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SAR EVALUATION REPORT

Applicant Name:
Samsung Electronics, Co. Ltd.
129, Samsung-ro, Maetan dong,
Yeongtong-gu, Suwon-si
Gyeonggi-do 443-742, Korea

Date of Testing:
11/18/13 - 11/19/13
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1311152174.A3L

FCC ID: **A3LSGHM819N**

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

DUT Type:	Portable Handset
Application Type:	Class II Permissive Change
FCC Rule Part(s):	CFR §2.1093
Model(s):	SGH-M819N
Permissive Change(s):	See FCC Change Document
Date of original Certification:	10/22/2013

Equipment Class	Band & Mode	Tx Frequency	Measured Conducted Power [dBm]	SAR		
				1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Hotspot (W/kg)
PCE	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	31.20	0.12	0.62	0.75
PCE	UMTS 1900	1852.4 - 1907.6 MHz	24.05	0.24	1.07	1.07
PCE	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	22.80	0.12	0.92	0.92
Simultaneous SAR per KDB 690783 D01v01r02:				0.48	1.51	1.30

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.

Note: The table above shows PCS GSM/UMTS and LTE Band 2 SAR Test Data evaluated for the current test report. Please refer to RF Exposure Technical Report S/N 0Y1309091831.A3L for original compliance evaluation.

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

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

Randy Ortanez
President

ACCREDITED
TESTING LABORATORY
CERTIFICATE #2041.01

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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE 850	Voice/Data	824.20 - 848.80 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
UMTS 1750	Voice/Data	1712.4 - 1752.5 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
LTE Band 2 (PCS)	Data	1850.7 - 1909.3 MHz
LTE Band 4 (AWS)	Data	1710.7 - 1754.3 MHz
LTE Band 5 (Cell)	Data	826.5 - 846.5 MHz
LTE Band 17	Data	706.5 - 713.5 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
5.8 GHz WLAN	Data	5745 - 5825 MHz
5.2 GHz WLAN	Data	5180 - 5240 MHz
5.3 GHz WLAN	Data	5260 - 5320 MHz
5.5 GHz WLAN	Data	5500 - 5700 MHz
Bluetooth	Data	2402 - 2480 MHz
NFC	Data	13.56 MHz

1.2 Nominal and Maximum Output Power Specifications

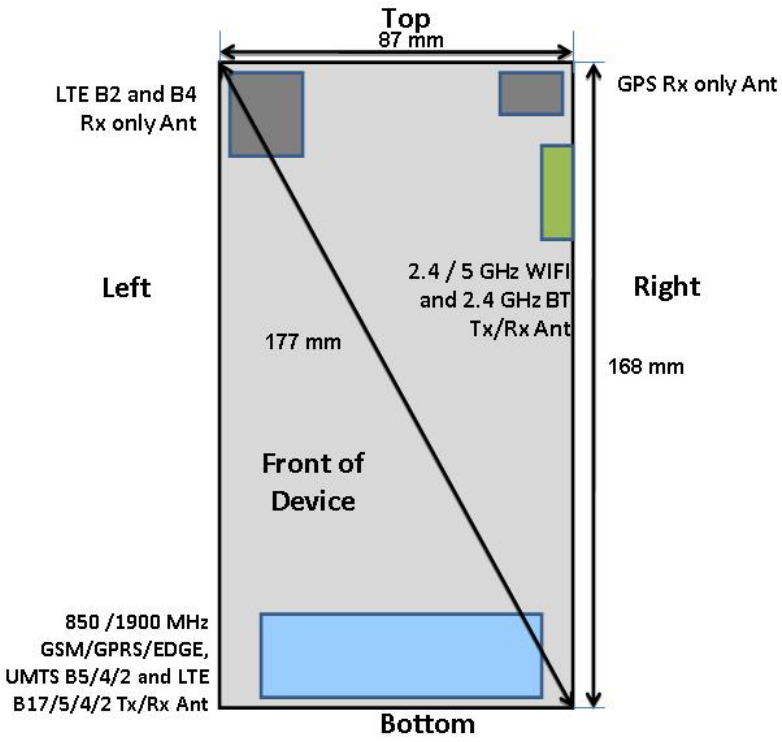
This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v05.

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slot	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*
GSM/GPRS/EDGE 1900	Maximum	**31.2**	**31.2**	**29.0**	**27.5**	**26.5**	**27.0**	**25.5**	**23.5**	**22.5**
	Nominal	**30.7**	**30.7**	**28.5**	**27.0**	**26.0**	**26.5**	**25.0**	**23.0**	**22.0**

Mode / Band		Modulated Average (dBm)			
		3GPP Rel 99	*3GPP Rel 5*	*3GPP Rel 6*	*3GPP Rel 8*
		WCDMA	*HSDPA*	*HSUPA*	*DC-HSDPA*
UMTS Band 2 (1900 MHz)	Maximum	**24.2**	**23.0**	**23.0**	**23.0**
	Nominal	**23.7**	**22.5**	**22.5**	**22.5**

Mode / Band		Modulated Average (dBm)
LTE Band 2 (PCS)	Maximum	**22.8**
	Nominal	**22.3**

1.3 DUT Antenna Locations



Note:

1. Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC Filing.
2. Since the diagonal dimension of this device is greater than 160 mm but less than 200 mm, it is considered a "phablet."

Figure 1-1
DUT Antenna Locations

Table 1-1
Sides for SAR Testing

Mode	Exposure Condition	Back	Front	Top	Bottom	Right	Left
GPRS 1900	Hotspot	Yes	Yes	No	Yes	Yes	Yes
UMTS 1900	Hotspot	Yes	Yes	No	Yes	Yes	Yes
LTE Band 2 (PCS)	Hotspot	Yes	Yes	No	Yes	Yes	Yes

Note: Particular DUT edges were not required to be evaluated for Wireless Router SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v01 guidance, page 2 and FCC KDB 648474 D04 Handset SAR v01r01. However, they may be tested per manufacturer's request.

1.4 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the specialized battery. The SAR tests were performed with the specialized battery (model: B700BE).

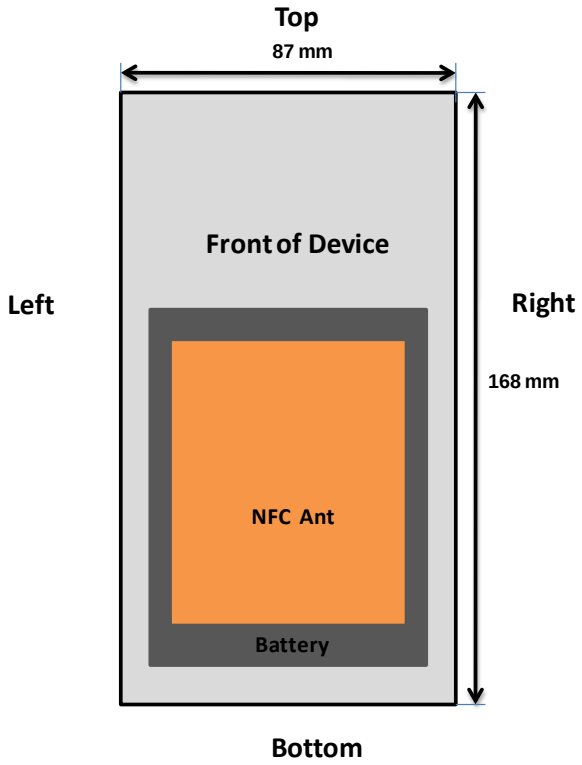


Figure 1-2
NFC Antenna Locations

1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D05v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-3 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
Simultaneous Transmission Paths

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

Table 1-2
Simultaneous Transmission Scenarios

Ref.	Simultaneous Transmit Configurations	Head	Body-Worn Accessory	Hot Spot	Extremity	Note
		IEEE 1528, Supp C	Supplement C	FCC KDB 941225 D06	FCC KDB 648474	
1	GSM 850/1900 MHz Voice + 2.4 GHz WIFI	Yes	10mm	N/A	Yes	
2	GSM 850/1900 MHz Voice + 5 GHz WIFI	Yes	10mm	N/A	Yes	
3	GSM 850/1900 MHz Voice + Bluetooth	N/A	10mm	N/A	Yes	
4	UMTS 850/1750/1900 MHz Voice + 2.4 GHz WIFI	Yes	10mm	N/A	Yes	
5	UMTS 850/1750/1900 MHz Voice + 5 GHz WIFI	Yes	10mm	N/A	Yes	
6	UMTS 850/1750/1900 MHz Voice + Bluetooth	N/A	10mm	N/A	Yes	
7	GPRS 850 /1900 MHz Data + 2.4 GHz WIFI	N/A	N/A	Yes	Yes	
8	GPRS 850/1750/1900 MHz Data + 5.8 GHz WIFI	N/A	N/A	Yes	Yes	
9	UMTS 850/1750/1900 MHz Data + 2.4 GHz WIFI	Yes	10mm	Yes	Yes	
10	UMTS 850/1750/1900 MHz Data + 5.8 GHz WIFI	Yes	10mm	Yes	Yes	
11	LTE Band 2/4/5/17 Data + 2.4 GHz WIFI	Yes	10mm	Yes	Yes	
12	LTE Band 2/4/5/17 Data + 5.8 GHz WIFI	Yes	10mm	Yes	Yes	
13	LTE Band 2/4/5/17 Data + Bluetooth	N/A	10mm	N/A	Yes	
14	GPRS 850/1900 MHz Data + 5.2-5.7 GHz WIFI	N/A	N/A	N/A	N/A	
15	UMTS 850/1750/1900 MHz Data + 5.2-5.7 GHz WIFI	N/A	N/A	N/A	N/A	
16	LTE Band 2/4/5/17 Data + 5.2-5.7 GHz WIFI	N/A	N/A	N/A	N/A	
17	All Voice +LTE	N/A	N/A	N/A	N/A	Not supppрted by HW
18	All Voice + LTE + WIFI	N/A	N/A	N/A	N/A	Not supppрted by HW

Notes:

1. Bluetooth and WLAN share the same antenna path and cannot transmit simultaneously.

Per the manufacturer, WIFI Direct is not expected to be used in conjunction with a held-to-ear or body-worn accessory voice call. Therefore, there are no simultaneous transmission scenarios involving WIFI direct beyond what is listed in the above table.

1.5 SAR Test Exclusions Applied

Per the FCC change document for this device, the GSM/GPRS/EDGE 850 MHz, UMTS 850/1750 MHz, LTE Bands 4/5/17, 2.4 GHz WLAN/Bluetooth, and 5 GHz WLAN modes remain the same as the original certified device. Therefore, no additional SAR evaluations were required for these bands/modes.

(A) Licensed Transmitter(s)

GSM/GPRS/EDGE DTM is not supported for US bands. Therefore, the GSM Voice modes in this report do not transmit simultaneously with GPRS/EDGE Data.

This device is only capable of QPSK HSUPA in the uplink. Therefore, no additional SAR tests are required beyond that described for devices with HSUPA in KDB 941225 D01v02.

When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher

than the highest bandwidth; and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02.

Per FCC KDB Publication 648474 D04v01r01, this device is considered a "phablet" since the diagonal distance is greater than160 mm and less than 200 mm. Therefore, extremity SAR tests are required when hotspot mode does not apply or if hotspot 1g SAR > 1.2 W/kg. Extremity SAR was not evaluated for licensed transmitters since Hotspot SAR was < 1.2 W/kg.

1.6 Power Reduction for SAR

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

1.7 Guidance Applied

- FCC OET Bulletin 65 Supplement C [June 2001]
- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (2G/3G/4G and Hotspot)
- FCC KDB Publication 447498 D01v05 (General SAR Guidance)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 648474 D03-D04 (Phablet Procedures)

1.8 Device Serial Numbers

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

Mode	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
GSM/GPRS/EDGE 1900	FK-344-B	FK-344-B	FK-344-B
UMTS 1900	FK-344-C	FK-344-C	FK-344-C
LTE Band 2 (PCS)	FK-344-A	FK-344-A	FK-344-A

2 LTE INFORMATION

LTE Information			
FCC ID	**A3LSGHM819N**		
Form Factor	Portable Handset		
Frequency Range of each LTE transmission band	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)		
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)		
	LTE Band 5 (Cell) (826.5 - 846.5 MHz)		
	LTE Band 17 (706.5 - 713.5 MHz)		
Channel Bandwidths	LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 5 (Cell): 5 MHz, 10 MHz		
	LTE Band 17: 5 MHz, 10 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)	1880 (18900)	1909.3 (19193)
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	1880 (18900)	1908.5 (19185)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	1880 (18900)	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855 (18650)	1880 (18900)	1905 (19150)
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	1880 (18900)	1902.5 (19125)
LTE Band 2 (PCS): 20 MHz	1860 (18700)	1880 (18900)	1900 (19100)
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)	1732.5 (20175)	1754.3 (20393)
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)	1732.5 (20175)	1753.5 (20385)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	1732.5 (20175)	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715 (20000)	1732.5 (20175)	1750 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	1732.5 (20175)	1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720 (20050)	1732.5 (20175)	1745 (20300)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
LTE Band 17: 5 MHz	706.5 (23755)	710 (23790)	713.5 (23825)
LTE Band 17: 10 MHz	709 (23780)	710 (23790)	711 (23800)
UE Category	3		
Modulations Supported in UL	QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		

3 INTRODUCTION

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

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [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/m^3)
E = Total RMS electric field strength (V/m)

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

4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure:

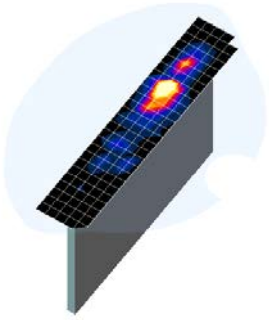


Figure 4-1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01 (See Table 4-1).

2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.

3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table 4-1). On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

   a. 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.

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

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

5 DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

Figure 5-2 shows the front, back and side views of the SAM Twin Phantom. The point "M" is the reference point for the center of the mouth, "LE" is the left ear reference point (ERP), and "RE" is the right ERP. The ERP is 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 5-1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 5-1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].

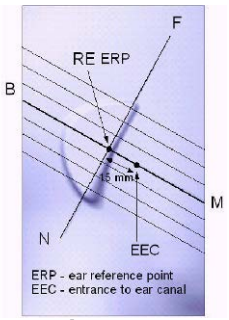


Figure 5-1
Close-Up Side view of ERP

5.2 HANDSET REFERENCE POINTS

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

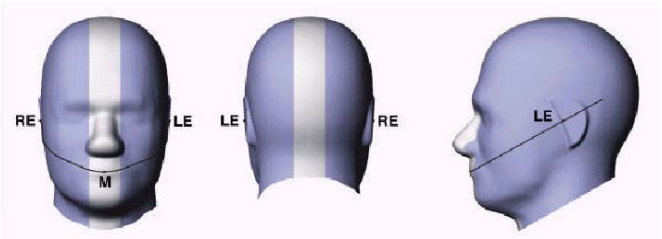


Figure 5-2
Front, back and side view of SAM Twin Phantom

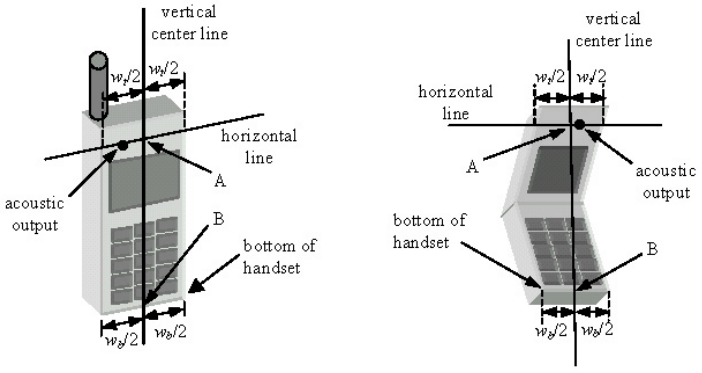


Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

6 TEST CONFIGURATION POSITIONS FOR HANDSETS

6.1 Device Holder

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

6.2 Positioning for Cheek

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

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

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

6.3 Positioning for Ear / 15º Tilt

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

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

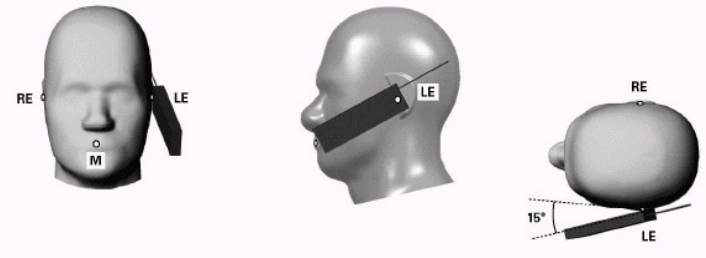


Figure 6-2 Front, Side and Top View of Ear/15º Tilt Position

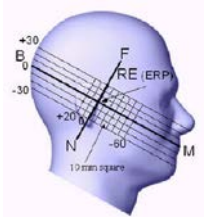


Figure 6-3
Side view w/ relevant markings

6.4 Body-Worn Accessory Configurations

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

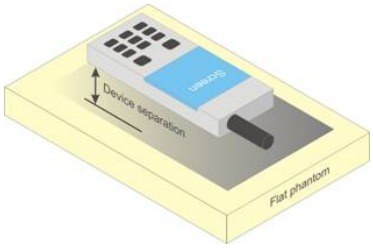


Figure 6-4
Sample Body-Worn Diagram

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

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

6.5 Extremity Exposure Configurations

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

For smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC minitablets that support voice calls next to the ear, the phablets procedures outlined in KDB Publication 648474 D04 v01r01DR04 should be applied to evaluate SAR compliance. A device marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance. In addition to the normally required head and body-worn accessory SAR test procedures required for handsets, the UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna <=25 mm from that surface or edge, in direct contact with the phantom, for 10-g SAR. The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g SAR > 1.2 W/kg.

6.6 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

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

7 RF EXPOSURE LIMITS

7.1 Uncontrolled Environment

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

7.2 Controlled Environment

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

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

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

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

8 FCC MEASUREMENT PROCEDURES

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

8.1 Measured and Reported SAR

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

8.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01 "SAR Measurement Procedures for 3G Devices" v02, October 2007.

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

8.3 SAR Measurement Conditions for UMTS

8.3.1 Output Power Verification

Maximum output power is measured on the High, Middle and Low channels for each applicable transmission band according to the general descriptions in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all "1s".

Maximum output power is verified on the High, Middle and Low channels according to the general descriptions in section 5.2 of 3GPP TS 34.121 (release 5), using the appropriate RMC with TPC (transmit power control) set to all "1s" or applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HS-DPCCH etc) are tabulated in this test report. All configurations that are not supported by the DUT or cannot be measured due to technical or equipment limitations are identified.

8.3.2 Head SAR Measurements for Handsets

SAR for head exposure configurations is measured using the 12.2 kbps RMC with TPC bits configured to all "1s". SAR in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than 0.25 dB higher than that measured in 12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a 3.4 kbps SRB (signaling radio bearer) using the exposure configuration that resulted in the highest SAR for that RF channel in the 12.2 kbps RMC mode.

8.3.3 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all "1s".

8.3.4 SAR Measurements for Handsets with Rel 5 HSDPA

Body SAR for HSDPA is not required for handsets with HSDPA capabilities when the maximum average output power of each RF channel with HSDPA active is less than 0.25 dB higher than that measured without HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2 kbps RMC is ≤ 75% of the SAR limit. Otherwise, SAR is measured for HSDPA, using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration measured in 12.2 kbps RMC without HSDPA, on the maximum output channel with the body exposure configuration that resulted in the highest SAR in 12.2 kbps RMC mode for that RF channel.

The H-set used in FRC for HSDPA should be configured according to the UE category of a test device. The number of HS-DSCH/HSPDSCHs, HARQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the applicable H-set. To maintain a consistent test configuration and stable transmission conditions, QPSK is used in the FRC for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 2 ms to maintain a constant rate of active CQI slots. DPCCH and DPDCH gain factors of βc=9 and βd=15, and power offset parameters of ΔACK= ΔNACK =5 and ΔCQI=2 is used. The CQI value is determined by the UE category, transport block size, number of HS-PDSCHs and modulation used in the FRC.

Sub-Test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (Note 4)	15/15 (Note 4)	64	12/15 (Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.
Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and $\Delta_{NACK} = 8$ ($A_{hs} = 30/15$) with $\beta_{hs} = 30/15 * \beta_c$, and $\Delta_{CQI} = 7$ ($A_{hs} = 24/15$) with $\beta_{hs} = 24/15 * \beta_c$.
Note 3: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Figure 8-1
Table C.10.1.4 of TS 234.121-1

8.3.5 SAR Measurements for Handsets with Rel 6 HSUPA

Body SAR for HSUPA is not required when the maximum average output of each RF channel with HSUPA/HSDPA active is less than 0.25 dB higher than as measured without HSUPA/HSDPA using 12.2 kbps RMC and maximum SAR for 12.2 kbps RMC is ≤ 75 % of the SAR limit. Otherwise SAR is measured on the maximum output channel for the body exposure configuration produced highest SAR in 12.2 kbps RMC for that RF channel, using the additional procedures under "Release 6 HSPA data devices"

Head SAR for VOIP operations under HSPA is not required when maximum average output of each RF channel with HSPA is less than 0.25 dB higher than as measured using 12.2 kbps RMC. Otherwise SAR is measured using same HSPA configuration as used for body SAR.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (1)	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM (2) (dB)	MPR (dB)	AG (4) Index	E-TFCI
1	11/15 (3)	15/15 (3)	64	11/15 (3)	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}: 47/15 β_{ed2}: 47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (4)	15/15 (4)	64	15/15 (4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.
Note 2: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.
Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to β_c = 10/15 and β_d = 15/15.
Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to β_c = 14/15 and β_d = 15/15.
Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.
Note 6: β_{ed} can not be set directly; it is set by Absolute Grant Value.

8.3.6 SAR Measurement Conditions for DC-HSDPA

SAR test exclusion for DC-HSDPA devices is determined by power measurements according to the H-Set 12, Fixed Reference Channel (FRC) configuration in Table C.8.1.12 of 3GPP TS 34.121-1. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to qualify for SAR test exclusion. DC-HSDPA uplink maximum output power measurements using the four Rel. 5 HSDPA subtests in Table C.10.1.4 of TS 234.121-1 is required.

When the maximum average output power of each RF channel with DC-HSDPA active is ≤ ¼ dB higher than that measured using 12.2 kbps RMC, or the maximum reported SAR for 12.2 kbps RMC is ≤ 75% of the SAR limit, SAR evaluation for DC-HSDPA is not required.

8.4 SAR Measurement Conditions for LTE

LTE modes were tested according to FCC KDB 941225 D05v02 publication. Please see notes after the tabulated SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 was used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing.

8.4.1 Spectrum Plots for RB Configurations

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

8.4.2 MPR

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

8.4.3 A-MPR

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

8.4.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r01:

a. Per Section 5.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
   i. The required channel and offset combination with the highest maximum output power is required for SAR.
   ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is

required for the remaining required test channels using the RB offset configuration with highest output power for that channel.

iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.

b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.

c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.

d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to ½ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is <1.45 W/kg.

9 RF CONDUCTED POWERS

9.1 GSM Conducted Powers

		Maximum Burst-Averaged Output Power								
		Voice	*GPRS/EDGE Data (GMSK)*				*EDGE Data (8-PSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**	**EDGE [dBm] 1 Tx Slot**	**EDGE [dBm] 2 Tx Slot**	**EDGE [dBm] 3 Tx Slot**	**EDGE [dBm] 4 Tx Slot**
GSM 1900	512	31.10	31.02	28.57	26.99	**26.00**	26.74	25.26	22.69	21.64
	661	31.20	31.16	28.26	27.06	**26.36**	26.61	25.00	22.40	21.36
	810	31.11	31.20	28.82	26.90	**25.99**	26.64	25.27	22.77	21.81
		Calculated Maximum Frame-Averaged Output Power								
		Voice	*GPRS/EDGE Data (GMSK)*				*EDGE Data (8-PSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**	**EDGE [dBm] 1 Tx Slot**	**EDGE [dBm] 2 Tx Slot**	**EDGE [dBm] 3 Tx Slot**	**EDGE [dBm] 4 Tx Slot**
GSM 1900	512	22.07	21.99	22.55	22.73	**22.99**	17.71	19.24	18.43	18.63
	661	22.17	22.13	22.24	22.80	**23.35**	17.58	18.98	18.14	18.35
	810	22.08	22.17	22.80	22.64	**22.98**	17.61	19.25	18.51	18.80

Notes:
1. Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
2. The source-based frame-averaged output power was evaluated for all GPRS/EDGE slot configurations. The configuration with the highest target frame averaged output power was evaluated for hotspot SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
3. GPRS/EDGE (GMSK) output powers were measured with coding scheme setting of 1 (CS1) on the base station simulator. CS1 was configured to measure GPRS output power measurements and SAR to ensure GMSK modulation in the signal. Our Investigation has shown that CS1 - CS4 settings do not have any impact on the output levels or modulation in the GPRS modes.
4. EDGE (8-PSK) output powers were measured with MCS7 on the base station simulator. MCS7 coding scheme was used to measure the output powers for EDGE since investigation has shown that choosing MCS7 coding scheme will ensure 8-PSK modulation. It has been shown that MCS levels that produce 8PSK modulation do not have an impact on output power.

GSM Class: B
GPRS Multislot class: 12 (Max 4 Tx uplink slots)
EDGE Multislot class: 12 (Max 4 Tx uplink slots)
DTM Multislot Class: N/A

Figure 9-1
Power Measurement Setup

9.2 UMTS Conducted Powers

Mode	3GPP 34.121 Subtest	PCS Band [dBm]			3GPP MPR [dB]
		9262	9400	9538	
WCDMA	12.2 kbps RMC	24.05	23.96	23.67	-
	12.2 kbps AMR	23.95	23.84	23.65	-
HSDPA	Subtest 1	23.00	22.97	22.98	0
	Subtest 2	23.00	23.00	22.94	0
	Subtest 3	22.48	22.50	22.50	0.5
	Subtest 4	22.59	22.54	22.50	0.5
HSUPA	Subtest 1	23.00	22.95	22.91	0
	Subtest 2	21.71	21.72	21.80	2
	Subtest 3	21.92	21.97	21.86	1
	Subtest 4	22.75	22.20	22.07	2
	Subtest 5	22.20	22.32	22.27	0
DC-HSDPA	Subtest 1	22.10	22.14	22.05	0
	Subtest 2	22.10	22.04	22.04	0
	Subtest 3	21.59	21.68	21.54	0.5
	Subtest 4	21.50	21.57	21.51	0.5

UMTS SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v02. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.

DC-HSDPA considerations

- 3GPP Specification 34.121-1 Release 8 Ver 8.10.0 was used for DC-HSDPA guidance
- H-Set 12 (QPSK) was confirmed to be used during DC-HSDPA measurements
- Measured maximum output powers for DC-HSDPA were not greater than 1/4 dB higher than the WCDMA 12.2 kbps RMC maximum output, as a result, SAR is not required for DC-HSDPA
- The DUT supports UE category 24 for HSDPA

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

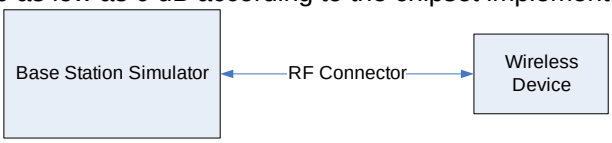


Figure 9-2
Power Measurement Setup

9.3 LTE Conducted Powers

9.3.1 LTE Band 2 (PCS)

Table 9-1
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1860	18700	20	QPSK	1	0	22.71	0	0
	1860	18700	20	QPSK	1	50	22.62	0	0
	1860	18700	20	QPSK	1	99	22.67	0	0
	1860	18700	20	QPSK	50	0	**21.75**	1	0-1
	1860	18700	20	QPSK	50	25	21.70	1	0-1
	1860	18700	20	QPSK	50	50	21.58	1	0-1
	1860	18700	20	QPSK	100	0	21.62	1	0-1
	1860	18700	20	16QAM	1	0	21.53	1	0-1
	1860	18700	20	16QAM	1	50	21.48	1	0-1
	1860	18700	20	16QAM	1	99	21.56	1	0-1
	1860	18700	20	16QAM	50	0	20.73	2	0-2
	1860	18700	20	16QAM	50	25	20.70	2	0-2
	1860	18700	20	16QAM	50	50	20.52	2	0-2
	1860	18700	20	16QAM	100	0	20.57	2	0-2
Mid	1880.0	18900	20	QPSK	1	0	**22.80**	0	0
	1880.0	18900	20	QPSK	1	50	22.79	0	0
	1880.0	18900	20	QPSK	1	99	22.78	0	0
	1880.0	18900	20	QPSK	50	0	21.70	1	0-1
	1880.0	18900	20	QPSK	50	25	21.64	1	0-1
	1880.0	18900	20	QPSK	50	50	21.60	1	0-1
	1880.0	18900	20	QPSK	100	0	21.64	1	0-1
	1880.0	18900	20	16QAM	1	0	21.75	1	0-1
	1880.0	18900	20	16QAM	1	50	21.79	1	0-1
	1880.0	18900	20	16QAM	1	99	21.80	1	0-1
	1880.0	18900	20	16QAM	50	0	20.53	2	0-2
	1880.0	18900	20	16QAM	50	25	20.59	2	0-2
	1880.0	18900	20	16QAM	50	50	20.60	2	0-2
	1880.0	18900	20	16QAM	100	0	20.53	2	0-2
High	1900	19100	20	QPSK	1	0	22.77	0	0
	1900	19100	20	QPSK	1	50	22.73	0	0
	1900	19100	20	QPSK	1	99	22.53	0	0
	1900	19100	20	QPSK	50	0	21.64	1	0-1
	1900	19100	20	QPSK	50	25	21.58	1	0-1
	1900	19100	20	QPSK	50	50	21.57	1	0-1
	1900	19100	20	QPSK	100	0	21.51	1	0-1
	1900	19100	20	16QAM	1	0	21.51	1	0-1
	1900	19100	20	16QAM	1	50	21.61	1	0-1
	1900	19100	20	16QAM	1	99	21.48	1	0-1
	1900	19100	20	16QAM	50	0	20.66	2	0-2
	1900	19100	20	16QAM	50	25	20.61	2	0-2
	1900	19100	20	16QAM	50	50	20.59	2	0-2
	1900	19100	20	16QAM	100	0	20.55	2	0-2

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1857.5	18675	15	QPSK	1	0	22.68	0	0
	1857.5	18675	15	QPSK	1	36	22.59	0	0
	1857.5	18675	15	QPSK	1	74	22.44	0	0
	1857.5	18675	15	QPSK	36	0	21.72	1	0-1
	1857.5	18675	15	QPSK	36	18	21.67	1	0-1
	1857.5	18675	15	QPSK	36	37	21.55	1	0-1
	1857.5	18675	15	QPSK	75	0	21.59	1	0-1
	1857.5	18675	15	16QAM	1	0	21.50	1	0-1
	1857.5	18675	15	16QAM	1	36	21.45	1	0-1
	1857.5	18675	15	16QAM	1	74	21.30	1	0-1
	1857.5	18675	15	16QAM	36	0	20.70	2	0-2
	1857.5	18675	15	16QAM	36	18	20.67	2	0-2
	1857.5	18675	15	16QAM	36	37	20.49	2	0-2
	1857.5	18675	15	16QAM	75	0	20.52	2	0-2
Mid	1880.0	18900	15	QPSK	1	0	22.71	0	0
	1880.0	18900	15	QPSK	1	36	22.74	0	0
	1880.0	18900	15	QPSK	1	74	22.75	0	0
	1880.0	18900	15	QPSK	36	0	21.62	1	0-1
	1880.0	18900	15	QPSK	36	18	21.61	1	0-1
	1880.0	18900	15	QPSK	36	37	21.57	1	0-1
	1880.0	18900	15	QPSK	75	0	21.61	1	0-1
	1880.0	18900	15	16QAM	1	0	21.72	1	0-1
	1880.0	18900	15	16QAM	1	36	21.76	1	0-1
	1880.0	18900	15	16QAM	1	74	21.77	1	0-1
	1880.0	18900	15	16QAM	36	0	20.50	2	0-2
	1880.0	18900	15	16QAM	36	18	20.56	2	0-2
	1880.0	18900	15	16QAM	36	37	20.57	2	0-2
	1880.0	18900	15	16QAM	75	0	20.50	2	0-2
High	1902.5	19125	15	QPSK	1	0	22.74	0	0
	1902.5	19125	15	QPSK	1	36	22.70	0	0
	1902.5	19125	15	QPSK	1	74	22.50	0	0
	1902.5	19125	15	QPSK	36	0	21.61	1	0-1
	1902.5	19125	15	QPSK	36	18	21.55	1	0-1
	1902.5	19125	15	QPSK	36	37	21.54	1	0-1
	1902.5	19125	15	QPSK	75	0	21.48	1	0-1
	1902.5	19125	15	16QAM	1	0	21.48	1	0-1
	1902.5	19125	15	16QAM	1	36	21.58	1	0-1
	1902.5	19125	15	16QAM	1	74	21.37	1	0-1
	1902.5	19125	15	16QAM	36	0	20.63	2	0-2
	1902.5	19125	15	16QAM	36	18	20.58	2	0-2
	1902.5	19125	15	16QAM	36	37	20.56	2	0-2
	1902.5	19125	15	16QAM	75	0	20.52	2	0-2

Table 9-3
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1855	18650	10	QPSK	1	0	22.67	0	0
	1855	18650	10	QPSK	1	25	22.54	0	0
	1855	18650	10	QPSK	1	49	22.44	0	0
	1855	18650	10	QPSK	25	0	21.73	1	0-1
	1855	18650	10	QPSK	25	12	21.68	1	0-1
	1855	18650	10	QPSK	25	25	21.56	1	0-1
	1855	18650	10	QPSK	50	0	21.60	1	0-1
	1855	18650	10	16QAM	1	0	21.51	1	0-1
	1855	18650	10	16QAM	1	25	21.49	1	0-1
	1855	18650	10	16QAM	1	49	21.31	1	0-1
	1855	18650	10	16QAM	25	0	20.71	2	0-2
	1855	18650	10	16QAM	25	12	20.68	2	0-2
	1855	18650	10	16QAM	25	25	20.50	2	0-2
	1855	18650	10	16QAM	50	0	20.53	2	0-2
Mid	1880.0	18900	10	QPSK	1	0	22.67	0	0
	1880.0	18900	10	QPSK	1	25	22.70	0	0
	1880.0	18900	10	QPSK	1	49	22.75	0	0
	1880.0	18900	10	QPSK	25	0	21.68	1	0-1
	1880.0	18900	10	QPSK	25	12	21.62	1	0-1
	1880.0	18900	10	QPSK	25	25	21.58	1	0-1
	1880.0	18900	10	QPSK	50	0	21.62	1	0-1
	1880.0	18900	10	16QAM	1	0	21.73	1	0-1
	1880.0	18900	10	16QAM	1	25	21.63	1	0-1
	1880.0	18900	10	16QAM	1	49	21.70	1	0-1
	1880.0	18900	10	16QAM	25	0	20.51	2	0-2
	1880.0	18900	10	16QAM	25	12	20.57	2	0-2
	1880.0	18900	10	16QAM	25	25	20.58	2	0-2
	1880.0	18900	10	16QAM	50	0	20.51	2	0-2
High	1905	19150	10	QPSK	1	0	22.73	0	0
	1905	19150	10	QPSK	1	25	22.71	0	0
	1905	19150	10	QPSK	1	49	22.50	0	0
	1905	19150	10	QPSK	25	0	21.62	1	0-1
	1905	19150	10	QPSK	25	12	21.56	1	0-1
	1905	19150	10	QPSK	25	25	21.55	1	0-1
	1905	19150	10	QPSK	50	0	21.46	1	0-1
	1905	19150	10	16QAM	1	0	21.49	1	0-1
	1905	19150	10	16QAM	1	25	21.59	1	0-1
	1905	19150	10	16QAM	1	49	21.60	1	0-1
	1905	19150	10	16QAM	25	0	20.64	2	0-2
	1905	19150	10	16QAM	25	12	20.59	2	0-2
	1905	19150	10	16QAM	25	25	20.57	2	0-2
	1905	19150	10	16QAM	50	0	20.53	2	0-2

Table 9-4
LTE Band 2 (PCS) 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	22.66	0	0
	1852.5	18625	5	QPSK	1	12	22.80	0	0
	1852.5	18625	5	QPSK	1	24	22.78	0	0
	1852.5	18625	5	QPSK	12	0	21.79	1	0-1
	1852.5	18625	5	QPSK	12	6	21.75	1	0-1
	1852.5	18625	5	QPSK	12	13	21.78	1	0-1
	1852.5	18625	5	QPSK	25	0	21.80	1	0-1
	1852.5	18625	5	16-QAM	1	0	21.59	1	0-1
	1852.5	18625	5	16-QAM	1	12	21.66	1	0-1
	1852.5	18625	5	16-QAM	1	24	21.60	1	0-1
	1852.5	18625	5	16-QAM	12	0	20.80	2	0-2
	1852.5	18625	5	16-QAM	12	6	20.78	2	0-2
	1852.5	18625	5	16-QAM	12	13	20.79	2	0-2
	1852.5	18625	5	16-QAM	25	0	20.73	2	0-2
Mid	1880.0	18900	5	QPSK	1	0	22.80	0	0
	1880.0	18900	5	QPSK	1	12	22.79	0	0
	1880.0	18900	5	QPSK	1	24	22.80	0	0
	1880.0	18900	5	QPSK	12	0	21.77	1	0-1
	1880.0	18900	5	QPSK	12	6	21.72	1	0-1
	1880.0	18900	5	QPSK	12	13	21.73	1	0-1
	1880.0	18900	5	QPSK	25	0	21.66	1	0-1
	1880.0	18900	5	16-QAM	1	0	21.66	1	0-1
	1880.0	18900	5	16-QAM	1	12	21.65	1	0-1
	1880.0	18900	5	16-QAM	1	24	21.65	1	0-1
	1880.0	18900	5	16-QAM	12	0	20.72	2	0-2
	1880.0	18900	5	16-QAM	12	6	20.75	2	0-2
	1880.0	18900	5	16-QAM	12	13	20.69	2	0-2
	1880.0	18900	5	16-QAM	25	0	20.54	2	0-2
High	1907.5	19175	5	QPSK	1	0	22.80	0	0
	1907.5	19175	5	QPSK	1	12	22.76	0	0
	1907.5	19175	5	QPSK	1	24	22.57	0	0
	1907.5	19175	5	QPSK	12	0	21.71	1	0-1
	1907.5	19175	5	QPSK	12	6	21.63	1	0-1
	1907.5	19175	5	QPSK	12	13	21.54	1	0-1
	1907.5	19175	5	QPSK	25	0	21.59	1	0-1
	1907.5	19175	5	16-QAM	1	0	21.80	1	0-1
	1907.5	19175	5	16-QAM	1	12	21.71	1	0-1
	1907.5	19175	5	16-QAM	1	24	21.52	1	0-1
	1907.5	19175	5	16-QAM	12	0	20.63	2	0-2
	1907.5	19175	5	16-QAM	12	6	20.66	2	0-2
	1907.5	19175	5	16-QAM	12	13	20.55	2	0-2
	1907.5	19175	5	16-QAM	25	0	20.47	2	0-2

Table 9-5
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1851.5	18615	3	QPSK	1	0	22.64	0	0
	1851.5	18615	3	QPSK	1	7	22.51	0	0
	1851.5	18615	3	QPSK	1	14	22.41	0	0
	1851.5	18615	3	QPSK	8	0	21.70	1	0-1
	1851.5	18615	3	QPSK	8	4	21.65	1	0-1
	1851.5	18615	3	QPSK	8	7	21.53	1	0-1
	1851.5	18615	3	QPSK	15	0	21.57	1	0-1
	1851.5	18615	3	16-QAM	1	0	21.48	1	0-1
	1851.5	18615	3	16-QAM	1	7	21.46	1	0-1
	1851.5	18615	3	16-QAM	1	14	21.28	1	0-1
	1851.5	18615	3	16-QAM	8	0	20.68	2	0-2
	1851.5	18615	3	16-QAM	8	4	20.65	2	0-2
	1851.5	18615	3	16-QAM	8	7	20.47	2	0-2
	1851.5	18615	3	16-QAM	15	0	20.50	2	0-2
Mid	1880.0	18900	3	QPSK	1	0	22.64	0	0
	1880.0	18900	3	QPSK	1	7	22.67	0	0
	1880.0	18900	3	QPSK	1	14	22.72	0	0
	1880.0	18900	3	QPSK	8	0	21.65	1	0-1
	1880.0	18900	3	QPSK	8	4	21.59	1	0-1
	1880.0	18900	3	QPSK	8	7	21.55	1	0-1
	1880.0	18900	3	QPSK	15	0	21.59	1	0-1
	1880.0	18900	3	16-QAM	1	0	21.70	1	0-1
	1880.0	18900	3	16-QAM	1	7	21.60	1	0-1
	1880.0	18900	3	16-QAM	1	14	21.67	1	0-1
	1880.0	18900	3	16-QAM	8	0	20.48	2	0-2
	1880.0	18900	3	16-QAM	8	4	20.54	2	0-2
	1880.0	18900	3	16-QAM	8	7	20.55	2	0-2
	1880.0	18900	3	16-QAM	15	0	20.48	2	0-2
High	1908.5	19185	3	QPSK	1	0	22.70	0	0
	1908.5	19185	3	QPSK	1	7	22.68	0	0
	1908.5	19185	3	QPSK	1	14	22.47	0	0
	1908.5	19185	3	QPSK	8	0	21.59	1	0-1
	1908.5	19185	3	QPSK	8	4	21.56	1	0-1
	1908.5	19185	3	QPSK	8	7	21.52	1	0-1
	1908.5	19185	3	QPSK	15	0	21.43	1	0-1
	1908.5	19185	3	16-QAM	1	0	21.46	1	0-1
	1908.5	19185	3	16-QAM	1	7	21.56	1	0-1
	1908.5	19185	3	16-QAM	1	14	21.57	1	0-1
	1908.5	19185	3	16-QAM	8	0	20.61	2	0-2
	1908.5	19185	3	16-QAM	8	4	20.56	2	0-2
	1908.5	19185	3	16-QAM	8	7	20.54	2	0-2
	1908.5	19185	3	16-QAM	15	0	20.51	2	0-2

Table 9-6
LTE Band 2 (PCS) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1850.7	18607	1.4	QPSK	1	0	22.64	0	0
	1850.7	18607	1.4	QPSK	1	2	22.51	0	0
	1850.7	18607	1.4	QPSK	1	5	22.41	0	0
	1850.7	18607	1.4	QPSK	3	0	21.90	0	0
	1850.7	18607	1.4	QPSK	3	2	22.03	0	0
	1850.7	18607	1.4	QPSK	3	3	22.03	0	0
	1850.7	18607	1.4	QPSK	6	0	21.57	1	0-1
	1850.7	18607	1.4	16-QAM	1	0	21.48	1	0-1
	1850.7	18607	1.4	16-QAM	1	2	21.46	1	0-1
	1850.7	18607	1.4	16-QAM	1	5	21.28	1	0-1
	1850.7	18607	1.4	16-QAM	3	0	21.30	1	0-1
	1850.7	18607	1.4	16-QAM	3	2	21.08	1	0-1
	1850.7	18607	1.4	16-QAM	3	3	21.03	1	0-1
	1850.7	18607	1.4	16-QAM	6	0	20.50	2	0-2
Mid	1880.0	18900	1.4	QPSK	1	0	22.64	0	0
	1880.0	18900	1.4	QPSK	1	2	22.67	0	0
	1880.0	18900	1.4	QPSK	1	5	22.72	0	0
	1880.0	18900	1.4	QPSK	3	0	21.87	0	0
	1880.0	18900	1.4	QPSK	3	2	21.88	0	0
	1880.0	18900	1.4	QPSK	3	3	21.97	0	0
	1880.0	18900	1.4	QPSK	6	0	21.59	1	0-1
	1880.0	18900	1.4	16-QAM	1	0	21.70	1	0-1
	1880.0	18900	1.4	16-QAM	1	2	21.60	1	0-1
	1880.0	18900	1.4	16-QAM	1	5	21.67	1	0-1
	1880.0	18900	1.4	16-QAM	3	0	20.97	1	0-1
	1880.0	18900	1.4	16-QAM	3	2	21.06	1	0-1
	1880.0	18900	1.4	16-QAM	3	3	21.10	1	0-1
	1880.0	18900	1.4	16-QAM	6	0	20.48	2	0-2
High	1909.3	19193	1.4	QPSK	1	0	22.70	0	0
	1909.3	19193	1.4	QPSK	1	2	22.68	0	0
	1909.3	19193	1.4	QPSK	1	5	22.47	0	0
	1909.3	19193	1.4	QPSK	3	0	21.96	0	0
	1909.3	19193	1.4	QPSK	3	2	22.06	0	0
	1909.3	19193	1.4	QPSK	3	3	22.10	0	0
	1909.3	19193	1.4	QPSK	6	0	21.43	1	0-1
	1909.3	19193	1.4	16-QAM	1	0	21.46	1	0-1
	1909.3	19193	1.4	16-QAM	1	2	21.56	1	0-1
	1909.3	19193	1.4	16-QAM	1	5	21.57	1	0-1
	1909.3	19193	1.4	16-QAM	3	0	21.16	1	0-1
	1909.3	19193	1.4	16-QAM	3	2	21.45	1	0-1
	1909.3	19193	1.4	16-QAM	3	3	21.36	1	0-1
	1909.3	19193	1.4	16-QAM	6	0	20.50	2	0-2

10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C°)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
11/19/2013	1900H	21.9	1850	1.375	39.748	1.400	40.000	*-1.79%*	*-0.63%*
			1880	1.401	39.642	1.400	40.000	*0.07%*	*-0.89%*
			1910	1.432	39.424	1.400	40.000	*2.29%*	*-1.44%*
11/18/2013	1900B	22.9	1850	1.520	52.713	1.520	53.300	*0.00%*	*-1.10%*
			1880	1.546	52.518	1.520	53.300	*1.71%*	*-1.47%*
			1910	1.587	52.404	1.520	53.300	*4.41%*	*-1.68%*
11/19/2013	1900B	23.7	1850	1.533	51.579	1.520	53.300	*0.86%*	*-3.23%*
			1880	1.564	51.539	1.520	53.300	*2.89%*	*-3.30%*
			1910	1.594	51.411	1.520	53.300	*4.87%*	*-3.54%*

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

10.2 Test System Verification

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

Table 10-2
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	$Deviation_{1g}$ (%)
F	1900	HEAD	11/19/2013	24.0	21.5	0.040	5d148	3213	1.710	39.700	42.750	7.68%
G	1900	BODY	11/18/2013	24.4	22.9	0.100	5d148	3209	4.290	40.800	42.900	5.15%
G	1900	BODY	11/19/2013	23.7	23.6	0.100	5d148	3209	4.350	40.800	43.500	6.62%

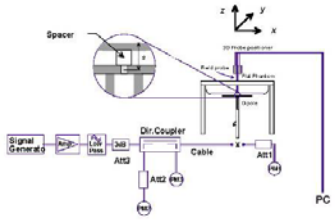


Figure 10-1
System Verification Setup Diagram

Figure 10-2
System Verification Setup Photo

11 SAR DATA SUMMARY

11.1 Standalone Head SAR Data

Table 11-1
GSM 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	661	GSM 1900	GSM	31.2	31.20	0.14	Right	Cheek	FK-344-B	1:8.3	0.093	1.000	0.093	
1880.00	661	GSM 1900	GSM	31.2	31.20	0.15	Right	Tilt	FK-344-B	1:8.3	0.094	1.000	0.094	
1880.00	661	GSM 1900	GSM	31.2	31.20	0.16	Left	Cheek	FK-344-B	1:8.3	0.118	1.000	0.118	A1
1880.00	661	GSM 1900	GSM	31.2	31.20	0.13	Left	Tilt	FK-344-B	1:8.3	0.087	1.000	0.087	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 11-2
UMTS 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	24.2	23.96	-0.12	Right	Cheek	FK-344-C	1:1	0.170	1.057	0.180	
1880.00	9400	UMTS 1900	RMC	24.2	23.96	0.07	Right	Tilt	FK-344-C	1:1	0.158	1.057	0.167	
1880.00	9400	UMTS 1900	RMC	24.2	23.96	0.00	Left	Cheek	FK-344-C	1:1	0.229	1.057	**0.242**	A2
1880.00	9400	UMTS 1900	RMC	24.2	23.96	0.06	Left	Tilt	FK-344-C	1:1	0.171	1.057	0.181	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 11-3
LTE Band 2 (PCS) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.8	22.80	0.03	0	Right	Cheek	QPSK	1	0	FK-344-A	1:1	0.107	1.000	0.107	
1860.00	18700	Low	LTE Band 2 (PCS)	20	21.8	21.75	-0.14	1	Right	Cheek	QPSK	50	0	FK-344-A	1:1	0.065	1.012	0.066	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.8	22.80	0.05	0	Right	Tilt	QPSK	1	0	FK-344-A	1:1	0.099	1.000	0.099	
1860.00	18700	Low	LTE Band 2 (PCS)	20	21.8	21.75	0.06	1	Right	Tilt	QPSK	50	0	FK-344-A	1:1	0.074	1.012	0.075	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.8	22.80	0.00	0	Left	Cheek	QPSK	1	0	FK-344-A	1:1	0.118	1.000	0.118	A3
1860.00	18700	Low	LTE Band 2 (PCS)	20	21.8	21.75	0.03	1	Left	Cheek	QPSK	50	0	FK-344-A	1:1	0.089	1.012	0.090	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.8	22.80	0.03	0	Left	Tilt	QPSK	1	0	FK-344-A	1:1	0.109	1.000	0.109	
1860.00	18700	Low	LTE Band 2 (PCS)	20	21.8	21.75	0.04	1	Left	Tilt	QPSK	50	0	FK-344-A	1:1	0.070	1.012	0.070	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

11.2 Standalone Body-Worn SAR Data

Table 11-4
GSM/UMTS Body-Worn SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of Time Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
1880.00	661	GSM 1900	GSM	31.2	31.20	-0.01	10 mm	FK-344-B	1	1:8.3	back	0.620	1.000	0.620	A4
1852.40	9262	UMTS 1900	RMC	24.2	24.05	-0.01	10 mm	FK-344-C	N/A	1:1	back	0.878	1.035	0.909	
1880.00	9400	UMTS 1900	RMC	24.2	23.96	-0.04	10 mm	FK-344-C	N/A	1:1	back	1.010	1.057	1.068	A6
1907.60	9538	UMTS 1900	RMC	24.2	23.67	-0.03	10 mm	FK-344-C	N/A	1:1	back	0.916	1.130	1.035	
1880.00	9400	UMTS 1900	RMC	24.2	23.96	0.00	10 mm	FK-344-C	N/A	1:1	back	0.952	1.057	1.006	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population												Body 1.6 W/kg (mW/g) averaged over 1 gram			

Note: Blue entry represents variability SAR data

Table 11-5
LTE Body-Worn SAR

MEASUREMENT RESULTS																		
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.8	22.71	-0.02	0	FK-344-A	QPSK	1	0	10 mm	back	1:1	0.745	1.021	0.761	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.8	22.80	-0.03	0	FK-344-A	QPSK	1	0	10 mm	back	1:1	0.916	1.000	0.916	A7
1900.00	19100	High	LTE Band 2 (PCS)	20	22.8	22.77	0.01	0	FK-344-A	QPSK	1	0	10 mm	back	1:1	0.883	1.007	0.889	
1860.00	18700	Low	LTE Band 2 (PCS)	20	21.8	21.75	-0.14	1	FK-344-A	QPSK	50	0	10 mm	back	1:1	0.683	1.012	0.691	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	21.8	21.64	-0.02	1	FK-344-A	QPSK	100	0	10 mm	back	1:1	0.692	1.038	0.718	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population																Body 1.6 W/kg (mW/g) averaged over 1 gram			

11.3 Standalone Wireless Router SAR Data

Table 11-6
GPRS/UMTS Hotspot SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of GPRS Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
1880.00	661	GSM 1900	GPRS	26.5	26.36	-0.05	10 mm	FK-344-B	4	1:2.076	back	0.727	1.033	0.751	A5
1880.00	661	GSM 1900	GPRS	26.5	26.36	0.05	10 mm	FK-344-B	4	1:2.076	front	0.588	1.033	0.607	
1880.00	661	GSM 1900	GPRS	26.5	26.36	0.09	10 mm	FK-344-B	4	1:2.076	bottom	0.382	1.033	0.395	
1880.00	661	GSM 1900	GPRS	26.5	26.36	0.01	10 mm	FK-344-B	4	1:2.076	right	0.066	1.033	0.068	
1880.00	661	GSM 1900	GPRS	26.5	26.36	0.03	10 mm	FK-344-B	4	1:2.076	left	0.183	1.033	0.189	
1852.40	9262	UMTS 1900	RMC	24.2	24.05	-0.01	10 mm	FK-344-C	N/A	1:1	back	0.878	1.035	0.909	
1880.00	9400	UMTS 1900	RMC	24.2	23.96	-0.04	10 mm	FK-344-C	N/A	1:1	back	1.010	1.057	**1.068**	A6
1907.60	9538	UMTS 1900	RMC	24.2	23.67	-0.03	10 mm	FK-344-C	N/A	1:1	back	0.916	1.130	1.035	
1880.00	9400	UMTS 1900	RMC	24.2	23.96	0.09	10 mm	FK-344-C	N/A	1:1	front	0.457	1.057	0.483	
1880.00	9400	UMTS 1900	RMC	24.2	23.96	-0.08	10 mm	FK-344-C	N/A	1:1	bottom	0.528	1.057	0.558	
1880.00	9400	UMTS 1900	RMC	24.2	23.96	-0.01	10 mm	FK-344-C	N/A	1:1	right	0.125	1.057	0.132	
1880.00	9400	UMTS 1900	RMC	24.2	23.96	-0.04	10 mm	FK-344-C	N/A	1:1	left	0.304	1.057	0.321	
1880.00	9400	UMTS 1900	RMC	24.2	23.96	0.00	10 mm	FK-344-C	N/A	1:1	back	0.952	1.057	1.006	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population**												**Body** **1.6 W/kg (mW/g)** averaged over 1 gram			

Note: Blue entry represents variability SAR data

Table 11-7
LTE Band 2 (PCS) Hotspot SAR

MEASUREMENT RESULTS																		
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.8	22.71	-0.02	0	FK-344-A	QPSK	1	0	10 mm	back	1:1	0.745	1.021	0.761	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.8	22.80	-0.03	0	FK-344-A	QPSK	1	0	10 mm	back	1:1	0.916	1.000	0.916	A7
1900.00	19100	High	LTE Band 2 (PCS)	20	22.8	22.77	0.01	0	FK-344-A	QPSK	1	0	10 mm	back	1:1	0.883	1.007	0.889	
1860.00	18700	Low	LTE Band 2 (PCS)	20	21.8	21.75	-0.14	1	FK-344-A	QPSK	50	0	10 mm	back	1:1	0.683	1.012	0.691	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	21.8	21.64	-0.02	1	FK-344-A	QPSK	100	0	10 mm	back	1:1	0.692	1.038	0.718	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.8	22.80	-0.02	0	FK-344-A	QPSK	1	0	10 mm	front	1:1	0.645	1.000	0.645	
1860.00	18700	Low	LTE Band 2 (PCS)	20	21.8	21.75	-0.01	1	FK-344-A	QPSK	50	0	10 mm	front	1:1	0.483	1.012	0.489	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.8	22.80	-0.05	0	FK-344-A	QPSK	1	0	10 mm	bottom	1:1	0.415	1.000	0.415	
1860.00	18700	Low	LTE Band 2 (PCS)	20	21.8	21.75	0.00	1	FK-344-A	QPSK	50	0	10 mm	bottom	1:1	0.316	1.012	0.320	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.8	22.80	0.02	0	FK-344-A	QPSK	1	0	10 mm	right	1:1	0.088	1.000	0.088	
1860.00	18700	Low	LTE Band 2 (PCS)	20	21.8	21.75	-0.04	1	FK-344-A	QPSK	50	0	10 mm	right	1:1	0.060	1.012	0.061	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.8	22.80	0.08	0	FK-344-A	QPSK	1	0	10 mm	left	1:1	0.147	1.000	0.147	
1860.00	18700	Low	LTE Band 2 (PCS)	20	21.8	21.75	-0.01	1	FK-344-A	QPSK	50	0	10 mm	left	1:1	0.116	1.012	0.117	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population**														**Body** **1.6 W/kg (mW/g)** averaged over 1 gram					

11.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, FCC/OET Bulletin 65, Supplement C [June 2001] and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements. The battery incorporating NFC Antenna was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01, Body Worn SAR was evaluated without a headset connected to the device. Since the standalone reported SAR was ≤ 1.2 W/kg, no additional SAR evaluations using a headset cable were required.
8. Per FCC KDB 865664 D01 v01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 13 for variability analysis.
9. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.6 for more details).

GSM Test Notes:

1. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
2. Justification for reduced test configurations per KDB Publication 941225 D03v01 and October 2013 TCB Workshop Notes: The source-based frame-averaged output power was evaluated for all GPRS/EDGE slot configurations. The configuration with the highest target frame averaged output power was evaluated for hotspot SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
3. Per FCC KDB Publication 447498 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

UMTS Notes:

1. UMTS mode in Body SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v02. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.
2. Per FCC KDB Publication 447498 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r01. The general test procedures used for testing can be found in Section 8.4.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator.

12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

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

12.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05 IV.C.1.iii, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05 4.3.2 2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

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

Table 12-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2441	10.00	10	**0.208**

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

12.3 Head SAR Simultaneous Transmission Analysis

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

Simult Tx	Configuration	GSM 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.093	0.046	0.139
	Right Tilt	0.094	0.041	0.135
	Left Cheek	0.118	0.095	**0.213**
	Left Tilt	0.087	0.059	0.146

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.180	0.046	0.226
	Right Tilt	0.167	0.041	0.208
	Left Cheek	0.242	0.095	**0.337**
	Left Tilt	0.181	0.059	0.240

Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.107	0.046	0.153
	Right Tilt	0.099	0.041	0.140
	Left Cheek	0.118	0.095	**0.213**
	Left Tilt	0.109	0.059	0.168

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

Simult Tx	Configuration	GSM 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.093	0.034	0.127
	Right Tilt	0.094	0.053	0.147
	Left Cheek	0.118	0.235	**0.353**
	Left Tilt	0.087	0.124	0.211

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.180	0.034	0.214
	Right Tilt	0.167	0.053	0.220
	Left Cheek	0.242	0.235	**0.477**
	Left Tilt	0.181	0.124	0.305

Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.107	0.034	0.141
	Right Tilt	0.099	0.053	0.152
	Left Cheek	0.118	0.235	**0.353**
	Left Tilt	0.109	0.124	0.233

The worst case 5 GHz WLAN reported SAR for each head configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Hotspot capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

12.4 Body-Worn Simultaneous Transmission Analysis

Table 12-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 10 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 1900	0.620	0.228	0.848
Back Side	UMTS 1900	1.068	0.228	**1.296**
Back Side	LTE Band 2 (PCS)	0.916	0.228	1.144

Table 12-5
Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 10 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 1900	0.620	0.446	1.066
Back Side	UMTS 1900	1.068	0.446	**1.514**
Back Side	LTE Band 2 (PCS)	0.916	0.446	1.362

The worst case 5 GHz WLAN reported SAR for body worn configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Hotspot capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN

Table 12-6
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 10 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 1900	0.620	0.208	0.828
Back Side	UMTS 1900	1.068	0.208	**1.276**
Back Side	LTE Band 2 (PCS)	0.916	0.208	1.124

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

12.5 Hotspot SAR Simultaneous Transmission Analysis

Per FCC KDB Publication 941225 D06v01, the devices edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR ("-").

Table 12-7
Simultaneous Transmission Scenario (2.4 GHz Hotspot at 1.0 cm)

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.751	0.228	**0.979**
	Front	0.607	0.031	0.638
	Top	-	0.025	0.025
	Bottom	0.395	-	0.395
	Right	0.068	0.076	0.144
	Left	0.189	-	0.189

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	1.068	0.228	**1.296**
	Front	0.483	0.031	0.514
	Top	-	0.025	0.025
	Bottom	0.558	-	0.558
	Right	0.132	0.076	0.208
	Left	0.321	-	0.321

Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.916	0.228	**1.144**
	Front	0.645	0.031	0.676
	Top	-	0.025	0.025
	Bottom	0.415	-	0.415
	Right	0.088	0.076	0.164
	Left	0.147	-	0.147

Table 12-8
Simultaneous Transmission Scenario (5.8 GHz Hotspot at 1.0 cm)

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.751	0.206	**0.957**
	Front	0.607	0.030	0.637
	Top	-	0.040	0.040
	Bottom	0.395	-	0.395
	Right	0.068	0.214	0.282
	Left	0.189	-	0.189
Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	1.068	0.206	**1.274**
	Front	0.483	0.030	0.513
	Top	-	0.040	0.040
	Bottom	0.558	-	0.558
	Right	0.132	0.214	0.346
	Left	0.321	-	0.321
Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.916	0.206	**1.122**
	Front	0.645	0.030	0.675
	Top	-	0.040	0.040
	Bottom	0.415	-	0.415
	Right	0.088	0.214	0.302
	Left	0.147	-	0.147

12.6 Simultaneous Transmission Conclusion

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

13 SAR MEASUREMENT VARIABILITY

13.1 Measurement Variability

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

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

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

Table 13-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS													
Band	FREQUENCY		Mode	Service	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)	
1900	1880.00	9400	UMTS 1900	RMC	back	10 mm	1.010	0.952	1.06	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram						

13.2 Measurement Uncertainty

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

14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	5/3/2013	Annual	5/3/2014	836371/0079
Rohde & Schwarz	CMU200	Base Station Simulator	9/23/2013	Annual	9/23/2014	109892
Rohde & Schwarz	NRVD	Dual Channel Power Meter	10/12/2012	Biennial	10/12/2014	101695
Rohde & Schwarz	NRVS	Single Channel Power Meter	10/31/2013	Annual	10/31/2014	835360/0079
Rohde & Schwarz	NRV-Z32	Peak Power Sensor	10/12/2012	Biennial	10/12/2014	836019/013
SPEAG	ES3DV3	SAR Probe	4/29/2013	Annual	4/29/2014	3213
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/22/2013	Annual	4/22/2014	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/8/2013	Annual	3/8/2014	1334
SPEAG	ES3DV3	SAR Probe	3/15/2013	Annual	3/15/2014	3209
Rohde & Schwarz	SMIQ03B	Signal Generator	4/17/2013	Annual	4/17/2014	DE27259
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	10/16/2013	Annual	10/16/2014	100976
Anritsu	MA2481A	Power Sensor	2/14/2013	Annual	2/14/2014	5318
Anritsu	ML2438A	Power Meter	2/14/2013	Annual	2/14/2014	1190013
Anritsu	ML2438A	Power Meter	2/14/2013	Annual	2/14/2014	98150041
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	10/4/2013	Biennial	10/4/2015	103962
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Seekonk	NC-100	Torque Wrench (8" lb)	11/29/2011	Triennial	11/29/2014	21053
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00579
SPEAG	D1900V2	1900 MHz SAR Dipole	2/6/2013	Annual	2/6/2014	5d148
Agilent	8753ES	S-Parameter Network Analyzer	10/29/2013	Annual	10/29/2014	US39170122

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

15 MEASUREMENT UNCERTAINTIES

Applicable for frequencies less than 3000 MHz.

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

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

16 CONCLUSION

16.1 Measurement Conclusion

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

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

17 REFERENCES

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

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

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

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

[5] Federal Communications Commission, OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, June 2001.

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

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

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

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

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

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

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

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

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

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

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

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

[18] Federal Communications Commission, OET Bulletin 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields. Supplement C, Dec. 1997.

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

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

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

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

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

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

[25] FCC Public Notice DA-02-1438. Office of Engineering and Technology Announces a Transition Period for the Phantom Requirements of Supplement C to OET Bulletin 65, June 19, 2002

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

[27] SAR Measurement procedures for IEEE 802.11a/b/g KDB Publication 248227 D01v01r02

[28] FCC SAR Considerations for Handsets with Multiple Transmitters and Antennas, KDB Publications 648474 D02-D04

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

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

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

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

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

APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHM819N; Type: Portable Handset; Serial: FK-344-B

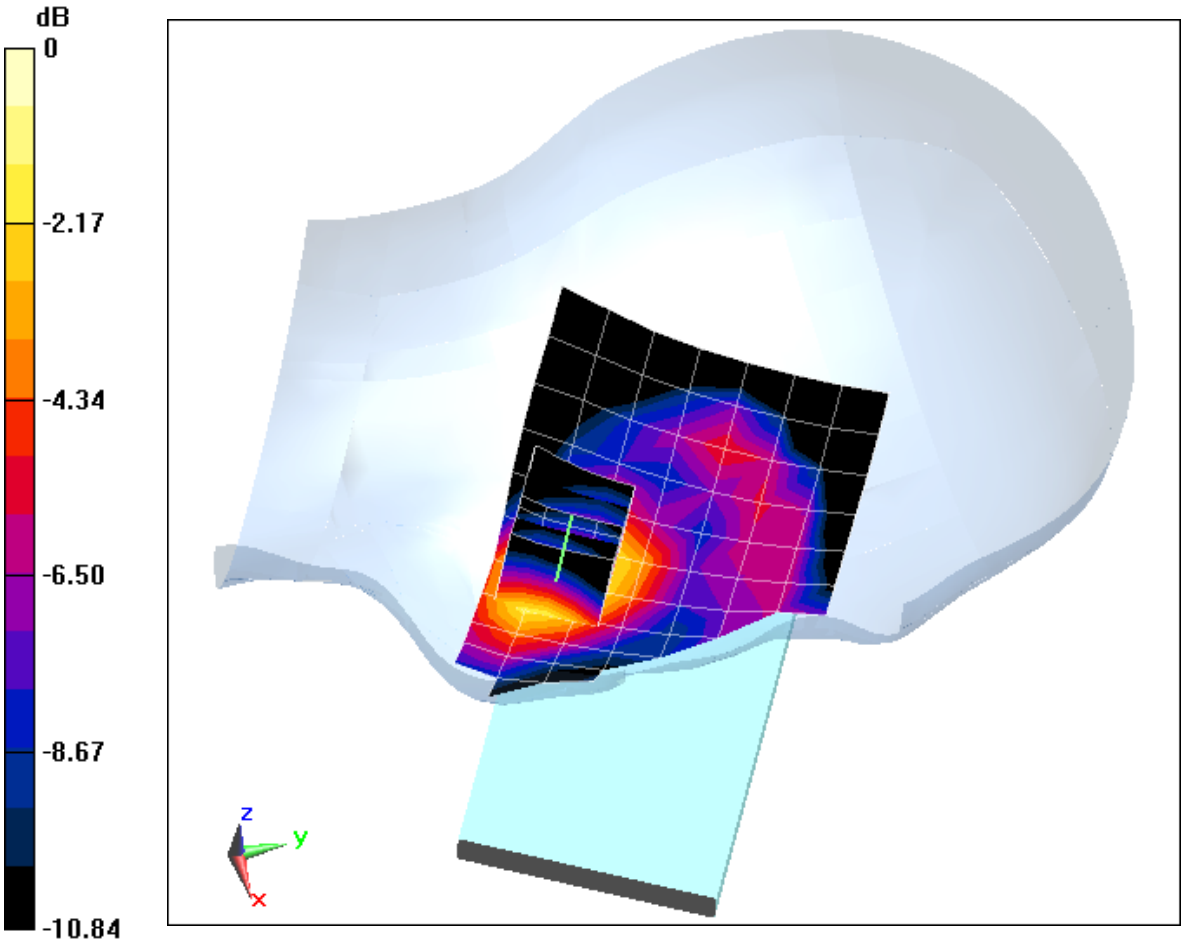
Communication System:GSM; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.401 S/m; ε_r = 39.642; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 11-19-2013; Ambient Temp: 24.0°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3213; ConvF(5.08, 5.08, 5.08); Calibrated: 4/29/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 4/22/2013
Phantom: SAM Front; Type: QD000P40CD; Serial: 1717
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

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

Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.047 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 0.178 W/kg
SAR(1 g) = 0.118 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHM819N; Type: Portable Handset; Serial: FK-344-C

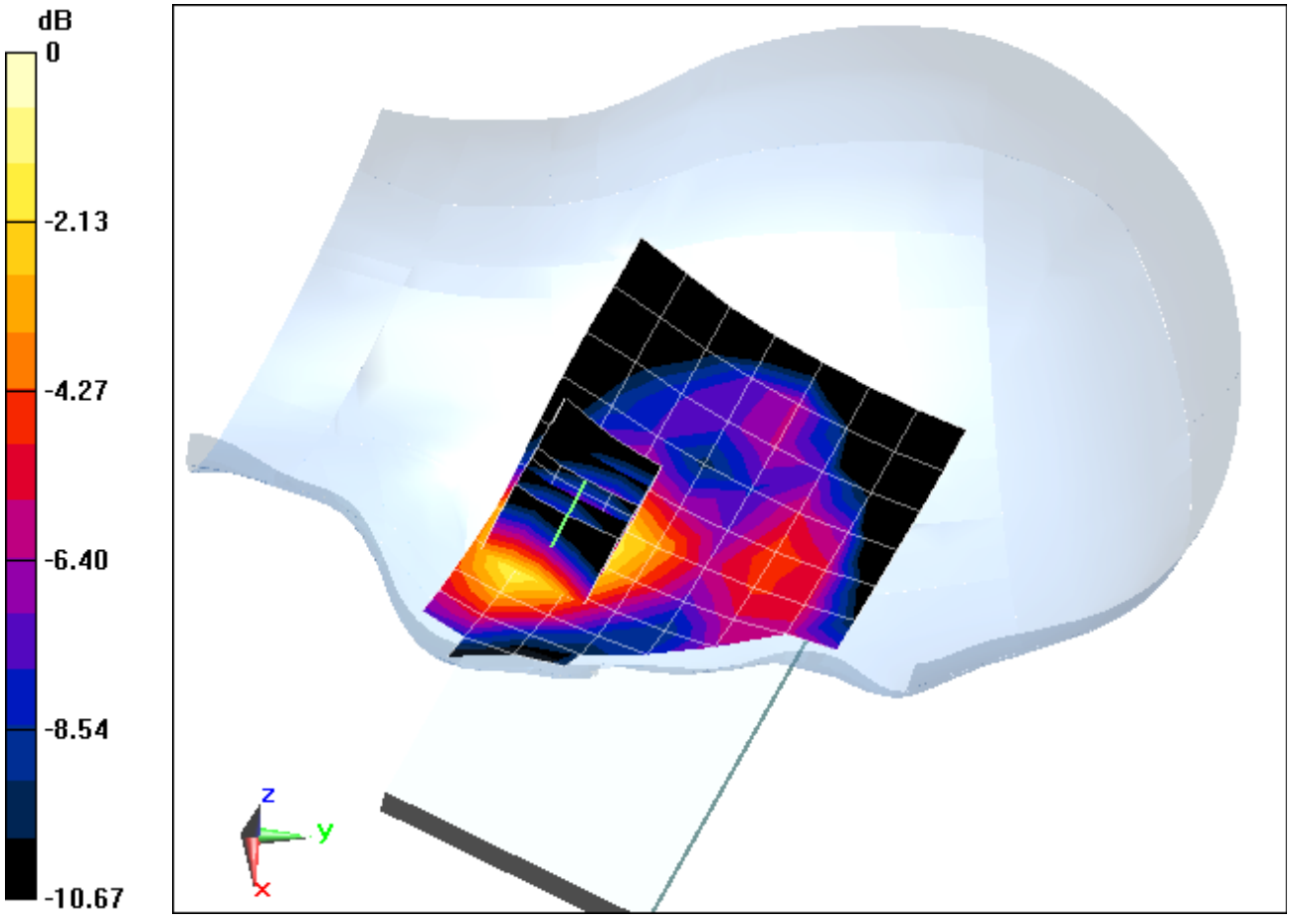
Communication System: UMTS; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.401 S/m; ε_r = 39.642; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 11-19-2013; Ambient Temp: 24.0°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3213; ConvF(5.08, 5.08, 5.08); Calibrated: 4/29/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 4/22/2013
Phantom: SAM Front; Type: QD000P40CD; Serial: 1717
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

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

Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.201 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.340 W/kg
SAR(1 g) = 0.229 W/kg



0 dB = 0.252 W/kg = -5.99 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHM819N; Type: Portable Handset; Serial: FK-344-A

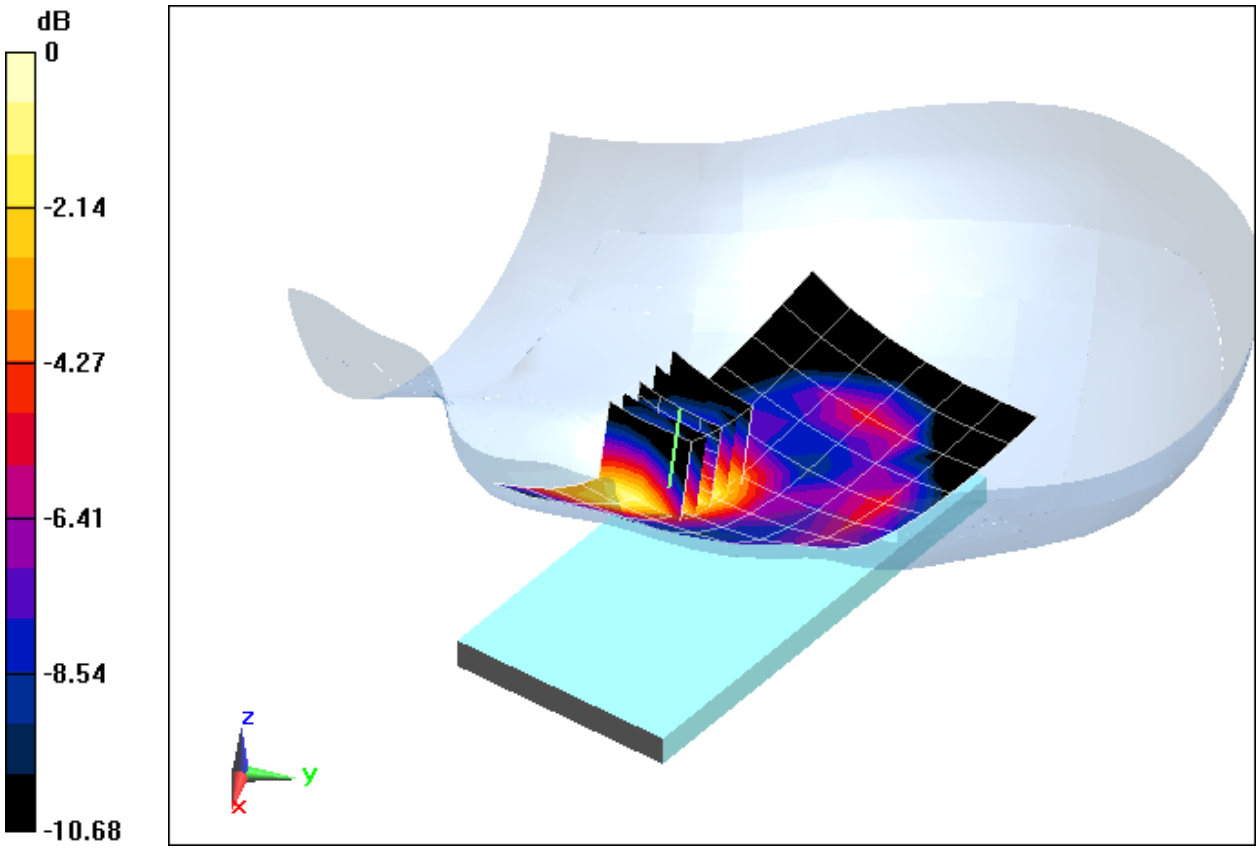
Communication System: LTE Band 2; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.401 S/m; ε_r = 39.642; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 11-19-2013; Ambient Temp: 24.0°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3213; ConvF(5.08, 5.08, 5.08); Calibrated: 4/29/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 4/22/2013
Phantom: SAM Front; Type: QD000P40CD; Serial: 1717
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: LTE Band 2 (PCS), Left Head, Cheek, Mid.ch, QPSK,
20 MHz Bandwidth, 1 RB, 0 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 = 10.257 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.173 W/kg
SAR(1 g) = 0.118 W/kg



0 dB = 0.125 W/kg = -9.03 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHM819N; Type: Portable Handset; Serial: FK-344-B

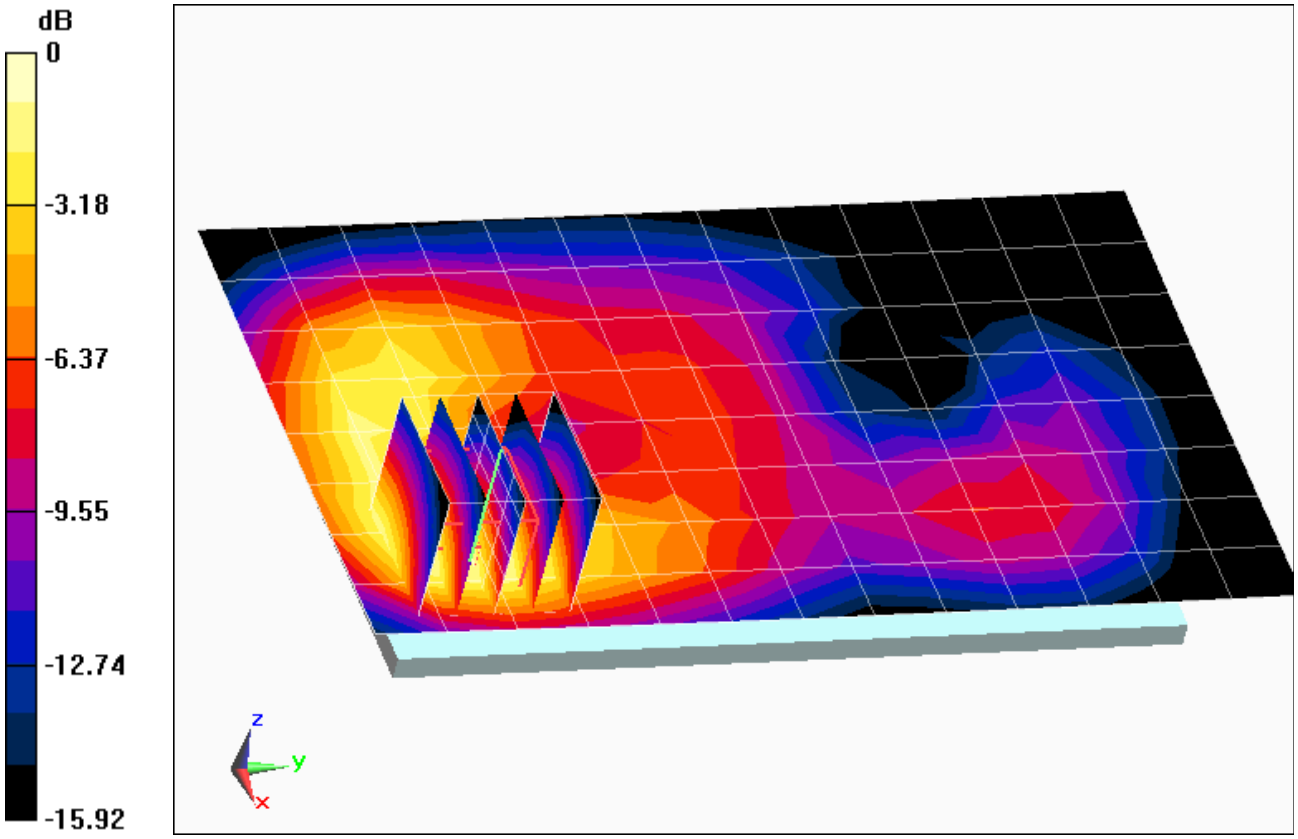
Communication System: GSM; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.546 S/m; ε_r = 52.518; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space 1.0 cm

Test Date: 11-18-2013; Ambient Temp: 24.4°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3209; ConvF(4.77, 4.77, 4.77); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

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

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.264 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.05 W/kg
SAR(1 g) = 0.620 W/kg



0 dB = 0.665 W/kg = -1.77 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHM819N; Type: Portable Handset; Serial: FK-344-B

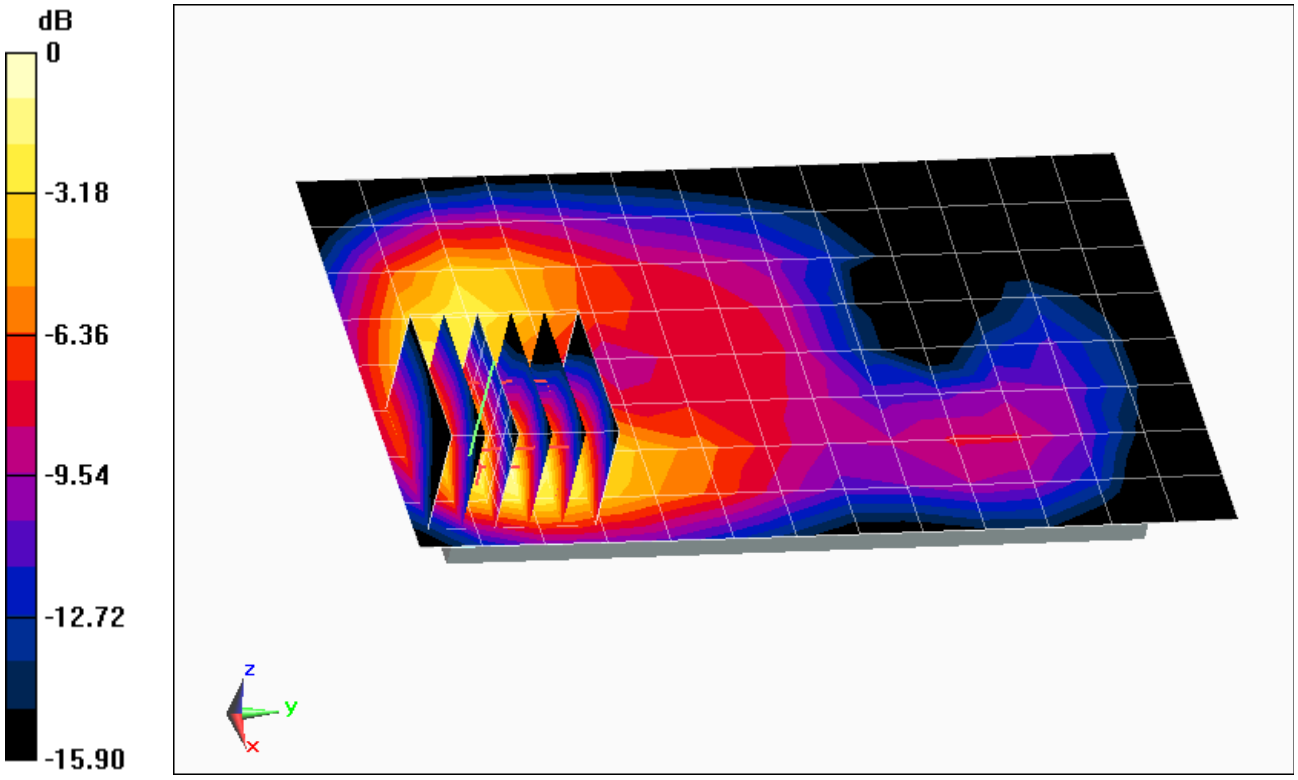
Communication System: GSM GPRS; 4 Tx slots; Frequency: 1880 MHz;Duty Cycle: 1:2.076
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.546 S/m; ε_r = 52.518; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 11-18-2013; Ambient Temp: 24.4°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3209; ConvF(4.77, 4.77, 4.77); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: GPRS 1900, Body SAR, Back Side, Mid.ch, 4 Tx Slots

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.208 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 1.26 W/kg
SAR(1 g) = 0.727 W/kg



0 dB = 0.779 W/kg = -1.08 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHM819N; Type: Portable Handset; Serial: FK-344-C

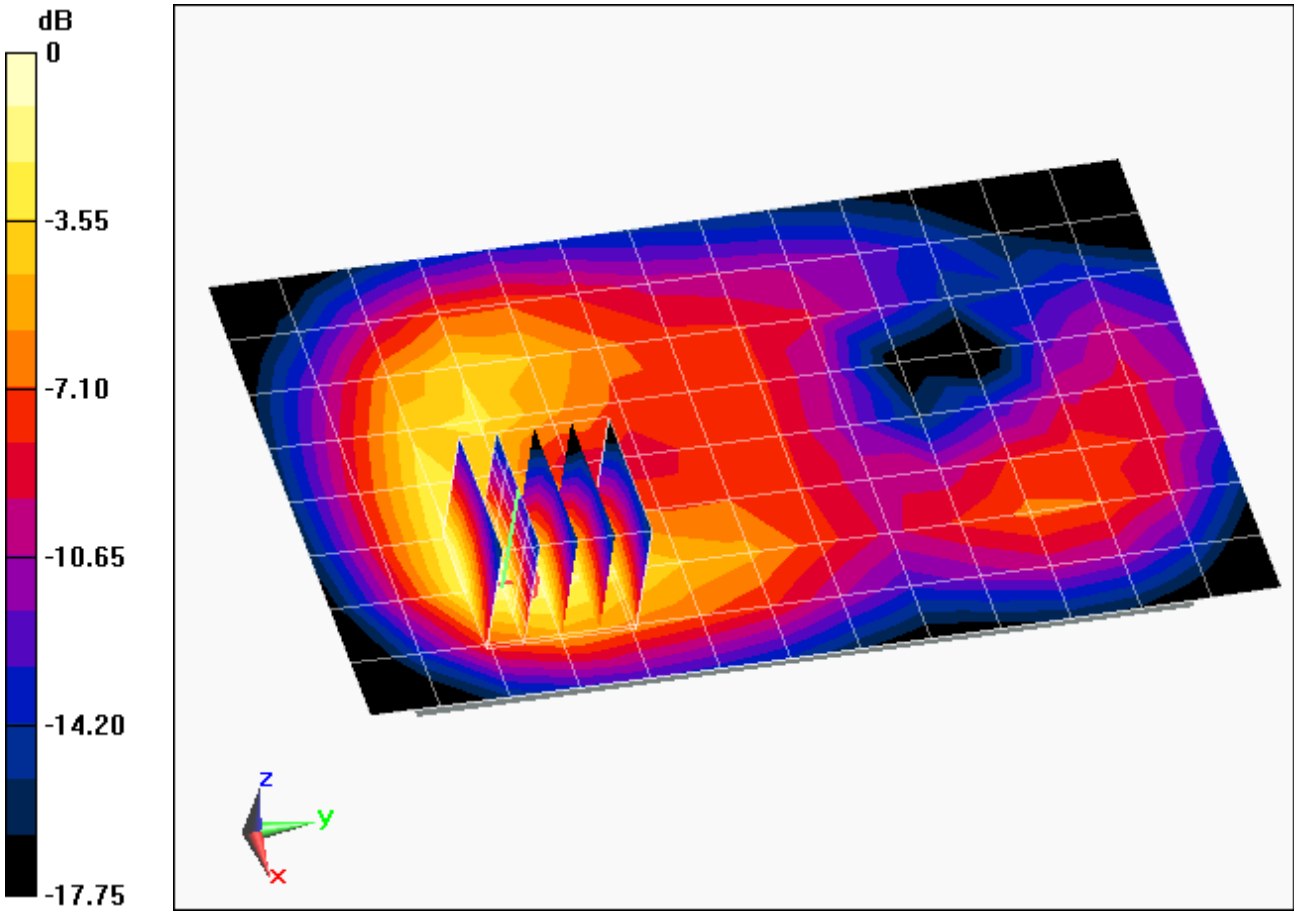
Communication System: UMTS; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.546 S/m; ε_r = 52.518; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 11-18-2013; Ambient Temp: 24.4°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3209; ConvF(4.77, 4.77, 4.77); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

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

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.076 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.72 W/kg
SAR(1 g) = 1.01 W/kg



0 dB = 1.15 W/kg = 0.61 dBW/kg

DUT: A3LSGHM819N; Type: Portable Handset; Serial: FK-344-A

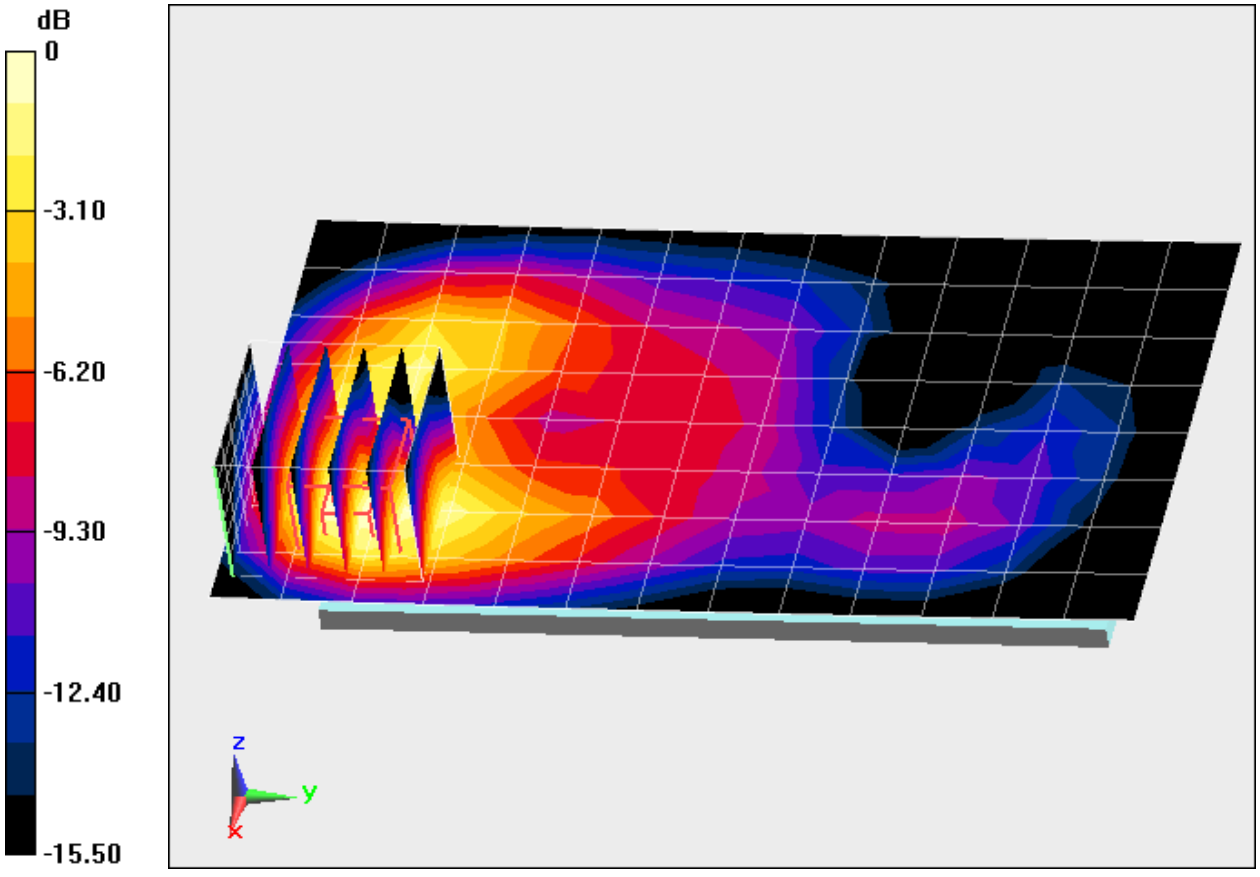
Communication System: LTE Band 2; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.546 S/m; ε_r = 52.518; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 11-18-2013; Ambient Temp: 24.4°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3209; ConvF(4.77, 4.77, 4.77); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

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

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.591 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.58 W/kg
SAR(1 g) = 0.916 W/kg



0 dB = 0.872 W/kg = -0.59 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

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

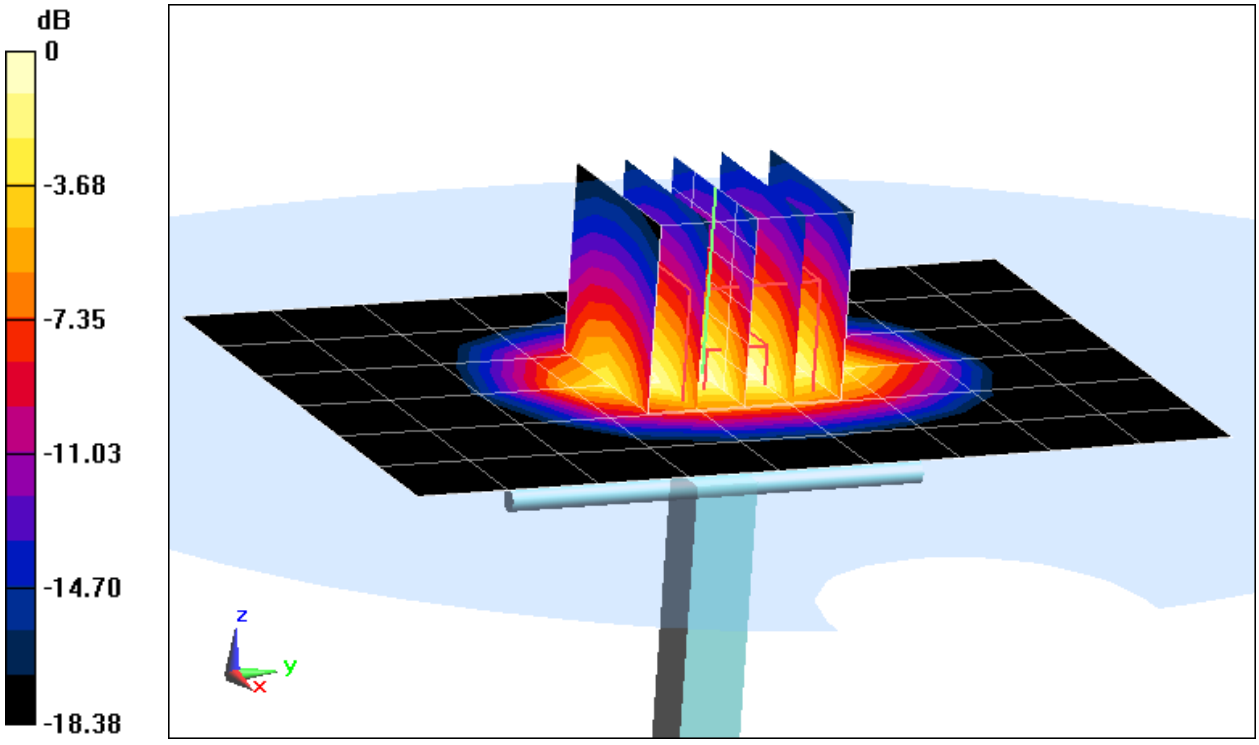
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.422 S/m; ε_r = 39.497; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 11-19-2013; Ambient Temp: 24.0°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3213; ConvF(5.08, 5.08, 5.08); Calibrated: 4/29/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 4/22/2013
Phantom: SAM Front; Type: QD000P40CD; Serial: 1717
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power: 16 dBm (40 mW)
Peak SAR (extrapolated) = 3.19 W/kg
SAR(1 g) = 1.71 W/kg;
Deviation: 7.68%



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

PCTEST ENGINEERING LABORATORY, INC.

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

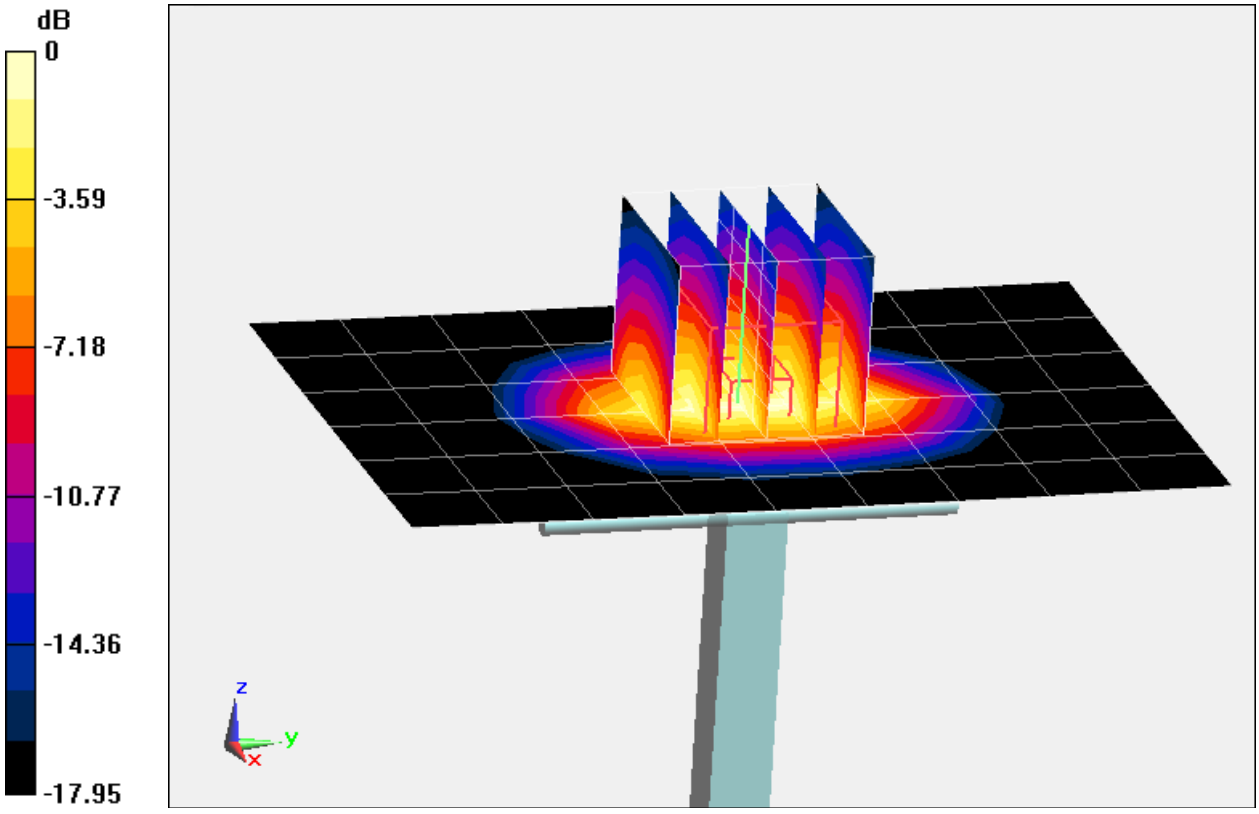
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.584 S/m; ε_r = 51.454; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 11-19-2013; Ambient Temp: 23.7°C; Tissue Temp: 23.6°C

Probe: ES3DV3 - SN3209; ConvF(4.77, 4.77, 4.77); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power: 20 dBm (100 mW)
Peak SAR (extrapolated) = 7.98 W/kg
SAR(1 g) = 4.35 W/kg
Deviation: 6.62%



0 dB = 4.86 W/kg = 6.87 dBW/kg

APPENDIX C: PROBE CALIBRATION

Calibration Laboratory of
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Accreditation No.: SCS 108

Client PC Test

Certificate No: D1900V2-5d148_Feb13

CALIBRATION CERTIFICATE

Object: D1900V2 - SN: 5d148

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

Calibration date: February 06, 2013

KOK 2/21/13

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	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13

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-12)	In house check: Oct-13

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

Issued: February 6, 2013

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) 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:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.4 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**39.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.8 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.9 ± 6 %	1.53 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**40.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.7 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.1 Ω + 5.9 jΩ
Return Loss	- 24.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.3 Ω + 6.3 jΩ
Return Loss	- 23.6 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: 06.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

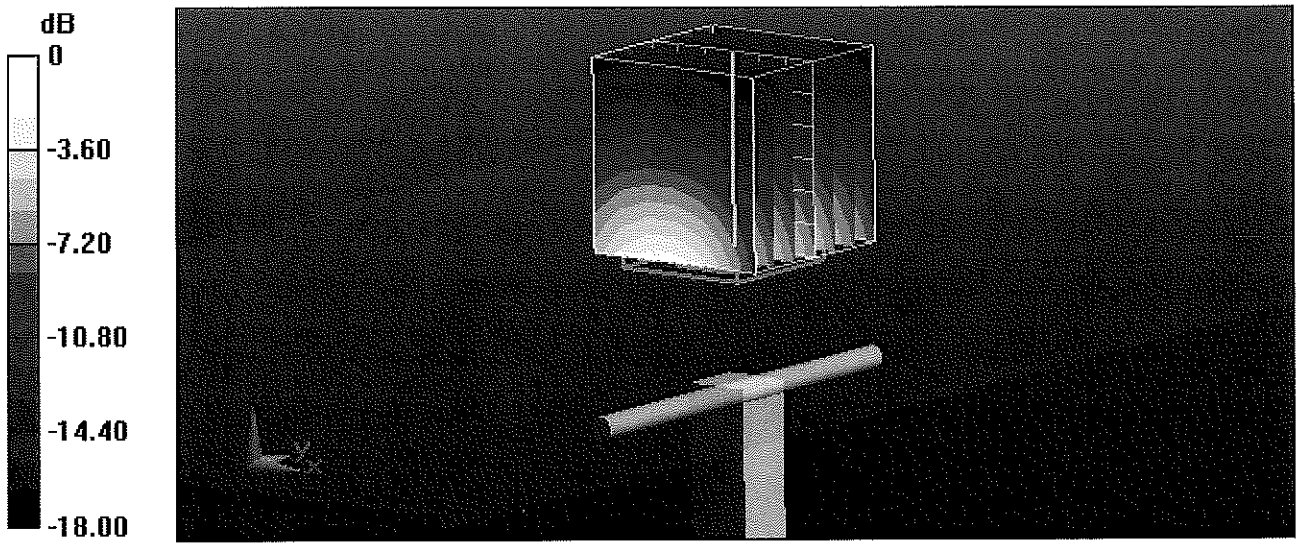
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 S/m; ε_r = 39.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

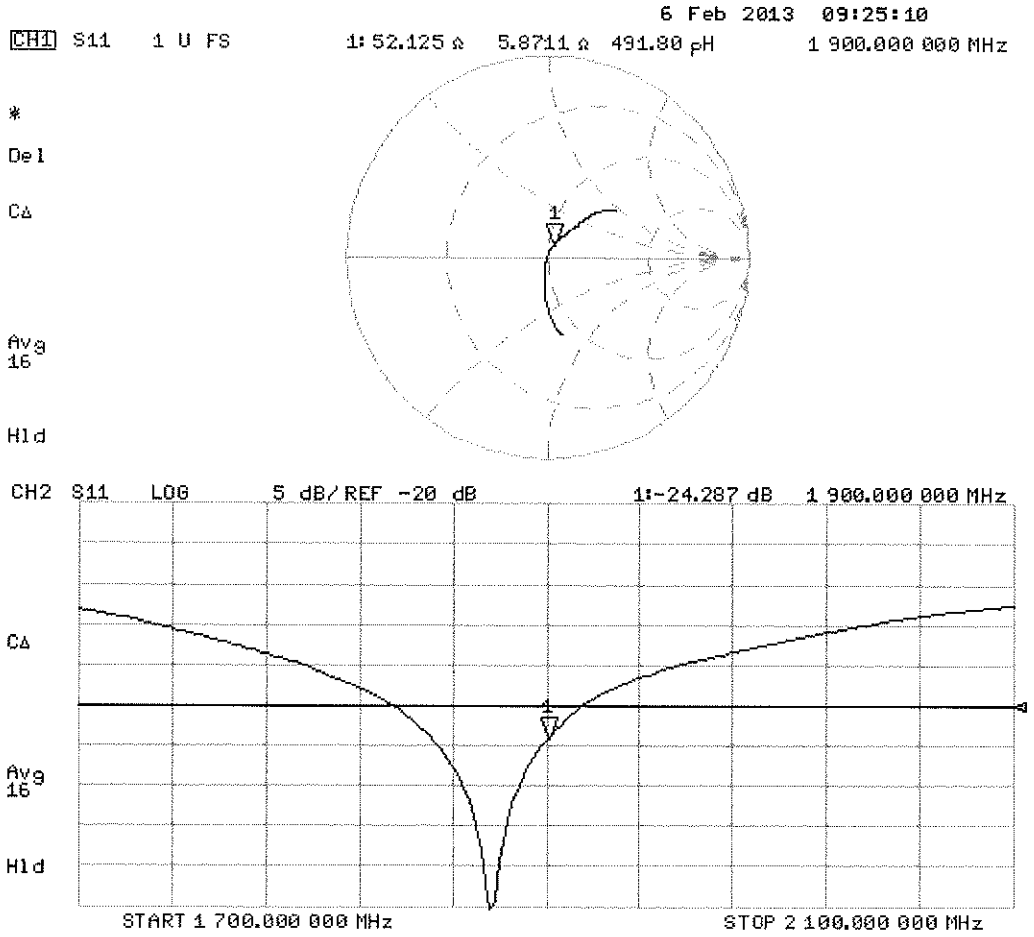
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.534 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 17.8 W/kg
SAR(1 g) = 9.87 W/kg; SAR(10 g) = 5.18 W/kg
Maximum value of SAR (measured) = 12.1 W/kg



0 dB = 12.1 W/kg = 10.83 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 06.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

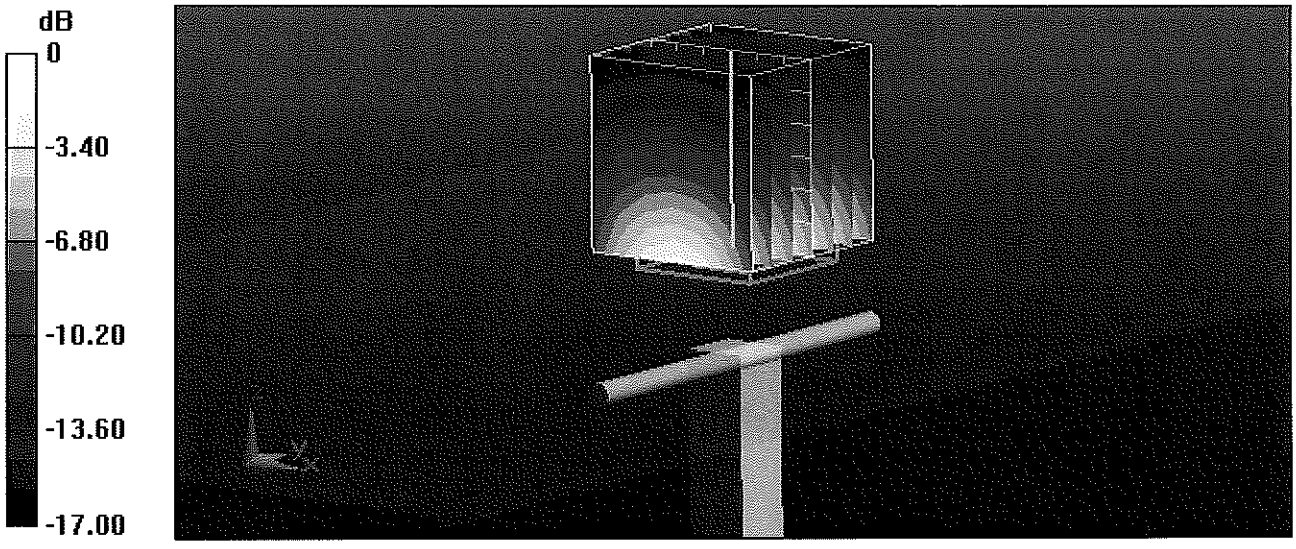
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.53 S/m; ε_r = 51.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

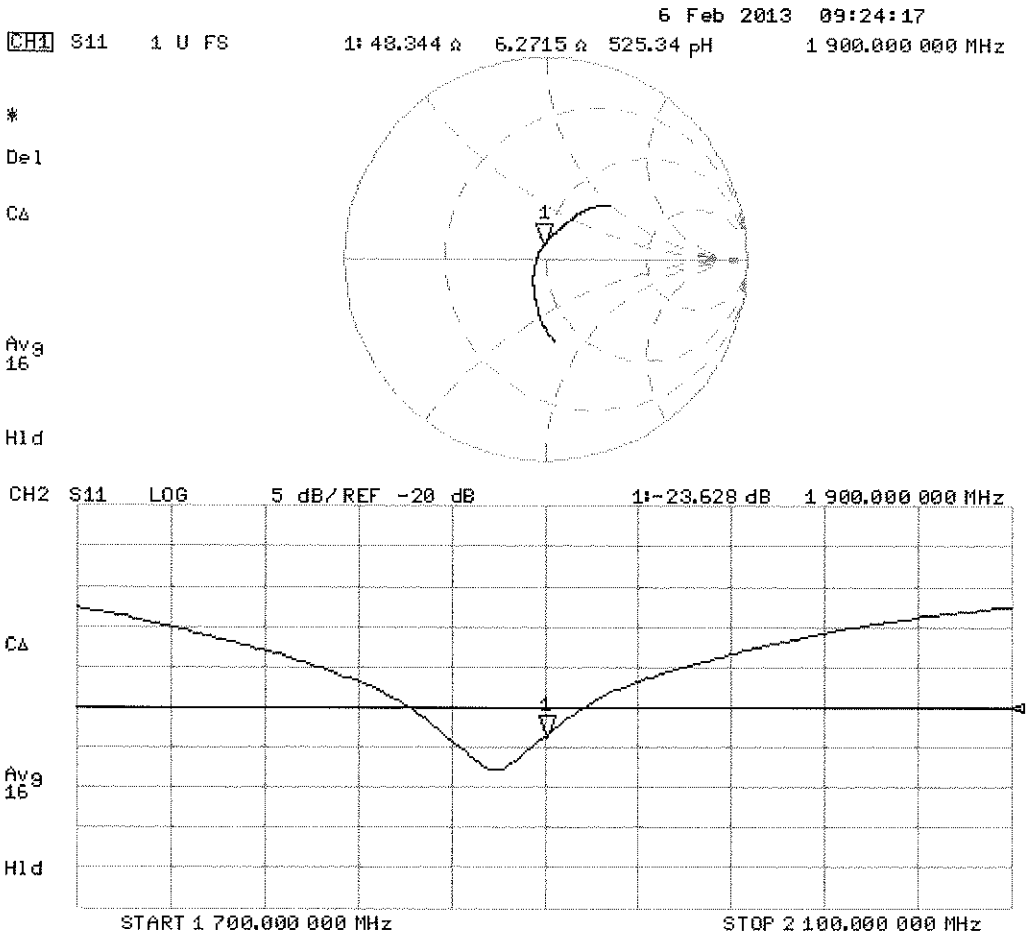
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.534 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 17.9 W/kg
SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.45 W/kg
Maximum value of SAR (measured) = 13.1 W/kg



0 dB = 13.1 W/kg = 11.17 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: ES3-3209_Mar13

CALIBRATION CERTIFICATE

Object ES3DV3 - SN:3209

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

Calibration date: March 15, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
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-12)	In house check: Oct-13

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

Issued: March 15, 2013

80244

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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

a) 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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3209

Manufactured: October 14, 2008
Calibrated: March 15, 2013

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.35	1.33	1.14	± 10.1 %
DCP (mV)[B]	99.2	97.8	98.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	163.6	±3.5 %
		Y	0.0	0.0	1.0		170.3	
		Z	0.0	0.0	1.0		158.7	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 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:3209

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.74	6.74	6.74	0.76	1.18	± 12.0 %
835	41.5	0.90	6.46	6.46	6.46	0.31	1.81	± 12.0 %
1750	40.1	1.37	5.39	5.39	5.39	0.80	1.21	± 12.0 %
1900	40.0	1.40	5.21	5.21	5.21	0.78	1.26	± 12.0 %
2450	39.2	1.80	4.57	4.57	4.57	0.65	1.43	± 12.0 %
2600	39.0	1.96	4.43	4.43	4.43	0.75	1.36	± 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:3209

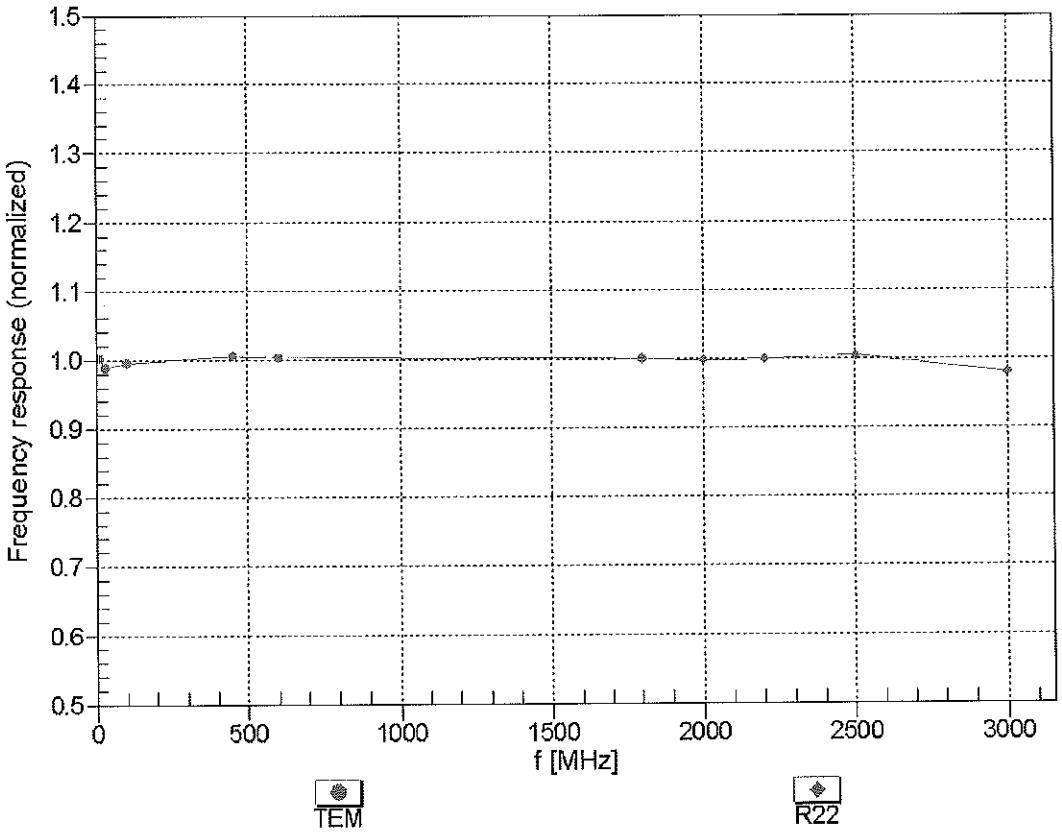
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.38	6.38	6.38	0.80	1.16	± 12.0 %
835	55.2	0.97	6.28	6.28	6.28	0.52	1.45	± 12.0 %
1750	53.4	1.49	5.03	5.03	5.03	0.58	1.45	± 12.0 %
1900	53.3	1.52	4.77	4.77	4.77	0.70	1.36	± 12.0 %
2450	52.7	1.95	4.34	4.34	4.34	0.80	1.15	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.80	1.00	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

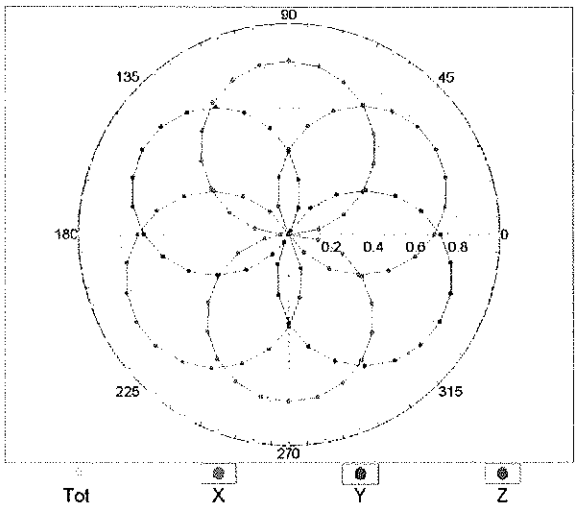
(TEM-Cell:ifi110 EXX, Waveguide: R22)



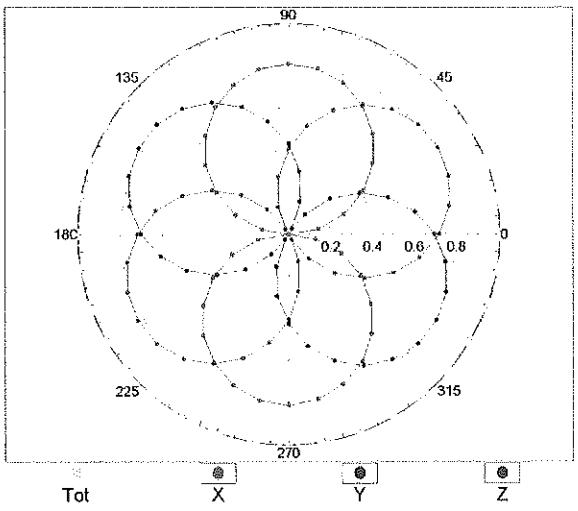
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

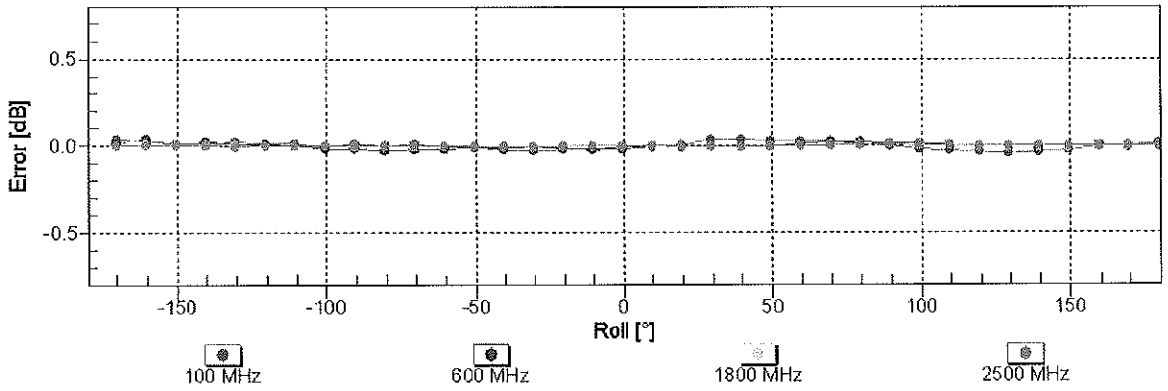
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



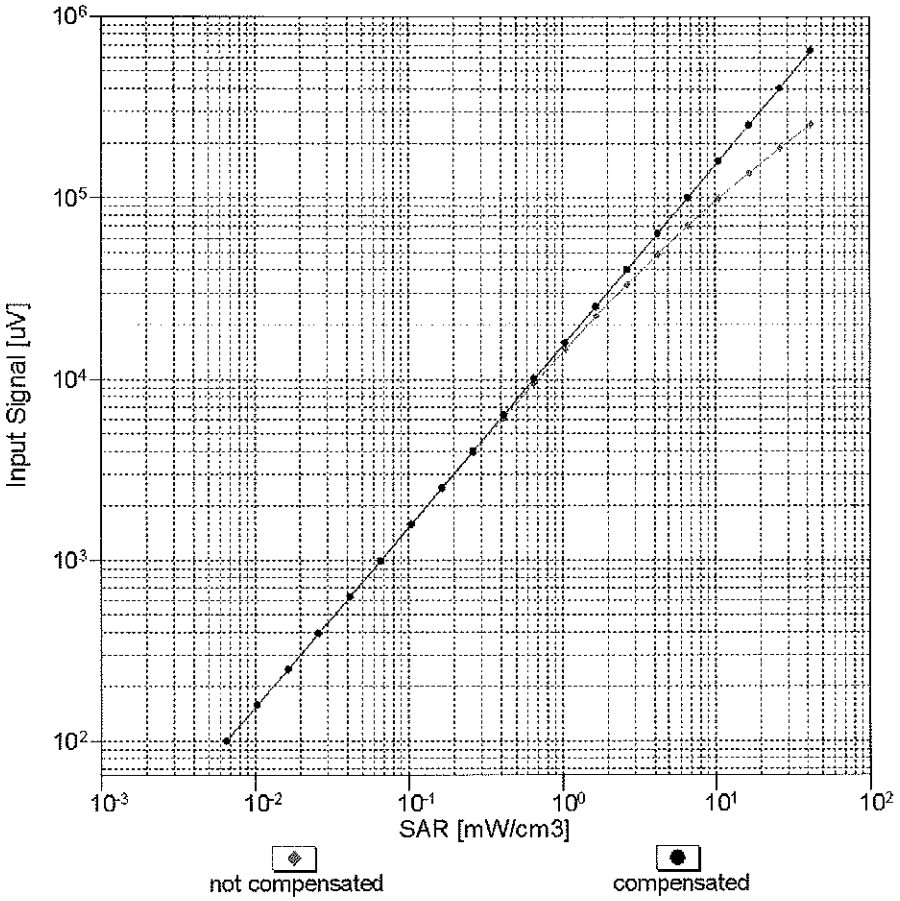
f=1800 MHz,R22

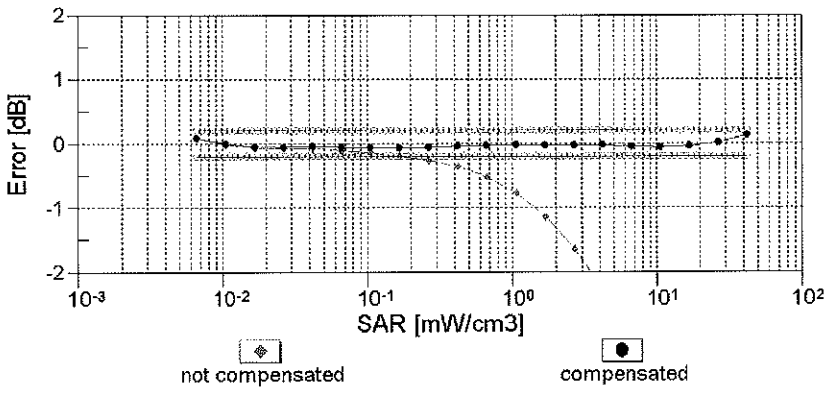




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

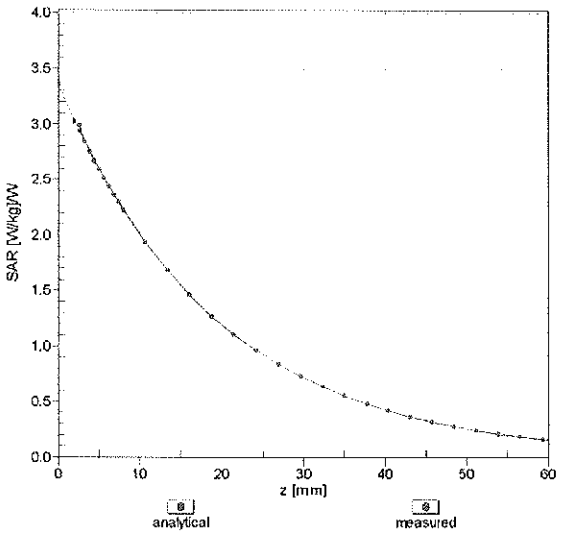




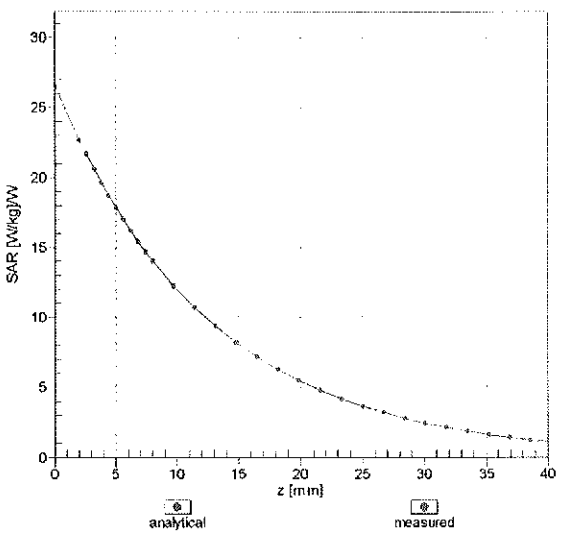
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

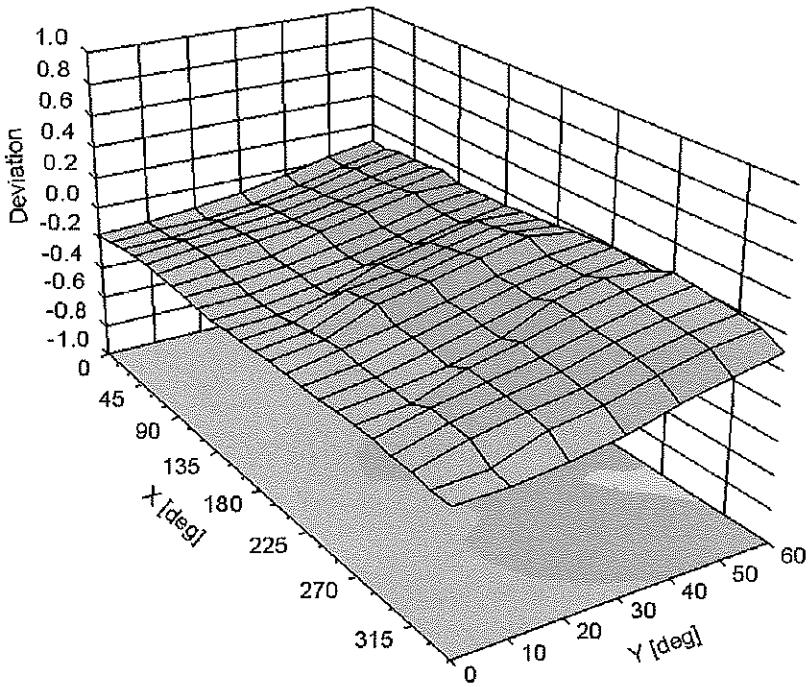


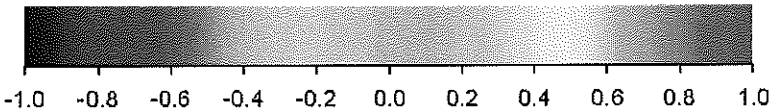
f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-40.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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

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

Accreditation No.: SCS 108

Client PC Test

Certificate No: ES3-3213_Apr13

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3213

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

Calibration date: April 29, 2013

Kak 5/6/13

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 29, 2013

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

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

Accredited by the Swiss Accreditation Service (SAS) **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
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

a) 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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3213

Manufactured: October 14, 2008
Calibrated: April 29, 2013

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.47	1.36	1.33	± 10.1 %
DCP (mV)[B]	103.0	100.8	100.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	171.2	±2.7 %
		Y	0.0	0.0	1.0		172.4	
		Z	0.0	0.0	1.0		169.5	

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:3213

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.54	6.54	6.54	0.45	1.49	± 12.0 %
835	41.5	0.90	6.30	6.30	6.30	0.31	1.77	± 12.0 %
1450	40.5	1.20	5.41	5.41	5.41	0.26	2.35	± 12.0 %
1750	40.1	1.37	5.22	5.22	5.22	0.79	1.18	± 12.0 %
1900	40.0	1.40	5.08	5.08	5.08	0.80	1.20	± 12.0 %
2450	39.2	1.80	4.49	4.49	4.49	0.79	1.28	± 12.0 %
2600	39.0	1.96	4.36	4.36	4.36	0.79	1.24	± 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.

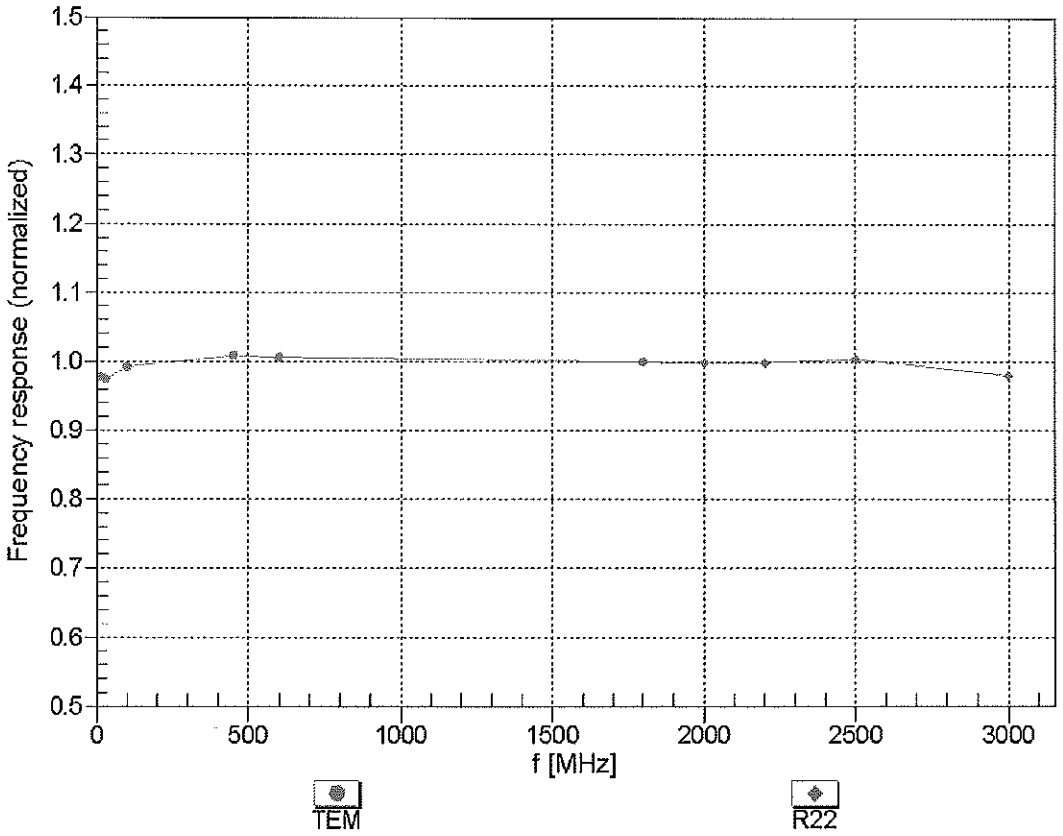
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3213

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.32	6.32	6.32	0.44	1.54	± 12.0 %
835	55.2	0.97	6.25	6.25	6.25	0.37	1.77	± 12.0 %
1450	54.0	1.30	5.28	5.28	5.28	0.57	1.42	± 12.0 %
1750	53.4	1.49	4.95	4.95	4.95	0.66	1.34	± 12.0 %
1900	53.3	1.52	4.73	4.73	4.73	0.55	1.51	± 12.0 %
2450	52.7	1.95	4.29	4.29	4.29	0.65	1.18	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.60	0.87	± 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.

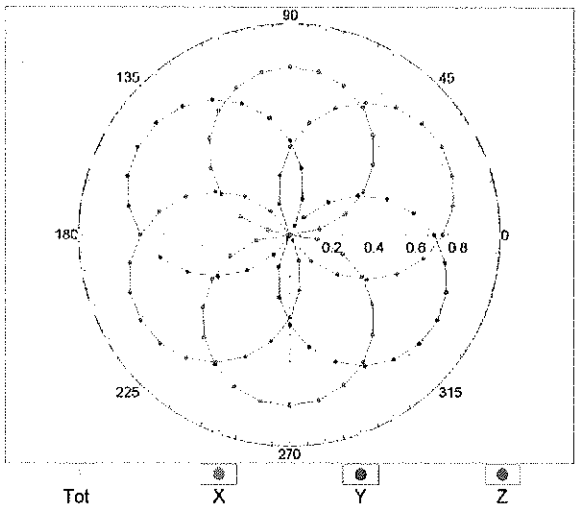
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



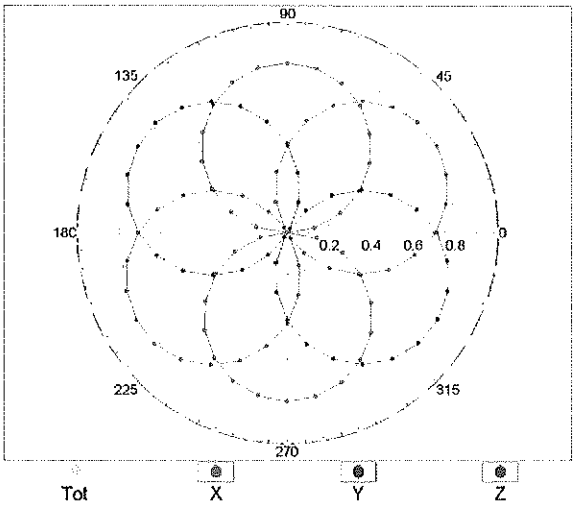
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

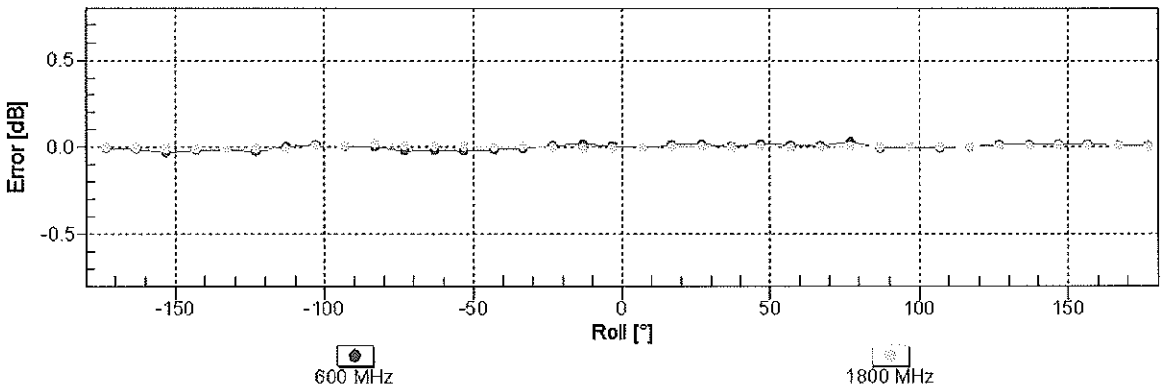
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



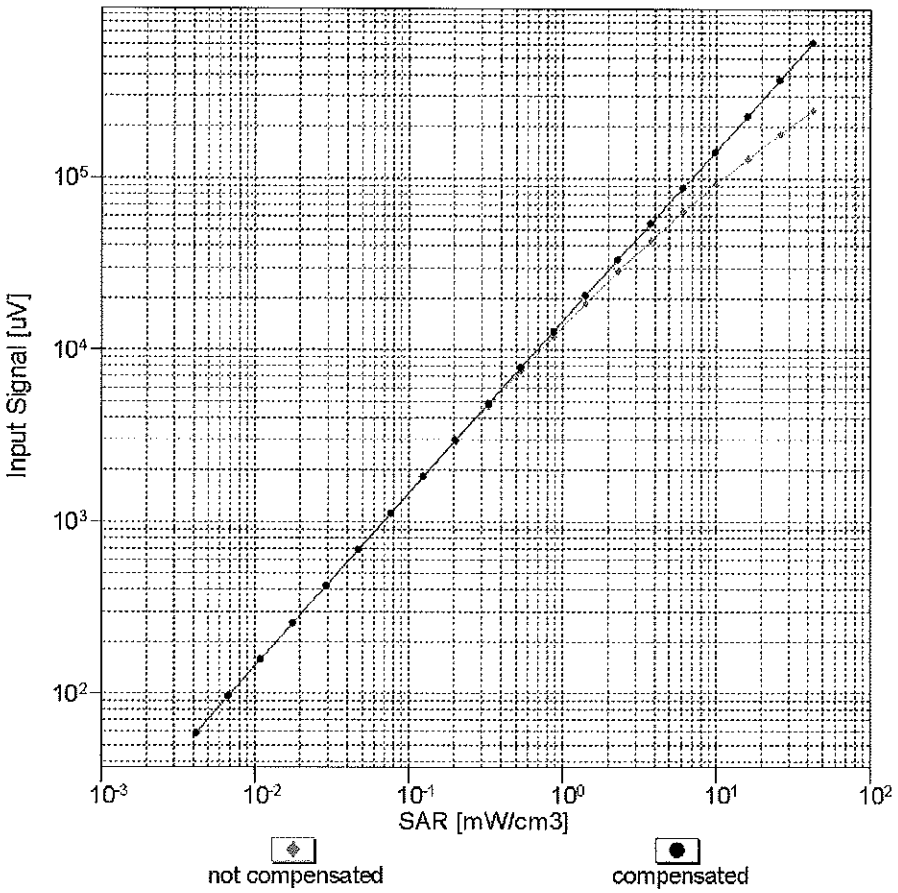
f=1800 MHz,R22

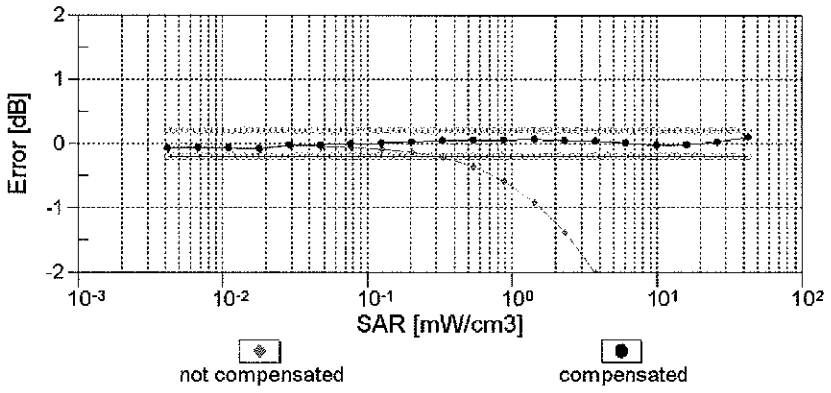




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

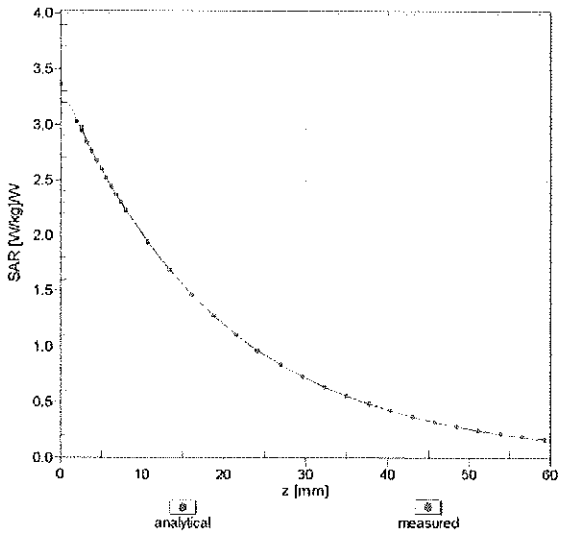




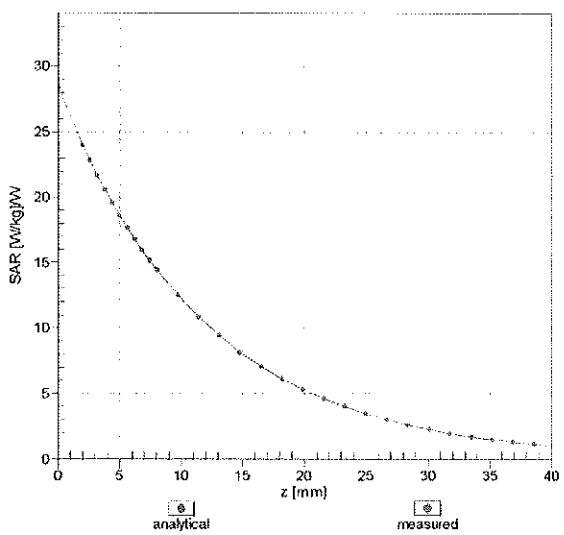
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

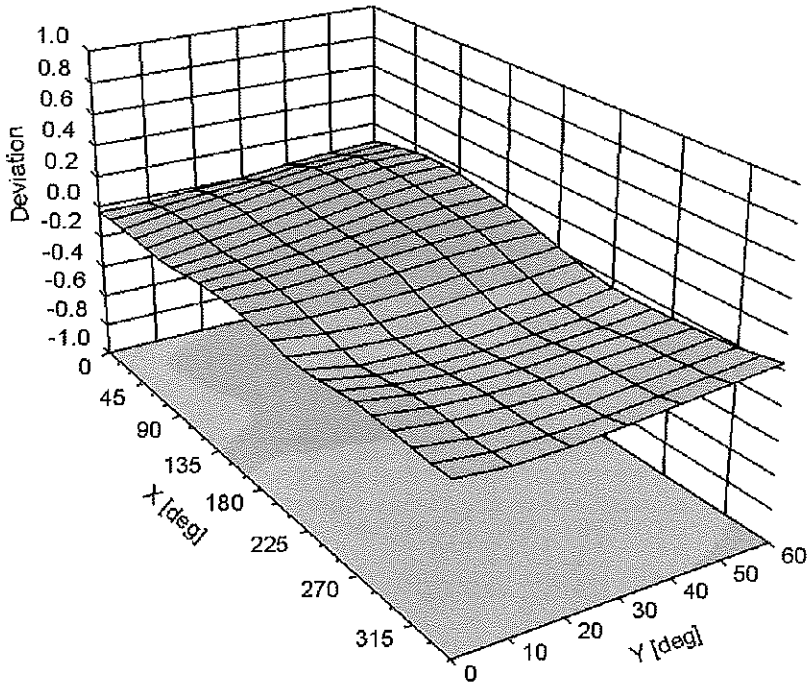


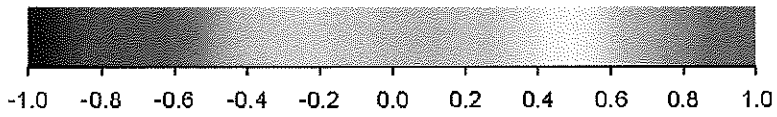
f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-33.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

APPENDIX D: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue verification:

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the tissue. The tissue was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
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):

$$Y = \frac{j2\omega\varepsilon_r\varepsilon_0}{\left[\ln(b/a)\right]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi' \frac{\exp\left[-j\omega r(\mu_0\varepsilon_r'\varepsilon_0)^{1/2}\right]}{r} d\phi' d\rho' d\rho$$

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

Table D-I
Composition of the Tissue Equivalent Matter

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

APPENDIX E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in IEEE 1528-2003 and FCC KDB 865664 D01 v01. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table E-I
SAR System Validation Summary

SAR SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
							(σ)	(ε_r)	SENSI-TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
F	1900	5/9/2013	3213	ES3DV3	1900	Head	1.464	39.97	PASS	PASS	PASS	GMSK	PASS	N/A
G	1900	3/26/2013	3209	ES3DV3	1900	Body	1.556	52.37	PASS	PASS	PASS	GMSK	PASS	N/A

NOTE: All measurements were performed using probes calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.