0.39
Water	54.9	70.17

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5 DOSIMETRIC ASSESSMENT

5.1 Measurement Procedure

The evaluation was performed using the following procedure:

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 interface and the horizontal grid resolution was 15mm and 15mm for frequencies < 3 GHz in the x and y directions respectively. When applicable, for frequencies above 3 GHz, a 10 mm by 10 mm resolution was used.
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 1 gram cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak area of the maximum absorption was determined by spline interpolation. Around this point, a volume of 32mm x 32mm x 30mm (fine resolution volume scan, zoom scan) was assessed by measuring at least 5 x 5 x 7 points. On this 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. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
 - b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
 - c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

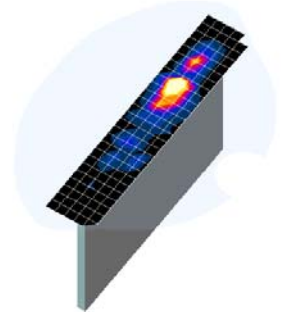


Figure 5-1
Sample SAR Area Scan

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6

DEFINITION OF REFERENCE POINTS

6.1 EAR REFERENCE POINT

Figure 6-2 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 6-1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 6-2). 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].

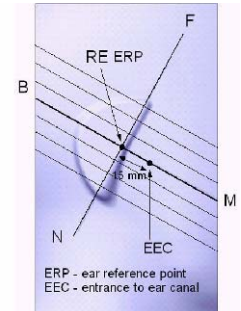


Figure 6-1
Close-Up Side view
of ERP

6.2 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 “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (See Figure 6-3). The “test device reference point” was then located at the same level as the center of the ear reference point. The test device was positioned so that the “vertical centerline” was bisecting the front surface of the handset at it’s 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 6-2
Front, back and side view of SAM Twin Phantom

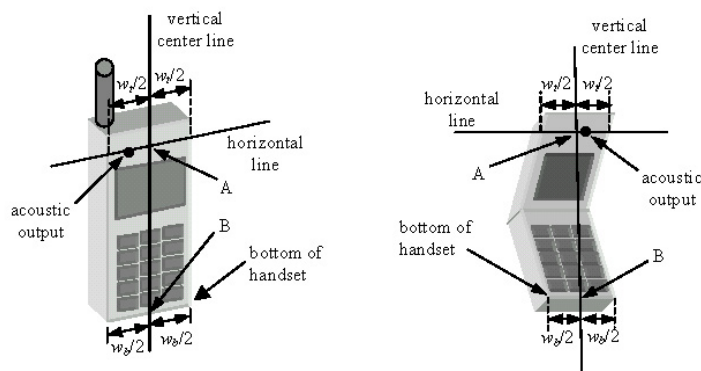


Figure 6-3
Handset Vertical Center & Horizontal Line Reference Points

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7 TEST CONFIGURATION POSITIONS FOR HANDSETS

7.1 Device Holder

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

7.2 Positioning for Cheek/Touch

1. The test device was positioned with the handset 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 7-1), 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.

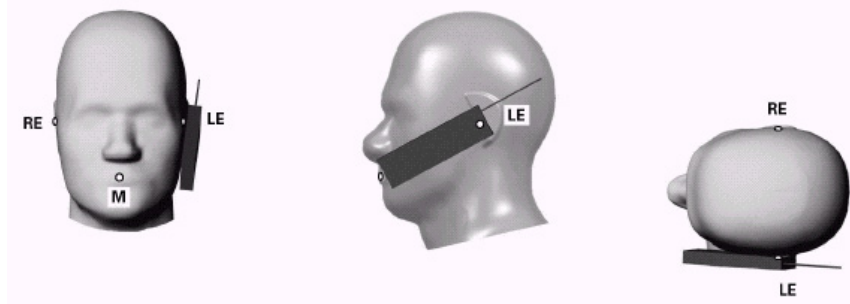


Figure 7-1 Front, Side and Top View of Cheek/Touch Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).
4. The phone was then rotated around the vertical centerline until the phone (horizontal line) was symmetrical with respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear (cheek) (See Figure 7-2).

7.3 Positioning for Ear / 15° Tilt

With the test device aligned in the “Cheek/Touch 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 15degree.
2. The phone was then rotated around the horizontal line by 15 degree.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches 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. 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 7-2).

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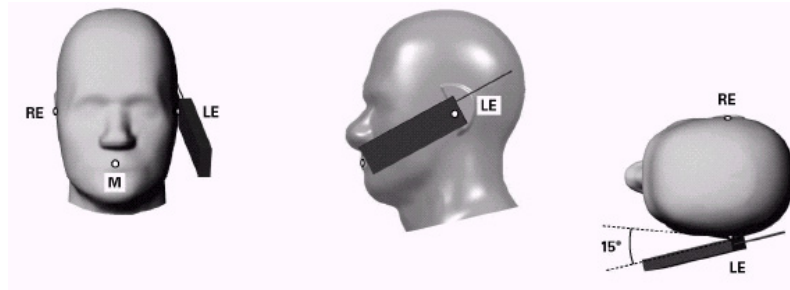


Figure 7-2 Front, Side and Top View of Ear/15° Tilt Position

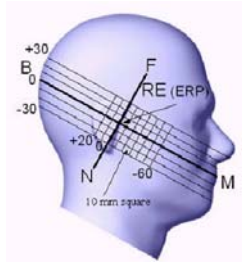


Figure 7-3
Side view w/ relevant markings



Figure 7-4 Body SAR Sample Photo
(Not Actual EUT)

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

Antennas located near the bottom of a phone may require SAR measurements around the mouth and jaw regions of the SAM head phantom. This typically applies to clam-shell style phones that are generally longer in the unfolded normal use positions or to certain older style long rectangular phones.

Under these circumstances, the following procedures apply, adopted from the FCC guidance on SAR handsets document publication 648474. The SAR required in these regions of SAM should be measured using a flat phantom. **Rectangular shaped phones** should be positioned with its bottom edge positioned from the flat phantom with the same distance provided by the cheek touching position using SAM. The ear reference point (ERP, as defined for SAM) of the phone should be positioned ½ cm from the flat phantom shell. **Clam-shell phones** should be positioned with the hinge against a smooth edge of the flat phantom where the upper half of the phone is unfolded and extended beyond the phantom side wall. The lower half of the phone is secured in the test device holder at a fixed distance below the flat phantom determined by the minimum separation along the lower edge of the phone in the cheek touching position using SAM. Any case with substantial variation in separation distance along the lower edge of a clam shell is discussed with the FCC for best-to-use methodology.

The latest IEEE 1528 committee developments propose the usage of a tilted phantom when the antenna of the phone is mounted at the bottom or in all cases the peak absorption is in the chin region. Both SAM heads of the TwinSAM-Chin20 are rotated 20 degrees around the NF line. Each head can be removed individually from the table for emptying and cleaning.

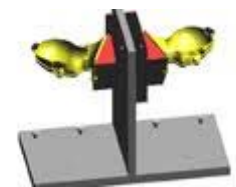


Figure 7-5 Twin SAM
Chin20

7.5 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 7-4). A device with a headset output is tested with a headset connected to the device.

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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.

7.6 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive internet connectivity through simultaneous transmission of WIFI in conjunction with a separate licensed transmitter. The FCC has provided guidance in KDB Publication 941225 D06 where SAR test considerations for handsets ($L \times W \geq 9 \text{ cm} \times 5 \text{ cm}$) are based on a composite test separation distance of 10 mm from the front, back and edges of the device with antennas 2.5 cm or closer to the edge of the device, 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. Therefore, SAR must be evaluated for each frequency transmission and mode separately and summed with the WIFI transmitter according to KDB 648474 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal.

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8 FCC RF EXPOSURE LIMITS

8.1 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.

8.2 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 8-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT <i>General Population</i> (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT <i>Occupational</i> (W/kg) or (mW/g)
SPATIAL PEAK SAR Brain	1.6	8.0
SPATIAL AVERAGE SAR Whole Body	0.08	0.4
SPATIAL PEAK SAR Hands, Feet, Ankles, Wrists	4.0	20

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

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

9.1 SAR Measurement Conditions for LTE

LTE modes were tested according to FCC KDB 941225 D05 publication. Please see notes following SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 was used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing.

9.1.1 MPR

MPR is implemented for this device by the manufacturer when the transmit power is not limited by the power reduction mechanism. 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.

9.1.2 A-MPR

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

9.1.3 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05:

- a. Per Page 4, 3) A), QPSK with 50% RB is required for the highest bandwidth.
- b. Per Page 4, footnote 2, when the maximum output power across high, mid., and low channels is < 0.5 dB, mid channel is tested. Low and high channel SAR tests are not required for QPSK, 50% RB allocation when the SAR is < 0.8 W/kg.
- c. Per Page 4, 3) B), QPSK with 1 RB for both channel edges are required.
- d. Per Page 4, footnote 6, QPSK 1 RB allocation SAR tests were performed on the highest output power channel for the RB allocation when the average output power of the 1 RB allocation was > 0.5 dB higher than the 50% RB allocation for QPSK. Otherwise, SAR tests are performed on the channel that produced the highest SAR for QPSK with 50% RB.
- e. Per Page 4, 3) B), I), when the SAR for QPSK 1 RB allocation tests is <1.45 W/kg, testing on the other channels is not required.
- f. Per Page 4, 4) A), 16QAM with 50% RB is required for the highest bandwidth on the channel with the highest measured SAR for QPSK with 50% RB allocation.
- g. Per Page 4, 4) A), I), when the SAR for 16 QAM, 50 % allocation tests is <1.45 W/kg, testing on the other channels is not required.
- h. Per Page 4, 4) B) and Page 5 footnote 9, 16QAM with 1RB for both channel edges are required for the highest bandwidth on the highest output power channel for the 1 RB allocation when the average output power of the 1 RB allocation is >0.5 dB higher than the 50% allocation for 16 QAM. Otherwise, SAR tests are performed on the channel that produced the highest SAR for 16 QAM with 50% RB.
- i. Per Page 5, 4) B), I), when the SAR for 16 QAM 1 RB allocation tests is <1.45 W/kg, testing on the other channels is not required.
- j. Per Page 4, 4), A) I) and Page 5, 4), A) I, 100% RB Allocation is not required to be tested when the SAR is not > 1.45 W/kg for the highest bandwidth.

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10 LTE BAND 2 (PCS) CONDUCTED POWERS

Table 10-1
LTE Band 2 (PCS) Maximum Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1852.5	18625	5	QPSK	1	0	23.19	0	0
	1852.5	18625	5	QPSK	1	24	23.28	0	0
	1852.5	18625	5	QPSK	12	6	22.27	1	0-1
	1852.5	18625	5	QPSK	25	0	22.39	1	0-1
	1852.5	18625	5	16-QAM	1	0	22.14	1	0-1
	1852.5	18625	5	16-QAM	1	24	22.18	1	0-1
	1852.5	18625	5	16-QAM	12	6	21.24	2	0-2
	1852.5	18625	5	16-QAM	25	0	21.28	2	0-2
Mid	1880.0	18900	5	QPSK	1	0	23.12	0	0
	1880.0	18900	5	QPSK	1	24	23.08	0	0
	1880.0	18900	5	QPSK	12	6	22.16	1	0-1
	1880.0	18900	5	QPSK	25	0	22.12	1	0-1
	1880.0	18900	5	16-QAM	1	0	22.05	1	0-1
	1880.0	18900	5	16-QAM	1	24	21.92	1	0-1
	1880.0	18900	5	16-QAM	12	6	21.10	2	0-2
	1880.0	18900	5	16-QAM	25	0	21.01	2	0-2
High	1907.5	19175	5	QPSK	1	0	23.43	0	0
	1907.5	19175	5	QPSK	1	24	23.21	0	0
	1907.5	19175	5	QPSK	12	6	22.33	1	0-1
	1907.5	19175	5	QPSK	25	0	22.30	1	0-1
	1907.5	19175	5	16-QAM	1	0	22.34	1	0-1
	1907.5	19175	5	16-QAM	1	24	22.15	1	0-1
	1907.5	19175	5	16-QAM	12	6	21.30	2	0-2
	1907.5	19175	5	16-QAM	25	0	21.31	2	0-2

Note:

1. See Section 9.1.3 for General Test procedures.
2. The bolded powers were tested for SAR.



Figure 10-1
Power Measurement Setup

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11 LTE POWER REDUCTION

11.1 Introduction to LTE Band 2 Power Reduction

This device is capable of Simultaneous Voice and LTE (SVLTE) calls, with the voice call supported by a CDMA 1xRTT transmitter and the data connection supported by a separate LTE transmitter. A LTE power reduction scheme is applied during a LTE connection operating simultaneously with 1xRTT voice calls. The maximum transmit power of LTE is limited depending on the CDMA 1x voice transmit power level. When CDMA 1x Voice is operating at a certain range of high power levels, the maximum LTE transmit power is limited. When CDMA 1x Voice transmit power is below a certain threshold transmit power level, LTE can transmit at the maximum power. Target levels of LTE Band 2 power reduction and CDMA voice threshold levels are provided in **Table 11-1**.

Table 11-1
SVLTE Power Reduction Scheme

Mode	Voice Avg Power(P) 1x 850/1900 MHz (dBm)	Max. B2 LTE Data Avg Power (dBm)
SVLTE	$P \geq 18$	18
	$P < 18$	23

11.2 Output Power Verification

Per KDB Publication 941225 D05, 5) B), output powers were measured in SVLTE mode to determine that the power reduction mechanism was operating reliably and consistently. The power reduction was investigated by simultaneously connecting the device to both LTE and CDMA base station simulators. LTE output powers were measured through conducted RF connections by first connecting the device in a LTE data call and subsequently a CDMA 1xRTT call. CDMA powers were controlled by configuring the CDMA base station simulator to active bits. The LTE output power was monitored while changing the cell output power level.

The power reduction targets and threshold level described in **Table 11-1** were confirmed. Please see results in **Table 11-2**.

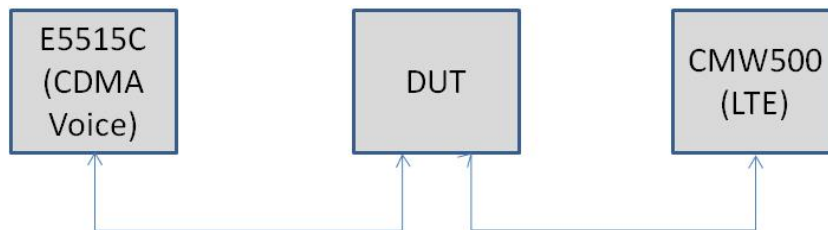


Figure 11-1
SVLTE Conducted Test Setup Diagram

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Table 11-2
SVLTE Power Reduction Verification Results

1xRTT CDMA Voice Band	BC0 1xRTT CDMA Voice Channel	BC0 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			Low Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
835 MHz	1013	25	18.21	18	18.07	18.11	18.16	18.05	18.05	18.01
		24	18.1	18.13	18.13	18.03	18.15	18	18.07	18.02
		23	18.15	18.11	18.11	18	18.11	17.95	17.98	18
		22	18.14	18	18	18.09	18.14	18.02	18	17.98
		21	18.17	18.13	18.06	18.08	18.09	17.97	17.97	17.96
		20	18	18	18.11	18.12	18	18.03	18.01	17.88
		19	18.2	18.06	18.13	18.11	18.06	18.01	18	17.94
		18	18.1	18.11	18.13	18.14	18.1	18	17.96	17.95
		17	22.1	23	23.01	22.04	21.01	22.01	22.05	21.06
		16	22.05	23	23	22.12	21.01	21.97	22.06	21.05
		15	22.04	23.11	22.98	22.11	21.01	21.95	22.1	21.07
		14	22.08	23.03	22.97	22.02	20.97	21.96	21.99	20.98
		13	22.09	23.02	23.02	22.1	20.98	22.1	21.98	20.93
		12	22	23.04	23.05	22.07	20.99	22	21.96	20.89
		11	22.04	22.99	23.04	22.08	21	21.95	22	20.97
835 MHz	384	25	18.01	18.03	18.04	18.03	18.06	18.1	18.04	18.1
		24	18	18.01	18.03	18	18.05	18.1	18.03	18.05
		23	18.02	18.02	18.01	18.09	18.01	18.02	17.99	17.98
		22	18.02	18.03	18.06	18.03	18	17.98	18.1	18
		21	18.07	18.1	18.1	18.02	18.04	17.95	18	18.04
		20	18	18	18.01	18.11	18.09	18.02	18.04	18.02
		19	18.04	18.16	18.03	18.04	18.1	17.99	17.96	17.98
		18	18	18.1	18	18.12	18.06	17.98	18.01	18.05
		17	22.03	23.1	23	22.02	21.05	22.06	22	21.04
		16	22.05	23.05	23.01	22	21.06	21.99	22.04	21.06
		15	22.02	23.01	22.97	22.03	20.99	22	22.05	21.02
		14	22.07	23.02	22.96	22.01	20.98	21.98	22	20.99
		13	22.05	22.99	23.01	22.04	21	22.05	22.03	20.97
		12	22	23.03	23	22.05	21	22.1	22	21
		11	22.03	23	23.01	22	20.99	22	22.02	21
835 MHz	777	25	18.11	18.05	18.04	18.03	18.01	18.02	18.02	18.04
		24	18.1	18.03	18.03	18.02	18.05	18.01	18	18
		23	18.12	18.01	18.01	18	18.11	17.99	18	18.02
		22	18.04	18	18.06	18	18.04	18.01	18.02	17.99
		21	18.07	18	18	18.08	18.08	18	17.98	17.98
		20	18	18.04	18.01	18.11	18	18	17.99	17.93
		19	18	18.02	18.02	18.12	18	18.1	17.98	17.98
		18	18.01	18.06	18.03	18.14	18.06	18.04	18	18.01
		17	21.96	23.02	23	22.01	21.02	22	22	21.02
		16	22.05	23.05	23.1	22.1	21.01	22	22.1	21.06
		15	22.04	23.01	23.05	22.11	21.01	22.01	22.05	21.04
		14	22.02	23	23.07	22	20.97	21.97	21.99	21
		13	22.06	23	23.04	22.06	21	21.98	21.97	20.99
		12	22.1	23.01	23.02	22.05	21	22	21.96	20.94
		11	22.05	23	23.05	22.07	21.03	21.96	22.01	20.99

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1xRTT CDMA Voice Band	BC1 1xRTT CDMA Voice Channel	BC1 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			Low Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
1900 MHz	25	25	17.99	18.01	18.02	18.06	18.1	18.04	17.99	18
		24	17.98	18.03	18.03	18	18.11	17.99	18	18.01
		23	18.01	18.11	18.1	18.03	18.05	17.98	18.02	18.02
		22	18.02	18	18.06	18.09	18.1	18	18.03	18.02
		21	18	18.1	18.04	18.05	18.08	18	18.01	17.98
		20	18	18.05	18.03	18.11	18.07	18.01	18	18
		19	18.15	18.06	18.11	18.08	18	18.03	18.02	17.99
		18	18.03	18.09	18.13	18.09	18.02	18.06	17.96	18.03
		17	21.98	23	22.99	22	21.02	21.97	22.04	21.02
		16	21.96	23	23.01	22.02	21.03	22	22.06	21
		15	22	23.11	23.02	22.01	21.03	21.98	22.06	21
		14	22.02	23.03	23.03	22.04	20.97	22.04	22	20.99
		13	22.04	23.02	23	22	21	22.05	21.99	20.98
		12	22.01	23.04	23.04	22.06	20.98	22.01	21.96	21
		11	22	22.99	23	22.07	20.99	22.06	22.02	20.96
1xRTT CDMA Voice Band	BC1 1xRTT CDMA Voice Channel	BC1 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			Low Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
1900 MHz	600	25	18.11	18.03	18.03	18.06	18.06	18.02	18.03	18.02
		24	18.05	18.1	18.1	18	18.11	18	18.05	18.01
		23	18.05	18.11	18.01	18.03	18.05	18	17.98	18
		22	18.01	18	18.06	18.08	18.04	18.03	18	18
		21	18.01	18	18	18.08	18.09	18.02	18	17.97
		20	18	18	18	18.12	18.01	18.03	18.05	17.98
		19	18	18.02	18.03	18.02	18.06	18.01	18.04	18.01
		18	18.1	18.05	18.03	18.02	18.06	18.01	17.96	18.02
		17	22.05	22.96	23	22.02	21	22.02	22.02	21.05
		16	22.02	23.01	23.04	22.02	21.01	22.03	22.02	21.05
		15	22.04	23.06	23	22.01	21.01	22.04	21.97	21.07
		14	22	23.03	23.02	22.02	21.02	21.97	22	21.03
		13	22	23	23.01	22.1	21	21.98	21.98	20.93
		12	22.01	23.04	23.05	22.07	21	22	21.99	21.02
		11	22	23.04	23.02	22.06	21.04	21.99	22.04	21
1xRTT CDMA Voice Band	BC1 1xRTT CDMA Voice Channel	BC1 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			Low Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
1900 MHz	1175	25	18.01	18.03	18.06	18.01	18.1	18.02	18.02	18
		24	18.02	18.11	18.1	18	18.05	18.01	18.07	18.02
		23	18.05	18.05	18.05	18.03	18.11	18	18.08	18.04
		22	18.04	18.02	18.04	18.07	18.04	18.01	18	17.98
		21	18.1	18.03	18.06	18.08	18.02	18.07	18.04	18
		20	18.1	18.05	18.11	18.02	18.05	18.04	18.01	18
		19	18.11	18	18.03	18.11	18	18.01	18	18.01
		18	18.06	18.01	18.03	18.04	18.05	18.02	18.01	17.95
		17	21.99	23.05	23.02	22.02	21.01	22	22.05	20.97
		16	21.98	23.02	23.02	22.1	21.02	22.01	22.06	20.98
		15	22.04	23.01	23	22.01	21.02	22.04	22.1	21.07
		14	22.08	23.03	23	22.02	21.04	22	21.99	21
		13	22.09	23.02	23.01	22.05	21.04	22.11	22	21
		12	22.05	23.11	23.05	22.07	21	22.09	21.96	21.01
		11	22.04	23.06	23.05	22	21.02	22.04	22.01	21.02

1xRTT CDMA Voice Band	BC0 1xRTT CDMA Voice Channel	BC0 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			Mid Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
835 MHz	1013	25	18.13	18.19	18.11	18	18	18.05	18.02	17.93
		24	18.17	18.11	18.09	18.09	18.06	18	18	17.95
		23	18.14	18.12	18.14	18.1	18.07	17.95	17.99	17.93
		22	18.15	18.15	18.2	18.11	18.04	18.01	17.98	17.96
		21	18.11	18	18.13	18.03	18.06	17.96	17.96	17.97
		20	18.13	18.04	18.16	18.06	18.07	17.99	17.98	17.93
		19	18.18	18.08	18.1	18.05	18.05	18.03	18.05	17.96
		18	18.09	18.07	18.08	18.11	18.04	17.96	17.99	18
		17	22.04	23.04	23.12	22	21.04	22	22.1	21.07
		16	22.01	23.02	23.08	22.12	21	22.01	22.05	21.05
		15	22.02	23.04	23	22.11	21.03	22.07	22	20.99
		14	22	22.98	23.12	22.1	21.04	22.05	21.98	21.06
		13	21.99	23.02	23.09	22.08	21.12	22.01	21.93	21.03
		12	22.05	23.04	23.15	22.05	21.01	22.02	22.01	21.01
		11	22.01	23.05	23.11	22.08	21.03	22.04	22.02	21.03
1xRTT CDMA Voice Band	BC0 1xRTT CDMA Voice Channel	BC0 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			Mid Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
835 MHz	384	25	18.03	18.09	18.1	18.08	18.1	18.05	18	18.03
		24	18	18.01	18.04	18	18.03	18.1	18.1	18.01
		23	18	18.02	18.04	18.1	18.05	18.08	18	18
		22	18.05	18.05	18	18.08	18.02	18.01	17.97	18
		21	18.1	18.1	18	18.07	18.04	17.99	17.99	18.01
		20	18.03	18	18.1	18.05	18.05	18	18	17.98
		19	18.08	18	18.02	18.02	18	17.97	18.02	17.99
		18	18.07	18.04	18.03	18.04	18	18	17.96	18
		17	22	23.02	23.1	22.1	21	22.01	22.05	21.02
		16	22.1	23	23.1	22.02	21.1	22	22	21.07
		15	22	23	23.04	22.11	21.05	22.05	22.1	21
		14	22.05	22.98	23.02	22.06	21	22.07	21.96	21.05
		13	22	23.04	23.01	22.06	21	22	21.98	21
		12	22.03	23.01	23.05	22.07	21.3	22	22	21
		11	22.04	23.02	23.04	22.1	21.2	22.02	21.99	20.97
1xRTT CDMA Voice Band	BC0 1xRTT CDMA Voice Channel	BC0 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			Mid Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
835 MHz	777	25	18.04	18.09	18.05	18.04	18.02	18.04	18.04	17.99
		24	18.07	18.1	18.04	18.03	18.04	17.99	18.05	18
		23	18.04	18.02	18.1	18.09	18	18.01	18	17.98
		22	18.15	18.05	18.11	18	18.04	18	17.99	18
		21	18.1	18.04	18.12	18.1	18	18	17.96	17.97
		20	18.03	18	18.06	18.04	18.05	17.96	18.02	17.97
		19	18.1	18	18.05	18.02	18.05	17.97	17.97	17.96
		18	18.03	18.02	18	18.01	18.02	17.99	17.99	18.02
		17	21.98	23	23.1	22.1	21.02	22.04	22.05	21.05
		16	21.97	23	23.05	22.02	21.01	22	22.05	21.02
		15	22	23.02	23.02	22.07	21	22.05	22.01	20.99
		14	22.02	23.01	23.02	22.08	21	22.02	21.98	20.99
		13	22	23.02	23.1	22.05	21.02	22	22	21.03
		12	22.01	22.99	23.05	22	21	22	21.98	21
		11	22.05	22.98	23.02	22	21.05	22.05	22.05	21.04

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1xRTT CDMA Voice Band	BC1 1xRTT CDMA Voice Channel	BC1 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			Mid Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
1900 MHz	25	25	18.03	18.09	18.1	18.02	18.06	18.01	18.04	18
		24	18.07	18	17.99	18.03	18.08	18.05	18.1	18.05
		23	18.04	18.1	17.98	18.07	18.07	18.1	18	18.03
		22	18.05	18.05	18.02	18.1	18.02	18.08	18	18.06
		21	18.01	18.1	18.03	18	18.01	18.04	18.01	18.07
		20	18.1	18.03	18.04	18.04	18	17.99	18.02	18.01
		19	18.08	18.08	18.05	18.05	18	18.03	18.04	18
		18	18	18.02	18.08	18.11	18.04	17.96	18	17.99
		17	22	23.02	23.02	22.04	21.07	22.04	22	20.98
		16	22.03	23.01	23.03	22.02	21.04	22	22.01	20.99
		15	22.04	23.05	23.1	22.1	21	22.04	22.02	21.02
		14	21.99	23	23.09	22.1	21.06	22.03	22.05	21.04
		13	22	23	23.08	22.08	21.12	22	22.07	21.03
		12	22.01	23.04	23.05	22.05	21.03	22.01	22.01	21.01
		11	22.05	23.01	23	22.04	21.08	21.99	21.97	21
1xRTT CDMA Voice Band	BC1 1xRTT CDMA Voice Channel	BC1 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			Mid Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
1900 MHz	600	25	18.03	18.09	18.04	18.01	18.02	18.03	18	17.96
		24	18.07	18.01	18.08	18.02	18.07	18.03	18.02	18
		23	18.05	18.02	18.04	18.02	18.07	18.01	18.01	17.97
		22	18.01	18.05	18.13	18.03	18.04	18.01	17.98	17.98
		21	18.04	18	18.11	18.05	18.04	18	17.99	18
		20	18.02	18	18.02	18.07	18	17.98	18.05	18.02
		19	18	18.04	18.1	18.07	18.07	18.03	18.02	18.02
		18	18	18.02	18	18.01	18.05	18.01	17.99	18.06
		17	22	23.02	23	22.1	21.05	22.06	22.05	21.03
		16	22.03	23.01	23.04	22.1	21.05	22.05	21.99	21.04
		15	22.02	23.04	23.04	22.06	21	22.05	21.98	20.99
		14	22.02	23.01	23	22.05	21	22.01	22	21.01
		13	22.02	23	23.01	22.04	21.1	22	22.05	21.02
		12	22	23.02	23.01	22.04	21.04	22.01	22.04	21.01
		11	22.01	23.02	22.97	22	21.01	22.02	22	21.04
1xRTT CDMA Voice Band	BC1 1xRTT CDMA Voice Channel	BC1 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			Mid Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
1900 MHz	1175	25	18.11	18.09	18.1	18.02	18.01	18.03	18.01	18.04
		24	18.07	18.11	18.01	18.03	18.06	18.03	18.01	18.05
		23	18.14	18.08	18.04	18.1	18.07	18	17.99	17.99
		22	18.15	18.05	18.01	18.06	18.04	18.01	18	17.96
		21	18.15	18.04	18.13	18.03	18.03	18.01	18.01	18.01
		20	18.13	18.04	18.06	18.06	18.02	18.02	18.03	17.93
		19	18.01	18.08	18.1	18.05	18.05	18.03	18.05	18.02
		18	18.04	18.06	18.08	18.01	18.04	17.96	17.99	18.05
		17	22.04	23.01	23.02	22.02	21.03	21.97	22.01	21.07
		16	22.01	23.02	23.08	22	21.02	21.98	22.04	21
		15	22.02	23.02	23	22.11	21.03	22.07	22	20.99
		14	22.02	22.98	23.02	22.04	21	22	21.98	21.06
		13	21.99	23.01	23.09	22.08	21	22.01	22.01	21.04
		12	22	23.04	23.05	22	21.01	22.01	22.01	21.04
		11	22.01	23.02	23.01	22.01	21.02	22	22.04	21.01

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1xRTT CDMA Voice Band	BC0 1xRTT CDMA Voice Channel	BC0 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			High Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
835 MHz	1013	25	18.01	18	18.02	18.1	18.01	18.02	17.95	17.93
		24	18.07	18.01	18.04	18.04	18	18.03	17.96	17.92
		23	18.05	18.02	17.97	18.01	18.06	18.05	18	17.91
		22	18.02	18.1	17.98	18.02	18.07	18.02	17.98	17.97
		21	18	18.06	18	18.03	18.04	18	17.96	17.96
		20	18.04	18.11	18.03	18.04	18.02	18	18	18
		19	18.06	18.05	18.05	18	18.07	17.98	17.99	17.93
		18	18.02	18.04	18.02	18.03	18	17.98	18	17.91
		17	22.01	23	23.01	22.01	21	21.95	21.99	20.98
		16	22.1	23.01	23.03	22.04	21	21.93	21.93	20.86
		15	22.05	23.05	23	22.01	20.98	21.97	22	20.89
		14	22.04	23.02	23.02	22	20.99	21.95	21.94	20.87
		13	22.03	23.01	23.02	21.95	20.97	22.01	21.96	20.88
		12	22.02	22.97	23.05	21.98	20.99	21.94	22	21
		11	22	22.96	22.98	21.99	21	21.98	22	20.93
1xRTT CDMA Voice Band	BC0 1xRTT CDMA Voice Channel	BC0 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			High Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
835 MHz	384	25	18.01	18.02	18.01	18	18.04	18.01	18	18.04
		24	18	18.04	18	18.01	18.12	18.04	18.02	18.02
		23	18.02	18	18.02	18.4	18.11	18.05	18.04	18.01
		22	18.02	18	18.01	18.03	18.1	18	18.01	18
		21	18	18.1	18.04	18.1	18.07	18.01	17.96	18
		20	18.03	18.05	18	18.04	18	18.02	18.02	18.05
		19	18.01	18.02	18.04	18	18	17.99	17.99	18.01
		18	18.03	18.04	18.1	18.2	18.02	17.98	18.04	17.99
		17	22.1	23.01	23.1	22.05	21.1	21.97	22	20.93
		16	22	23.05	23.02	22.1	21.07	21.98	22.01	20.99
		15	22.05	23.02	23.1	22	21.02	22	22.03	21
		14	22.04	23	23	22	20.99	22	21.97	21
		13	22.01	23	23	21.99	20.98	22.04	21.96	21.1
		12	22	23.04	23.04	21.98	20.97	22.02	22.01	21.05
		11	22.04	23	22.99	21.97	21	22.01	22.02	21.02
1xRTT CDMA Voice Band	BC0 1xRTT CDMA Voice Channel	BC0 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			High Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
835 MHz	777	25	18	18.04	18.01	18.03	17.98	18.01	17.97	17.94
		24	18.05	18.01	18.03	18.01	17.96	18	18	17.98
		23	18.02	18.03	17.99	18	18	18.05	18.04	18
		22	18.1	18.05	18	18.02	18.02	18.02	18.01	18
		21	18	18.06	17.96	18.03	18.04	18.02	18.02	18.02
		20	18.04	18.1	18	18	18.01	18.03	17.98	18.01
		19	18	18.1	18.01	18	18.07	18	18.02	18.04
		18	18.01	18.04	17.98	18.03	18.04	17.99	18	18.05
		17	22	22.95	23.02	22.02	20.98	21.95	21.98	20.98
		16	22.05	22.98	23	22	20.97	22	21.97	21
		15	22.05	23.01	23.01	22	21	22.04	22.02	21
		14	22	23.02	23	22.02	21	22.01	22	21.02
		13	22.02	23.01	23.02	22	20.98	22.01	22.05	21.03
		12	22.02	23	23.02	22.01	21	22	22.03	21.04
		11	22.1	23	22.98	22.04	21.02	22.04	22.07	21.06

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1xRTT CDMA Voice Band	BC1 1xRTT CDMA Voice Channel	BC1 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			High Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
1900 MHz	25	25	18.07	18.01	18.03	18.05	18.02	18.04	18.05	17.99
		24	18.01	18.01	18	18.04	18	18.02	18.06	17.96
		23	18.05	18	18.07	18.01	18.05	18	18.02	17.97
		22	18.05	18.07	18.04	18.02	18.07	18.03	18	17.94
		21	18.05	18.06	18	18.03	18.05	18.03	18	18
		20	18	18.01	18.01	18.04	18.05	18.1	17.98	18.02
		19	18.06	18.04	18.03	18.04	18.07	17.99	17.96	18.04
		18	18.06	18.04	17.98	18	18.07	17.98	18	18.05
		17	22.01	23.01	23	22.01	21.02	22	21.98	21.05
		16	22.01	23.02	23.01	22.03	21.02	21.98	22	21.07
		15	22	23.06	23.02	22.01	20.98	21.95	22.01	21.02
		14	22.03	23.02	23.02	22.05	21	22	22.03	21
		13	22.02	23	23.03	21.95	20.97	22.01	22.05	21
		12	22.01	23	23.05	22.01	21	22	22.04	21.01
		11	22.04	22.96	23.04	22.03	21.01	22.03	22.01	21.02
1xRTT CDMA Voice Band	BC1 1xRTT CDMA Voice Channel	BC1 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			High Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
1900 MHz	600	25	18.03	18.02	18.01	18.04	18.03	18.01	18.05	17.97
		24	18.07	18.02	18.04	17.99	18.05	18.03	17.99	18
		23	18.07	18.04	18.05	17.98	18.06	18.05	17.94	17.98
		22	18.02	18.1	18.08	17.96	17.97	18.05	17.98	17.97
		21	18	18.06	18.08	18.01	17.98	18.05	18.01	18.02
		20	18	18.06	18	18.03	18.02	18	18.02	17.96
		19	18.02	18.05	18.05	18.03	18.07	18.01	17.96	18.02
		18	18.02	18.04	18.01	18.01	18.04	18.02	17.94	18.01
		17	22.02	23	23.01	22.01	21.05	21.95	21.99	20.98
		16	22.02	23.04	22.97	21.99	21.06	21.99	22.03	20.94
		15	22.06	23.05	22.98	21.98	20.98	22	22.01	20.96
		14	22.03	22.97	23	22.02	21.01	22.01	22	21
		13	22	23.02	23.01	22.02	20.97	22.01	22.06	21.01
		12	22.02	23.02	23.04	22.01	21.02	22.05	22.01	21
		11	22.01	23.01	23.02	22.04	21.04	22.06	22	21.04
1xRTT CDMA Voice Band	BC1 1xRTT CDMA Voice Channel	BC1 1xRTT CDMA Voice Tx [dBm]	LTE Band 2 Conducted Power (dBm)							
			High Channel							
			QPSK 12 RB 6RB offset	QPSK 1 RB ORB offset	QPSK 1 RB 24RB offset	QPSK 25 RB ORB offset	16QAM 12RB 6RB offset	16QAM 1RB ORB offset	16QAM 1RB 24RB offset	16QAM 25RB ORB offset
1900 MHz	1175	25	18.06	18.04	18.01	18	18.02	18.01	17.96	17.94
		24	18.04	18	18.04	18.02	18.01	18.03	17.99	17.92
		23	18.05	18	18.07	18.01	18.06	18.04	17.94	18
		22	18.01	18.11	18	18.02	18.07	18.02	18	17.97
		21	18.07	18.06	18.02	18.05	18.07	18	17.94	17.99
		20	18.04	18.01	18	18.04	18.02	18.02	17.94	17.94
		19	18	18.04	18.05	18.06	18.07	18.02	18	18
		18	18.02	18.04	18.02	18.03	18.06	17.98	18.02	17.94
		17	22.04	23.02	23.01	22.02	21.01	22	21.99	20.93
		16	22.03	23.01	23.03	22.04	21.02	21.98	21.93	20.91
		15	22	23	23	22.02	20.98	21.99	21.94	20.94
		14	22	23.02	23.01	22	21	22	21.99	21
		13	22.02	23.04	23.01	22	21.02	22.05	22	20.97
		12	22.01	23	22.98	21.98	21.01	21.94	22.01	20.96
		11	22.04	22.96	23	22.04	21.02	22.01	22.03	21

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11.3 SVLTE SAR Testing Procedures

SAR testing was additionally performed on the devices at the standalone threshold 1x-RTT CDMA and LTE power levels with respect to the simultaneous transmission scenarios. Additional samples were tuned to fixed reduced power levels for the purpose of evaluating simultaneous SAR based on the sum SAR of the standalone 1x-RTT CDMA and standalone LTE combinations. While the power reduction mechanism is activated at the CDMA Voice power level of 18dBm, simultaneous SAR summations of were evaluated at maximum power LTE. SAR was additionally evaluated at reduced power LTE levels to perform simultaneous SAR analysis when CDMA voice is at maximum output power.

11.3.1 Reduced LTE Conducted Powers

Table 11-3
Reduced LTE Band 2 Conducted Powers

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1852.5	18625	5	QPSK	1	0	18.19	0	0
	1852.5	18625	5	QPSK	1	24	18.30	0	0
	1852.5	18625	5	QPSK	12	6	18.25	0	0-1
	1852.5	18625	5	QPSK	25	0	18.21	0	0-1
	1852.5	18625	5	16-QAM	1	0	18.43	0	0-1
	1852.5	18625	5	16-QAM	1	24	18.38	0	0-1
	1852.5	18625	5	16-QAM	12	6	18.25	0	0-2
Mid	1852.5	18625	5	16-QAM	25	0	18.30	0	0-2
	1880.0	18900	5	QPSK	1	0	18.32	0	0
	1880.0	18900	5	QPSK	1	24	18.17	0	0
	1880.0	18900	5	QPSK	12	6	18.39	0	0-1
	1880.0	18900	5	QPSK	25	0	18.48	0	0-1
	1880.0	18900	5	16-QAM	1	0	18.50	0	0-1
	1880.0	18900	5	16-QAM	1	24	18.33	0	0-1
High	1880.0	18900	5	16-QAM	12	6	18.26	0	0-2
	1880.0	18900	5	16-QAM	25	0	18.22	0	0-2
	1907.5	19175	5	QPSK	1	0	18.06	0	0
	1907.5	19175	5	QPSK	1	24	18.32	0	0
	1907.5	19175	5	QPSK	12	6	18.41	0	0-1
	1907.5	19175	5	QPSK	25	0	18.44	0	0-1
	1907.5	19175	5	16-QAM	1	0	18.36	0	0-1
	1907.5	19175	5	16-QAM	1	24	18.35	0	0-1
	1907.5	19175	5	16-QAM	12	6	18.49	0	0-2
	1907.5	19175	5	16-QAM	25	0	18.43	0	0-2
	1907.5	19175	5	16-QAM	25	0	18.43	0	0-2

Note:

1. See Section 9.1.3 for General Test procedures.
2. The bolded powers were tested for SAR.

11.3.2 Fixed CDMA Conducted Powers

Please see RF Exposure Technical Report S/N 0Y1203290373.A3L filed with original compliance for Fixed CDMA Conducted Powers.



Figure 11-2
Power Measurement Setup

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12 SYSTEM VERIFICATION

12.1 Tissue Verification

Table 12-1
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
08/23/2012	1900H	22.5	1850	1.373	41.19	1.400	40.000	-1.93%	2.97%
			1880	1.419	41.00	1.400	40.000	1.36%	2.50%
			1910	1.455	40.90	1.400	40.000	3.93%	2.25%
08/21/2012	1900B	22.8	1850	1.466	55.22	1.520	53.300	-3.55%	3.60%
			1880	1.479	54.85	1.520	53.300	-2.70%	2.91%
			1910	1.510	54.87	1.520	53.300	-0.66%	2.95%

The above measured tissue parameters were used in the DASY software to perform interpolation via the DASY software to determine actual dielectric parameters at the test frequencies (per IEEE 1528 6.6.1.2). The SAR test plots may slightly differ from the table above since the DASY software rounds to three significant digits.

12.2 Measurement Procedure for Tissue verification

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

$$Y = \frac{j2\omega\epsilon_r\epsilon_0}{[\ln(b/a)]^2} \int_a^b \int_a^b \int_0^\pi \frac{\cos\phi' \exp[-j\omega r(\mu_0\epsilon_r'\epsilon_0)^{1/2}]}{r} d\phi' d\rho' d\rho$$

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

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12.3 Test System Verification

Prior to assessment, the system is verified to $\pm 10\%$ of the manufacturer SAR measurement on the reference dipole at the time of calibration.

Table 12-2
System Verification Results

System Verification TARGET & MEASURED											
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 (%)
1900	Head	08/23/2012	23.9	22.7	0.100	5d149	3287	4.18	39.300	41.800	6.36%
1900	Body	08/21/2012	24.6	23.2	0.100	5d148	3288	3.77	39.100	37.700	-3.58%

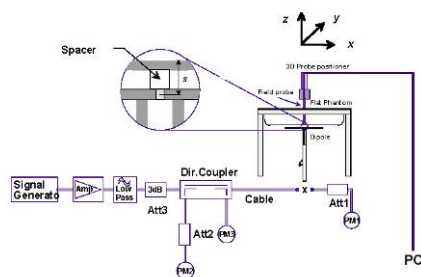


Figure 12-1
System Verification Setup Diagram



Figure 12-2
System Verification Setup Photo

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13 SAR DATA SUMMARY

13.1 Standalone Head SAR Data

Table 13-1
LTE Band 2 (PCS) Head SAR Results – Maximum Power

MEASUREMENT RESULTS															
FREQUENCY			Mode	Bandwidth [MHz]	Target Conducted Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	# of RB	RB Offset	Device Serial Number	SAR (1g)
MHz	Ch.														(W/kg)
1880.00	18900	Mid	LTE Band 2 (PCS)	5	22	22.16	0.04	1	Right	Cheek	QPSK	12	6	FJ-220-A	0.105
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.43	0.06	0	Right	Cheek	QPSK	1	0	FJ-220-A	0.117
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.21	-0.03	0	Right	Cheek	QPSK	1	24	FJ-220-A	0.116
1880.00	18900	Mid	LTE Band 2 (PCS)	5	21	21.10	0.04	2	Right	Cheek	16 QAM	12	6	FJ-220-A	0.082
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.34	0.15	1	Right	Cheek	16 QAM	1	0	FJ-220-A	0.094
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.15	0.03	1	Right	Cheek	16 QAM	1	24	FJ-220-A	0.097
1880.00	18900	Mid	LTE Band 2 (PCS)	5	22	22.16	0.03	1	Right	Tilt	QPSK	12	6	FJ-220-A	0.075
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.43	0.11	0	Right	Tilt	QPSK	1	0	FJ-220-A	0.072
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.21	-0.08	0	Right	Tilt	QPSK	1	24	FJ-220-A	0.073
1880.00	18900	Mid	LTE Band 2 (PCS)	5	21	21.10	0.08	2	Right	Tilt	16 QAM	12	6	FJ-220-A	0.057
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.34	0.11	1	Right	Tilt	16 QAM	1	0	FJ-220-A	0.058
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.15	0.11	1	Right	Tilt	16 QAM	1	24	FJ-220-A	0.059
1880.00	18900	Mid	LTE Band 2 (PCS)	5	22	22.16	0.10	1	Left	Cheek	QPSK	12	6	FJ-220-A	0.186
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.43	0.15	0	Left	Cheek	QPSK	1	0	FJ-220-A	0.200
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.21	0.16	0	Left	Cheek	QPSK	1	24	FJ-220-A	0.178
1880.00	18900	Mid	LTE Band 2 (PCS)	5	21	21.10	0.09	2	Left	Cheek	16 QAM	12	6	FJ-220-A	0.146
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.34	0.03	1	Left	Cheek	16 QAM	1	0	FJ-220-A	0.162
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.15	0.19	1	Left	Cheek	16 QAM	1	24	FJ-220-A	0.149
1880.00	18900	Mid	LTE Band 2 (PCS)	5	22	22.16	0.21	1	Left	Tilt	QPSK	12	6	FJ-220-A	0.042
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.43	0.00	0	Left	Tilt	QPSK	1	0	FJ-220-A	0.057
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.21	0.03	0	Left	Tilt	QPSK	1	24	FJ-220-A	0.050
1880.00	18900	Mid	LTE Band 2 (PCS)	5	21	21.10	-0.07	2	Left	Tilt	16 QAM	12	6	FJ-220-A	0.046
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.34	0.13	1	Left	Tilt	16 QAM	1	0	FJ-220-A	0.046
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.15	0.04	1	Left	Tilt	16 QAM	1	24	FJ-220-A	0.045
ANSI / IEEE C95.1 1992 - SAFETY LIMIT									Head						
Spatial Peak									1.6 W/kg (mW/g)						
Uncontrolled Exposure/General Population									averaged over 1 gram						

Note: Per KDB 941225 D05, when the maximum average output power of 1 RB allocation is more than 0.5 dB higher than the 50% RB allocation, the highest output power for the 1 RB allocations is tested. Therefore, high channel was tested for the QPSK, 1 RB allocation and 16 QAM, 1 RB allocation configurations.

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Table 13-2
LTE Band 2 (PCS) Head SAR Results – Reduced Power

MEASUREMENT RESULTS															
FREQUENCY			Mode	Bandwidth [MHz]	Target Conducted Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	# of RB	RB Offset	Device Serial Number	SAR (1g)
MHz	Ch.														(W/kg)
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.39	0.06	0	Right	Cheek	QPSK	12	6	1009-1	0.049
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.32	-0.04	0	Right	Cheek	QPSK	1	0	1009-1	0.050
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.17	0.02	0	Right	Cheek	QPSK	1	24	1009-1	0.046
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.26	0.03	0	Right	Cheek	16 QAM	12	6	1009-1	0.048
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.50	0.00	0	Right	Cheek	16 QAM	1	0	1009-1	0.053
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.33	0.06	0	Right	Cheek	16 QAM	1	24	1009-1	0.051
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.39	0.11	0	Right	Tilt	QPSK	12	6	1009-1	0.027
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.32	0.07	0	Right	Tilt	QPSK	1	0	1009-1	0.027
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.17	0.16	0	Right	Tilt	QPSK	1	24	1009-1	0.025
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.26	-0.09	0	Right	Tilt	16 QAM	12	6	1009-1	0.027
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.50	0.02	0	Right	Tilt	16 QAM	1	0	1009-1	0.030
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.33	0.15	0	Right	Tilt	16 QAM	1	24	1009-1	0.029
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.39	0.07	0	Left	Cheek	QPSK	12	6	1009-1	0.081
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.32	-0.05	0	Left	Cheek	QPSK	1	0	1009-1	0.076
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.17	0.12	0	Left	Cheek	QPSK	1	24	1009-1	0.075
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.26	-0.19	0	Left	Cheek	16 QAM	12	6	1009-1	0.079
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.50	-0.04	0	Left	Cheek	16 QAM	1	0	1009-1	0.079
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.33	-0.02	0	Left	Cheek	16 QAM	1	24	1009-1	0.079
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.39	-0.11	0	Left	Tilt	QPSK	12	6	1009-1	0.018
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.32	0.07	0	Left	Tilt	QPSK	1	0	1009-1	0.017
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.17	0.06	0	Left	Tilt	QPSK	1	24	1009-1	0.017
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.26	0.08	0	Left	Tilt	16 QAM	12	6	1009-1	0.018
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.50	-0.17	0	Left	Tilt	16 QAM	1	0	1009-1	0.019
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.33	-0.13	0	Left	Tilt	16 QAM	1	24	1009-1	0.018
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram						

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13.2 Standalone Body-Worn SAR Data

Table 13-3
LTE Band 2 (PCS) Body-Worn SAR Results

MEASUREMENT RESULTS															
FREQUENCY			Mode	Bandwidth [MHz]	Target Conducted Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	# of RB	RB Offset	Spacing	Side	SAR (1g)
MHz	Ch.	(W/kg)													
1852.50	18625	Low	LTE Band 2 (PCS)	5	22	22.27	0.02	1	FJ-220-A	QPSK	12	6	1.0 cm	back	0.903
1880.00	18900	Mid	LTE Band 2 (PCS)	5	22	22.16	0.01	1	FJ-220-A	QPSK	12	6	1.0 cm	back	0.813
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.33	-0.03	1	FJ-220-A	QPSK	12	6	1.0 cm	back	0.710
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.43	0.05	0	FJ-220-A	QPSK	1	0	1.0 cm	back	0.876
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.21	0.02	0	FJ-220-A	QPSK	1	24	1.0 cm	back	0.855
1852.50	18625	Low	LTE Band 2 (PCS)	5	21	21.24	0.02	2	FJ-220-A	16 QAM	12	6	1.0 cm	back	0.713
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.34	-0.08	1	FJ-220-A	16 QAM	1	0	1.0 cm	back	0.720
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.15	-0.09	1	FJ-220-A	16 QAM	1	24	1.0 cm	back	0.740
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.39	-0.09	0	1009-1	QPSK	12	6	1.0 cm	back	0.260
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.32	-0.05	0	1009-1	QPSK	1	0	1.0 cm	back	0.241
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.17	-0.07	0	1009-1	QPSK	1	24	1.0 cm	back	0.232
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.26	-0.12	0	1009-1	16 QAM	12	6	1.0 cm	back	0.299
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.50	0.00	0	1009-1	16 QAM	1	0	1.0 cm	back	0.304
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.33	0.00	0	1009-1	16 QAM	1	24	1.0 cm	back	0.301
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:

1. Per FCC guidance, when the reported SAR measured for 1 cm air-gap without headset cable is >1.2 W/kg, the highest reported SAR configuration for the mode and band should be repeated with headset attached, per past FCC guidance. Since the measured SAR was not >1.2 W/kg, LTE hotspot SAR data for the back sides additionally show body-worn compliance.
2. Per KDB 941225 D05, when the maximum average output power of 1 RB allocation is more than 0.5 dB higher than the 50% RB allocation, the highest output power for the 1 RB allocations is tested. Therefore, for LTE Band 2 Max Power high channel was tested for the QPSK, 1 RB allocation and 16 QAM, 1 RB allocation configurations.
3. Per KDB 941225 D05, when the maximum output power of QPSK 50% RB allocation across high, mid., and low channels are < 0.5 dB, mid channel is tested. Low and high channel SAR tests were tested for QPSK, 50% RB allocation when the SAR was > 0.8 W/kg.
4. Per KDB 941225 D05, 16QAM 50% RB allocation was tested on the channel with the highest measured SAR for QPSK with 50% RB allocation. Therefore, low channel was tested for max power 16QAM 50% RB allocation back side configuration.

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13.3 Standalone Wireless Router SAR Data

Table 13-4
LTE Band 2 (PCS) Hotspot SAR Data – Maximum Power

MEASUREMENT RESULTS															
FREQUENCY			Mode	Bandwidth [MHz]	Target Conducted Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	# of RB	RB Offset	Spacing	Side	SAR (1g)
MHz	Ch.														(W/kg)
1852.50	18625	Low	LTE Band 2 (PCS)	5	22	22.27	0.02	1	FJ-220-A	QPSK	12	6	1.0 cm	back	0.903
1880.00	18900	Mid	LTE Band 2 (PCS)	5	22	22.16	0.01	1	FJ-220-A	QPSK	12	6	1.0 cm	back	0.813
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.33	-0.03	1	FJ-220-A	QPSK	12	6	1.0 cm	back	0.710
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.43	0.05	0	FJ-220-A	QPSK	1	0	1.0 cm	back	0.876
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.21	0.02	0	FJ-220-A	QPSK	1	24	1.0 cm	back	0.855
1852.50	18625	Low	LTE Band 2 (PCS)	5	21	21.24	0.02	2	FJ-220-A	16 QAM	12	6	1.0 cm	back	0.713
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.34	-0.08	1	FJ-220-A	16 QAM	1	0	1.0 cm	back	0.720
1907.50	19175	High	LTE Band 2 (PCS)	5	23	22.15	-0.09	1	FJ-220-A	16 QAM	1	24	1.0 cm	back	0.740
1880.00	18900	Mid	LTE Band 2 (PCS)	5	22	22.16	-0.02	1	FJ-220-A	QPSK	12	6	1.0 cm	front	0.357
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.43	-0.09	0	FJ-220-A	QPSK	1	0	1.0 cm	front	0.407
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.21	-0.04	0	FJ-220-A	QPSK	1	24	1.0 cm	front	0.397
1880.00	18900	Mid	LTE Band 2 (PCS)	5	21	21.10	0.02	2	FJ-220-A	16 QAM	12	6	1.0 cm	front	0.276
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.34	0.13	1	FJ-220-A	16 QAM	1	0	1.0 cm	front	0.336
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.15	-0.21	1	FJ-220-A	16 QAM	1	24	1.0 cm	front	0.333
1880.00	18900	Mid	LTE Band 2 (PCS)	5	22	22.16	0.00	1	FJ-220-A	QPSK	12	6	1.0 cm	bottom	0.527
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.43	0.03	0	FJ-220-A	QPSK	1	0	1.0 cm	bottom	0.606
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.21	-0.03	0	FJ-220-A	QPSK	1	24	1.0 cm	bottom	0.581
1880.00	18900	Mid	LTE Band 2 (PCS)	5	21	21.10	0.04	2	FJ-220-A	16 QAM	12	6	1.0 cm	bottom	0.404
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.34	0.10	1	FJ-220-A	16 QAM	1	0	1.0 cm	bottom	0.495
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.15	0.01	1	FJ-220-A	16 QAM	1	24	1.0 cm	bottom	0.491
1880.00	18900	Mid	LTE Band 2 (PCS)	5	22	22.16	-0.01	1	FJ-220-A	QPSK	12	6	1.0 cm	left	0.133
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.43	-0.01	0	FJ-220-A	QPSK	1	0	1.0 cm	left	0.131
1907.50	19175	High	LTE Band 2 (PCS)	5	23	23.21	-0.07	0	FJ-220-A	QPSK	1	24	1.0 cm	left	0.129
1880.00	18900	Mid	LTE Band 2 (PCS)	5	21	21.10	0.11	2	FJ-220-A	16 QAM	12	6	1.0 cm	left	0.101
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.34	-0.07	1	FJ-220-A	16 QAM	1	0	1.0 cm	left	0.107
1907.50	19175	High	LTE Band 2 (PCS)	5	22	22.15	-0.11	1	FJ-220-A	16 QAM	1	24	1.0 cm	left	0.105
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram						

- Per KDB 941225 D05, when the maximum average output power of 1 RB allocation is more than 0.5 dB higher than the 50% RB allocation, the highest output power for the 1 RB allocations is tested. Therefore high channel was tested for the QPSK, 1 RB allocation and 16 QAM, 1 RB allocation configurations.
- Per KDB 941225 D05, when the maximum output power of QPSK 50% RB allocation across high, mid., and low channels is < 0.5 dB, mid channel is tested. Low and high channel SAR tests were tested for QPSK 50% RB allocation when the SAR was > 0.8 W/kg.
- Per KDB 941225 D05, 16QAM 50% RB allocation was tested on the channel with the highest measured SAR for QPSK with 50% RB allocation. Therefore, low channel was tested for max power 16QAM 50% RB allocation back side configuration.

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Table 13-5
LTE Band 2 (PCS) Hotspot SAR Data – Reduced Power

MEASUREMENT RESULTS															
FREQUENCY		Ch.	Mode	Bandwidth [MHz]	Target Conducted Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	# of RB	RB Offset	Spacing	Side	SAR (1g) (W/kg)
MHz															
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.39	-0.09	0	1009-1	QPSK	12	6	1.0 cm	back	0.260
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.32	-0.05	0	1009-1	QPSK	1	0	1.0 cm	back	0.241
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.17	-0.07	0	1009-1	QPSK	1	24	1.0 cm	back	0.232
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.26	-0.12	0	1009-1	16 QAM	12	6	1.0 cm	back	0.299
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.50	0.00	0	1009-1	16 QAM	1	0	1.0 cm	back	0.304
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.33	0.00	0	1009-1	16 QAM	1	24	1.0 cm	back	0.301
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.39	-0.08	0	1009-1	QPSK	12	6	1.0 cm	front	0.118
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.32	0.06	0	1009-1	QPSK	1	0	1.0 cm	front	0.113
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.17	-0.04	0	1009-1	QPSK	1	24	1.0 cm	front	0.110
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.26	-0.11	0	1009-1	16 QAM	12	6	1.0 cm	front	0.113
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.50	0.02	0	1009-1	16 QAM	1	0	1.0 cm	front	0.115
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.33	-0.06	0	1009-1	16 QAM	1	24	1.0 cm	front	0.115
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.39	-0.06	0	1009-1	QPSK	12	6	1.0 cm	bottom	0.203
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.32	0.01	0	1009-1	QPSK	1	0	1.0 cm	bottom	0.193
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.17	0.05	0	1009-1	QPSK	1	24	1.0 cm	bottom	0.189
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.26	0.00	0	1009-1	16 QAM	12	6	1.0 cm	bottom	0.201
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.50	-0.02	0	1009-1	16 QAM	1	0	1.0 cm	bottom	0.204
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.33	0.03	0	1009-1	16 QAM	1	24	1.0 cm	bottom	0.201
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.39	0.03	0	1009-1	QPSK	12	6	1.0 cm	left	0.049
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.32	0.15	0	1009-1	QPSK	1	0	1.0 cm	left	0.048
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.17	0.04	0	1009-1	QPSK	1	24	1.0 cm	left	0.044
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.26	-0.01	0	1009-1	16 QAM	12	6	1.0 cm	left	0.051
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.50	-0.05	0	1009-1	16 QAM	1	0	1.0 cm	left	0.054
1880.00	18900	Mid	LTE Band 2 (PCS)	5	18	18.33	0.20	0	1009-1	16 QAM	1	24	1.0 cm	left	0.051
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram						

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13.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC OET Bulletin 65 Supplement C [June 2001].
2. Batteries are fully charged for all readings. The standard battery was used.
3. Tissue parameters and temperatures are listed on the SAR plots.
4. Liquid tissue depth was at least 15.0 cm. To confirm the proper SAR liquid depth, the z-axis plots from the system verifications were included since the system verifications were performed using the same liquid, probe and DAE as the SAR tests in the same time period.
5. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical, and thermal characteristics expected for production units.
6. LTE test configurations are determined according to SAR Test Considerations for LTE handsets and Data Modems KDB 941225 D05 Publication. General test procedures can be found in Section 9.1.3.
7. MPR is implemented for this device by the manufacturer when the transmit power is not limited by the power reduction mechanism. 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. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator.
9. Per FCC guidance, when the reported SAR measured for 1 cm air-gap without headset cable is >1.2 W/kg, the highest reported SAR configuration for the mode and band should be repeated with headset attached, per past FCC guidance. Since the measured SAR was not >1.2 W/kg, LTE hotspot SAR data for the back sides additionally show body-worn compliance.
10. Top and Right Edges for the LTE transmitter was not tested since the antenna distance from the edge was greater than 2.5 cm per FCC KDB Publication 941225 D06 guidance (see Section 1.3).
11. During SAR Testing for the Wireless Router conditions per KDB 941225 D06, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 7.6.)

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14 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

14.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” FCC KDB Publication 648474 are applicable to handsets with built-in unlicensed transmitters such as 802.11a/b/g/n and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

14.2 FCC Power Tables & Conditions

	2.45	5.15 - 5.35	5.47 - 5.85	GHz
P_{Ref}	12	6	5	mW
Device output power should be rounded to the nearest mW to compare with values specified in this table.				

Figure 14-1
Output Power Thresholds for Unlicensed Transmitters

	Individual Transmitter	Simultaneous Transmission
Licensed Transmitters	<u>Routine evaluation required</u>	SAR not required: <u>Unlicensed only</u>
Unlicensed Transmitters	<u>When there is no simultaneous transmission –</u> - output ≤ 60/f: SAR not required - output > 60/f: stand-alone SAR required <u>When there is simultaneous transmission –</u> <u>Stand-alone SAR not required when</u> - output $\leq 2 \cdot P_{Ref}$ and antenna is ≥ 5.0 cm from other antennas - output $\leq P_{Ref}$ and antenna is ≥ 2.5 cm from other antennas - output $\leq P_{Ref}$ and antenna is < 2.5 cm from other antennas, each with either output power $\leq P_{Ref}$ or 1-g SAR < 1.2 W/kg <u>Otherwise stand-alone SAR is required</u> <u>When stand-alone SAR is required</u> - test SAR on highest output channel for each wireless mode and exposure condition - if SAR for highest output channel is $> 50\%$ of SAR limit, evaluate all channels according to normal procedures	<u>Licensed & Unlicensed</u> - when the sum of the 1-g SAR is < 1.6 W/kg for all simultaneous transmitting antennas - when SAR to peak location separation ratio of simultaneous transmitting antenna pair is < 0.3 SAR required: <u>Licensed & Unlicensed</u> antenna pairs with SAR to peak location separation ratio ≥ 0.3; test is only required for the configuration that results in the highest SAR in stand-alone configuration for each wireless mode and exposure condition Note: simultaneous transmission exposure conditions for head and body can be different for different style phones; therefore, different test requirements may apply

Figure 14-2
SAR Evaluation Requirements for Multiple Transmitter Handsets

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14.3 Simultaneous Transmission Capabilities

According to Figure 14-1 and Figure 14-2, simultaneous transmission analysis of SAR may be required for this device for the two licensed and unlicensed transmitters. Possible simultaneous transmissions (between the two licensed transmitters and the unlicensed transmitter) for this device indicated in Table 14-1 were numerically summed using stand-alone SAR data (Please see RF Exposure Technical Report S/N 0Y1203290373.A3L for original compliance evaluation for stand-alone SAR data of modes/bands other than LTE Band 2) and are shown in the following tables.

Table 14-1
Simultaneous Transmission Scenarios with LTE Band 2

Ref.	Simultaneous Transmit Configurations	Power Reduction	Head	Body-Worn Accessory	Hot Spot
			IEEE 1528, Supp C	Supplement C	FCC KDB 941225 D06 edges/sides
A	BC0/BC1 850/1900 MHz 1x-RTT CDMA Voice + LTE B2 Data	LTE	Table 14-5	Table 14-6	-
B	BC0/BC1 850/1900 MHz 1x-RTT CDMA Voice + LTE B2 Data + 2.4 GHz WIFI	LTE	Table 14-5	Table 14-6	Table 14-7
C	LTE B2 Data + 2.4 GHz WIFI	None	Table 14-2	Table 14-3	Table 14-4

14.4 Held-to-Ear and Body-worn Simultaneous Transmission Analysis

Table 14-2
Simultaneous Transmission Scenario (Held-to-Ear)

Simult Tx Ref	Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
C	Right Cheek	0.117	0.013	0.130
	Right Tilt	0.075	0.009	0.084
	Left Cheek	0.200	0.027	0.227
	Left Tilt	0.057	0.013	0.070

Table 14-3
Simultaneous Transmission Scenario (Body-Worn at 1.0 cm)

Simult Tx Ref	Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
C	Back Side	0.903	0.066	0.969

14.5 Hotspot Simultaneous Transmission Analysis

Table 14-4
Simultaneous Transmission Scenario (Hotspot at 1.0 cm)

Simult Tx Ref	Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
C	Back	0.903	0.066	0.969
	Front	0.407	0.007	0.414
	Top	-	0.004	0.004
	Bottom	0.606	-	0.606
	Right	-	0.023	0.023
	Left	0.133	-	0.133

Note: Per FCC KDB Publication 941225 D06, the edges with antennas more than 2.5 cm are not required to be evaluated for SAR ("").

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14.6 SVLTE Simultaneous Transmission Scenario Analysis

Table 14-5
Simultaneous Transmission Scenario (Held-to-Ear)

Simult. Tx Ref.	CDMA Power Level (dBm)	Configuration	Cell. CDMA - FCC Rule Part 22H SAR (W/kg)	LTE Band 2 SAR (W/kg)	2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
		Tx Ant	1	2	3	1+2	1+2+3
A, B	P $\geq$ 18	Target Power (dBm)	25	18	-		
		Right Cheek	0.100	0.053	0.013	0.153	0.166
		Right Tilt	0.068	0.030	0.009	0.098	0.107
		Left Cheek	0.100	0.081	0.027	0.181	0.208
		Left Tilt	0.070	0.019	0.013	0.089	0.102
	P<18	Target Power (dBm)	18	23	-		
		Right Cheek	0.025	0.117	0.013	0.142	0.155
		Right Tilt	0.016	0.075	0.009	0.091	0.100
		Left Cheek	0.020	0.200	0.027	0.220	0.247
		Left Tilt	0.014	0.057	0.013	0.071	0.084
Simult. Tx Ref.	CDMA Power Level (dBm)	Configuration	PCS CDMA - FCC Rule Part 24E SAR (W/kg)	LTE Band 2 SAR (W/kg)	2.4GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
		Tx Ant	1	2	3	1+2	1+2+3
A, B	P $\geq$ 18	Target Power (dBm)	25	18	-		
		Right Cheek	0.305	0.053	0.013	0.358	0.371
		Right Tilt	0.095	0.030	0.009	0.125	0.134
		Left Cheek	0.422	0.081	0.027	0.503	0.530
		Left Tilt	0.115	0.019	0.013	0.134	0.147
	P<18	Target Power (dBm)	18	23	-		
		Right Cheek	0.061	0.117	0.013	0.178	0.191
		Right Tilt	0.017	0.075	0.009	0.092	0.101
		Left Cheek	0.072	0.200	0.027	0.272	0.299
		Left Tilt	0.019	0.057	0.013	0.076	0.089

Table 14-6
Simultaneous Transmission Scenario (Body-Worn at 1.0 cm)

Simult Tx Ref.	Mode	CDMA SAR (W/kg)	LTE Band 2 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
	Tx Ant	1	2	3	1+2	1+2+3
	Target Power (dBm)	25	18	-		
A, B	Cell. CDMA - FCC Rule Part 22H	0.495	0.304	0.066	0.799	0.865
	PCS CDMA - FCC Rule Part 24E	1.030	0.304	0.066	1.334	1.400
	Target Power (dBm)	18	23	-		
A, B	Cell. CDMA - FCC Rule Part 22H	0.084	0.903	0.066	0.987	1.053
	PCS CDMA - FCC Rule Part 24E	0.245	0.903	0.066	1.148	1.214

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Table 14-7
Simultaneous Transmission Scenario (Hotspot at 1.0 cm)

Simult. Tx Ref.	CDMA Power Level (dBm)	Configuration	Cell. CDMA - FCC Rule Part 22H SAR (W/kg)	LTE Band 2 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		Tx Ant	1	2	3	1+2+3
B	P≥18	Target Power (dBm)	25	18	-	
		Back	0.495	0.304	0.066	0.865
		Front	0.251	0.118	0.007	0.376
		Top	-	-	0.004	0.004
		Bottom	0.218	0.204	-	0.422
		Right	0.308	-	0.023	0.331
		Left	-	0.054	-	0.054
	P<18	Target Power (dBm)	18	23	-	
		Back	0.084	0.903	0.066	1.053
		Front	0.036	0.407	0.007	0.450
		Top	-	-	0.004	0.004
		Bottom	0.032	0.606	-	0.638
		Right	0.042	-	0.023	0.065
		Left	-	0.133	-	0.133
Simult. Tx Ref.	CDMA Power Level (dBm)	Configuration	PCS CDMA - FCC Rule Part 24E SAR (W/kg)	LTE Band 2 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		Tx Ant	1	2	3	1+2+3
B	P≥18	Target Power (dBm)	25	18	-	
		Back	1.030	0.304	0.066	1.400
		Front	0.598	0.118	0.007	0.723
		Top	-	-	0.004	0.004
		Bottom	0.624	0.204	-	0.828
		Right	0.297	-	0.023	0.320
		Left	-	0.054	-	0.054
	P<18	Target Power (dBm)	18	23	-	
		Back	0.245	0.903	0.066	1.214
		Front	0.172	0.407	0.007	0.586
		Top	-	-	0.004	0.004
		Bottom	0.184	0.606	-	0.790
		Right	0.059	-	0.023	0.082
		Left	-	0.133	-	0.133

Note: Per FCC KDB Publication 941225 D06, the edges with antennas more than 2.5 cm are not required to be evaluated for SAR ("").

14.7 Simultaneous Transmission Conclusion

The above numerical summed SAR was below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit. No volumetric SAR summation is required per FCC KDB Publication 648474. The measured and numerical summed SAR remains compliant when extrapolated to the maximum tune-up power tolerance levels.

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15 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/5/2012	Annual	4/5/2013	MY45470194
Agilent	8753E	(30kHz-6GHz) Network Analyzer	4/3/2012	Annual	4/3/2013	US37390350
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8648D	(9kHz-4GHz) Signal Generator	10/10/2011	Annual	10/10/2012	3613A00315
Agilent	85070E	Dielectric Probe Kit	3/8/2012	Annual	3/8/2013	MY44300633
Agilent	8648D	Signal Generator	4/3/2012	Annual	4/3/2013	3629U00687
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00579
Amplifier Research	5S1G4	5W, 800MHz-4.2GHz	CBT	N/A	CBT	21910
Anritsu	ML2438A	Power Meter	10/13/2011	Annual	10/13/2012	1070030
Anritsu	ML2495A	Power Meter	10/13/2011	Annual	10/13/2012	1039008
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	8013
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	2400
Anritsu	MA2481A	Power Sensor	4/5/2012	Annual	4/5/2013	5605
Anritsu	MA2411B	Pulse Sensor	10/13/2011	Annual	10/13/2012	1027293
Anritsu	MT8820C	Radio Communication Tester	11/11/2011	Annual	11/11/2012	6200901190
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
Control Company	61220-416	Long-Stem Thermometer	10/12/2011	Biennial	10/12/2013	111860844
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/12/2011	Annual	10/12/2012	1833460
Gigatronics	8651A	Universal Power Meter	10/12/2011	Annual	10/12/2012	8650319
Intelligent Weigh	PD-3000	Electronic Balance	3/27/2012	Annual	3/27/2013	11081534
Intelligent Weighing	PD-3000	Electronic Balance	6/29/2012	Annual	6/29/2013	120405017
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	8/25/2011	Annual	8/25/2012	100976
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	11/30/2011	Annual	11/30/2012	101699
Rohde & Schwarz	SMI003B	Signal Generator	4/5/2012	Annual	4/5/2013	DE27259
Seekonk	NC-100	Torque Wrench (8" lb)	11/29/2011	Triennial	11/29/2014	21053
Seekonk	NC-100	Torque Wrench (8" lb)	3/5/2012	Triennial	3/5/2015	N/A
SPEAG	D1900V2	1900 MHz SAR Dipole	2/8/2012	Annual	2/8/2013	5d148
SPEAG	D1900V2	1900 MHz SAR Dipole	2/22/2012	Annual	2/22/2013	5d149
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/20/2012	Annual	2/20/2013	649
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/12/2012	Annual	4/12/2013	1333
SPEAG	ES3DV3	SAR Probe	2/7/2012	Annual	2/7/2013	3288
SPEAG	ES3DV3	SAR Probe	2/7/2012	Annual	2/7/2013	3287
Tektronix	RSA-6114A	Real Time Spectrum Analyzer	4/5/2012	Annual	4/5/2013	B010177
VWR	62344-925	Mini-Thermometer	10/24/2011	Biennial	10/24/2013	111886430
VWR	36934-158	Wall-Mounted Thermometer	9/30/2011	Biennial	9/30/2013	111859332

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

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16 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
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.2	23.5

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

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17 CONCLUSION

17.1 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: A3LSPHL710; Type: Portable Handset; Serial: FJ-220-A

Communication System: LTE Band 2 (PCS); Frequency: 1907.5 MHz; Duty Cycle: 1:1

Medium: 1900 Head; Medium parameters used (interpolated):

$f = 1907.5 \text{ MHz}$; $\sigma = 1.452 \text{ mho/m}$; $\epsilon_r = 40.908$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 08-23-2012; Ambient Temp: 23.9°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3287; ConvF(5.06, 5.06, 5.06); Calibrated: 2/7/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/20/2012

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Mode: LTE Band 2 (PCS), Right Head, Cheek, High.ch,
5 MHz Bandwidth, QPSK, 1 RB, RB Offset 0**

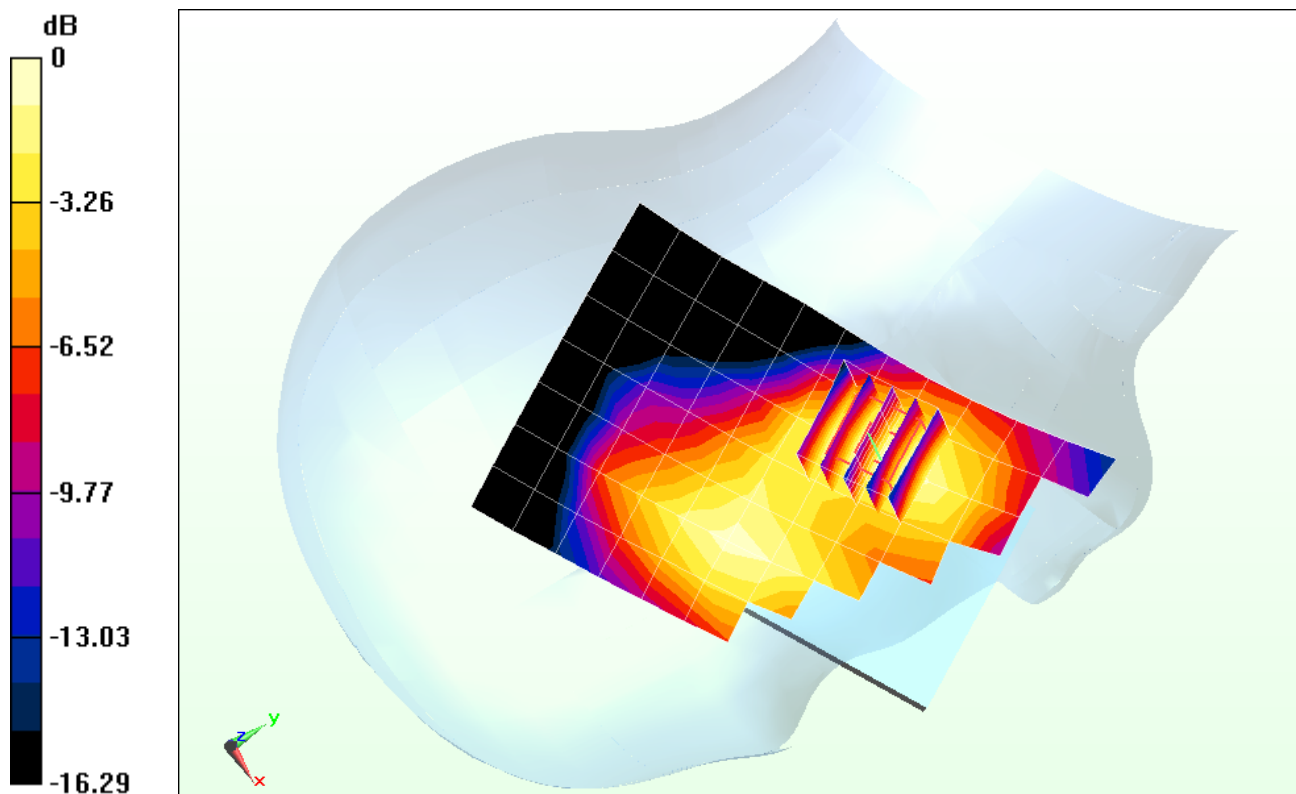
Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 9.669 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.184 mW/g

SAR(1 g) = 0.117 mW/g; SAR(10 g) = 0.071 mW/g



0 dB = 0.122 mW/g = -18.27 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSPHL710; Type: Portable Handset; Serial: FJ-220-A

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

Medium: 1900 Head; Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.419 \text{ mho/m}$; $\epsilon_r = 41$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 08-23-2012; Ambient Temp: 23.9°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3287; ConvF(5.06, 5.06, 5.06); Calibrated: 2/7/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/20/2012

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Mode: LTE Band 2 (PCS), Right Head, Tilt, Mid.ch,
5 MHz Bandwidth, QPSK, 12 RB, 6 RB Offset**

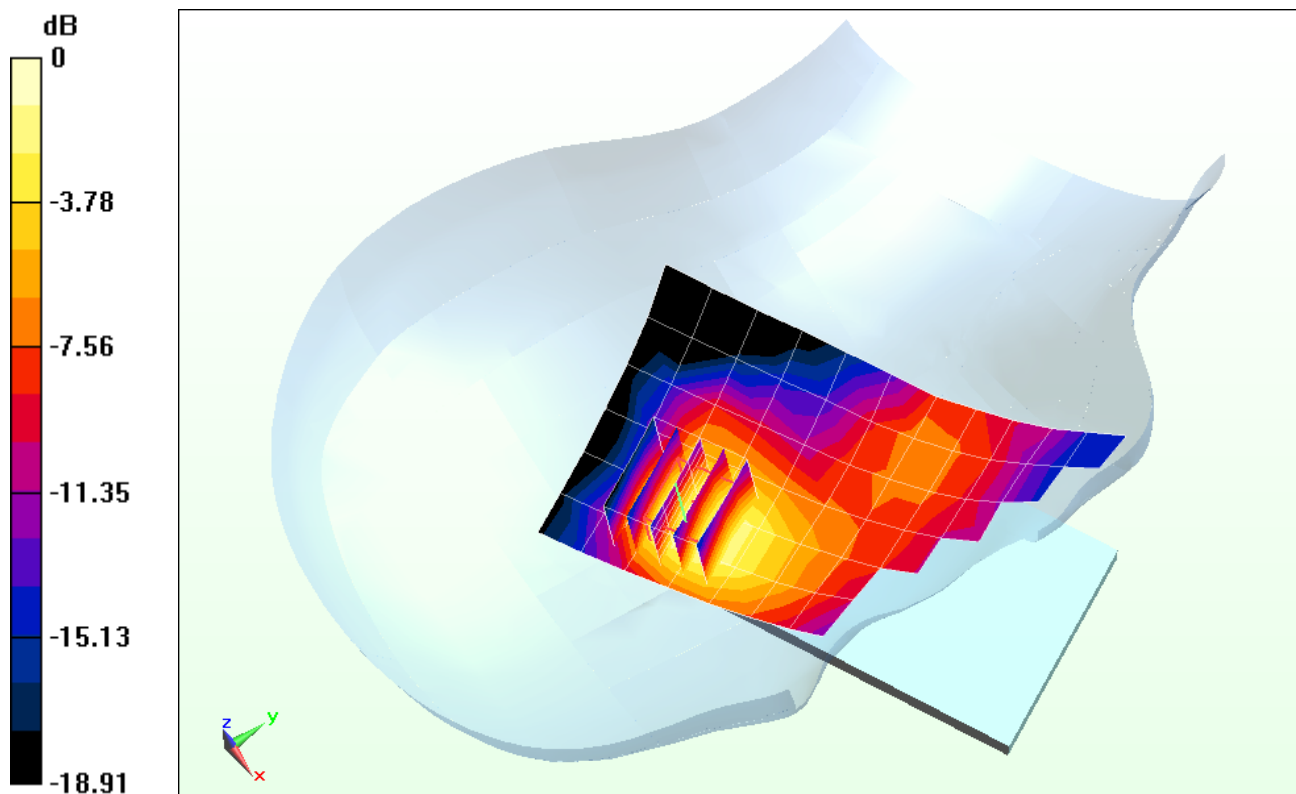
Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 7.404 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.122 mW/g

SAR(1 g) = 0.075 mW/g; SAR(10 g) = 0.044 mW/g



0 dB = 0.0834 mW/g = -21.58 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSPHL710; Type: Portable Handset; Serial: FJ-220-A

Communication System: LTE Band 2 (PCS); Frequency: 1907.5 MHz; Duty Cycle: 1:1

Medium: 1900 Head; Medium parameters used (interpolated):

$f = 1907.5 \text{ MHz}$; $\sigma = 1.452 \text{ mho/m}$; $\epsilon_r = 40.908$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 08-23-2012; Ambient Temp: 23.9°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3287; ConvF(5.06, 5.06, 5.06); Calibrated: 2/7/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/20/2012

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

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

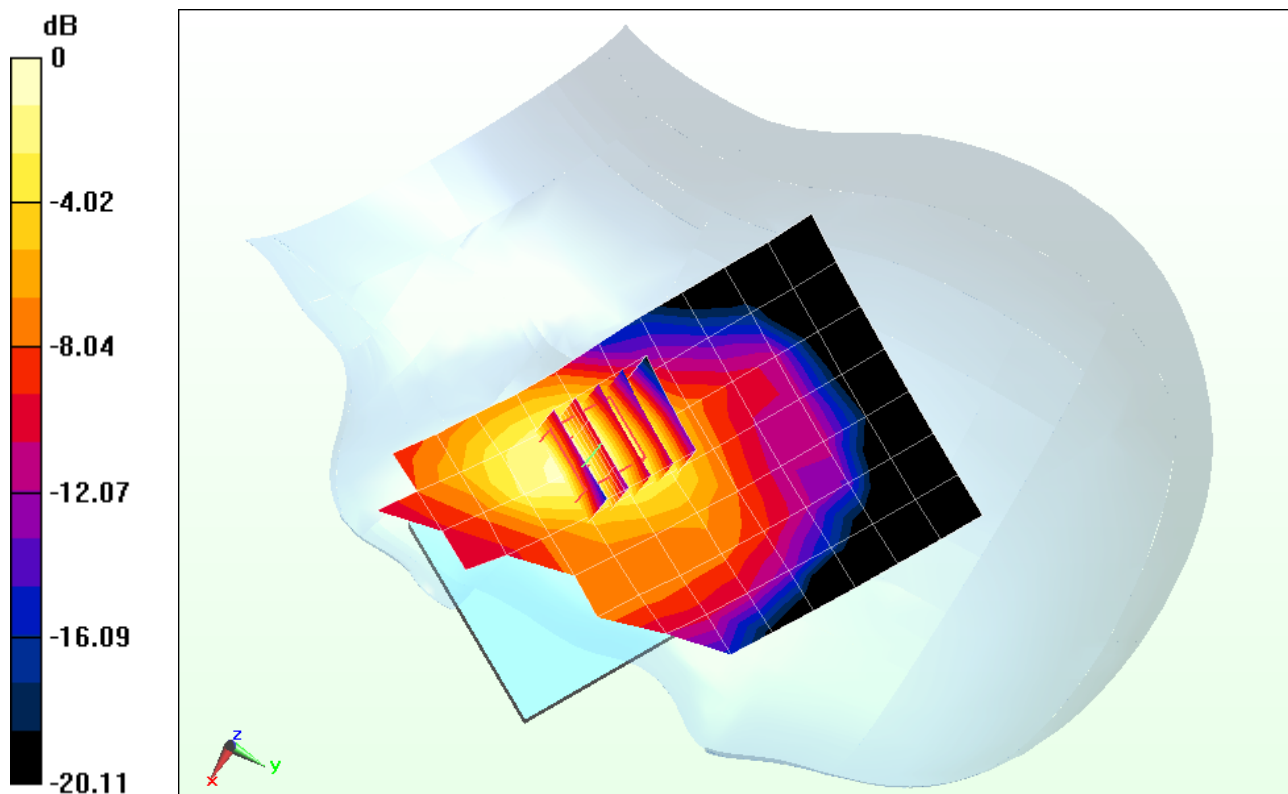
Area Scan (8x12x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 12.733 V/m; Power Drift = 0.15 dB

Peak SAR (extrapolated) = 0.317 mW/g

SAR(1 g) = 0.200 mW/g; SAR(10 g) = 0.122 mW/g



0 dB = 0.206 mW/g = -13.72 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSPHL710; Type: Portable Handset; Serial: FJ-220-A

Communication System: LTE Band 2 (PCS); Frequency: 1907.5 MHz; Duty Cycle: 1:1

Medium: 1900 Head; Medium parameters used (interpolated):

$f = 1907.5 \text{ MHz}$; $\sigma = 1.452 \text{ mho/m}$; $\epsilon_r = 40.908$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 08-23-2012; Ambient Temp: 23.9°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3287; ConvF(5.06, 5.06, 5.06); Calibrated: 2/7/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/20/2012

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Mode: LTE Band 2 (PCS), Left Head, Tilt, High.ch,
5 MHz Bandwidth, QPSK, 1 RB, RB Offset 0**

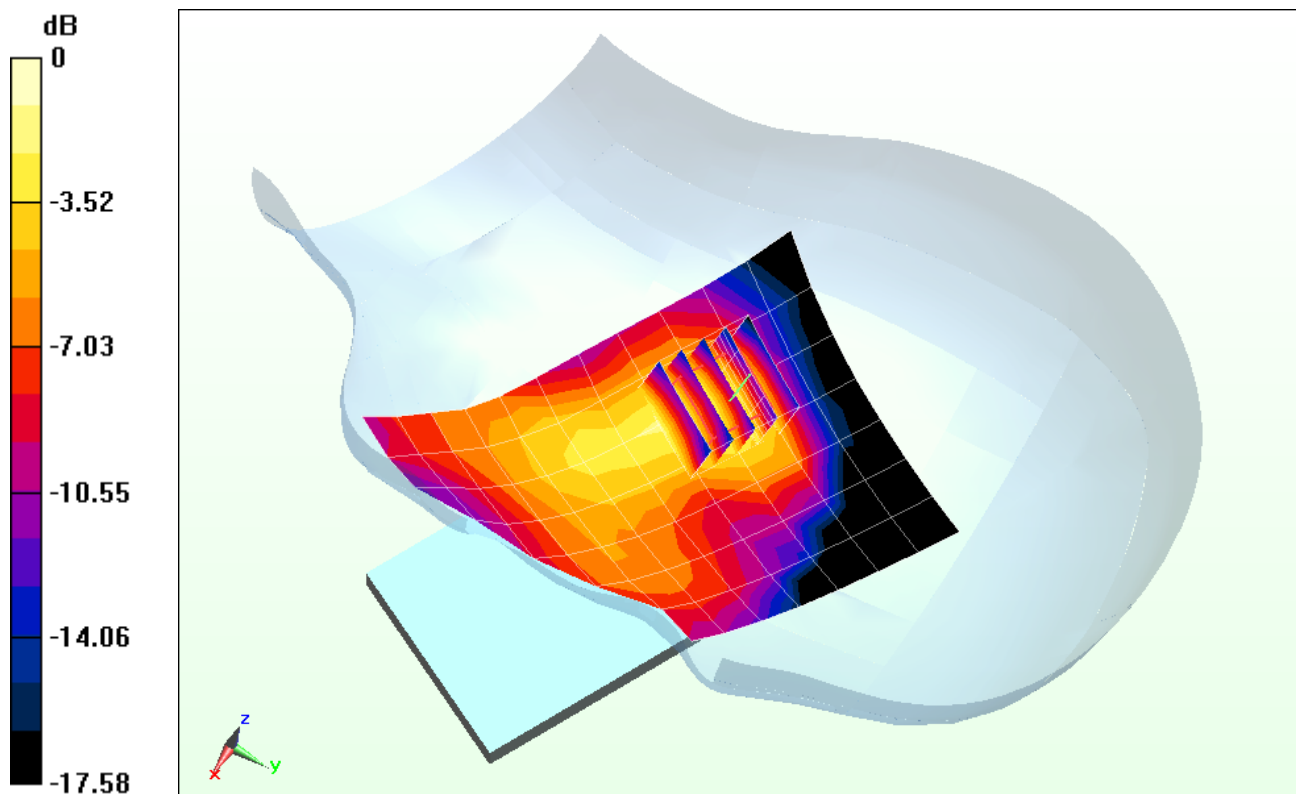
Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 6.947 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.089 mW/g

SAR(1 g) = 0.057 mW/g; SAR(10 g) = 0.034 mW/g



0 dB = 0.0603 mW/g = -24.39 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSPHL710; Type: Portable Handset; Serial: FJ-220-A

Communication System: LTE Band 2 (PCS); Frequency: 1852.5 MHz; Duty Cycle: 1:1

Medium: 1900 Body; Medium parameters used (interpolated):

$f = 1852.5 \text{ MHz}$; $\sigma = 1.467 \text{ mho/m}$; $\epsilon_r = 55.189$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-21-2012; Ambient Temp: 24.6°C; Tissue Temp: 23.2°C

Probe: ES3DV3 - SN3288; ConvF(5.02, 5.02, 5.02); Calibrated: 2/7/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 4/12/2012

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

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Mode: LTE Band 2 (PCS), Body SAR, Back side, Low.ch,
5 MHz Bandwidth, QPSK, 12 RB, 6 RB Offset**

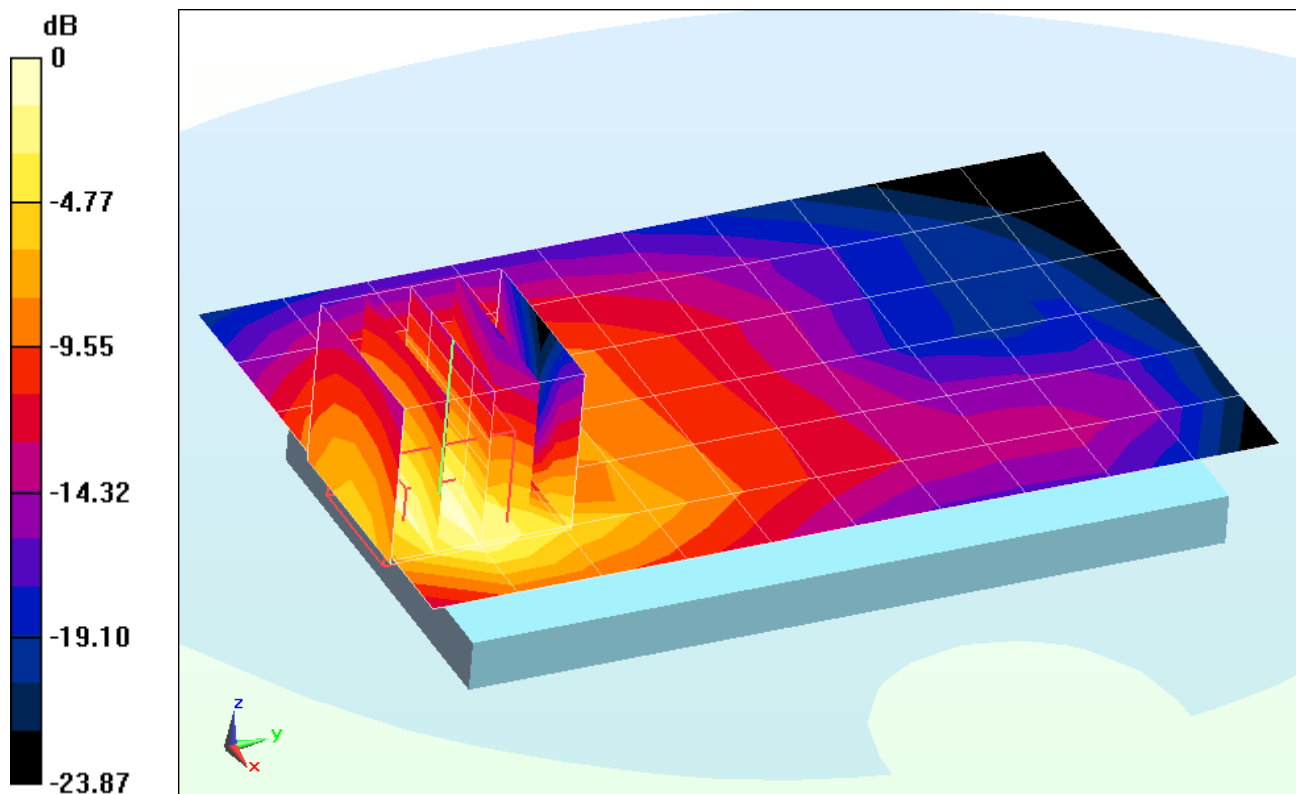
Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 26.260 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 1.613 mW/g

SAR(1 g) = 0.903 mW/g; SAR(10 g) = 0.458 mW/g



0 dB = 0.971 mW/g = -0.26 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSPHL710; Type: Portable Handset; Serial: FJ-220-A

Communication System: LTE Band 2 (PCS); Frequency: 1907.5 MHz; Duty Cycle: 1:1

Medium: 1900 Body; Medium parameters used (interpolated):

$f = 1907.5 \text{ MHz}$; $\sigma = 1.507 \text{ mho/m}$; $\epsilon_r = 54.868$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-21-2012; Ambient Temp: 24.6°C; Tissue Temp: 23.2°C

Probe: ES3DV3 - SN3288; ConvF(5.02, 5.02, 5.02); Calibrated: 2/7/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 4/12/2012

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

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Mode: LTE Band 2 (PCS), Body SAR, Front side, High.ch,
5 MHz Bandwidth, QPSK, 1 RB, RB Offset 0**

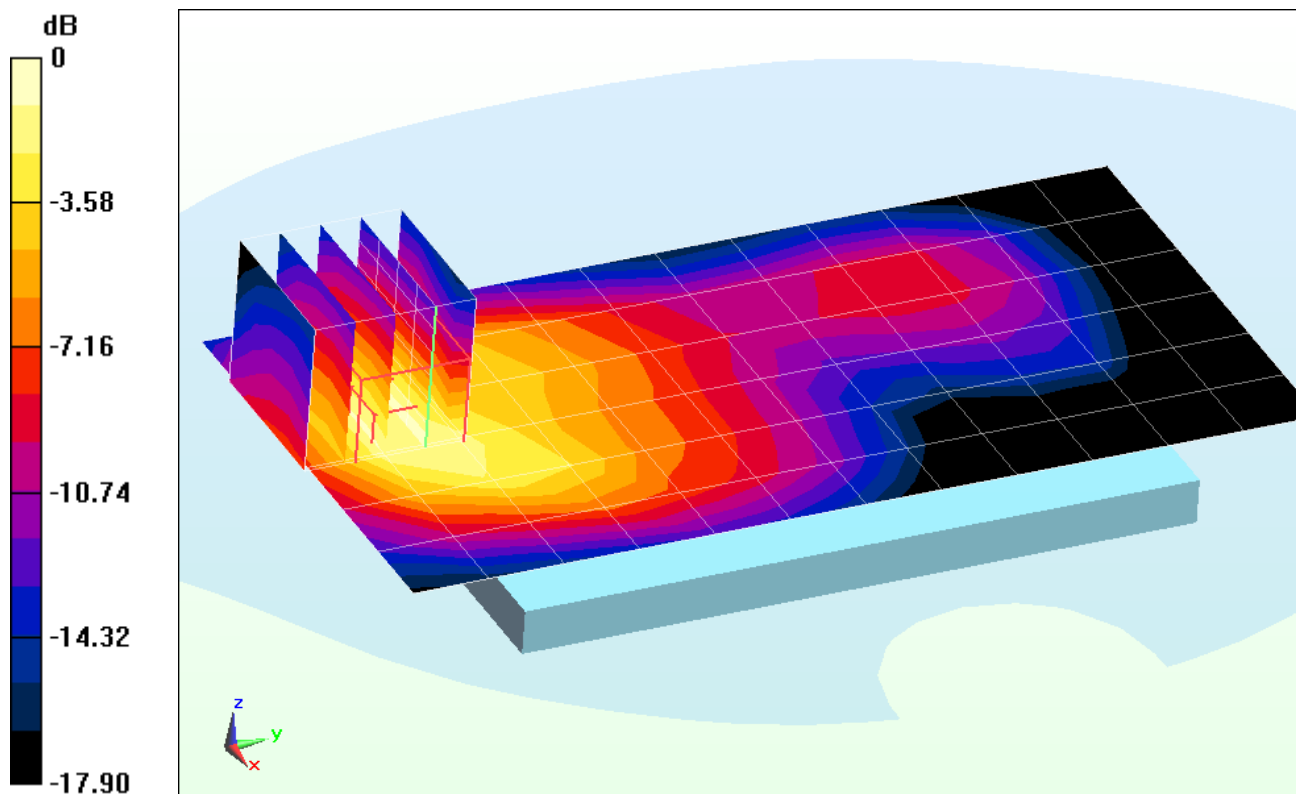
Area Scan (7x13x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 16.017 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 0.671 mW/g

SAR(1 g) = 0.407 mW/g; SAR(10 g) = 0.227 mW/g



0 dB = 0.446 mW/g = -7.01 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSPHL710; Type: Portable Handset; Serial: FJ-220-A

Communication System: LTE Band 2 (PCS); Frequency: 1907.5 MHz; Duty Cycle: 1:1

Medium: 1900 Body; Medium parameters used (interpolated):

$f = 1907.5 \text{ MHz}$; $\sigma = 1.507 \text{ mho/m}$; $\epsilon_r = 54.868$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-21-2012; Ambient Temp: 24.6°C; Tissue Temp: 23.2°C

Probe: ES3DV3 - SN3288; ConvF(5.02, 5.02, 5.02); Calibrated: 2/7/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 4/12/2012

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

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Mode: LTE Band 2 (PCS), Body SAR, Bottom Edge, High.ch,
5 MHz Bandwidth, QPSK, 1 RB, RB Offset 0**

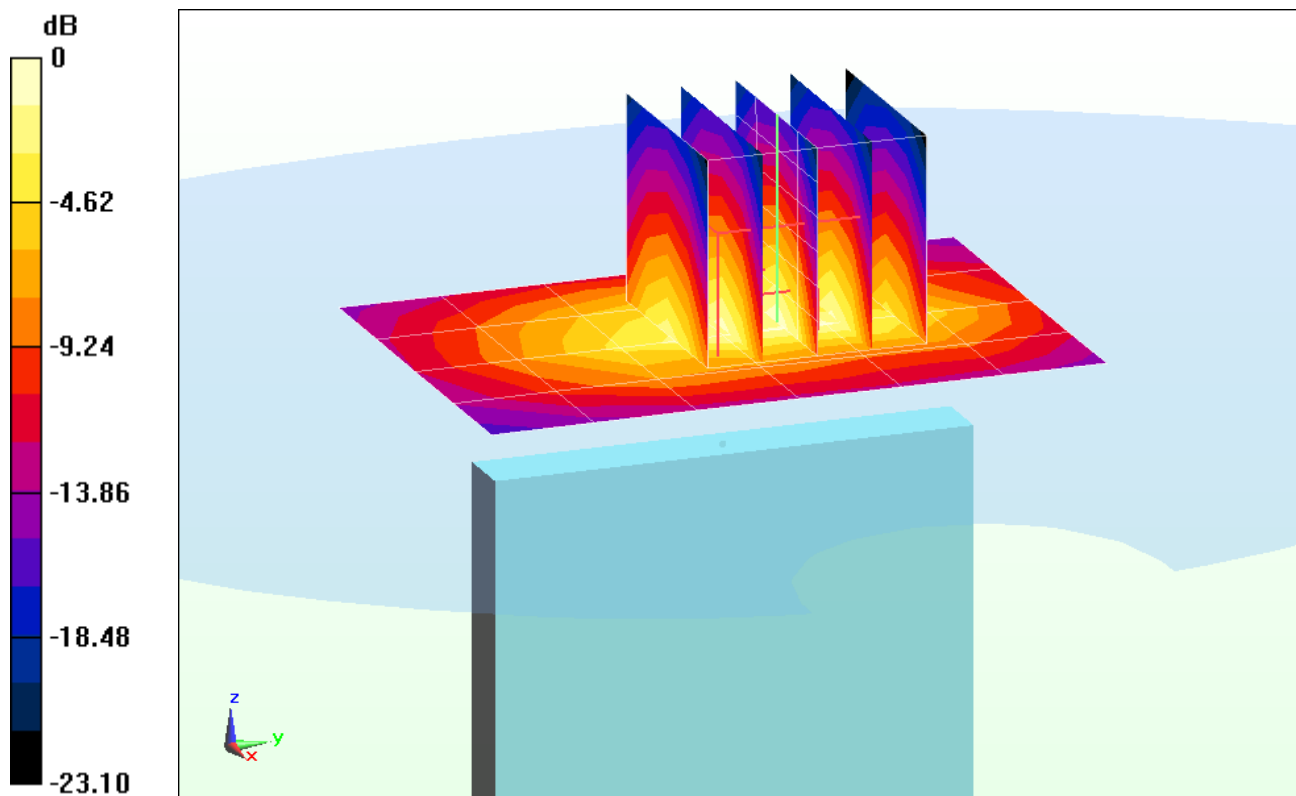
Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 22.014 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.015 mW/g

SAR(1 g) = 0.606 mW/g; SAR(10 g) = 0.328 mW/g



0 dB = 0.691 mW/g = -3.21 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSPHL710; Type: Portable Handset; Serial: FJ-220-A

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

Medium: 1900 Body; Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.479 \text{ mho/m}$; $\epsilon_r = 54.85$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-21-2012; Ambient Temp: 24.6°C; Tissue Temp: 23.2°C

Probe: ES3DV3 - SN3288; ConvF(5.02, 5.02, 5.02); Calibrated: 2/7/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 4/12/2012

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

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Mode: LTE Band 2 (PCS), Body SAR, Left Edge, Mid.ch,
5 MHz Bandwidth, QPSK, 12 RB, 6 RB Offset**

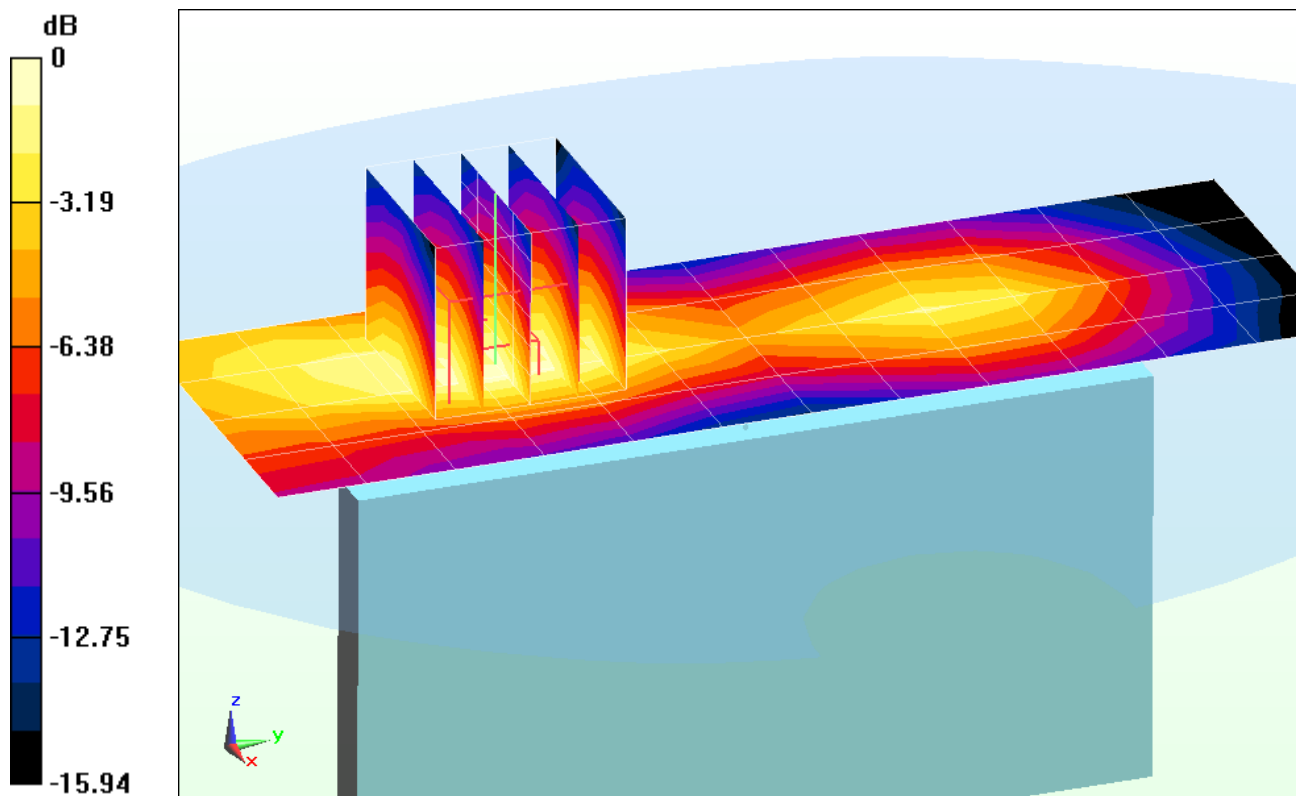
Area Scan (5x13x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 9.748 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.211 mW/g

SAR(1 g) = 0.133 mW/g; SAR(10 g) = 0.078 mW/g



0 dB = 0.147 mW/g = -16.65 dB mW/g

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.443 \text{ mho/m}$; $\epsilon_r = 40.933$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-23-2012; Ambient Temp: 23.9°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3287; ConvF(5.06, 5.06, 5.06); Calibrated: 2/7/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/20/2012

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

1900 MHz System Verification

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

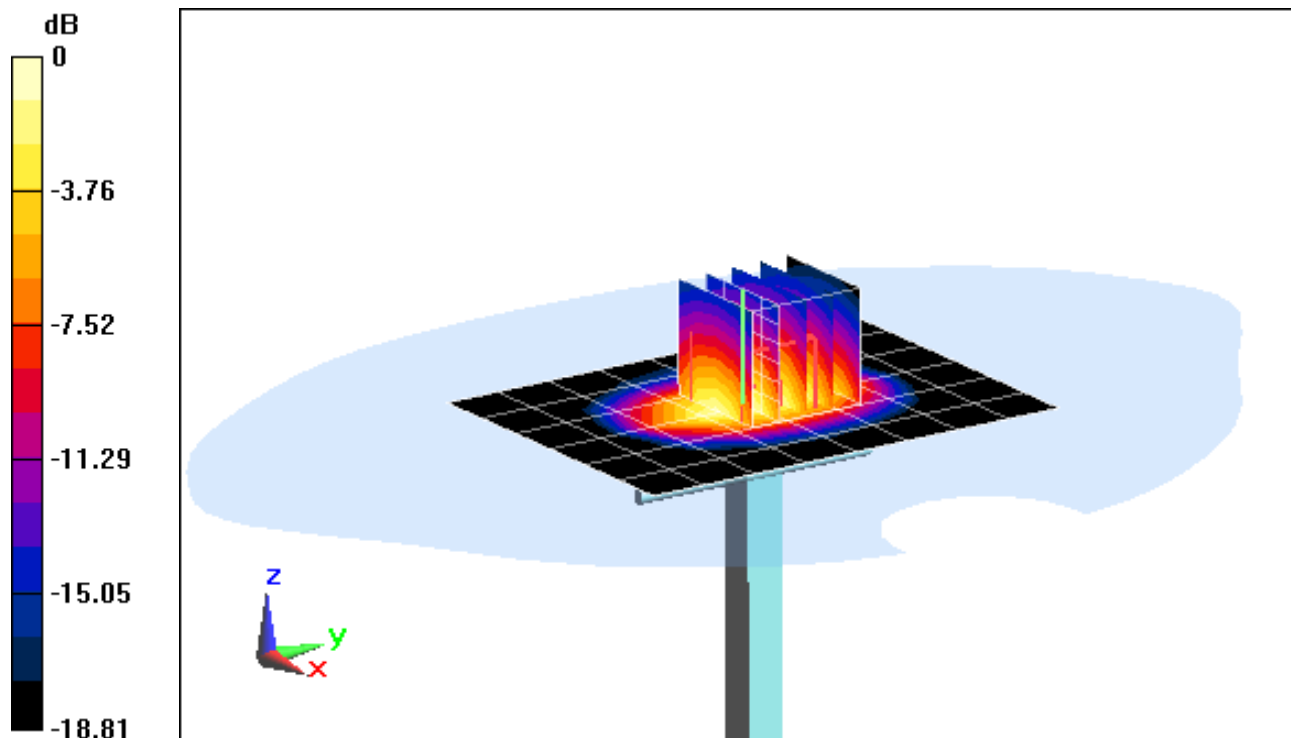
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.789 mW/g

SAR(1 g) = 4.18 mW/g; SAR(10 g) = 2.17 mW/g

Deviation: 6.36%



0 dB = 4.64 mW/g = 13.33 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.443 \text{ mho/m}$; $\epsilon_r = 40.933$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-23-2012; Ambient Temp: 23.9°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3287; ConvF(5.06, 5.06, 5.06); Calibrated: 2/7/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/20/2012

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

1900 MHz System Verification

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

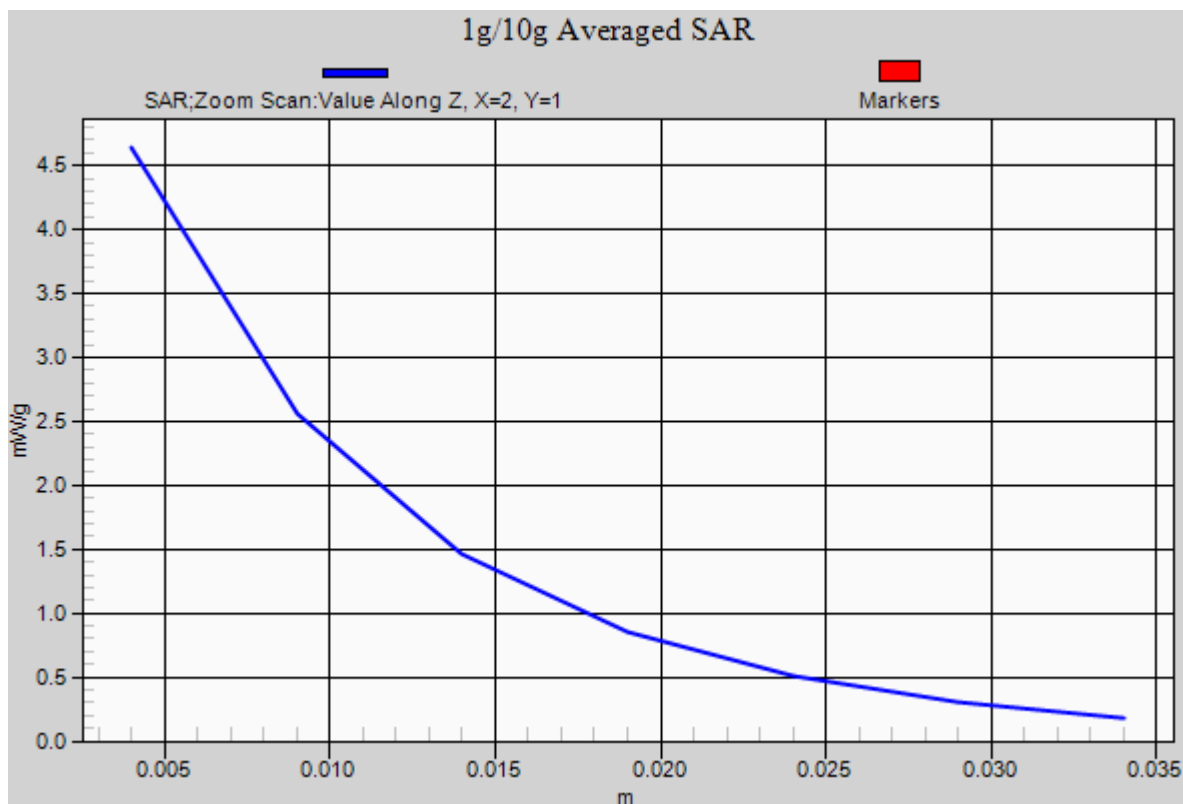
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.789 mW/g

SAR(1 g) = 4.18 mW/g; SAR(10 g) = 2.17 mW/g

Deviation: 6.36%



PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body; Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.5 \text{ mho/m}$; $\epsilon_r = 54.863$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-21-2012; Ambient Temp: 24.6°C; Tissue Temp: 23.2°C

Probe: ES3DV3 - SN3288; ConvF(5.02, 5.02, 5.02); Calibrated: 2/7/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 4/12/2012

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

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

1900 MHz System Verification

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

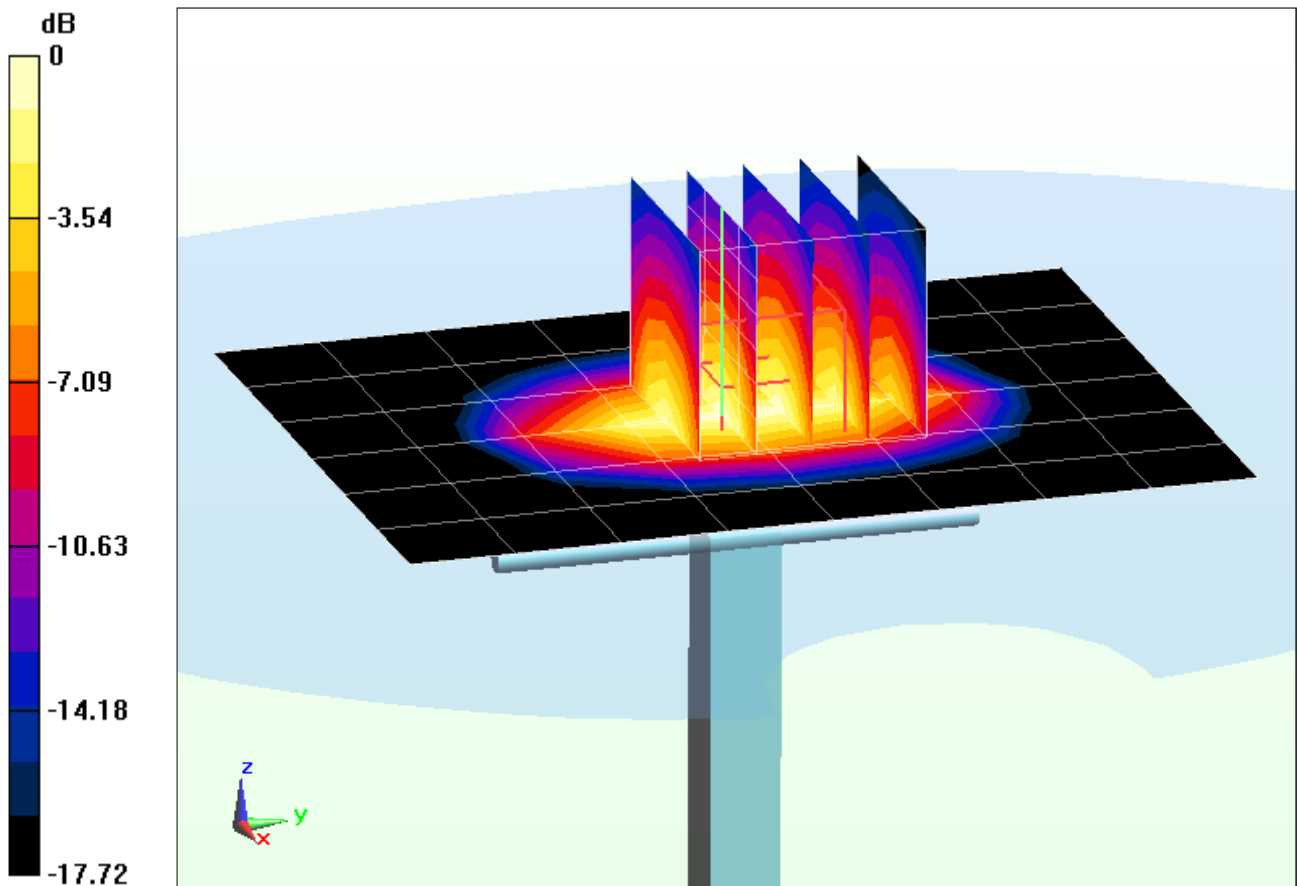
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 6.608 mW/g

SAR(1 g) = 3.77 mW/g; SAR(10 g) = 2 mW/g

Deviation = -3.58%



0 dB = 4.21 mW/g = 12.49 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body; Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.5 \text{ mho/m}$; $\epsilon_r = 54.863$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-21-2012; Ambient Temp: 24.6°C; Tissue Temp: 23.2°C

Probe: ES3DV3 - SN3288; ConvF(5.02, 5.02, 5.02); Calibrated: 2/7/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 4/12/2012

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

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

1900 MHz System Verification

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

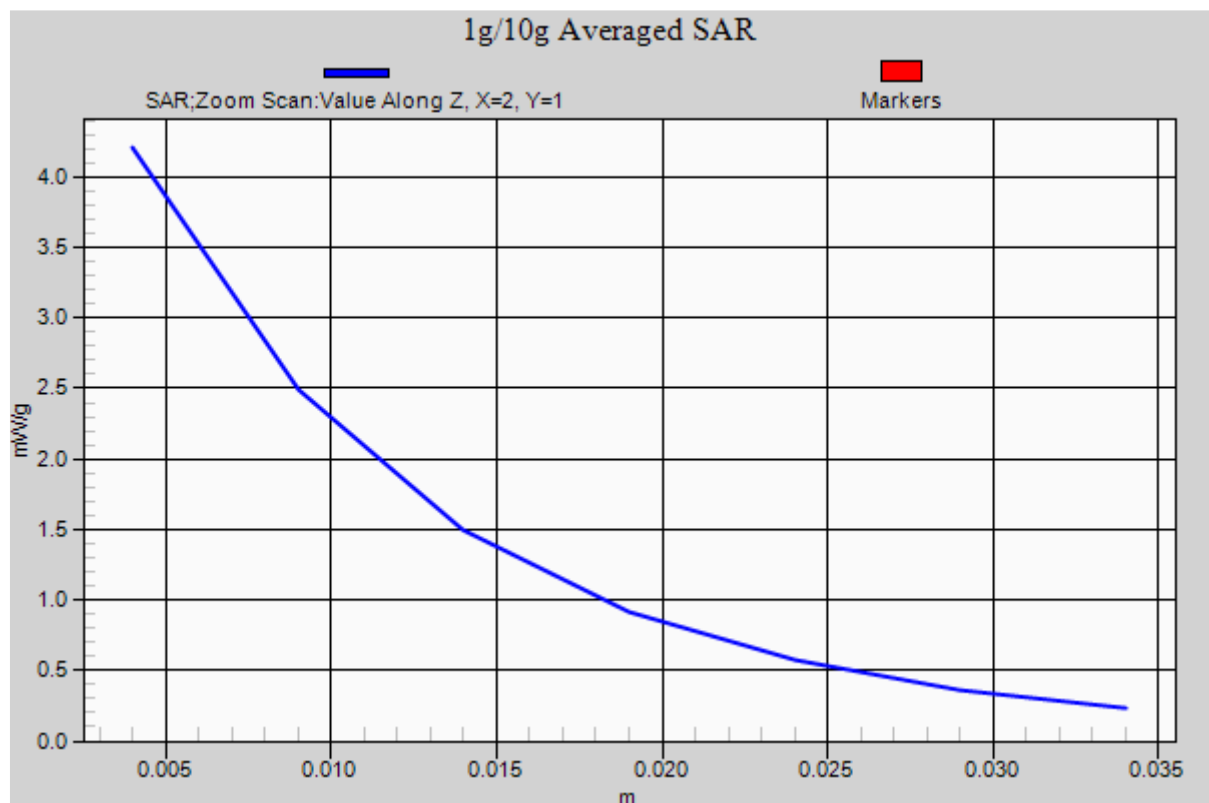
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 6.608 mW/g

SAR(1 g) = 3.77 mW/g; SAR(10 g) = 2 mW/g

Deviation = -3.58%



APPENDIX C: PROBE CALIBRATION



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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d149_Feb12**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d149**

Calibration procedure(s) **QA CAL-05.v8**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **February 22, 2012**

✓ KOK
 4/11/12

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	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: February 23, 2012

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



Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- 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.

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.4 $\pm$ 6 %	1.40 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.80 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.3 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.18 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.7 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.0 $\pm$ 6 %	1.56 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.99 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	39.3 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.23 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.7 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.4 \Omega + 5.5 j\Omega$
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.0 \Omega + 6.7 j\Omega$
Return Loss	- 23.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 22.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.4$ mho/m; $\epsilon_r = 40.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

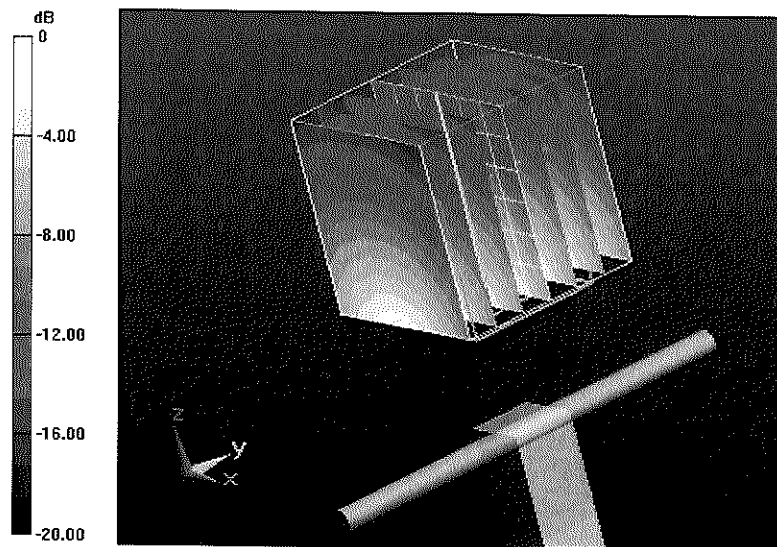
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.685 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 17.4710

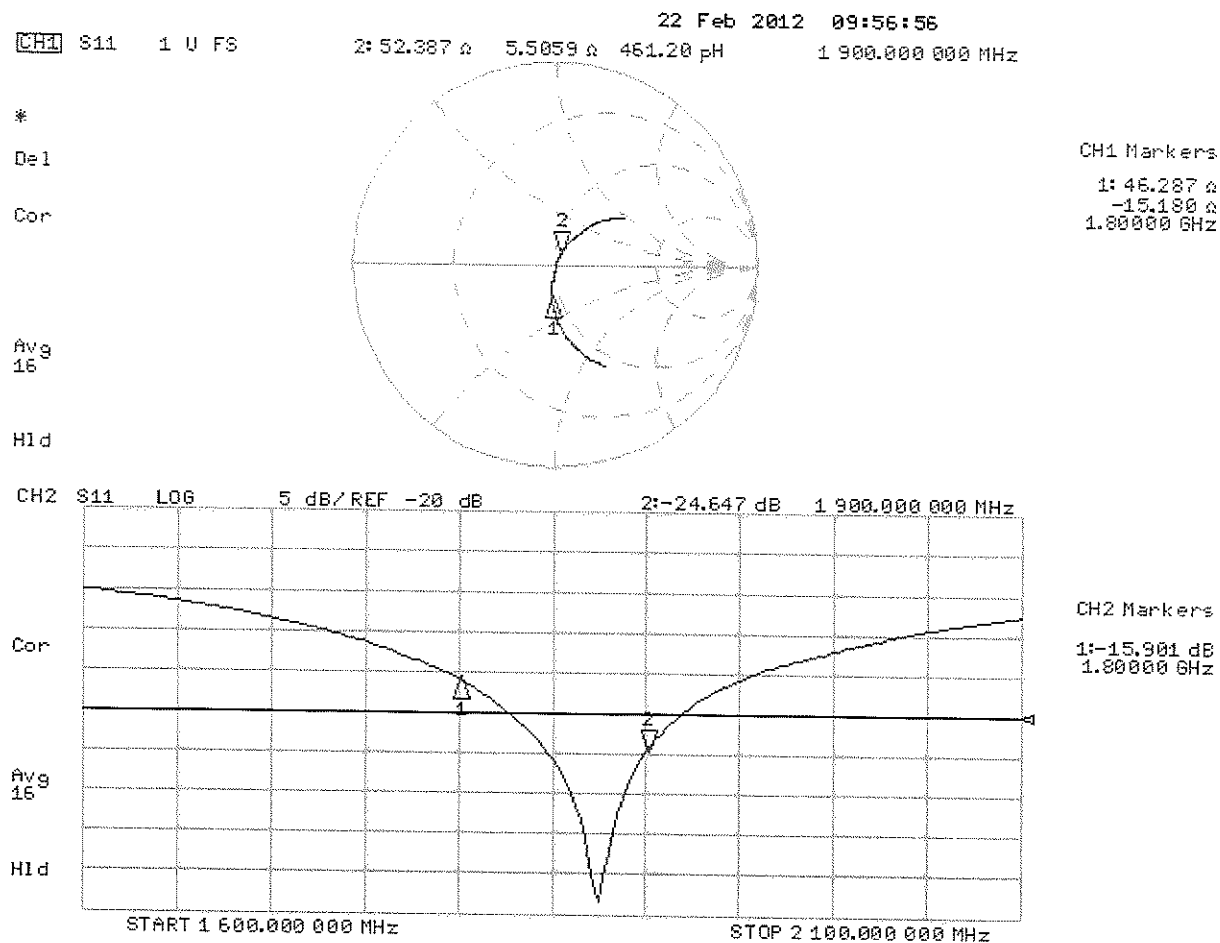
SAR(1 g) = 9.8 mW/g; SAR(10 g) = 5.18 mW/g

Maximum value of SAR (measured) = 12.114 mW/g



0 dB = 12.110mW/g = 21.66 dB mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 06.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.56$ mho/m; $\epsilon_r = 53$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

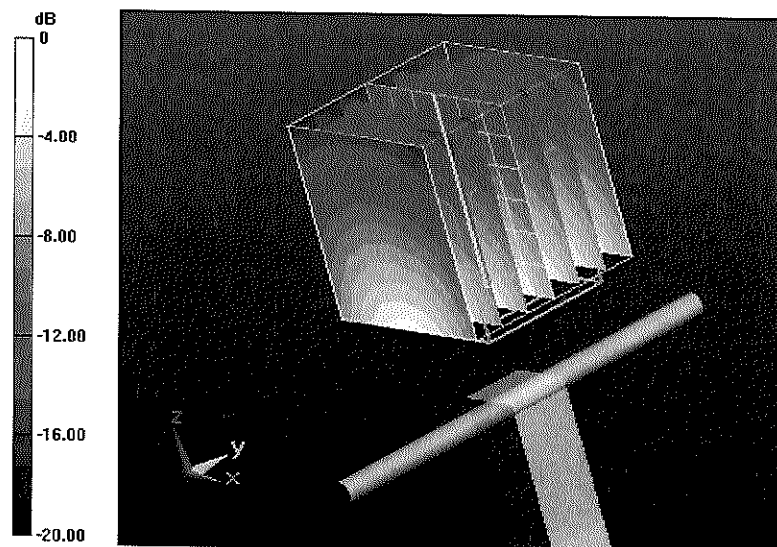
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.047 V/m; Power Drift = 0.0017 dB

Peak SAR (extrapolated) = 18.1310

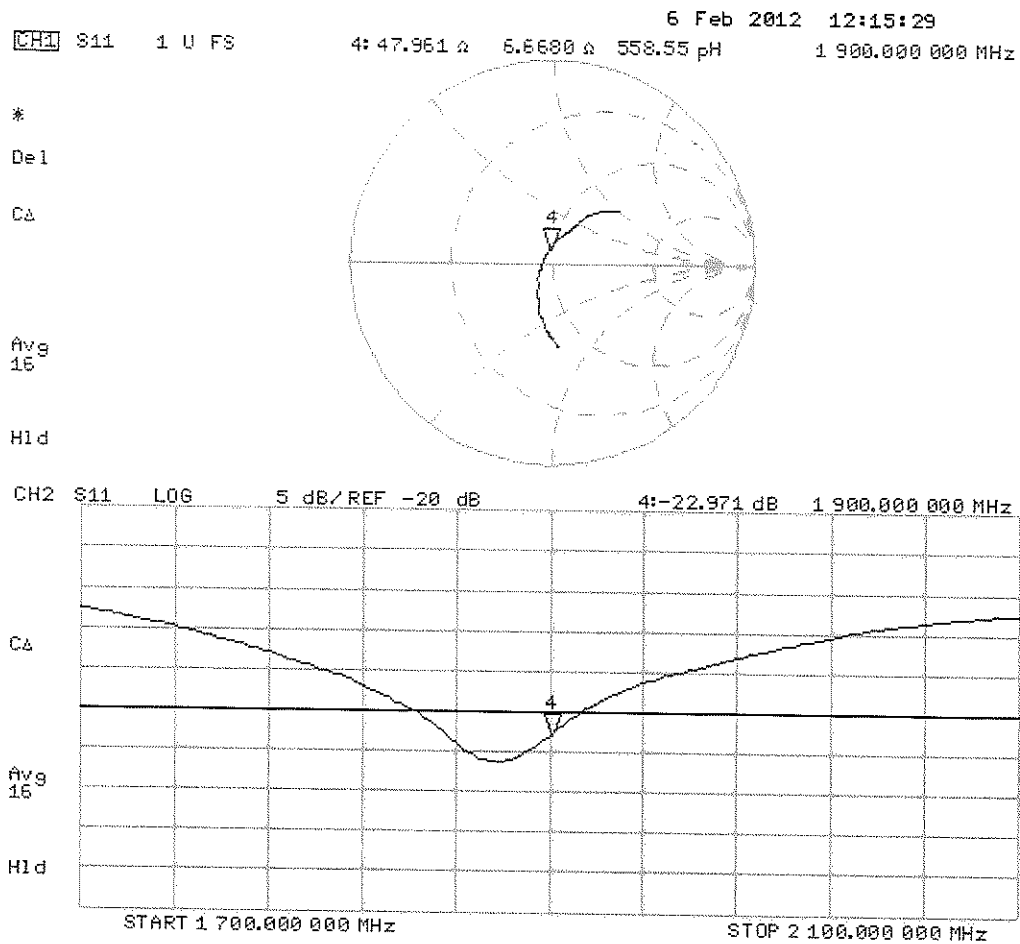
SAR(1 g) = 9.99 mW/g; SAR(10 g) = 5.23 mW/g

Maximum value of SAR (measured) = 12.672 mW/g



0 dB = 12.670mW/g = 22.06 dB mW/g

Impedance Measurement Plot for Body TSL





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d148_Feb12**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d148**

Calibration procedure(s) **QA CAL-05.v8**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **February 08, 2012**

✓ 5/14/12
KOK

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	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by: **Claudio Leubler** **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** **Technical Manager**

Signature

Issued: February 8, 2012

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Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- 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.

Measurement Conditions

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

DASY Version	DASY5	V52.8.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.4 $\pm$ 6 %	1.40 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.5 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.35 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.4 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.0 $\pm$ 6 %	1.56 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.95 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	39.1 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.25 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.8 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 Ω + 4.9 j Ω
Return Loss	- 25.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.9 Ω + 6.3 j Ω
Return Loss	- 23.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 08.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.4$ mho/m; $\epsilon_r = 40.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (8x7x7)/Cube 0:

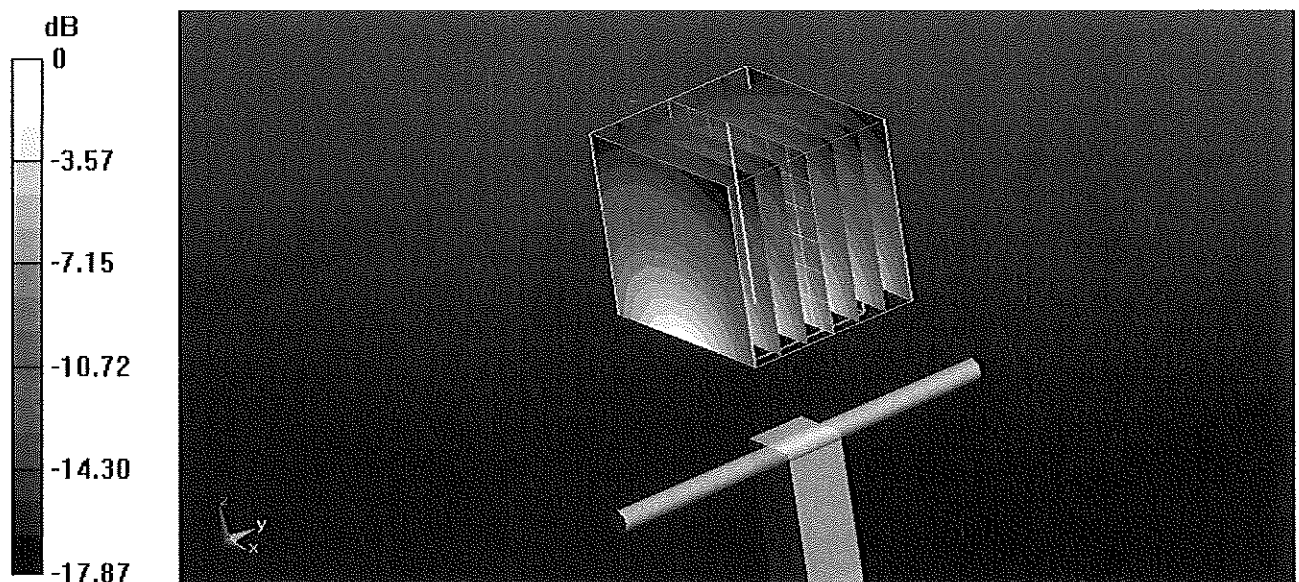
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.284 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 18.0570

SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.35 mW/g

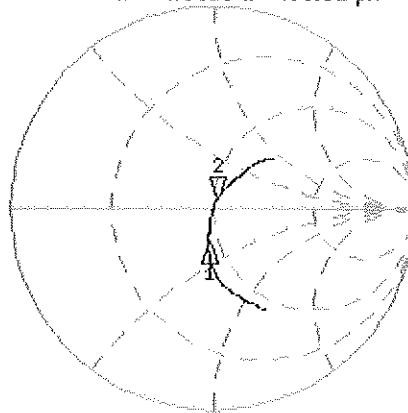
Maximum value of SAR (measured) = 12.808 mW/g



Impedance Measurement Plot for Head TSL

8 Feb 2012 11:26:41
 [CH1] S11 1 U FS 2: 51.727 Ω 4.8828 Ω 409.01 μ H 1 900.000 000 MHz

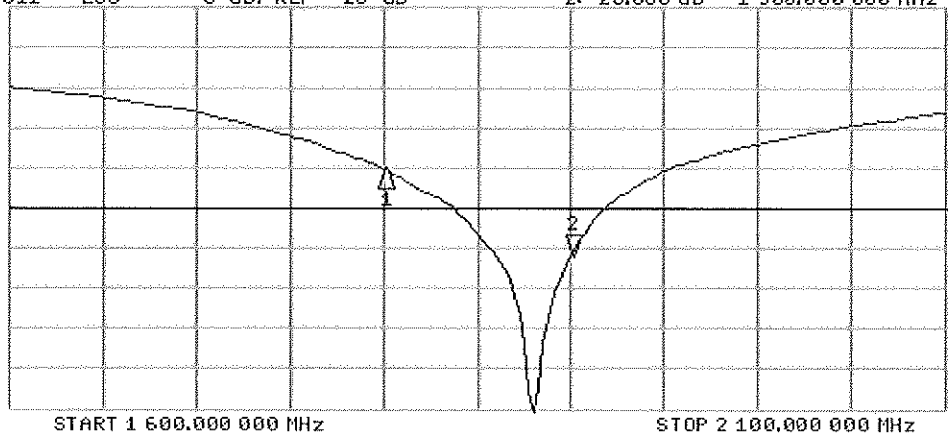
*
 Del
 CA
 Avg
 16
 H1d



CH1 Markers
 1: 44.816 Ω
 -16.234 Ω
 1.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 2:-25.868 dB 1 900.000 000 MHz

CA
 Avg
 16
 H1d



CH2 Markers
 1: -15.032 dB
 -25.868 dB
 1.80000 GHz

DASY5 Validation Report for Body TSL

Date: 06.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.56$ mho/m; $\epsilon_r = 53$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

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

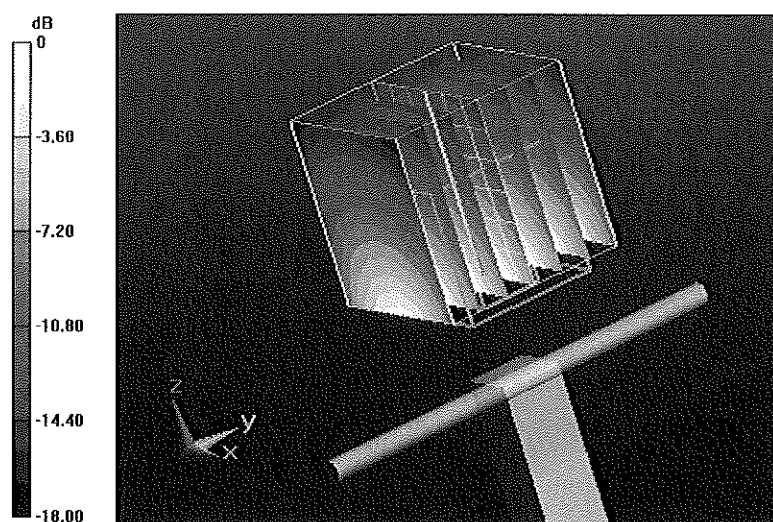
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.855 V/m; Power Drift = 0.006 dB

Peak SAR (extrapolated) = 17.7160

SAR(1 g) = 9.95 mW/g; SAR(10 g) = 5.25 mW/g

Maximum value of SAR (measured) = 12.606 mW/g

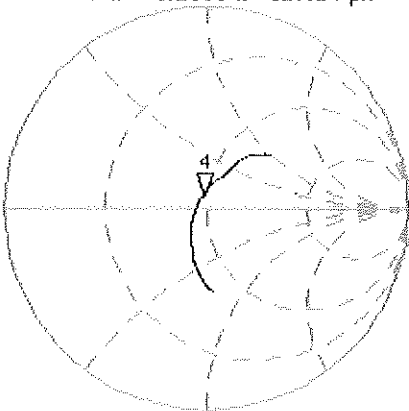


0 dB = 12.610mW/g = 22.01 dB mW/g

Impedance Measurement Plot for Body TSL

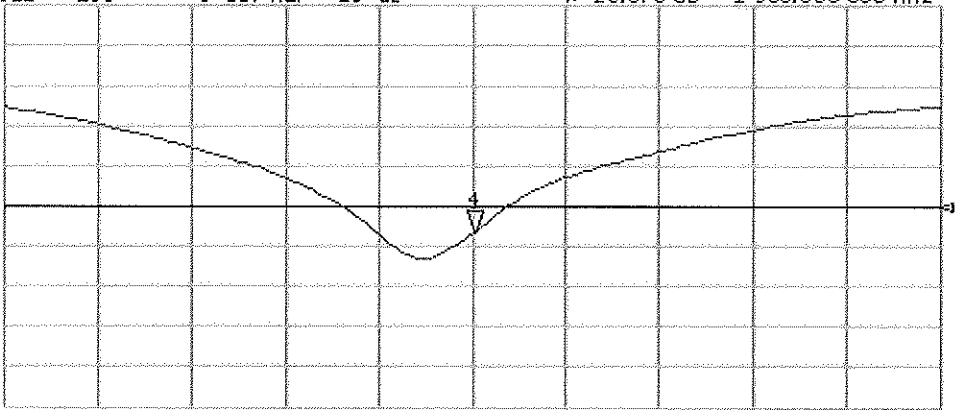
6 Feb 2012 12:11:40
[CH1] S11 1 U FS 4: 47.852 Ω 6.2930 Ω 527.14 μ H 1 900.000 000 MHz

*
De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 4:-23.373 dB 1 900.000 000 MHz

CA
Avg
16
H1d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3287_Feb12**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3287**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **February 7, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

✓ KOK
5/14/12

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: February 7, 2012

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3287

Manufactured: June 7, 2010
Calibrated: February 7, 2012

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V/m})^2$) ^A	1.32	1.25	1.25	± 10.1 %
DCP (mV) ^B	105.6	102.9	99.3	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	119.5	±3.0 %
			Y	0.00	0.00	1.00	112.1	
			Z	0.00	0.00	1.00	115.8	

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

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.25	6.25	6.25	0.27	2.05	± 12.0 %
835	41.5	0.90	6.06	6.06	6.06	0.63	1.27	± 12.0 %
1900	40.0	1.40	5.06	5.06	5.06	0.72	1.25	± 12.0 %
2450	39.2	1.80	4.44	4.44	4.44	0.76	1.32	± 12.0 %
2600	39.0	1.96	4.24	4.24	4.24	0.80	1.32	± 12.0 %

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

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

Calibration Parameter Determined in Body Tissue Simulating Media

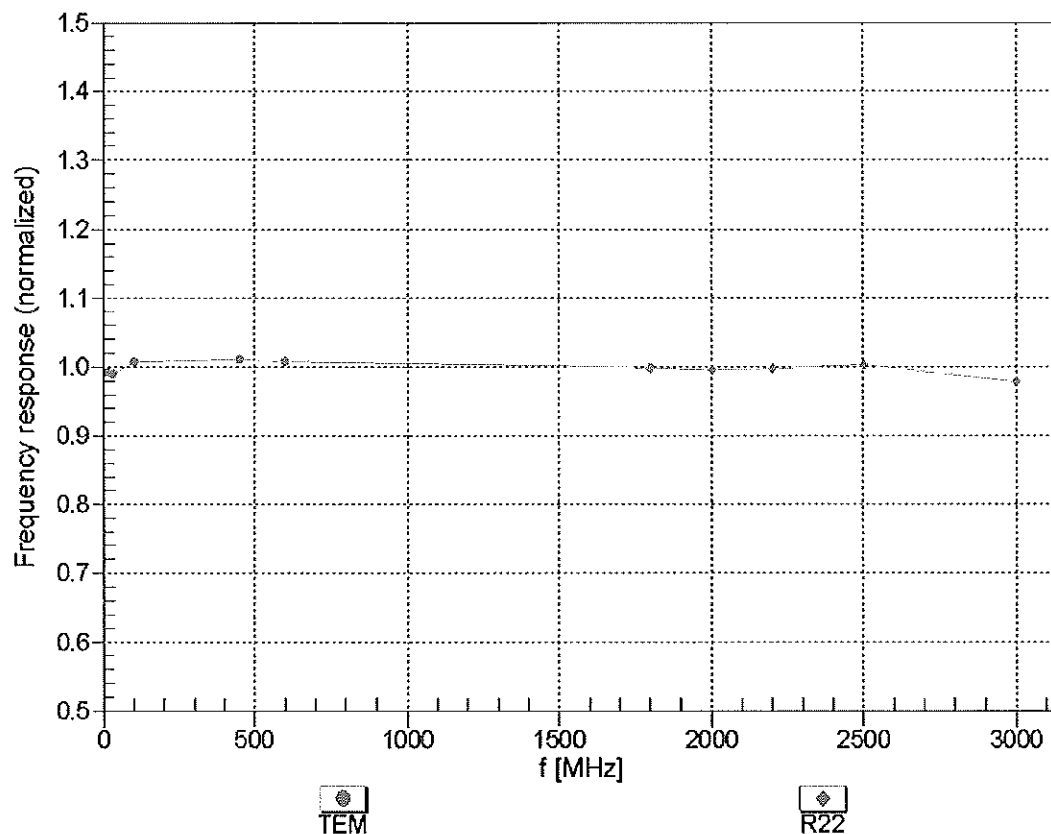
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.11	6.11	6.11	0.44	1.54	± 12.0 %
835	55.2	0.97	6.02	6.02	6.02	0.35	1.80	± 12.0 %
1900	53.3	1.52	4.76	4.76	4.76	0.59	1.56	± 12.0 %
2450	52.7	1.95	4.28	4.28	4.28	0.80	1.09	± 12.0 %
2600	52.5	2.16	4.05	4.05	4.05	0.80	1.03	± 12.0 %

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

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

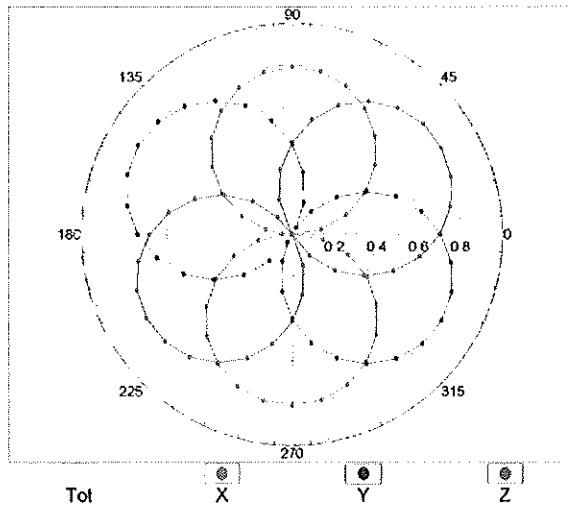
(TEM-Cell:ifi110 EXX, Waveguide: R22)



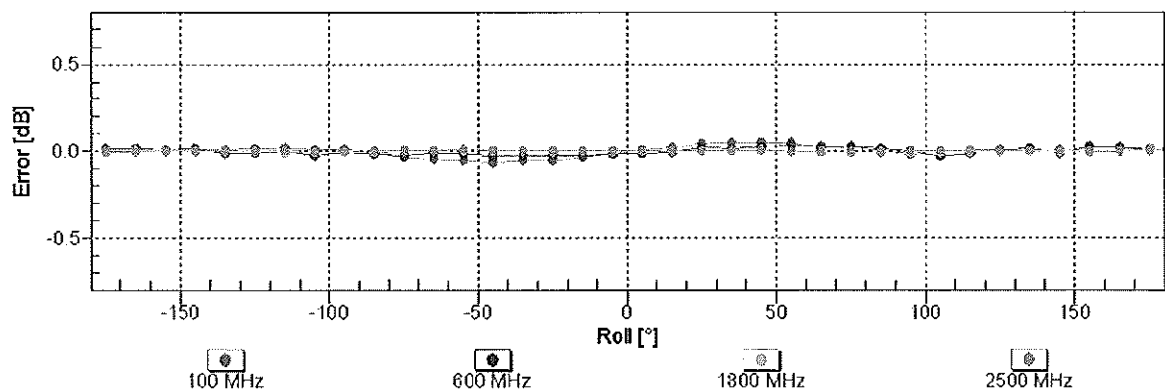
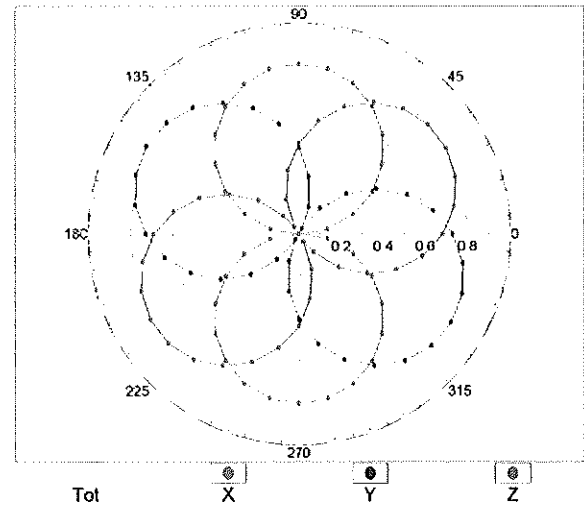
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

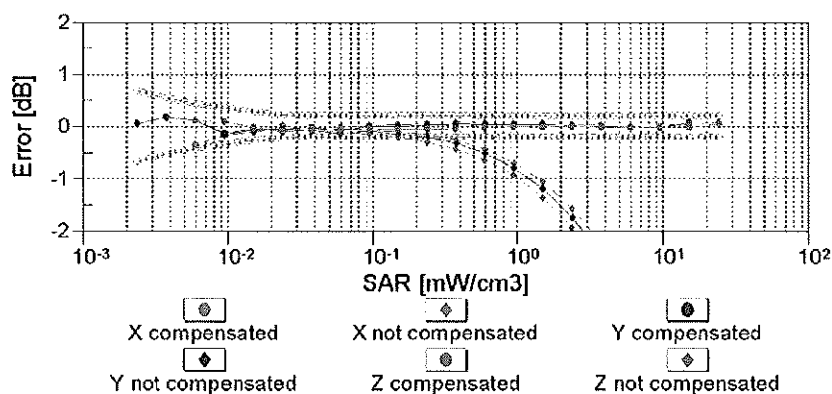
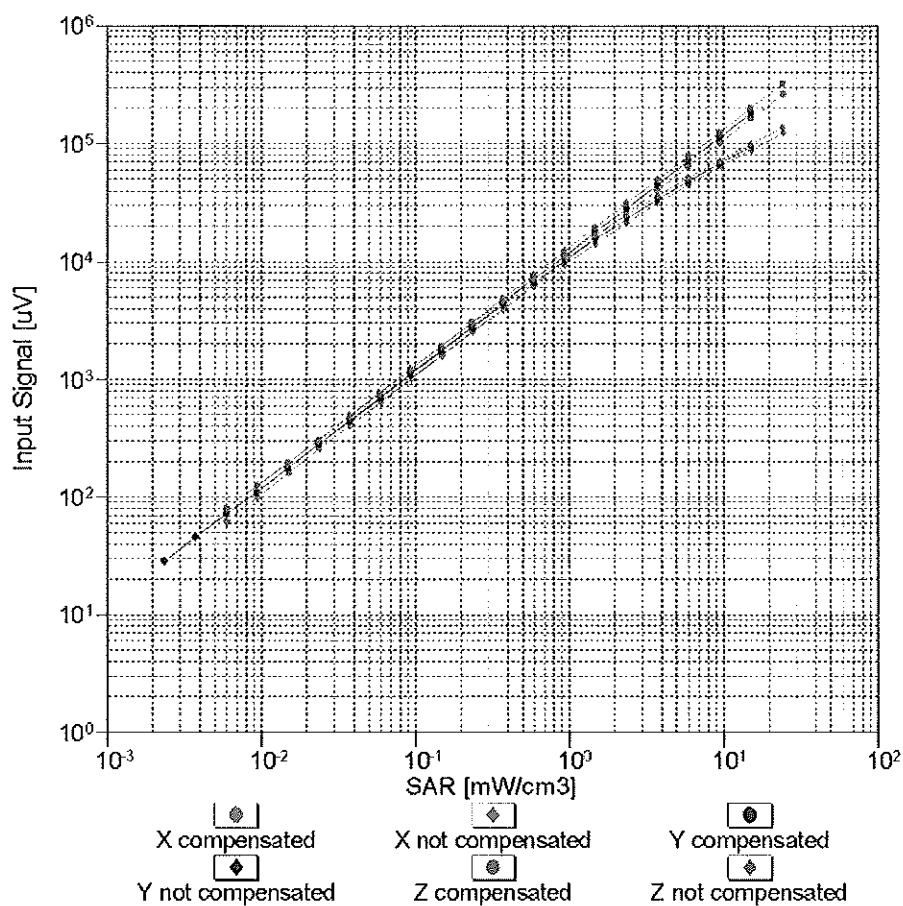


f=1800 MHz,R22



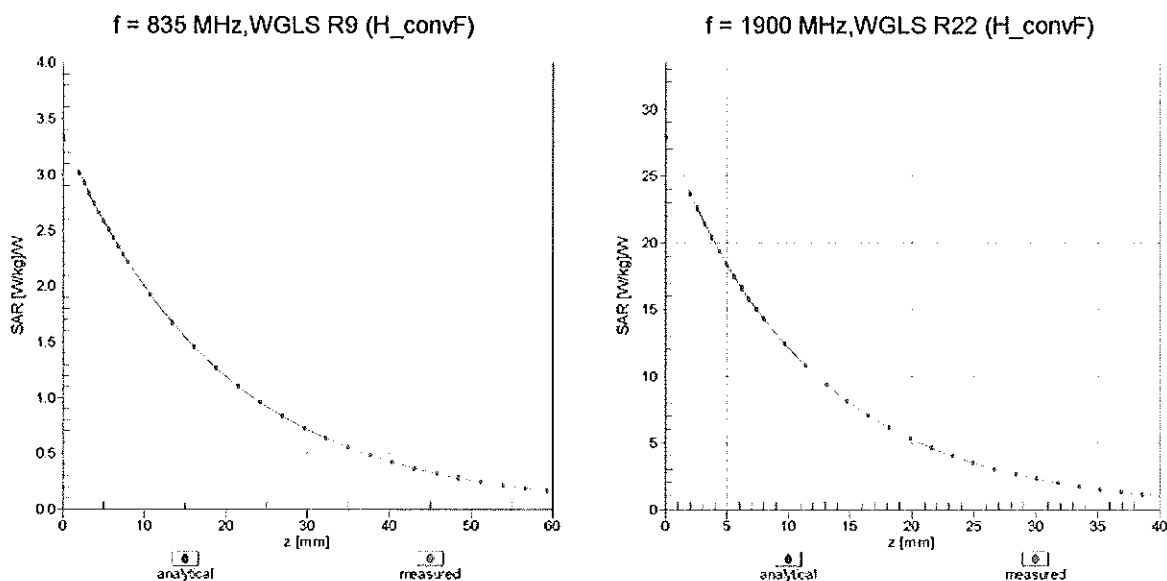
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



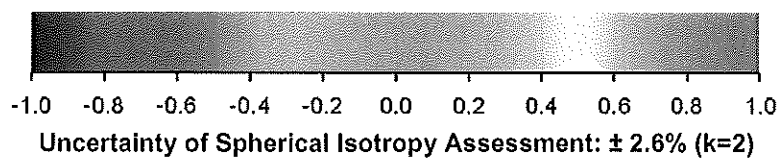
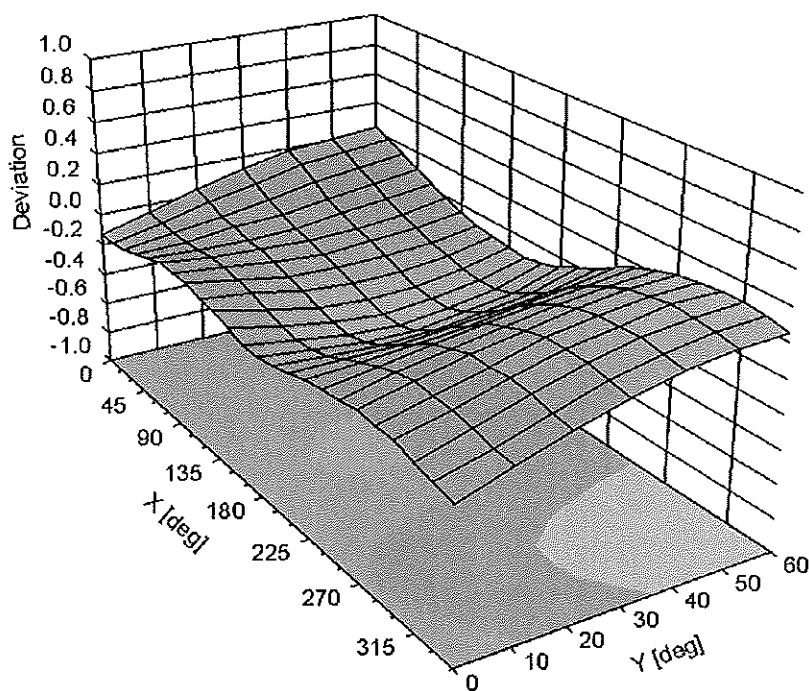
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:

ES3DV3

Serial Number:

3287

Place of Assessment:

Zurich

Date of Assessment:

July 9, 2012

Probe Calibration Date:

February 7, 2012

✓
2/12/12
KOK

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. The evaluation is coupled with measured conversion factors (probe calibration date indicated above). The uncertainty of the numerical assessment is based on the extrapolation from measured value at 835 MHz or at 1900 MHz.

Assessed by:



Dosimetric E-Field Probe ES3DV3 SN:3287Conversion factor ($\pm$ standard deviation)**1750 $\pm$ 50 MHz** *ConvF* **5.42 $\pm$ 7%**

$\epsilon_r = 40.1 \pm 5\%$
 $\sigma = 1.37 \pm 5\%$ mho/m
(head tissue)

1750 $\pm$ 50 MHz *ConvF* **5.06 $\pm$ 7%**

$\epsilon_r = 53.4 \pm 5\%$
 $\sigma = 1.49 \pm 5\%$ mho/m
(body tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also DASY Manual.



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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3288_Feb12**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3288**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **February 7, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: February 7, 2012

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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3288

Manufactured: July 6, 2010
Calibrated: February 7, 2012

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.87	0.96	0.75	$\pm 10.1 \%$
DCP (mV) ^B	104.3	103.1	103.2	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	117.5	$\pm 2.7 \%$
			Y	0.00	0.00	1.00	99.3	
			Z	0.00	0.00	1.00	107.8	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.46	6.46	6.46	0.46	1.42	± 12.0 %
835	41.5	0.90	6.20	6.20	6.20	0.31	1.86	± 12.0 %
1900	40.0	1.40	5.16	5.16	5.16	0.80	1.18	± 12.0 %
2450	39.2	1.80	4.54	4.54	4.54	0.68	1.36	± 12.0 %
2600	39.0	1.96	4.36	4.36	4.36	0.75	1.32	± 12.0 %

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

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

Calibration Parameter Determined in Body Tissue Simulating Media

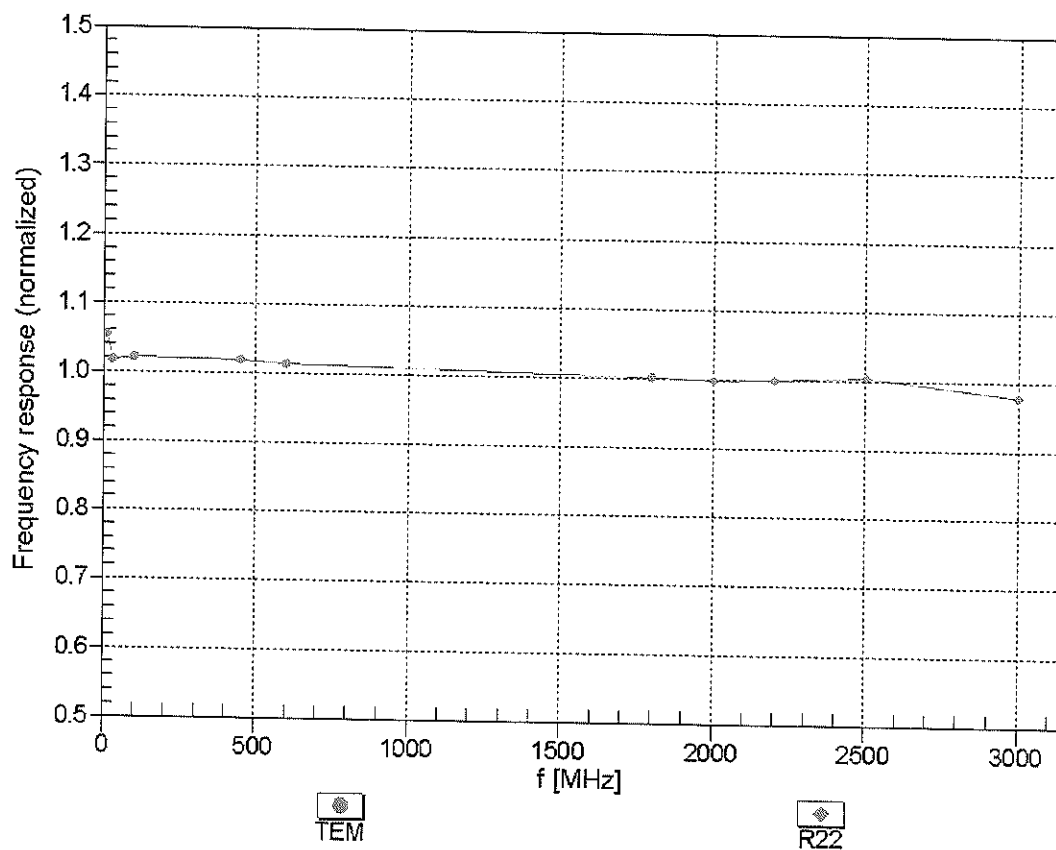
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.34	6.34	6.34	0.70	1.27	± 12.0 %
835	55.2	0.97	6.22	6.22	6.22	0.56	1.40	± 12.0 %
1900	53.3	1.52	5.02	5.02	5.02	0.61	1.54	± 12.0 %
2450	52.7	1.95	4.47	4.47	4.47	0.76	1.08	± 12.0 %
2600	52.5	2.16	4.21	4.21	4.21	0.80	1.04	± 12.0 %

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

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

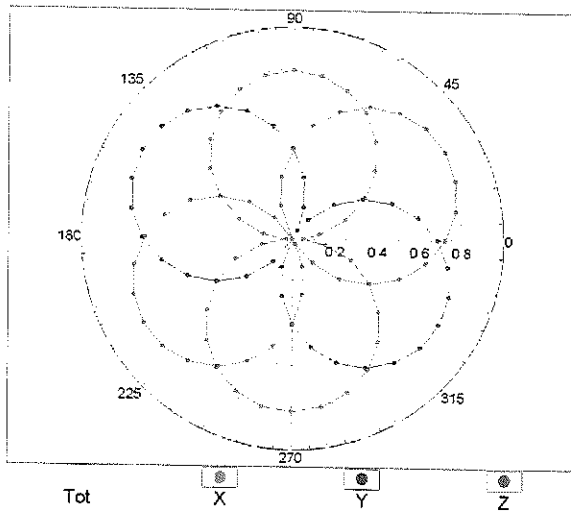
(TEM-Cell:ifi110 EXX, Waveguide: R22)



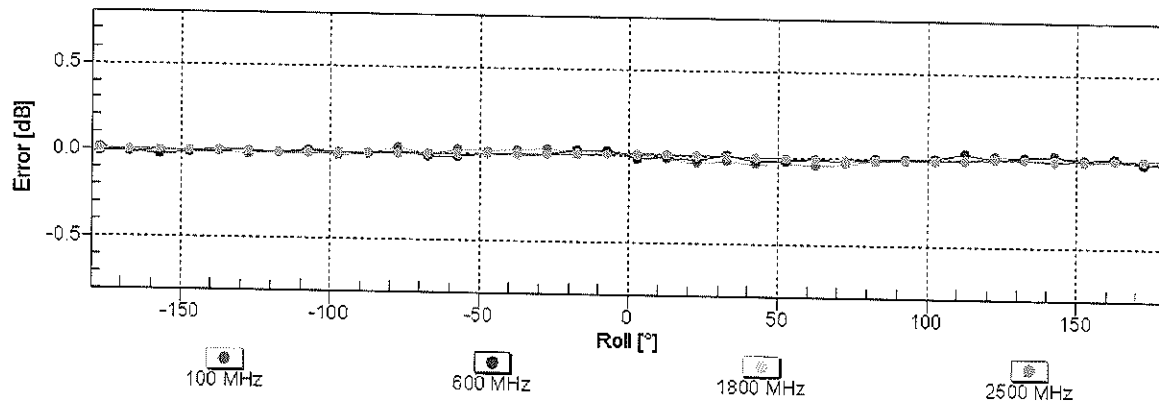
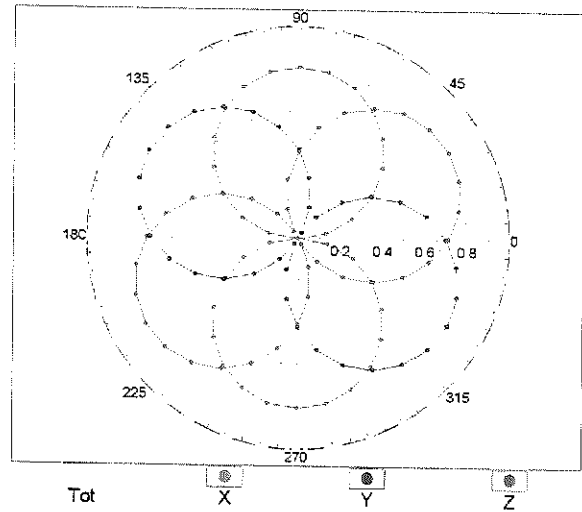
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

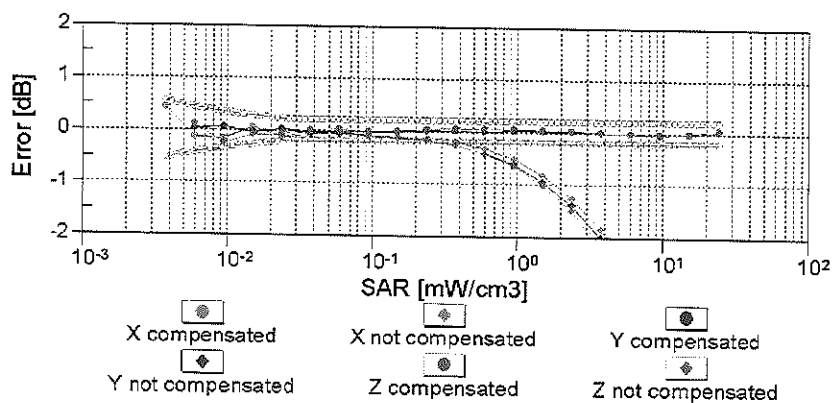
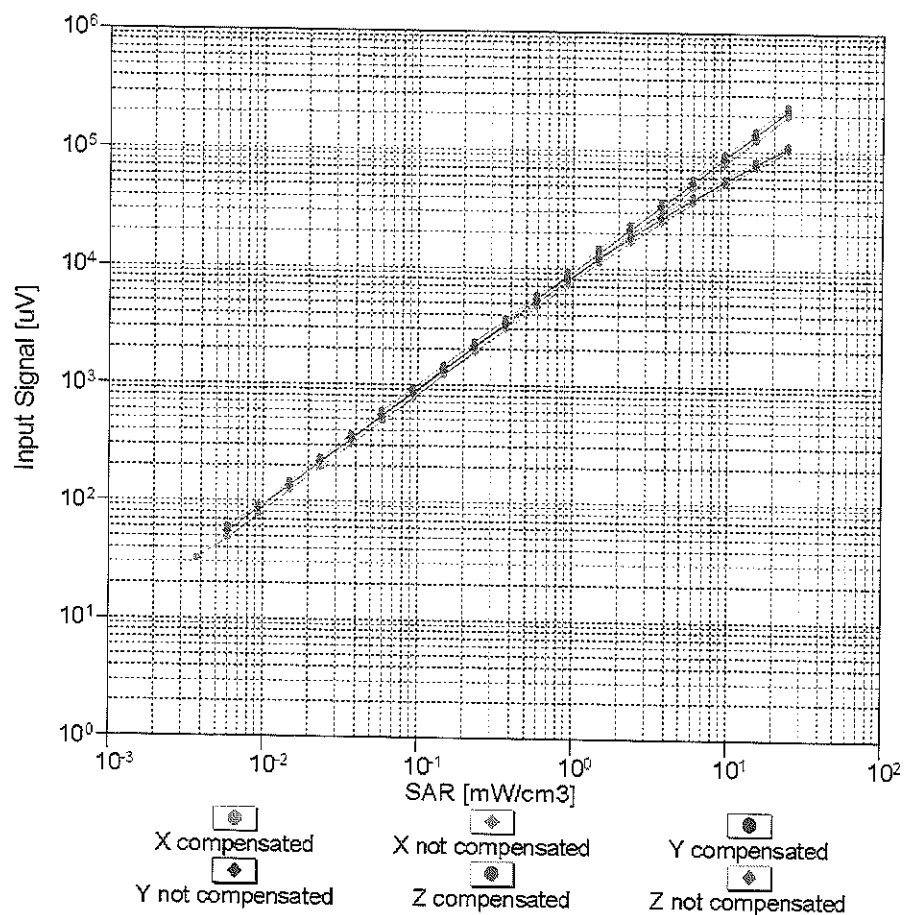


f=1800 MHz,R22



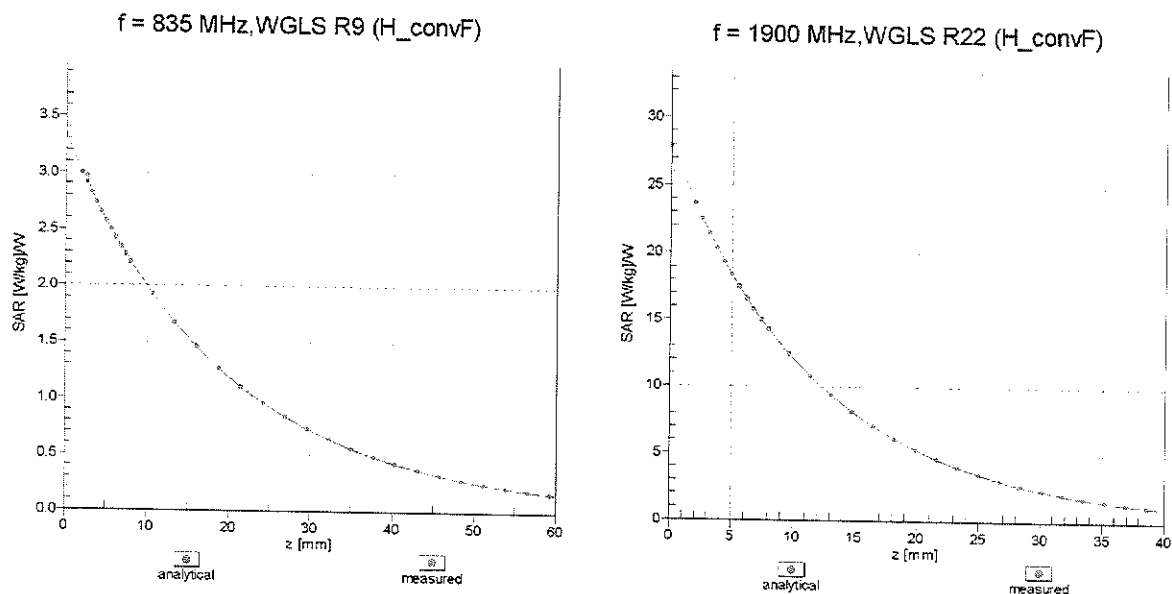
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



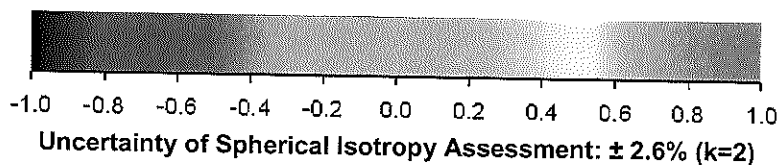
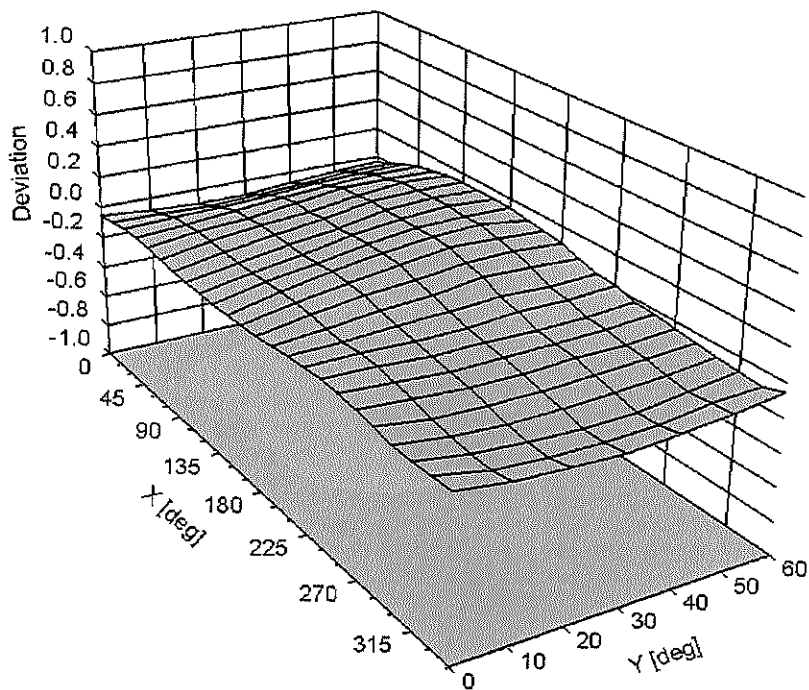
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:

ES3DV3

Serial Number:

3288

Place of Assessment:

Zurich

Date of Assessment:

July 9, 2012

Probe Calibration Date:

February 7, 2012

✓
7/9/12
KOK

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. The evaluation is coupled with measured conversion factors (probe calibration date indicated above). The uncertainty of the numerical assessment is based on the extrapolation from measured value at 835 MHz or at 1900 MHz.

Assessed by:



Dosimetric E-Field Probe ES3DV3 SN:3288Conversion factor ($\pm$ standard deviation)**1750 $\pm$ 50 MHz** *ConvF* **5.53 $\pm$ 7%**

$\epsilon_r = 40.1 \pm 5\%$
 $\sigma = 1.37 \pm 5\%$ mho/m
(head tissue)

1750 $\pm$ 50 MHz *ConvF* **5.16 $\pm$ 7%**

$\epsilon_r = 53.4 \pm 5\%$
 $\sigma = 1.49 \pm 5\%$ mho/m
(body tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also DASY Manual.