PCTEST ENGINEERING LABORATORY, INC.
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. +1.410.290.6652 / Fax +1.410.290.6654
http://www.pctestlab.com

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:
01/27/14 - 02/03/14
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1401240176-R1.A3L

FCC ID: **A3LSMT535**

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

DUT Type: Portable Tablet
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): SM-T535

Equipment Class	Band & Mode	Tx Frequency	Measured Conducted Power [dBm]	SAR 1 gm Body (W/kg)
PCB	GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	29.50	1.10
PCB	UMTS 850	826.40 - 846.60 MHz	22.85	0.74
PCB	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	26.00	0.97
PCB	UMTS 1900	1852.4 - 1907.6 MHz	23.00	1.10
PCB	LTE Band 5 (Cell)	824.7 - 848.3 MHz	22.53	0.77
DTS	2.4 GHz WLAN	2412 - 2462 MHz	11.30	0.98
DTS	5.8 GHz WLAN	5745 - 5825 MHz	10.29	1.05
DTS	Bluetooth LE	2402 - 2480 MHz	1.68	N/A
NII	5.2 GHz WLAN	5180 - 5240 MHz	10.44	0.80
NII	5.3 GHz WLAN	5260 - 5320 MHz	10.37	0.88
NII	5.5 GHz WLAN	5500 - 5700 MHz	10.25	1.10
DSS	Bluetooth	2402 - 2480 MHz	9.04	0.22
Simultaneous SAR per KDB 690783 D01v01r02:				1.50

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.

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

Note: This revised Test Report (S/N: 0Y1401240176-R1.A3L) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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

Randy Ortanez
President

ACCREDITED
TESTING 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
UMTS 850	Voice/Data	826.40 - 846.60 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
LTE Band 5 (Cell)	Data	824.7 - 848.3 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
ANT+	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

This device uses a proximity sensor for SAR compliance. The capacitive proximity sensor is activated when used in close proximity to the user's body. The capacitive proximity sensor triggers power reduction for data and voice modes and is only applicable for tablet operations.

Since the device is a full size tablet, the Body SAR was evaluated per FCC KDB Publication 616217 D04 for full sized tablets.

1.3 Nominal and Maximum Output Power Specifications

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

Maximum Power:

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slot	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*
GSM/GPRS/EDGE 850	Maximum	**33.0**	**33.0**	**31.0**	**29.5**	**28.0**	**27.5**	**26.5**	**25.5**	**24.5**
	Nominal	**32.5**	**32.5**	**30.5**	**29.0**	**27.5**	**27.0**	**26.0**	**25.0**	**24.0**
GSM/GPRS/EDGE 1900	Maximum	**30.0**	**30.0**	**29.0**	**27.0**	**26.0**	**26.5**	**25.5**	**24.5**	**23.5**
	Nominal	**29.5**	**29.5**	**28.5**	**26.5**	**25.5**	**26.0**	**25.0**	**24.0**	**23.0**

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Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA Rel 99	*3GPP HSDPA Rel 5*	*3GPP HSUPA Rel 6*	*3GPP DC-HSDPA Rel 8*
UMTS Band 5 (850 MHz)	Maximum	**23.0**	**23.0**	**23.0**	**23.0**
	Nominal	**22.5**	**22.5**	**22.5**	**22.5**
UMTS Band 2 (1900 MHz)	Maximum	**23.0**	**23.0**	**23.0**	**23.0**
	Nominal	**22.5**	**22.5**	**22.5**	**22.5**

Mode / Band		Modulated Average (dBm)
LTE Band 5 (Cell)	Maximum	**23.0**
	Nominal	**22.5**

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	**11.5**
	Nominal	**11.0**
IEEE 802.11g (2.4 GHz)	Maximum	**10.5**
	Nominal	**10.0**
IEEE 802.11n (2.4 GHz)	Maximum	**9.5**
	Nominal	**9.0**
IEEE 802.11a (5 GHz)	Maximum	**10.5**
	Nominal	**10.0**
IEEE 802.11n (5 GHz)	Maximum	**10.5**
	Nominal	**10.0**
Bluetooth	Maximum	**9.5**
	Nominal	**9.0**
Bluetooth LE	Maximum	**2.0**
	Nominal	**1.5**

Reduced Power – Body at 0mm:

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 850	Maximum	**28.0**	**28.0**	**26.0**	**24.5**	**23.0**	**23.0**	**22.5**	**21.5**	**20.5**
	Nominal	**27.5**	**27.5**	**25.5**	**24.0**	**22.5**	**22.5**	**22.0**	**21.0**	**20.0**
GSM 1900	Maximum	**20.0**	**20.0**	**19.0**	**17.0**	**16.0**	**17.0**	**16.0**	**14.5**	**13.5**
	Nominal	**19.5**	**19.5**	**18.5**	**16.5**	**15.5**	**16.5**	**15.5**	**14.0**	**13.0**

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA Rel 99	*3GPP HSDPA Rel 5*	*3GPP HSUPA Rel 6*	*3GPP DC-HSDPA Rel 8*
UMTS Band 5 (850 MHz)	Maximum	**18.0**	**18.0**	**17.5**	**17.5**
	Nominal	**17.5**	**17.5**	**17.0**	**17.0**
UMTS Band 2 (1900 MHz)	Maximum	**14.5**	**14.0**	**13.5**	**13.5**
	Nominal	**14.0**	**13.5**	**13.0**	**13.0**

Mode / Band		Modulated Average (dBm)
LTE Band 5 (Cell)	Maximum	**18.0**
	Nominal	**17.5**

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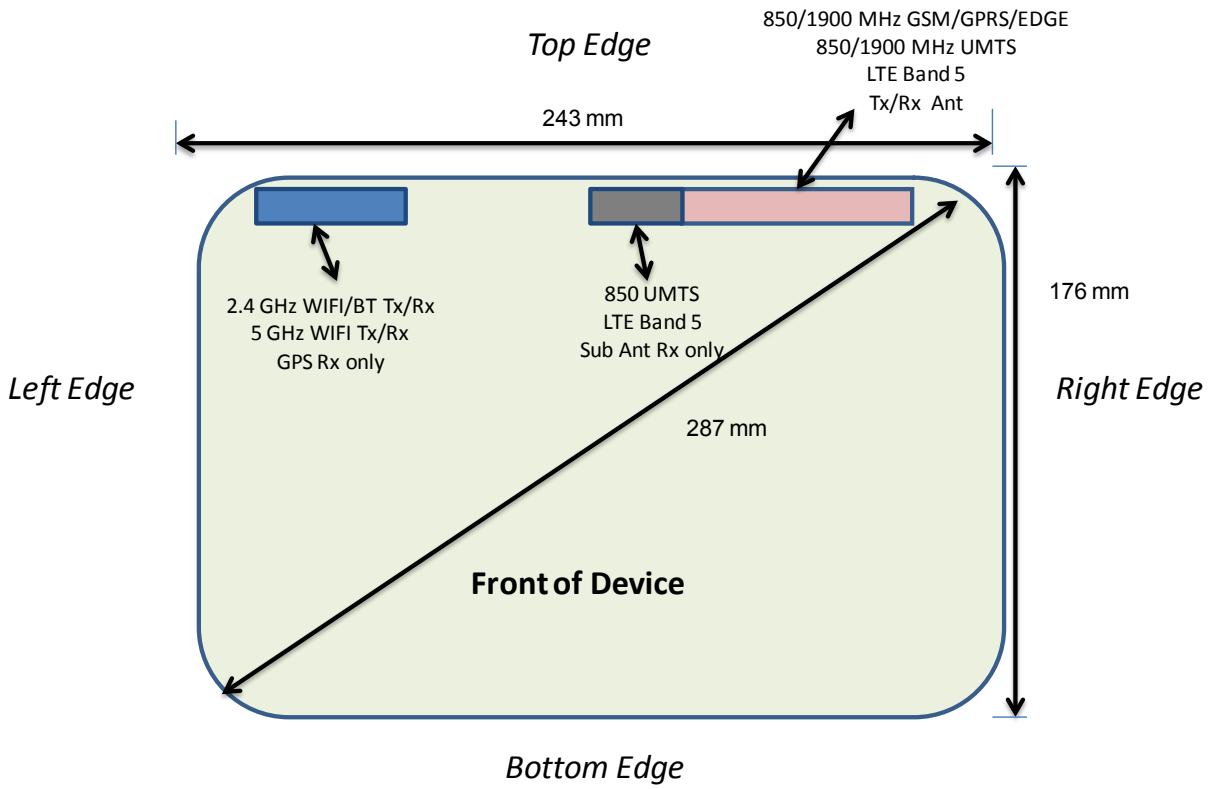
1.4 DUT Antenna Locations



Note: Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC Filing.

Figure 1-1
DUT Antenna Locations

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1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D05v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-2 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.

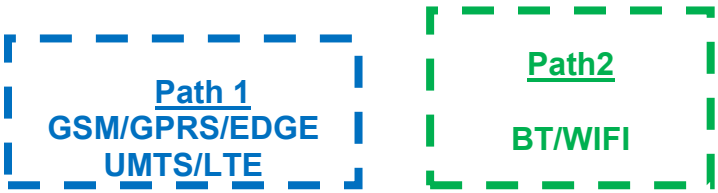

Figure 1-2
Simultaneous Transmission Paths

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

Table 1-1
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Body	Notes
1	UMTS + 2.4 GHz WI-FI	Yes	
2	UMTS + 5 GHz WI-FI	Yes	5 GHz Client only
3	UMTS + 2.4 GHz Bluetooth	Yes	
4	LTE + 2.4 GHz WI-FI	Yes	
5	LTE + 5 GHz WI-FI	Yes	5 GHz Client only
6	LTE + 2.4 GHz Bluetooth	Yes	
7	GSM/GPRS/EDGE + 2.4 GHz WI-FI	Yes	
8	GSM/GPRS/EDGE + 5 GHz WI-FI	Yes	5 GHz Client only
9	GSM/GPRS/EDGE + 2.4 GHz Bluetooth	Yes	

Notes:
1. 2.4 GHz WLAN, 2.4 GHz Bluetooth, and 5 GHz WLAN share the same antenna path and cannot transmit simultaneously
2. GSM/GPRS/EDGE, LTE and UMTS share the same antenna path and cannot transmit simultaneously.
3. Per FCC KDB 616217 D04 4.3, when voice mode is limited to speaker mode or headset operations only, additional SAR testing for tablet voice use is not required. Therefore, voice standalone and simultaneous combinations are not evaluated for body configurations. Corresponding data modes are used for summation with Bluetooth when applicable.

1.6 SAR Test Exclusions Applied

(A) WIFI/BT

Per FCC KDB 447498 D01v05, the SAR exclusion threshold for distances <50mm is defined by the following equation:

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

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth SAR was not required; [(9/5)* √2.441] = 2.8< 3.0. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation. Bluetooth SAR is included in this report per the manufacturer's request.

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Based on the maximum conducted power of Bluetooth LE (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth LE SAR was not required; [(2/5)* √2.440] = 0.6< 3.0. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

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

(B) Licensed Transmitter(s)

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

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

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.

1.7 Guidance Applied

- FCC KDB Publication 941225 D01v02r02, D02v02r02, D03v01, D05v02r03 (2G/3G/4G)
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05 (General SAR Guidance)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 616217 D04 (Tablet SAR Considerations)
- FCC KDB Publication 648474 D04v01

1.8 Device Serial Numbers

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

	Reduced Power Body Serial Number	Maximum Power Body Serial Number
GSM/GPRS/EDGE 850	2014-7	2014-3
UMTS 850	2014-7	2014-3
GSM/GPRS/EDGE 1900	2014-4	2014-2
UMTS 1900	2014-4	2014-3
LTE Band 5 (Cell)	2014-4	2014-4
Bluetooth	-	2014-5
2.4 GHz WLAN	-	2014-5
5 GHz WLAN	-	2014-3

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2 LTE INFORMATION

LTE Information			
FCC ID	**A3LSMT535**		
Form Factor	Portable Tablet		
Frequency Range of each LTE transmission band	LTE Band 5 (Cell) (824.7 - 848.3 MHz)		
Channel Bandwidths	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)	836.5 (20525)	848.3 (20643)
LTE Band 5 (Cell): 3 MHz	825.5 (20415)	836.5 (20525)	847.5 (20635)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
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		

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3 INTRODUCTION

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

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

3.1 SAR Definition

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

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

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

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

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4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01 and IEEE 1528-2013:

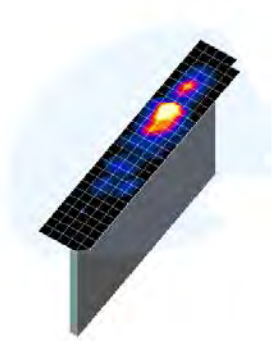

Figure 4-1
Sample SAR Area Scan

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) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table 4-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

   a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

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

*Also compliant to IEEE 1528-2013 Table 6

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5 SAR TESTING PROCEDURES

5.1 SAR Testing for Tablet per KDB Publication 616217 D04v01

This device can be used also in full sized tablet exposure conditions, due to its size. Per FCC KDB 616217, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR Exclusion Threshold in KDB 447498 D01v05 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

5.2 Additional Test Positions due to Proximity Sensor Considerations

This device uses a proximity sensor to reduce voice and data powers in tablet-device use conditions.

While the device's antenna is within a certain distance of the user, the capacitive proximity sensor activates and reduces the maximum output power allowed. However, the sensor is not active when the device is moved beyond the sensor triggering distance and the maximum output power is no longer limited. Therefore, an additional exposure condition is needed in the vicinity of the triggering distance to ensure SAR is compliant when the device is allowed to operate at a non-reduced output power level.

FCC KDB 616217 D04 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional exposure conditions. Since the capacitive proximity sensor activation distance for the back side of the device is 16 mm, a conservative distance of 15 mm was tested for SAR on the back side at maximum power. Since the capacitive proximity sensor activation distance for the top edge of the device is 17 mm, a conservative distance of 16 mm was tested for SAR on the top edge at maximum power. Sensor triggering distance summary data is included in Appendix G. The capacitive proximity sensor does not trigger power reduction from the front of the device.

The sensor is designed to support sufficient detection range and sensitivity to cover regions of the sensors in all applicable directions since the sensor entirely covers the antenna.

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6 RF EXPOSURE LIMITS

6.1 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.

6.2 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 6-1
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.

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7 FCC MEASUREMENT PROCEDURES

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

7.1 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.

7.2 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.

7.3 SAR Measurement Conditions for UMTS

7.3.1 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.

7.3.2 Body SAR Measurements

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

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7.3.3 Procedures Used to Establish RF Signal for SAR HSDPA Data Devices

The following procedures are applicable to HSDPA data devices operating under 3GPP Release 5. Body exposure conditions are typically applicable to these devices, including handsets and data modems operating in various electronic devices. HSDPA operates in conjunction with UMTS and requires an active DPCCH. The default test configuration is to measure SAR in UMTS without HSDPA, with an established radio link between the DUT and a communication test set with 12.2 kbps RMC mode configured in Test Loop Mode 1; and tested with HSDPA with FRC and a 12.2 kbps RMC using the highest SAR configuration in UMTS. SAR is selectively confirmed for other physical channel configurations according to output power, exposure conditions and device operating capabilities. Maximum output power is verified according to 3GPP TS 23.121 (Release 5) and SAR must be measured according to these maximum output conditions.

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 $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. 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 7-1
Table C.10.1.4 of TS 234.121-1

7.3.4 SAR Measurement Conditions for HSUPA Data Devices

SAR for body exposure configurations are measured according to the 'Body SAR Measurements' procedures in the 'WCDMA Handsets' section of the KDB 941225 D01 FCC 3G document. In addition, Body SAR is also measured for HSPA when the maximum average output of each RF channel with HSPA active is at least ¼ dB higher of that measured without HSPA in 12.2 kbps RMC mode or the maximum SAR for 12.2 kbps RMC is above 75% of the SAR limit. Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 with power control algorithm 2, according to the highest body SAR configuration in 12.2 kbps RMC without HSPA. When VOIP is applicable for head exposure, SAR is not required when the maximum output of each RF channel with HSPA is less than ¼ dB higher than that measured using 12.2 kbps RMC; otherwise, the same HSPA configuration used for body measurements should be used to test for head exposure.

Due to inner loop power control requirements in HSPA, a commercial communication test set should be used for the output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and EDCH configurations for HSPA should be configured according to the β values indicated below as well as other applicable procedures described in the 'WCDMA Handset' and 'Release 5 HSDPA Data Devices' sections of the FCC 3G document.

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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.

7.3.5 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.

7.4 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. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

7.4.1 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.

7.4.2 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.

7.4.3 A-MPR

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

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7.4.4 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.

7.5 SAR Testing with 802.11 Transmitters

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

7.5.1 General Device Setup

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

7.5.2 Frequency Channel Configurations [24]

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

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

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

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8 RF CONDUCTED POWERS

8.1 GSM Conducted Powers

Table 8-1
Maximum GSM/GPRS/EDGE Average RF 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 850	128	32.81	32.64	30.52	**29.42**	27.57	26.27	26.04	25.34	24.23
	190	32.77	32.82	30.83	**29.50**	27.69	26.38	26.23	25.48	24.26
	251	32.74	32.63	30.64	**29.48**	27.72	26.47	26.29	25.50	24.38
GSM 1900	512	29.60	29.58	28.71	26.52	**25.95**	24.72	24.56	23.92	22.83
	661	29.62	29.72	28.85	26.61	**25.99**	24.74	24.61	23.94	22.91
	810	30.00	29.99	29.00	26.85	**26.00**	24.91	24.78	24.12	23.11

		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 850	128	23.78	23.61	24.50	**25.16**	24.56	17.24	20.02	21.08	21.22
	190	23.74	23.79	24.81	**25.24**	24.68	17.35	20.21	21.22	21.25
	251	23.71	23.60	24.62	**25.22**	24.71	17.44	20.27	21.24	21.37
GSM 1900	512	20.57	20.55	22.69	22.26	**22.94**	15.69	18.54	19.66	19.82
	661	20.59	20.69	22.83	22.35	**22.98**	15.71	18.59	19.68	19.90
	810	20.97	20.96	22.98	22.59	**22.99**	15.88	18.76	19.86	20.10
GSM 850	**Frame Avg.Targets:**	23.47	23.47	24.48	**24.74**	24.49	17.97	19.98	20.74	20.99
GSM 1900		20.47	20.47	22.48	22.24	**22.49**	16.97	18.98	19.74	19.99

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Table 8-2
Reduced GSM/GPRS/EDGE Average RF Conducted Powers
Representing Body at 0 mm

		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 850	128	27.80	27.71	25.57	**23.99**	22.42	22.57	22.06	20.94	19.90
	190	27.82	27.64	25.38	**23.84**	22.16	22.44	21.93	20.91	19.90
	251	27.83	27.81	25.80	**24.02**	22.44	22.87	22.34	21.28	20.11
GSM 1900	512	19.75	19.69	18.65	16.51	**15.67**	16.79	15.76	14.47	13.05
	661	19.99	19.79	18.61	16.59	**15.66**	16.81	15.87	14.34	13.04
	810	20.00	19.98	18.85	16.73	**15.74**	16.90	15.87	14.50	13.01

		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 850	128	18.77	18.68	19.55	**19.73**	19.41	13.54	16.04	16.68	16.89
	190	18.79	18.61	19.36	**19.58**	19.15	13.41	15.91	16.65	16.89
	251	18.80	18.78	19.78	**19.76**	19.43	13.84	16.32	17.02	17.10
GSM 1900	512	10.72	10.66	12.63	12.25	**12.66**	7.76	9.74	10.21	10.04
	661	10.96	10.76	12.59	12.33	**12.65**	7.78	9.85	10.08	10.03
	810	10.97	10.95	12.83	12.47	**12.73**	7.87	9.85	10.24	10.00
GSM 850	**Frame Avg.Targets:**	18.47	18.47	19.48	**19.74**	19.49	13.47	15.98	16.74	16.99
GSM 1900		10.47	10.47	12.48	12.24	**12.49**	7.47	9.48	9.74	9.99

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. 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 body 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.

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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: 33 (Max 4 Tx uplink slots)
EDGE Multislot class: 33 (Max 4 Tx uplink slots)
DTM Multislot Class: N/A

Figure 8-1
Power Measurement Setup

8.2 UMTS Conducted Powers

Table 8-3
Maximum UMTS Average RF Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	22.68	22.85	22.87	23.00	22.89	22.93	-
99		12.2 kbps AMR	22.71	22.84	22.84	22.88	22.83	22.92	-
6	HSDPA	Subtest 1	21.69	21.90	21.81	21.92	21.88	21.88	0
6		Subtest 2	21.63	21.89	21.83	21.82	21.83	21.94	0
6		Subtest 3	21.13	21.29	21.25	21.38	21.37	21.41	0.5
6		Subtest 4	21.18	21.33	21.27	21.34	21.32	21.37	0.5
6	HSUPA	Subtest 1	21.02	21.70	21.55	21.00	21.01	21.52	0
6		Subtest 2	20.58	20.22	20.20	20.82	20.44	20.99	2
6		Subtest 3	20.40	20.35	20.84	20.37	20.67	20.15	1
6		Subtest 4	20.51	20.79	20.57	21.33	21.30	20.77	2
6		Subtest 5	21.63	21.67	21.62	21.02	21.38	21.39	0
8	DC-HSDPA	Subtest 1	21.76	21.74	21.69	21.37	21.42	21.46	0
8		Subtest 2	21.62	21.81	21.76	21.46	21.45	21.55	0
8		Subtest 3	21.25	21.29	21.21	20.94	20.89	20.92	0.5
8		Subtest 4	21.19	21.30	21.24	20.95	20.94	20.99	0.5

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Table 8-4
Reduced UMTS Average RF Conducted Powers
Representing Body at 0 mm

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	17.69	17.85	17.84	14.30	14.07	14.30	-
99		12.2 kbps AMR	17.66	17.79	17.83	14.50	14.28	14.49	-
6	HSDPA	Subtest 1	16.70	16.75	16.81	13.56	13.37	13.55	0
6		Subtest 2	16.78	16.86	16.88	13.67	13.29	13.51	0
6		Subtest 3	16.37	16.42	16.41	12.92	12.64	12.90	0.5
6		Subtest 4	16.35	16.38	16.40	12.90	12.60	12.87	0.5
6	HSUPA	Subtest 1	15.82	15.86	15.50	12.00	11.77	11.98	0
6		Subtest 2	15.59	15.29	15.41	12.31	12.05	12.31	2
6		Subtest 3	15.32	15.69	15.48	12.21	11.68	12.34	1
6		Subtest 4	15.97	16.20	16.07	12.38	12.59	12.87	2
6		Subtest 5	16.12	15.67	15.60	12.03	11.80	12.27	0
8	DC-HSDPA	Subtest 1	16.69	16.74	16.71	12.89	12.66	12.73	0
8		Subtest 2	16.77	16.70	16.73	12.99	12.81	12.95	0
8		Subtest 3	16.30	16.28	16.24	12.50	12.28	12.36	0.5
8		Subtest 4	16.23	16.35	16.31	12.40	12.18	12.25	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

It is expected by the manufacturer that MPR for some HSUPA subtests may be up to 2 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model.

Figure 8-2
Power Measurement Setup

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8.3 LTE Conducted Powers

8.3.1 LTE Band 5 (Cell)

Table 8-5
Maximum LTE Band 5 (Cell) 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]
Mid	836.5	20525	10	QPSK	1	0	22.38	0	0
	836.5	20525	10	QPSK	1	25	22.42	0	0
	836.5	20525	10	QPSK	1	49	**22.53**	0	0
	836.5	20525	10	QPSK	25	0	**21.53**	1	0-1
	836.5	20525	10	QPSK	25	12	21.43	1	0-1
	836.5	20525	10	QPSK	25	25	21.46	1	0-1
	836.5	20525	10	QPSK	50	0	21.48	1	0-1
	836.5	20525	10	16QAM	1	0	21.75	1	0-1
	836.5	20525	10	16QAM	1	25	21.78	1	0-1
	836.5	20525	10	16QAM	1	49	21.87	1	0-1
	836.5	20525	10	16QAM	25	0	20.59	2	0-2
	836.5	20525	10	16QAM	25	12	20.53	2	0-2
	836.5	20525	10	16QAM	25	25	20.53	2	0-2
	836.5	20525	10	16QAM	50	0	20.56	2	0-2

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

Table 8-6
Reduced LTE Band 5 (Cell) Conducted Powers - 10 MHz Bandwidth
Representing Body at 0 mm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	836.5	20525	10	QPSK	1	0	17.85	0	0
	836.5	20525	10	QPSK	1	25	17.84	0	0
	836.5	20525	10	QPSK	1	49	**17.86**	0	0
	836.5	20525	10	QPSK	25	0	**17.86**	0	0-1
	836.5	20525	10	QPSK	25	12	17.79	0	0-1
	836.5	20525	10	QPSK	25	25	17.85	0	0-1
	836.5	20525	10	QPSK	50	0	17.82	0	0-1
	836.5	20525	10	16QAM	1	0	18.00	0	0-1
	836.5	20525	10	16QAM	1	25	17.98	0	0-1
	836.5	20525	10	16QAM	1	49	17.97	0	0-1
	836.5	20525	10	16QAM	25	0	17.80	0	0-2
	836.5	20525	10	16QAM	25	12	17.75	0	0-2
	836.5	20525	10	16QAM	25	25	17.82	0	0-2
	836.5	20525	10	16QAM	50	0	17.78	0	0-2

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

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Table 8-7
Maximum LTE Band 5 (Cell) 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	826.5	20425	5	QPSK	1	0	22.20	0	0
	826.5	20425	5	QPSK	1	12	22.22	0	0
	826.5	20425	5	QPSK	1	24	22.24	0	0
	826.5	20425	5	QPSK	12	0	21.45	1	0-1
	826.5	20425	5	QPSK	12	6	21.39	1	0-1
	826.5	20425	5	QPSK	12	13	21.43	1	0-1
	826.5	20425	5	QPSK	25	0	21.43	1	0-1
	826.5	20425	5	16-QAM	1	0	21.32	1	0-1
	826.5	20425	5	16-QAM	1	12	21.36	1	0-1
	826.5	20425	5	16-QAM	1	24	21.36	1	0-1
	826.5	20425	5	16-QAM	12	0	20.43	2	0-2
	826.5	20425	5	16-QAM	12	6	20.40	2	0-2
	826.5	20425	5	16-QAM	12	13	20.40	2	0-2
	826.5	20425	5	16-QAM	25	0	20.42	2	0-2
Mid	836.5	20525	5	QPSK	1	0	22.47	0	0
	836.5	20525	5	QPSK	1	12	22.45	0	0
	836.5	20525	5	QPSK	1	24	22.49	0	0
	836.5	20525	5	QPSK	12	0	21.41	1	0-1
	836.5	20525	5	QPSK	12	6	21.43	1	0-1
	836.5	20525	5	QPSK	12	13	21.46	1	0-1
	836.5	20525	5	QPSK	25	0	21.40	1	0-1
	836.5	20525	5	16-QAM	1	0	21.52	1	0-1
	836.5	20525	5	16-QAM	1	12	21.48	1	0-1
	836.5	20525	5	16-QAM	1	24	21.53	1	0-1
	836.5	20525	5	16-QAM	12	0	20.55	2	0-2
	836.5	20525	5	16-QAM	12	6	20.51	2	0-2
	836.5	20525	5	16-QAM	12	13	20.52	2	0-2
	836.5	20525	5	16-QAM	25	0	20.55	2	0-2
High	846.5	20625	5	QPSK	1	0	22.41	0	0
	846.5	20625	5	QPSK	1	12	22.44	0	0
	846.5	20625	5	QPSK	1	24	22.45	0	0
	846.5	20625	5	QPSK	12	0	21.36	1	0-1
	846.5	20625	5	QPSK	12	6	21.38	1	0-1
	846.5	20625	5	QPSK	12	13	21.41	1	0-1
	846.5	20625	5	QPSK	25	0	21.40	1	0-1
	846.5	20625	5	16-QAM	1	0	21.57	1	0-1
	846.5	20625	5	16-QAM	1	12	21.53	1	0-1
	846.5	20625	5	16-QAM	1	24	21.59	1	0-1
	846.5	20625	5	16-QAM	12	0	20.40	2	0-2
	846.5	20625	5	16-QAM	12	6	20.39	2	0-2
	846.5	20625	5	16-QAM	12	13	20.40	2	0-2
	846.5	20625	5	16-QAM	25	0	20.40	2	0-2

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Table 8-8
Reduced LTE Band 5 (Cell) Conducted Powers - 5 MHz Bandwidth
Representing Body at 0 mm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	826.5	20425	5	QPSK	1	0	17.91	0	0
	826.5	20425	5	QPSK	1	12	17.89	0	0
	826.5	20425	5	QPSK	1	24	17.88	0	0
	826.5	20425	5	QPSK	12	0	17.84	0	0-1
	826.5	20425	5	QPSK	12	6	17.79	0	0-1
	826.5	20425	5	QPSK	12	13	17.78	0	0-1
	826.5	20425	5	QPSK	25	0	17.79	0	0-1
	826.5	20425	5	16-QAM	1	0	17.78	0	0-1
	826.5	20425	5	16-QAM	1	12	17.79	0	0-1
	826.5	20425	5	16-QAM	1	24	17.79	0	0-1
	826.5	20425	5	16-QAM	12	0	17.80	0	0-2
	826.5	20425	5	16-QAM	12	6	17.74	0	0-2
	826.5	20425	5	16-QAM	12	13	17.74	0	0-2
	826.5	20425	5	16-QAM	25	0	17.76	0	0-2
Mid	836.5	20525	5	QPSK	1	0	17.77	0	0
	836.5	20525	5	QPSK	1	12	17.71	0	0
	836.5	20525	5	QPSK	1	24	17.75	0	0
	836.5	20525	5	QPSK	12	0	17.82	0	0-1
	836.5	20525	5	QPSK	12	6	17.83	0	0-1
	836.5	20525	5	QPSK	12	13	17.84	0	0-1
	836.5	20525	5	QPSK	25	0	17.84	0	0-1
	836.5	20525	5	16-QAM	1	0	17.75	0	0-1
	836.5	20525	5	16-QAM	1	12	17.79	0	0-1
	836.5	20525	5	16-QAM	1	24	17.77	0	0-1
	836.5	20525	5	16-QAM	12	0	17.71	0	0-2
	836.5	20525	5	16-QAM	12	6	17.68	0	0-2
	836.5	20525	5	16-QAM	12	13	17.66	0	0-2
	836.5	20525	5	16-QAM	25	0	17.72	0	0-2
High	846.5	20625	5	QPSK	1	0	17.87	0	0
	846.5	20625	5	QPSK	1	12	17.99	0	0
	846.5	20625	5	QPSK	1	24	17.89	0	0
	846.5	20625	5	QPSK	12	0	17.81	0	0-1
	846.5	20625	5	QPSK	12	6	17.85	0	0-1
	846.5	20625	5	QPSK	12	13	17.81	0	0-1
	846.5	20625	5	QPSK	25	0	17.78	0	0-1
	846.5	20625	5	16-QAM	1	0	17.91	0	0-1
	846.5	20625	5	16-QAM	1	12	17.96	0	0-1
	846.5	20625	5	16-QAM	1	24	17.94	0	0-1
	846.5	20625	5	16-QAM	12	0	17.67	0	0-2
	846.5	20625	5	16-QAM	12	6	17.73	0	0-2
	846.5	20625	5	16-QAM	12	13	17.65	0	0-2
	846.5	20625	5	16-QAM	25	0	17.66	0	0-2

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Table 8-9
Maximum LTE Band 5 (Cell) 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	826.5	20425	5	QPSK	1	0	22.20	0	0
	826.5	20425	5	QPSK	1	12	22.22	0	0
	826.5	20425	5	QPSK	1	24	22.24	0	0
	826.5	20425	5	QPSK	12	0	21.45	1	0-1
	826.5	20425	5	QPSK	12	6	21.39	1	0-1
	826.5	20425	5	QPSK	12	13	21.43	1	0-1
	826.5	20425	5	QPSK	25	0	21.43	1	0-1
	826.5	20425	5	16-QAM	1	0	21.32	1	0-1
	826.5	20425	5	16-QAM	1	12	21.36	1	0-1
	826.5	20425	5	16-QAM	1	24	21.36	1	0-1
	826.5	20425	5	16-QAM	12	0	20.43	2	0-2
	826.5	20425	5	16-QAM	12	6	20.40	2	0-2
	826.5	20425	5	16-QAM	12	13	20.40	2	0-2
	826.5	20425	5	16-QAM	25	0	20.42	2	0-2
Mid	836.5	20525	5	QPSK	1	0	22.47	0	0
	836.5	20525	5	QPSK	1	12	22.45	0	0
	836.5	20525	5	QPSK	1	24	22.49	0	0
	836.5	20525	5	QPSK	12	0	21.41	1	0-1
	836.5	20525	5	QPSK	12	6	21.43	1	0-1
	836.5	20525	5	QPSK	12	13	21.46	1	0-1
	836.5	20525	5	QPSK	25	0	21.40	1	0-1
	836.5	20525	5	16-QAM	1	0	21.52	1	0-1
	836.5	20525	5	16-QAM	1	12	21.48	1	0-1
	836.5	20525	5	16-QAM	1	24	21.53	1	0-1
	836.5	20525	5	16-QAM	12	0	20.55	2	0-2
	836.5	20525	5	16-QAM	12	6	20.51	2	0-2
	836.5	20525	5	16-QAM	12	13	20.52	2	0-2
	836.5	20525	5	16-QAM	25	0	20.55	2	0-2
High	846.5	20625	5	QPSK	1	0	22.41	0	0
	846.5	20625	5	QPSK	1	12	22.44	0	0
	846.5	20625	5	QPSK	1	24	22.45	0	0
	846.5	20625	5	QPSK	12	0	21.36	1	0-1
	846.5	20625	5	QPSK	12	6	21.38	1	0-1
	846.5	20625	5	QPSK	12	13	21.41	1	0-1
	846.5	20625	5	QPSK	25	0	21.40	1	0-1
	846.5	20625	5	16-QAM	1	0	21.57	1	0-1
	846.5	20625	5	16-QAM	1	12	21.53	1	0-1
	846.5	20625	5	16-QAM	1	24	21.59	1	0-1
	846.5	20625	5	16-QAM	12	0	20.40	2	0-2
	846.5	20625	5	16-QAM	12	6	20.39	2	0-2
	846.5	20625	5	16-QAM	12	13	20.40	2	0-2
	846.5	20625	5	16-QAM	25	0	20.40	2	0-2

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Table 8-10
Reduced LTE Band 5 (Cell) Conducted Powers - 3 MHz Bandwidth
Representing Body at 0 mm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	825.5	20415	3	QPSK	1	0	17.86	0	0
	825.5	20415	3	QPSK	1	7	17.81	0	0
	825.5	20415	3	QPSK	1	14	17.83	0	0
	825.5	20415	3	QPSK	8	0	17.85	0	0-1
	825.5	20415	3	QPSK	8	4	17.80	0	0-1
	825.5	20415	3	QPSK	8	7	17.82	0	0-1
	825.5	20415	3	QPSK	15	0	17.81	0	0-1
	825.5	20415	3	16-QAM	1	0	17.99	0	0-1
	825.5	20415	3	16-QAM	1	7	18.00	0	0-1
	825.5	20415	3	16-QAM	1	14	17.99	0	0-1
	825.5	20415	3	16-QAM	8	0	17.67	0	0-2
	825.5	20415	3	16-QAM	8	4	17.64	0	0-2
	825.5	20415	3	16-QAM	8	7	17.66	0	0-2
	825.5	20415	3	16-QAM	15	0	17.73	0	0-2
Mid	836.5	20525	3	QPSK	1	0	17.93	0	0
	836.5	20525	3	QPSK	1	7	17.90	0	0
	836.5	20525	3	QPSK	1	14	17.94	0	0
	836.5	20525	3	QPSK	8	0	17.81	0	0-1
	836.5	20525	3	QPSK	8	4	17.79	0	0-1
	836.5	20525	3	QPSK	8	7	17.79	0	0-1
	836.5	20525	3	QPSK	15	0	17.85	0	0-1
	836.5	20525	3	16-QAM	1	0	17.94	0	0-1
	836.5	20525	3	16-QAM	1	7	17.89	0	0-1
	836.5	20525	3	16-QAM	1	14	17.97	0	0-1
	836.5	20525	3	16-QAM	8	0	17.65	0	0-2
	836.5	20525	3	16-QAM	8	4	17.63	0	0-2
	836.5	20525	3	16-QAM	8	7	17.64	0	0-2
	836.5	20525	3	16-QAM	15	0	17.70	0	0-2
High	847.5	20635	3	QPSK	1	0	17.97	0	0
	847.5	20635	3	QPSK	1	7	17.90	0	0
	847.5	20635	3	QPSK	1	14	17.93	0	0
	847.5	20635	3	QPSK	8	0	17.84	0	0-1
	847.5	20635	3	QPSK	8	4	17.75	0	0-1
	847.5	20635	3	QPSK	8	7	17.77	0	0-1
	847.5	20635	3	QPSK	15	0	17.82	0	0-1
	847.5	20635	3	16-QAM	1	0	17.88	0	0-1
	847.5	20635	3	16-QAM	1	7	17.80	0	0-1
	847.5	20635	3	16-QAM	1	14	17.81	0	0-1
	847.5	20635	3	16-QAM	8	0	17.72	0	0-2
	847.5	20635	3	16-QAM	8	4	17.62	0	0-2
	847.5	20635	3	16-QAM	8	7	17.65	0	0-2
	847.5	20635	3	16-QAM	15	0	17.70	0	0-2

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Table 8-11
Maximum LTE Band 5 (Cell) 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	824.7	20407	1.4	QPSK	1	0	22.38	0	0
	824.7	20407	1.4	QPSK	1	2	22.37	0	0
	824.7	20407	1.4	QPSK	1	5	22.47	0	0
	824.7	20407	1.4	QPSK	3	0	22.46	0	0
	824.7	20407	1.4	QPSK	3	2	22.44	0	0
	824.7	20407	1.4	QPSK	3	3	22.53	0	0
	824.7	20407	1.4	QPSK	6	0	21.37	1	0-1
	824.7	20407	1.4	16-QAM	1	0	21.36	1	0-1
	824.7	20407	1.4	16-QAM	1	2	21.33	1	0-1
	824.7	20407	1.4	16-QAM	1	5	21.53	1	0-1
	824.7	20407	1.4	16-QAM	3	0	21.38	1	0-1
	824.7	20407	1.4	16-QAM	3	2	21.41	1	0-1
	824.7	20407	1.4	16-QAM	3	3	21.49	1	0-1
	824.7	20407	1.4	16-QAM	6	0	20.33	2	0-2
Mid	836.5	20525	1.4	QPSK	1	0	22.51	0	0
	836.5	20525	1.4	QPSK	1	2	22.45	0	0
	836.5	20525	1.4	QPSK	1	5	22.52	0	0
	836.5	20525	1.4	QPSK	3	0	22.45	0	0
	836.5	20525	1.4	QPSK	3	2	22.46	0	0
	836.5	20525	1.4	QPSK	3	3	22.54	0	0
	836.5	20525	1.4	QPSK	6	0	21.46	1	0-1
	836.5	20525	1.4	16-QAM	1	0	21.60	1	0-1
	836.5	20525	1.4	16-QAM	1	2	21.53	1	0-1
	836.5	20525	1.4	16-QAM	1	5	21.60	1	0-1
	836.5	20525	1.4	16-QAM	3	0	21.41	1	0-1
	836.5	20525	1.4	16-QAM	3	2	21.39	1	0-1
	836.5	20525	1.4	16-QAM	3	3	21.40	1	0-1
	836.5	20525	1.4	16-QAM	6	0	20.48	2	0-2
High	848.3	20643	1.4	QPSK	1	0	22.65	0	0
	848.3	20643	1.4	QPSK	1	2	22.61	0	0
	848.3	20643	1.4	QPSK	1	5	22.66	0	0
	848.3	20643	1.4	QPSK	3	0	22.47	0	0
	848.3	20643	1.4	QPSK	3	2	22.44	0	0
	848.3	20643	1.4	QPSK	3	3	22.50	0	0
	848.3	20643	1.4	QPSK	6	0	21.48	1	0-1
	848.3	20643	1.4	16-QAM	1	0	21.31	1	0-1
	848.3	20643	1.4	16-QAM	1	2	21.21	1	0-1
	848.3	20643	1.4	16-QAM	1	5	21.31	1	0-1
	848.3	20643	1.4	16-QAM	3	0	21.42	1	0-1
	848.3	20643	1.4	16-QAM	3	2	21.37	1	0-1
	848.3	20643	1.4	16-QAM	3	3	21.46	1	0-1
	848.3	20643	1.4	16-QAM	6	0	20.61	2	0-2

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Table 8-12
Reduced LTE Band 5 (Cell) Conducted Powers – 1.4 MHz Bandwidth
Representing Body at 0 mm

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	824.7	20407	1.4	QPSK	1	0	17.93	0	0
	824.7	20407	1.4	QPSK	1	2	17.88	0	0
	824.7	20407	1.4	QPSK	1	5	17.92	0	0
	824.7	20407	1.4	QPSK	3	0	17.93	0	0
	824.7	20407	1.4	QPSK	3	2	17.98	0	0
	824.7	20407	1.4	QPSK	3	3	17.95	0	0
	824.7	20407	1.4	QPSK	6	0	17.88	0	0-1
	824.7	20407	1.4	16-QAM	1	0	17.77	0	0-1
	824.7	20407	1.4	16-QAM	1	2	17.74	0	0-1
	824.7	20407	1.4	16-QAM	1	5	17.88	0	0-1
	824.7	20407	1.4	16-QAM	3	0	17.92	0	0-1
	824.7	20407	1.4	16-QAM	3	2	17.86	0	0-1
	824.7	20407	1.4	16-QAM	3	3	17.92	0	0-1
	824.7	20407	1.4	16-QAM	6	0	17.69	0	0-2
Mid	836.5	20525	1.4	QPSK	1	0	17.91	0	0
	836.5	20525	1.4	QPSK	1	2	17.87	0	0
	836.5	20525	1.4	QPSK	1	5	17.91	0	0
	836.5	20525	1.4	QPSK	3	0	17.90	0	0
	836.5	20525	1.4	QPSK	3	2	17.93	0	0
	836.5	20525	1.4	QPSK	3	3	17.96	0	0
	836.5	20525	1.4	QPSK	6	0	17.89	0	0-1
	836.5	20525	1.4	16-QAM	1	0	17.92	0	0-1
	836.5	20525	1.4	16-QAM	1	2	17.92	0	0-1
	836.5	20525	1.4	16-QAM	1	5	17.94	0	0-1
	836.5	20525	1.4	16-QAM	3	0	17.78	0	0-1
	836.5	20525	1.4	16-QAM	3	2	17.77	0	0-1
	836.5	20525	1.4	16-QAM	3	3	17.77	0	0-1
	836.5	20525	1.4	16-QAM	6	0	17.71	0	0-2
High	848.3	20643	1.4	QPSK	1	0	17.97	0	0
	848.3	20643	1.4	QPSK	1	2	17.94	0	0
	848.3	20643	1.4	QPSK	1	5	17.98	0	0
	848.3	20643	1.4	QPSK	3	0	17.87	0	0
	848.3	20643	1.4	QPSK	3	2	17.85	0	0
	848.3	20643	1.4	QPSK	3	3	17.92	0	0
	848.3	20643	1.4	QPSK	6	0	17.80	0	0-1
	848.3	20643	1.4	16-QAM	1	0	17.66	0	0-1
	848.3	20643	1.4	16-QAM	1	2	17.59	0	0-1
	848.3	20643	1.4	16-QAM	1	5	17.63	0	0-1
	848.3	20643	1.4	16-QAM	3	0	17.75	0	0-1
	848.3	20643	1.4	16-QAM	3	2	17.76	0	0-1
	848.3	20643	1.4	16-QAM	3	3	17.80	0	0-1
	848.3	20643	1.4	16-QAM	6	0	17.86	0	0-2

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8.4 WLAN Conducted Powers

Table 8-13
IEEE 802.11b Average RF Power

Mode	Freq [MHz]	Channel	802.11b Conducted Power [dBm]			
			Data Rate [Mbps]			
			1	2	5.5	11
802.11b	2412	1*	10.66	10.71	10.74	10.89
802.11b	2437	6*	10.66	10.75	10.77	10.73
802.11b	2462	11*	**11.30**	11.40	11.43	11.47

Table 8-14
IEEE 802.11g Average RF Power

Mode	Freq [MHz]	Channel	802.11g Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11g	2412	1	9.92	9.94	9.93	9.94	9.94	9.91	9.88	9.92
802.11g	2437	6	10.00	10.01	10.01	10.04	10.00	9.96	10.00	10.01
802.11g	2462	11	10.45	10.45	10.43	10.47	10.41	10.44	10.42	10.44

Table 8-15
IEEE 802.11n Average RF Power

Mode	Freq [MHz]	Channel	802.11n (2.4GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	19.5	26	39	52	58.5	65
802.11n	2412	1	8.83	8.89	8.84	8.77	8.81	8.80	8.83	8.48
802.11n	2437	6	8.93	8.93	8.93	8.90	8.86	8.88	8.90	8.60
802.11n	2462	11	9.49	9.48	9.47	9.48	9.46	9.49	9.46	9.16

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Table 8-16
IEEE 802.11a Average RF Power

Mode	Freq [MHz]	Channel	802.11a Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11a	5180	36*	**10.44**	10.36	10.40	10.41	10.39	10.39	10.38	10.42
802.11a	5200	40	9.54	9.59	9.51	9.52	9.60	9.51	9.58	9.47
802.11a	5220	44	9.55	9.54	9.52	9.57	9.49	9.60	9.60	9.57
802.11a	5240	48*	9.82	9.69	9.58	9.66	9.71	9.58	9.62	9.58
802.11a	5260	52*	10.26	10.25	10.30	10.28	10.29	10.24	10.22	10.26
802.11a	5280	56	**10.37**	10.34	10.45	10.42	10.43	10.32	10.43	10.39
802.11a	5300	60	9.89	9.89	9.92	9.91	9.91	9.92	9.85	9.87
802.11a	5320	64*	9.49	9.46	9.57	9.53	9.50	9.44	9.42	9.49
802.11a	5500	100	10.04	9.98	9.98	10.07	10.00	10.08	9.98	10.10
802.11a	5520	104*	10.24	10.11	10.14	10.02	10.03	10.13	10.02	10.14
802.11a	5540	108	9.57	9.50	9.65	9.60	9.57	9.51	9.54	9.54
802.11a	5560	112	9.57	9.54	9.62	9.56	9.61	9.55	9.52	9.60
802.11a	5580	116*	10.24	10.24	10.25	10.29	10.21	10.26	10.31	10.22
802.11a	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5660	132	9.71	9.75	9.78	9.76	9.74	9.77	9.77	9.76
802.11a	5680	136*	9.68	9.66	9.63	9.60	9.66	9.64	9.73	9.64
802.11a	5700	140	**10.25**	10.21	10.30	10.28	10.33	10.26	10.22	10.28
802.11a	5745	149*	10.24	10.23	10.23	10.25	10.27	10.18	10.30	10.25
802.11a	5765	153	9.56	9.55	9.49	9.51	9.56	9.58	9.51	9.59
802.11a	5785	157*	9.55	9.58	9.57	9.62	9.55	9.63	9.56	9.51
802.11a	5805	161	**10.29**	10.28	10.30	10.31	10.34	10.23	10.28	10.23
802.11a	5825	165*	9.78	9.78	9.82	9.73	9.81	9.77	9.72	9.78

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

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

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Table 8-17
IEEE 802.11n Average RF Power – 20 MHz Bandwidth

Mode	Freq [MHz]	Channel	20MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	19.5	26	39	52	58.5	65
802.11n	5180	36	9.46	9.46	9.45	9.37	9.40	9.37	9.39	9.41
802.11n	5200	40	9.55	9.56	9.48	9.54	9.50	9.59	9.50	9.56
802.11n	5220	44	9.59	9.58	9.65	9.62	9.53	9.66	9.55	9.65
802.11n	5240	48	9.72	9.65	9.79	9.81	9.71	9.80	9.79	9.70
802.11n	5260	52	9.34	9.39	9.32	9.40	9.29	9.42	9.30	9.37
802.11n	5280	56	9.39	9.45	9.46	9.34	9.36	9.34	9.31	9.48
802.11n	5300	60	9.94	9.94	9.86	9.98	10.02	10.03	9.96	9.96
802.11n	5320	64	9.68	9.62	9.74	9.71	9.74	9.70	9.69	9.77
802.11n	5500	100	10.07	10.07	10.14	9.99	10.08	10.05	10.09	10.14
802.11n	5520	104	9.16	9.09	9.19	9.23	9.10	9.20	9.20	9.08
802.11n	5540	108	9.74	9.66	9.78	9.74	9.70	9.71	9.69	9.80
802.11n	5560	112	9.73	9.71	9.78	9.81	9.77	9.75	9.74	9.66
802.11n	5580	116	9.58	9.67	9.63	9.59	9.56	9.50	9.65	9.66
802.11n	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5660	132	9.62	9.61	9.58	9.65	9.55	9.58	9.65	9.60
802.11n	5680	136	9.59	9.60	9.52	9.61	9.57	9.52	9.52	9.62
802.11n	5700	140	10.08	10.14	10.03	10.02	10.09	10.15	10.07	10.15
802.11n	5745	149	10.14	10.19	10.09	10.22	10.12	10.08	10.22	10.15
802.11n	5765	153	9.75	9.69	9.80	9.72	9.75	9.74	9.78	9.72
802.11n	5785	157	9.80	9.73	9.76	9.74	9.85	9.71	9.75	9.73
802.11n	5805	161	10.12	10.11	10.18	10.10	10.11	10.21	10.11	10.11
802.11n	5825	165	9.67	9.66	9.59	9.61	9.73	9.72	9.65	9.73

Table 8-18
IEEE 802.11n Average RF Power – 40 MHz Bandwidth

Mode	Freq [MHz]	Channel	40MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			13.5	27	40.5	54	81	108	121.5	135
802.11n	5190	38	9.48	9.47	9.52	9.47	9.46	9.43	9.51	9.56
802.11n	5230	46	9.51	9.55	9.55	9.47	9.53	9.53	9.42	9.64
802.11n	5270	54	9.85	9.97	9.75	9.85	9.82	9.87	9.76	9.77
802.11n	5310	62	9.88	9.90	10.01	9.88	9.86	9.80	9.95	9.76
802.11n	5510	102	10.05	10.18	9.95	9.92	10.02	10.09	9.95	10.05
802.11n	5550	110	9.65	9.63	9.70	9.67	9.76	9.70	9.61	9.53
802.11n	5590	118	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5630	126	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5670	134	9.53	9.49	9.64	9.50	9.51	9.53	9.60	9.52
802.11n	5755	151	9.73	9.63	9.73	9.61	9.64	9.68	9.81	9.64
802.11n	5795	159	9.35	9.35	9.29	9.47	9.25	9.30	9.33	9.34

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

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

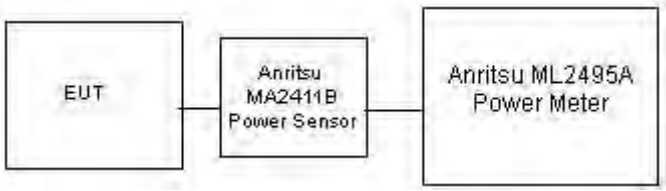

Figure 8-3
Power Measurement Setup

8.5 Bluetooth Conducted Powers

Table 8-19
Bluetooth RF Conducted Powers

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
			[dBm]	[mW]
2402	1.0	0	8.34	6.819
2441	1.0	39	8.62	7.283
2480	1.0	78	**9.04**	8.013
2402	2.0	0	6.80	4.792
2441	2.0	39	7.09	5.116
2480	2.0	78	7.49	5.611
2402	3.0	0	6.87	4.864
2441	3.0	39	7.16	5.200
2480	3.0	78	7.56	5.704

The bolded data rate and highest output power channel above were tested for SAR.

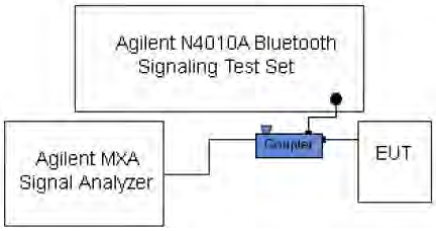

Figure 8-4
Power Measurement Setup

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9 SYSTEM VERIFICATION

9.1 Tissue Verification

Table 9-1
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
01/27/2014	835B	22.3	820	0.964	53.001	0.969	55.258	-0.52%	-4.08%
			835	0.977	52.829	0.970	55.200	0.72%	-4.30%
			850	0.995	52.689	0.988	55.154	0.71%	-4.47%
01/27/2014	1900B	22.2	1850	1.512	51.170	1.520	53.300	-0.53%	-4.00%
			1880	1.546	51.083	1.520	53.300	1.71%	-4.16%
			1910	1.578	50.939	1.520	53.300	3.82%	-4.43%
01/28/2014	2450B	22.1	2401	1.929	51.508	1.903	52.765	1.37%	-2.38%
			2450	1.984	51.182	1.950	52.700	1.74%	-2.88%
			2499	2.058	51.072	2.019	52.638	1.93%	-2.98%
02/03/2014	2450B	22.8	2401	1.971	51.560	1.903	52.765	3.57%	-2.28%
			2450	2.039	51.366	1.950	52.700	4.56%	-2.53%
			2499	2.099	51.177	2.019	52.638	3.96%	-2.78%
01/30/2014	5200B-5800B	22.0	5180	5.309	47.577	5.276	49.041	0.63%	-2.99%
			5200	5.345	47.515	5.299	49.014	0.87%	-3.06%
			5240	5.408	47.419	5.346	48.960	1.16%	-3.15%
			5280	5.465	47.349	5.393	48.906	1.34%	-3.18%
			5300	5.494	47.274	5.416	48.879	1.44%	-3.28%
			5500	5.800	46.765	5.650	48.607	2.65%	-3.79%
			5520	5.827	46.739	5.673	48.580	2.71%	-3.79%
			5580	5.924	46.531	5.743	48.499	3.15%	-4.06%
			5600	5.949	46.532	5.766	48.471	3.17%	-4.00%
			5700	6.106	46.271	5.883	48.336	3.79%	-4.27%
			5745	6.189	46.168	5.936	48.275	4.26%	-4.36%
			5800	6.256	46.055	6.000	48.200	4.27%	-4.45%
			5805	6.264	46.010	6.006	48.193	4.30%	-4.53%
			5825	6.308	45.963	6.029	48.166	4.63%	-4.57%

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

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9.2 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 9-2
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)	$Deviation_{1g}$ (%)
K	835	BODY	01/27/2014	23.4	22.3	0.100	4d119	3333	0.961	9.540	9.610	0.73%
D	1900	BODY	01/27/2014	23.0	22.2	0.100	5d148	3022	3.920	40.800	39.200	-3.92%
G	2450	BODY	01/28/2014	21.5	22.1	0.100	719	3209	5.210	51.700	52.100	0.77%
G	2450	BODY	02/03/2014	24.4	22.8	0.100	719	3209	5.050	51.700	50.500	-2.32%
E	5200	BODY	01/30/2014	24.2	22.0	0.100	1120	3914	7.840	76.600	78.400	2.35%
E	5300	BODY	01/30/2014	24.2	22.1	0.100	1120	3914	7.800	76.800	78.000	1.56%
E	5500	BODY	01/30/2014	24.3	22.1	0.100	1120	3914	7.650	79.800	76.500	-4.14%
E	5600	BODY	01/30/2014	24.4	22.2	0.100	1120	3914	8.040	80.700	80.400	-0.37%
E	5800	BODY	01/30/2014	24.4	22.2	0.100	1120	3914	7.170	75.500	71.700	-5.03%

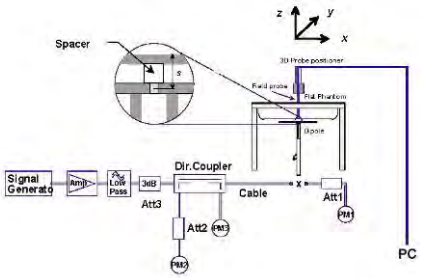

Figure 9-1
System Verification Setup Diagram

Figure 9-2
System Verification Setup Photo

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10 SAR DATA SUMMARY

10.1 Standalone Body SAR Data

Table 10-1
GSM/UMTS Body 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)	
824.20	128	GSM 850	GPRS	24.5	23.99	-0.04	0 mm	2014-7	3	1:2.76	back	0.970	1.125	1.091	
836.60	190	GSM 850	GPRS	24.5	23.84	0.09	0 mm	2014-7	3	1:2.76	back	0.867	1.164	1.009	
848.80	251	GSM 850	GPRS	24.5	24.02	-0.16	0 mm	2014-7	3	1:2.76	back	0.851	1.117	0.951	
836.60	190	GSM 850	GPRS	29.5	29.50	0.00	15 mm	2014-3	3	1:2.76	back	0.627	1.000	0.627	
836.60	190	GSM 850	GPRS	24.5	23.84	-0.02	0 mm	2014-7	3	1:2.76	top	0.409	1.164	0.476	
836.60	190	GSM 850	GPRS	29.5	29.50	-0.07	16 mm	2014-3	3	1:2.76	top	0.151	1.000	0.151	
836.60	190	GSM 850	GPRS	29.5	29.50	0.11	0 mm	2014-7	3	1:2.76	right	0.691	1.000	0.691	
824.20	128	GSM 850	GPRS	24.5	23.99	0.02	0 mm	2014-7	3	1:2.76	back	0.974	1.125	**1.096**	A1
836.60	4183	UMTS 850	RMC	18.0	17.85	0.09	0 mm	2014-7	N/A	1:1	back	0.719	1.035	0.744	A2
836.60	4183	UMTS 850	RMC	23.0	22.85	0.01	15 mm	2014-3	N/A	1:1	back	0.259	1.035	0.268	
836.60	4183	UMTS 850	RMC	18.0	17.85	0.06	0 mm	2014-7	N/A	1:1	top	0.276	1.035	0.286	
836.60	4183	UMTS 850	RMC	23.0	22.85	-0.04	16 mm	2014-3	N/A	1:1	top	0.120	1.035	0.124	
836.60	4183	UMTS 850	RMC	18.0	17.85	0.04	0 mm	2014-7	N/A	1:1	right	0.497	1.035	0.514	
1880.00	661	GSM 1900	GPRS	16.0	15.66	-0.14	0 mm	2014-4	4	1:2.076	back	0.371	1.081	0.401	
1850.20	512	GSM 1900	GPRS	26.0	25.95	-0.06	15 mm	2014-2	4	1:2.076	back	0.886	1.012	0.897	
1880.00	661	GSM 1900	GPRS	26.0	25.99	-0.11	15 mm	2014-2	4	1:2.076	back	0.842	1.002	0.844	
1909.80	810	GSM 1900	GPRS	26.0	26.00	-0.14	15 mm	2014-2	4	1:2.076	back	0.779	1.000	0.779	
1880.00	661	GSM 1900	GPRS	16.0	15.66	0.00	0 mm	2014-4	4	1:2.076	top	0.325	1.081	0.351	
1850.20	512	GSM 1900	GPRS	26.0	25.95	-0.15	16 mm	2014-2	4	1:2.076	top	0.961	1.012	0.973	A3
1880.00	661	GSM 1900	GPRS	26.0	25.99	0.04	16 mm	2014-2	4	1:2.076	top	0.908	1.002	0.910	
1909.80	810	GSM 1900	GPRS	26.0	26.00	-0.08	16 mm	2014-2	4	1:2.076	top	0.773	1.000	0.773	
1880.00	661	GSM 1900	GPRS	26.0	25.99	-0.05	0 mm	2014-4	4	1:2.076	right	0.221	1.002	0.221	
1852.40	9262	UMTS 1900	RMC	14.5	14.30	-0.21	0 mm	2014-4	N/A	1:1	back	0.946	1.047	0.990	
1880.00	9400	UMTS 1900	RMC	14.5	14.07	-0.08	0 mm	2014-4	N/A	1:1	back	0.748	1.104	0.826	
1907.60	9538	UMTS 1900	RMC	14.5	14.30	0.10	0 mm	2014-4	N/A	1:1	back	0.828	1.047	0.867	
1852.40	9262	UMTS 1900	RMC	23.0	23.00	0.04	15 mm	2014-3	N/A	1:1	back	1.070	1.000	1.070	
1880.00	9400	UMTS 1900	RMC	23.0	22.89	-0.01	15 mm	2014-3	N/A	1:1	back	0.931	1.026	0.955	
1907.60	9538	UMTS 1900	RMC	23.0	22.93	0.03	15 mm	2014-3	N/A	1:1	back	0.874	1.016	0.888	
1880.00	9400	UMTS 1900	RMC	14.5	14.07	0.09	0 mm	2014-4	N/A	1:1	top	0.563	1.104	0.622	
1852.40	9262	UMTS 1900	RMC	23.0	23.00	0.04	16 mm	2014-3	N/A	1:1	top	1.100	1.000	**1.100**	A4
1880.00	9400	UMTS 1900	RMC	23.0	22.89	0.02	16 mm	2014-3	N/A	1:1	top	0.930	1.026	0.954	
1907.60	9538	UMTS 1900	RMC	23.0	22.93	-0.02	16 mm	2014-3	N/A	1:1	top	0.880	1.016	0.894	
1880.00	9400	UMTS 1900	RMC	23.0	22.89	0.03	0 mm	2014-4	N/A	1:1	right	0.216	1.026	0.222	
1852.40	9262	UMTS 1900	RMC	23.0	23.00	0.01	16 mm	2014-3	N/A	1:1	top	1.090	1.000	1.090	
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 entries indicate variability measurements

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Table 10-2
LTE Body SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
836.50	20525	Mid	LTE Band 5 (Cell)	10	18.0	17.86	0.04	0	2014-4	QPSK	1	49	0 mm	back	1:1	0.741	1.033	0.765	A5
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.53	-0.03	0	2014-3	QPSK	1	49	15 mm	back	1:1	0.302	1.114	0.336	
836.50	20525	Mid	LTE Band 5 (Cell)	10	18.0	17.86	0.06	0	2014-4	QPSK	25	0	0 mm	back	1:1	0.720	1.033	0.744	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.53	0.09	1	2014-3	QPSK	25	0	15 mm	back	1:1	0.225	1.114	0.251	
836.50	20525	Mid	LTE Band 5 (Cell)	10	18.0	17.86	0.05	0	2014-4	QPSK	1	49	0 mm	top	1:1	0.197	1.033	0.204	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.53	-0.09	0	2014-3	QPSK	1	49	16 mm	top	1:1	0.110	1.114	0.123	
836.50	20525	Mid	LTE Band 5 (Cell)	10	18.0	17.86	0.04	0	2014-4	QPSK	25	0	0 mm	top	1:1	0.210	1.033	0.217	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.53	0.10	1	2014-3	QPSK	25	0	16 mm	top	1:1	0.086	1.114	0.096	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.53	-0.03	0	2014-3	QPSK	1	49	0 mm	right	1:1	0.497	1.114	0.554	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.53	0.02	1	2014-3	QPSK	25	0	0 mm	right	1:1	0.352	1.114	0.392	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram													

Table 10-3
WLAN and Bluetooth Body SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2480	78	Bluetooth	FHSS	9.5	9.04	0.00	0 mm	2014-5	1	back	1:1	0.199	1.112	**0.221**	A6
2480	78	Bluetooth	FHSS	9.5	9.04	-0.01	0 mm	2014-5	1	top	1:1	0.164	1.112	0.182	
2480	78	Bluetooth	FHSS	9.5	9.04	0.07	0 mm	2014-5	1	left	1:1	0.006	1.112	0.007	
2412	1	IEEE 802.11b	DSSS	11.5	10.66	0.08	0 mm	2014-5	1	back	1:1	0.762	1.213	0.924	
2437	6	IEEE 802.11b	DSSS	11.5	10.66	0.02	0 mm	2014-5	1	back	1:1	0.804	1.213	0.975	
2462	11	IEEE 802.11b	DSSS	11.5	11.30	0.04	0 mm	2014-5	1	back	1:1	0.903	1.047	0.945	A7
2462	11	IEEE 802.11b	DSSS	11.5	11.30	0.01	0 mm	2014-5	1	top	1:1	0.735	1.047	0.770	
2462	11	IEEE 802.11b	DSSS	11.5	11.30	0.02	0 mm	2014-5	1	left	1:1	0.026	1.047	0.027	
2462	11	IEEE 802.11b	DSSS	11.5	11.30	0.06	0 mm	2014-5	1	back	1:1	0.902	1.047	0.944	
5745	149	IEEE 802.11a	OFDM	10.5	10.24	0.00	0 mm	2014-3	6	back	1:1	0.888	1.062	0.943	
5805	161	IEEE 802.11a	OFDM	10.5	10.29	-0.06	0 mm	2014-3	6	back	1:1	0.901	1.050	0.946	A8
5825	165	IEEE 802.11a	OFDM	10.5	9.78	-0.07	0 mm	2014-3	6	back	1:1	0.892	1.180	**1.053**	
5805	161	IEEE 802.11a	OFDM	10.5	10.29	-0.17	0 mm	2014-3	6	top	1:1	0.081	1.050	0.085	
5805	161	IEEE 802.11a	OFDM	10.5	10.29	-0.15	0 mm	2014-3	6	left	1:1	0.020	1.050	0.021	
5805	161	IEEE 802.11a	OFDM	10.5	10.29	0.06	0 mm	2014-3	6	back	1:1	0.895	1.050	0.940	
5180	36	IEEE 802.11a	OFDM	10.5	10.44	-0.13	0 mm	2014-3	6	back	1:1	0.777	1.014	0.788	
5240	48	IEEE 802.11a	OFDM	10.5	9.82	-0.16	0 mm	2014-3	6	back	1:1	0.683	1.169	0.798	
5180	36	IEEE 802.11a	OFDM	10.5	10.44	-0.06	0 mm	2014-3	6	top	1:1	0.181	1.014	0.184	
5180	36	IEEE 802.11a	OFDM	10.5	10.44	-0.11	0 mm	2014-3	6	left	1:1	0.023	1.014	0.023	
5280	56	IEEE 802.11a	OFDM	10.5	10.37	-0.12	0 mm	2014-3	6	back	1:1	0.819	1.030	0.844	
5300	60	IEEE 802.11a	OFDM	10.5	9.89	-0.10	0 mm	2014-3	6	back	1:1	0.766	1.151	0.882	
5280	56	IEEE 802.11a	OFDM	10.5	10.37	-0.13	0 mm	2014-3	6	top	1:1	0.177	1.030	0.182	
5280	56	IEEE 802.11a	OFDM	10.5	10.37	-0.12	0 mm	2014-3	6	left	1:1	0.024	1.030	0.025	
5280	56	IEEE 802.11a	OFDM	10.5	10.37	0.03	0 mm	2014-3	6	back	1:1	0.816	1.030	0.840	
5520	104	IEEE 802.11a	OFDM	10.5	10.24	-0.10	0 mm	2014-3	6	back	1:1	1.030	1.062	**1.095**	A9
5580	116	IEEE 802.11a	OFDM	10.5	10.24	-0.08	0 mm	2014-3	6	back	1:1	1.020	1.062	1.083	
5700	140	IEEE 802.11a	OFDM	10.5	10.25	-0.09	0 mm	2014-3	6	back	1:1	1.020	1.059	1.080	
5700	140	IEEE 802.11a	OFDM	10.5	10.25	0.13	0 mm	2014-3	6	top	1:1	0.126	1.059	0.133	
5700	140	IEEE 802.11a	OFDM	10.5	10.25	-0.08	0 mm	2014-3	6	left	1:1	0.027	1.059	0.029	
5520	104	IEEE 802.11a	OFDM	10.5	10.24	0.01	0 mm	2014-3	6	back	1:1	1.020	1.062	1.083	
5580	116	IEEE 802.11a	OFDM	10.5	10.24	0.03	0 mm	2014-3	6	back	1:1	1.010	1.062	1.073	
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 entries indicate variability measurements

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10.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in KDB 616217, IEEE 1528-2003, and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. 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 12 for variability analysis.
7. Per FCC KDB 616217 D04 Section 4.3, SAR tests are required for the back surface and edges of the tablet with the tablet touching the phantom. The SAR Exclusion Threshold in FCC KDB 447498 D01v05 was applied to determine SAR test exclusion for adjacent edge configurations. Top and right edge SAR tests were required for the main antenna. Top and left edge SAR tests were required for the WLAN/BT antennas.

GSM Test Notes:

1. 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.
2. Per FCC KDB Publication 447498 D01v05, when the reported (scaled) SAR measured at the middle channel > 0.8 W/kg then testing at the other channels is required for such test configuration(s). Since the maximum output power variation across the required test channels is < ½ dB, the middle channel was the default channel used for SAR evaluation.

UMTS Notes:

1. UMTS mode in 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, when the reported (scaled) SAR measured at the middle channel > 0.8 W/kg then testing at the other channels is 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 must be 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 7.4.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

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WLAN/BT Notes:

1. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 2.4 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11b. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
2. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 5 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11a. Other IEEE 802.11 modes (including 802.11n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
3. WIFI transmission was verified using an uncalibrated spectrum analyzer.
4. When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is >1.6 W/kg or the reported 1g averaged SAR is >0.8 W/kg, SAR testing on other default channels was required.
5. There is no proximity sensor power reduction mechanism applied for WIFI/BT modes.
6. The Bluetooth highest output power channel was tested for SAR.

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11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

11.1 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 and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

11.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05 IV.C.1.iii and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific 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 11-1
Estimated SAR

Mode	Configuration	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
		[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth LE	Back side and Top edge Touching*	2440	2.00	5	**0.083**
Bluetooth LE	Left Edge	2440	2.00	20	**0.021**

Note:

1. For configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion since the test separation distance was >50 mm.
2. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.
3. (*) - Per FCC KDB Publication 447498, when the test separation distance is < 5 mm, a distance of 5 mm is applied to determine estimated SAR.

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11.3 Body SAR Simultaneous Transmission Analysis

Table 11-2
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body at 0 mm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.096	0.975	See Note 1	0.02
	Top	0.476	0.770	1.246	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.691	0.400	1.091	N/A
	Left	0.400	0.027	0.427	N/A

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.744	0.975	See Note 1	0.01
	Top	0.286	0.770	1.056	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.514	0.400	0.914	N/A
	Left	0.400	0.027	0.427	N/A

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.401	0.975	1.376	N/A
	Top	0.351	0.770	1.121	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.221	0.400	0.621	N/A
	Left	0.400	0.027	0.427	N/A

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.990	0.975	See Note 1	0.02
	Top	0.622	0.770	1.392	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.222	0.400	0.622	N/A
	Left	0.400	0.027	0.427	N/A

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.765	0.975	See Note 1	0.01
	Top	0.217	0.770	0.987	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.554	0.400	0.954	N/A
	Left	0.400	0.027	0.427	N/A

Table 11-3
Simultaneous Transmission Scenario with 5 GHz WLAN (Body SAR at 0 mm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.096	1.095	See Note 1	0.02
	Top	0.476	0.184	0.660	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.691	0.400	1.091	N/A
	Left	0.400	0.029	0.429	N/A

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.744	1.095	See Note 1	0.02
	Top	0.286	0.184	0.470	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.514	0.400	0.914	N/A
	Left	0.400	0.029	0.429	N/A

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.401	1.095	**1.496**	N/A
	Top	0.351	0.184	0.535	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.221	0.400	0.621	N/A
	Left	0.400	0.029	0.429	N/A

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.990	1.095	See Note 1	0.02
	Top	0.622	0.184	0.806	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.222	0.400	0.622	N/A
	Left	0.400	0.029	0.429	N/A

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.765	1.095	See Note 1	0.02
	Top	0.217	0.184	0.401	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.554	0.400	0.954	N/A
	Left	0.400	0.029	0.429	N/A

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Table 11-4
Simultaneous Transmission Scenario with Bluetooth (Body SAR at 0 mm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.096	0.221	1.317	N/A
	Top	0.476	0.182	0.658	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.691	0.400	1.091	N/A
	Left	0.400	0.021	0.421	N/A

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.744	0.221	0.965	N/A
	Top	0.286	0.182	0.468	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.514	0.400	0.914	N/A
	Left	0.400	0.021	0.421	N/A

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.401	0.221	0.622	N/A
	Top	0.351	0.182	0.533	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.221	0.400	0.621	N/A
	Left	0.400	0.021	0.421	N/A

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.990	0.221	1.211	N/A
	Top	0.622	0.182	0.804	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.222	0.400	0.622	N/A
	Left	0.400	0.021	0.421	N/A

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.765	0.221	0.986	N/A
	Top	0.217	0.182	0.399	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.554	0.400	0.954	N/A
	Left	0.400	0.021	0.421	N/A

Table 11-5
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Back at 15 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GSM 850	0.627	<0.975	See Note 1	<0.01
Back Side	UMTS 850	0.268	<0.975	<1.243	N/A
Back Side	GSM 1900	0.897	<0.975	See Note 1	<0.02
Back Side	UMTS 1900	1.070	<0.975	See Note 1	<0.02
Back Side	LTE Band 5 (Cell)	0.336	<0.975	<1.311	N/A

Table 11-6
Simultaneous Transmission Scenario with 5 GHz WLAN (Back at 15 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GSM 850	0.627	<1.095	See Note 1	<0.01
Back Side	UMTS 850	0.268	<1.095	<1.363	N/A
Back Side	GSM 1900	0.897	<1.095	See Note 1	<0.02
Back Side	UMTS 1900	1.070	<1.095	See Note 1	<0.02
Back Side	LTE Band 5 (Cell)	0.336	<1.095	<1.431	N/A

Table 11-7
Simultaneous Transmission Scenario with Bluetooth (Back at 15 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GSM 850	0.627	<0.221	<0.848	N/A
Back Side	UMTS 850	0.268	<0.221	<0.489	N/A
Back Side	GSM 1900	0.897	<0.221	<1.118	N/A
Back Side	UMTS 1900	1.070	<0.221	<1.291	N/A
Back Side	LTE Band 5 (Cell)	0.336	<0.221	<0.557	N/A

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Table 11-8
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Top at 16 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	GSM 850	0.151	<0.770	<0.921	N/A
Top Edge	UMTS 850	0.124	<0.770	<0.894	N/A
Top Edge	GSM 1900	0.973	<0.770	See Note 1	<0.01
Top Edge	UMTS 1900	1.100	<0.770	See Note 1	<0.02
Top Edge	LTE Band 5 (Cell)	0.123	<0.770	<0.893	N/A

Table 11-9
Simultaneous Transmission Scenario with 5 GHz WLAN (Top at 16 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	GSM 850	0.151	<0.184	<0.335	N/A
Top Edge	UMTS 850	0.124	<0.184	<0.308	N/A
Top Edge	GSM 1900	0.973	<0.184	<1.157	N/A
Top Edge	UMTS 1900	1.100	<0.184	<1.284	N/A
Top Edge	LTE Band 5 (Cell)	0.123	<0.184	<0.307	N/A

Table 11-10
Simultaneous Transmission Scenario with Bluetooth (Top at 16 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	GSM 850	0.151	<0.182	<0.333	N/A
Top Edge	UMTS 850	0.124	<0.182	<0.306	N/A
Top Edge	GSM 1900	0.973	<0.182	<1.155	N/A
Top Edge	UMTS 1900	1.100	<0.182	<1.281	N/A
Top Edge	LTE Band 5 (Cell)	0.123	<0.182	<0.305	N/A

Note:

1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was not higher than 0.04 per FCC KDB 447498 D01v05. See Section 11.4 for detailed SPLS ratio analysis.
2. For SAR summations for body back at 15 mm, WLAN SAR values for 0.0 cm were used since the 0.0 cm test distance for WLAN was more conservative. “<” denotes that the 0.0 cm WLAN SAR values were used for summation purposes.
3. For SAR summations for body top at 16 mm, WLAN SAR values for 0.0 cm were used since the 0.0 cm test distance for WLAN was more conservative. “<” denotes that the 0.0 cm WLAN SAR values were used for summation purposes.
4. For SAR summation for left edge at 0 mm estimated Bluetooth LE SAR values were used since estimated Bluetooth LE SAR was more conservative than measured Bluetooth SAR.
5. The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Direct capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

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11.4 SPLSR Evaluation and Analysis

Per FCC KDB Publication 447498 D01v05, when the sum of the standalone transmitters is more than 1.6 W/kg, the SAR sum to peak locations can be analyzed to determine SAR distribution overlaps. When the SAR peak to location ratio (shown below) for each pair of antennas is ≤ 0.04, simultaneous SAR evaluation is not required. The distance between the transmitters was calculated using the following formula.

$$\text{Distance}_{Tx1-Tx2} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

$$\text{SPLS Ratio} = \frac{(SAR_1 + SAR_2)^{1.5}}{R_i}$$

The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with GPRS 850MHz antenna operating at limited output power with 2.4GHz.

Table 11-11
Peak SAR Locations for Body Back Side at 0 mm GPRS 850 MHz and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
GPRS 850	-15.00	75.00
802.11b	-4.80	-78.00

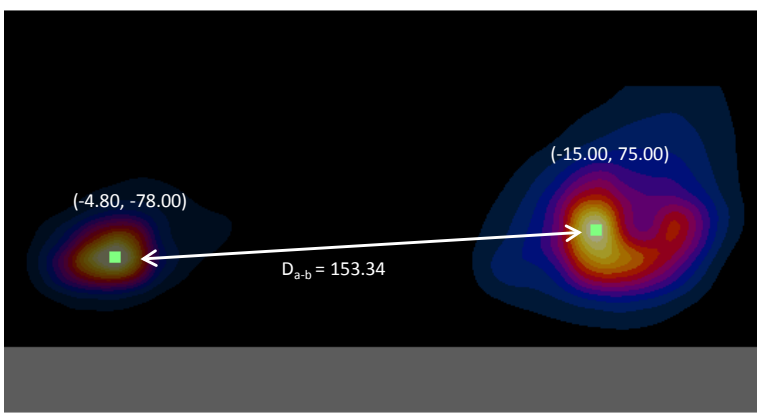

Figure 11-1
Peak SAR Locations of 2.4 GHz WLAN Antenna and GPRS 850 MHz

Table 11-12
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 850	802.11b	1.096	0.975	2.071	153.34	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 15 mm with GPRS 1900MHz antenna operating at maximum output power with 2.4GHz.

Table 11-13
Peak SAR Locations for Body Back Side at 15 mm GPRS 1900 MHz and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
GPRS 1900	-22.00	87.50
802.11b	-4.80	-78.00

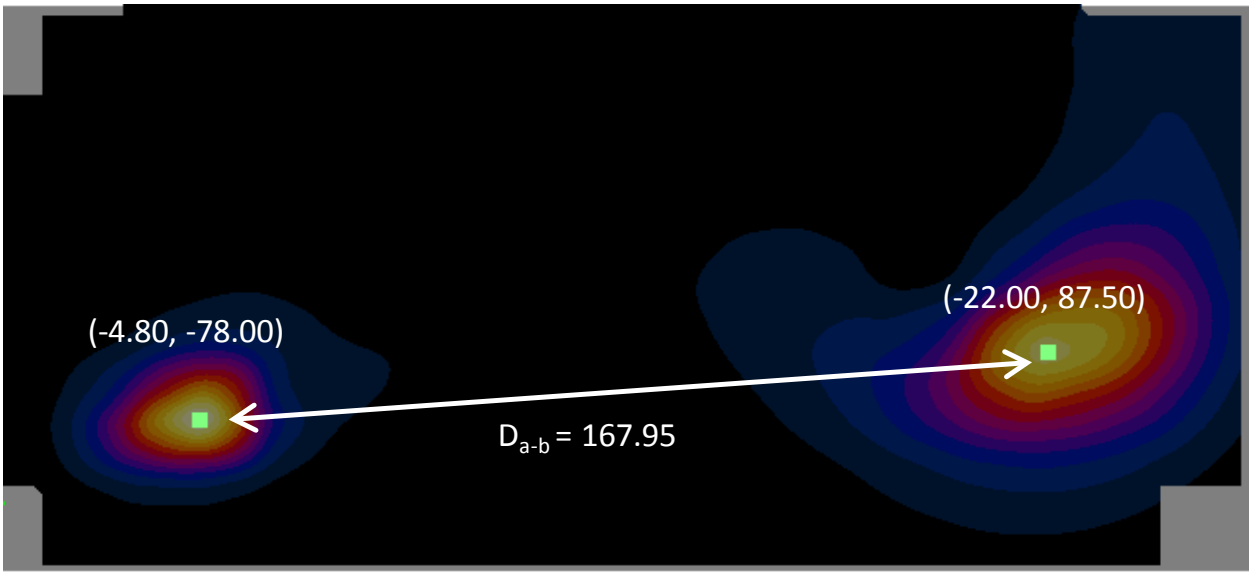

Figure 11-2
Peak SAR Locations of 2.4 GHz WLAN Antenna and GPRS 1900 MHz

Table 11-14
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900	802.11b	0.897	<0.975	<1.872	167.95	<0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with LTE Band 5 antenna operating at limited output power with 2.4GHz.

Table 11-15
Peak SAR Locations for Body Back Side at 0 mm LTE Band 5 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B5	-3.00	76.50
802.11b	-4.80	-78.00

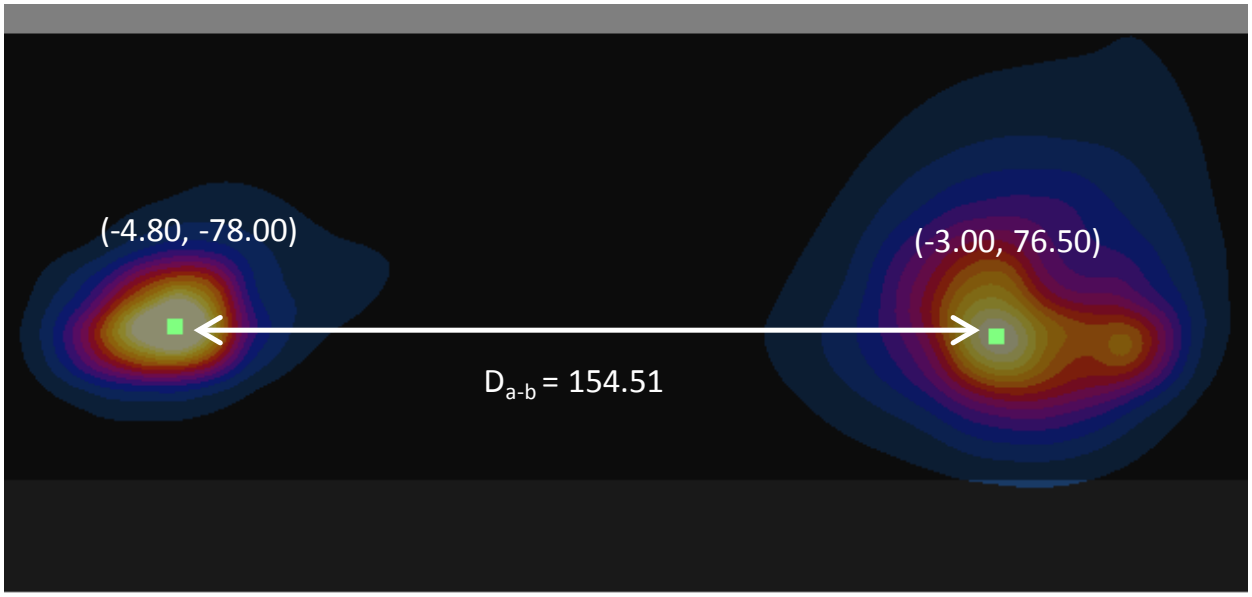

Figure 11-3
Peak SAR Locations of 2.4 GHz WLAN Antenna and LTE Band 5

Table 11-16
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE Band 5	802.11b	0.765	0.975	1.740	154.51	0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with UMTS 850MHz antenna operating at limited output power with 2.4GHz.

Table 11-17
Peak SAR Locations for Body Back Side at 0 mm UMTS 850 MHz and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
UMTS 850	-1.50	76.50
802.11b	-4.80	-78.00

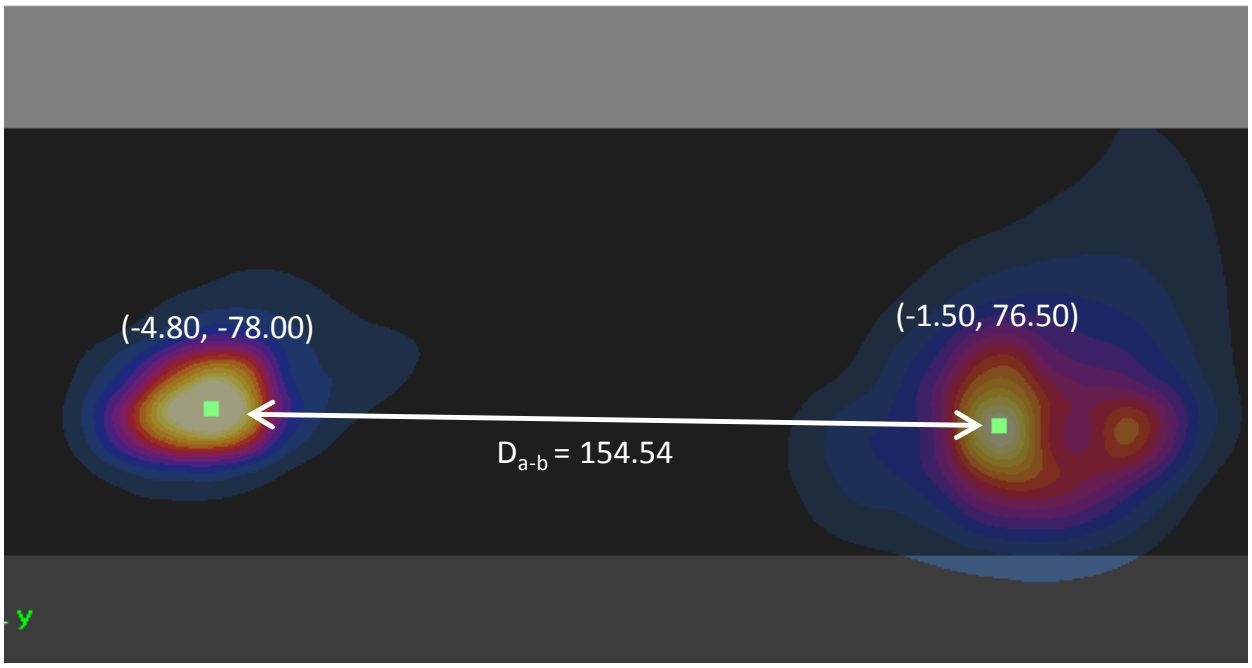

Figure 11-4
Peak SAR Locations of 2.4 GHz WLAN Antenna and UMTS 850 MHz

Table 11-18
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 850	802.11b	0.744	0.975	1.719	154.54	0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 15 mm with UMTS 1900MHz antenna operating at maximum output power with 2.4GHz.

Table 11-19
Peak SAR Locations for Body Back Side at 15 mm UMTS 1900 MHz and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
UMTS 1900	-2.00	78.00
802.11b	-4.80	-78.00

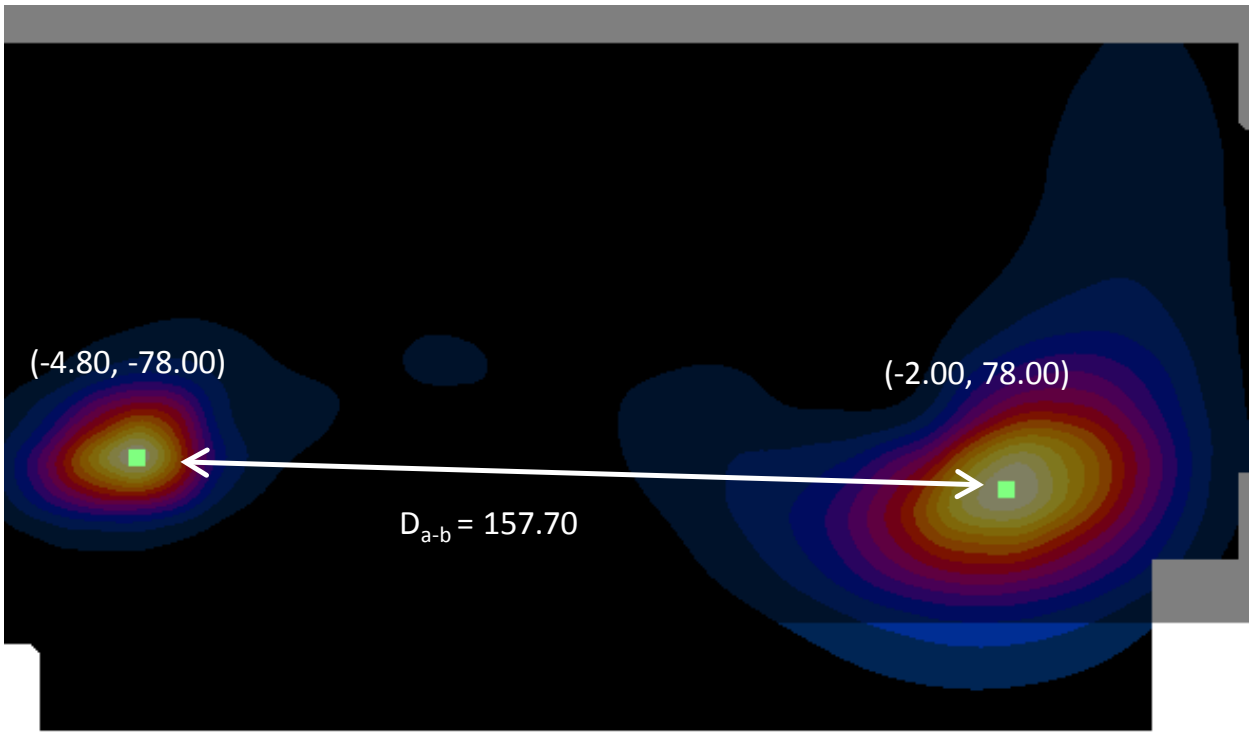

Figure 11-5
Peak SAR Locations of 2.4 GHz WLAN Antenna and UMTS 1900 MHz

Table 11-20
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 1900	802.11b	1.070	<0.975	<2.045	157.70	<0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with UMTS 1900MHz antenna operating at limited output power with 2.4GHz.

Table 11-21
Peak SAR Locations for Body Back Side at 0 mm UMTS 1900 MHz and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
UMTS 1900	-11.00	66.50
802.11b	-4.80	-78.00

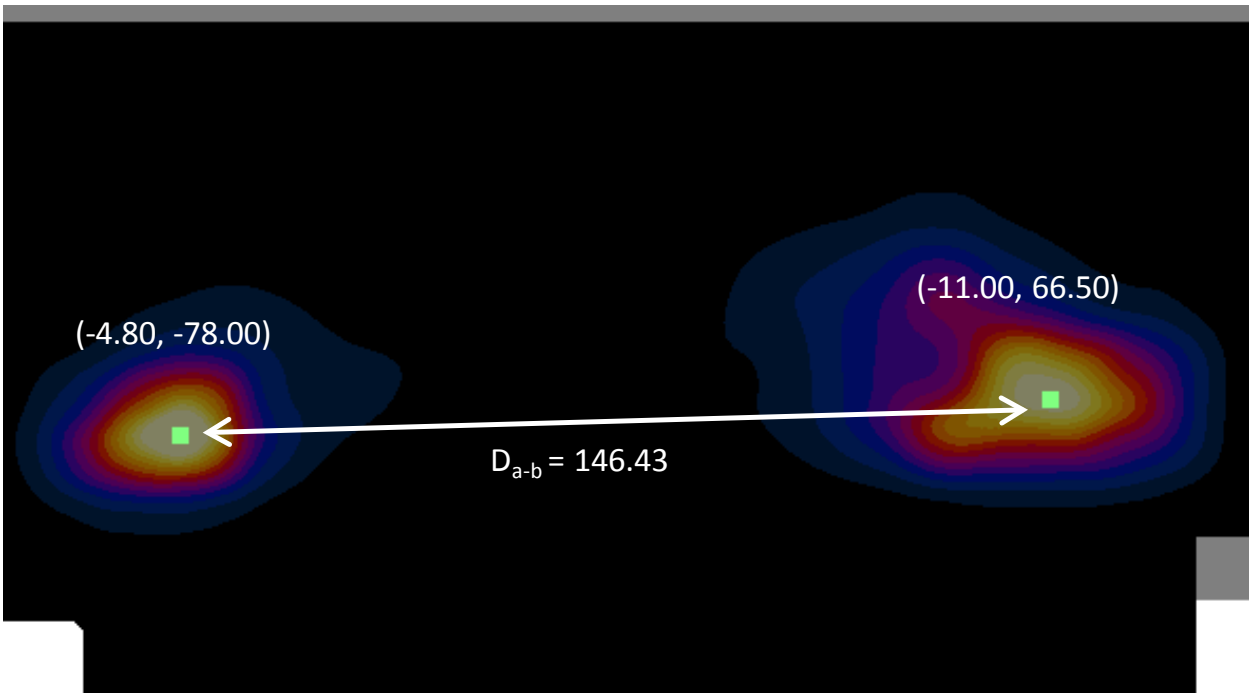

Figure 11-6
Peak SAR Locations of 2.4 GHz WLAN Antenna and UMTS 1900 MHz

Table 11-22
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 1900	802.11b	0.990	0.975	1.965	146.43	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 15 mm with GSM 850MHz antenna operating at maximum output power with 5GHz.

Table 11-23
Peak SAR Locations for Body Back Side at 15 mm GSM 850 MHz and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
GPRS 850	-3.00	76.50
802.11a	-27.00	-74.00

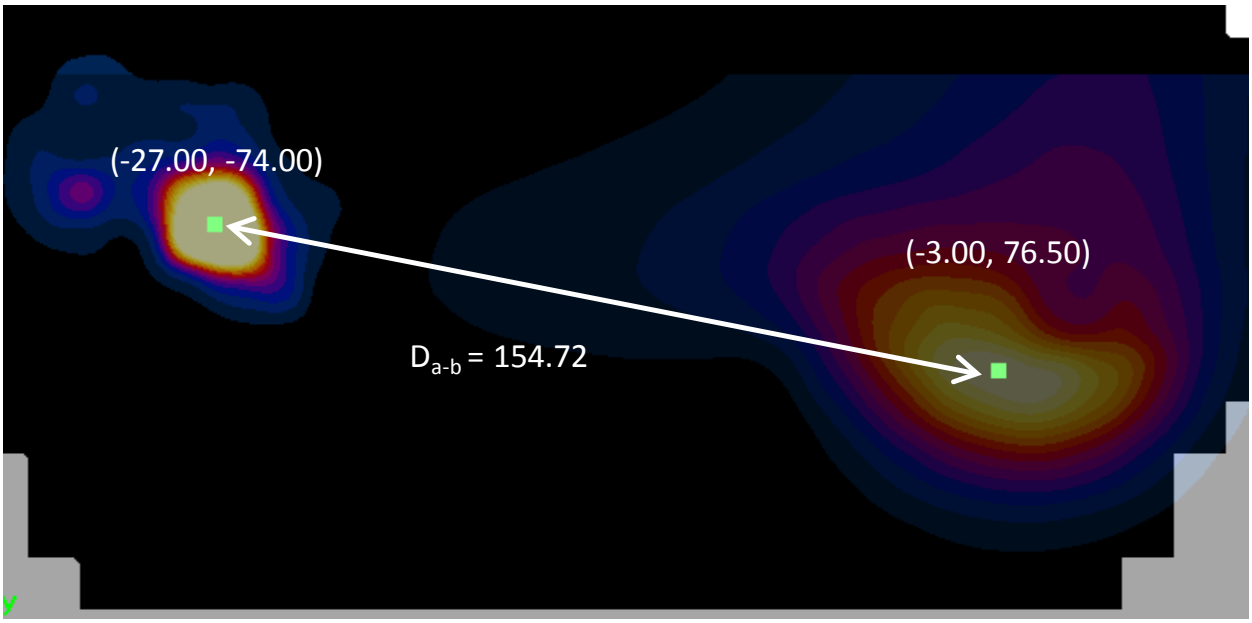

Figure 11-7
Peak SAR Locations of 5 GHz WLAN Antenna and GSM 850 MHz

Table 11-24
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 850	802.11a	0.627	<1.095	<1.722	154.72	<0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 15 mm with GSM 1900MHz antenna operating at maximum output power with 5GHz.

Table 11-25
Peak SAR Locations for Body Back Side at 15 mm GSM 1900 MHz and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
GPRS 1900	-22.00	87.50
802.11a	-27.00	-74.00

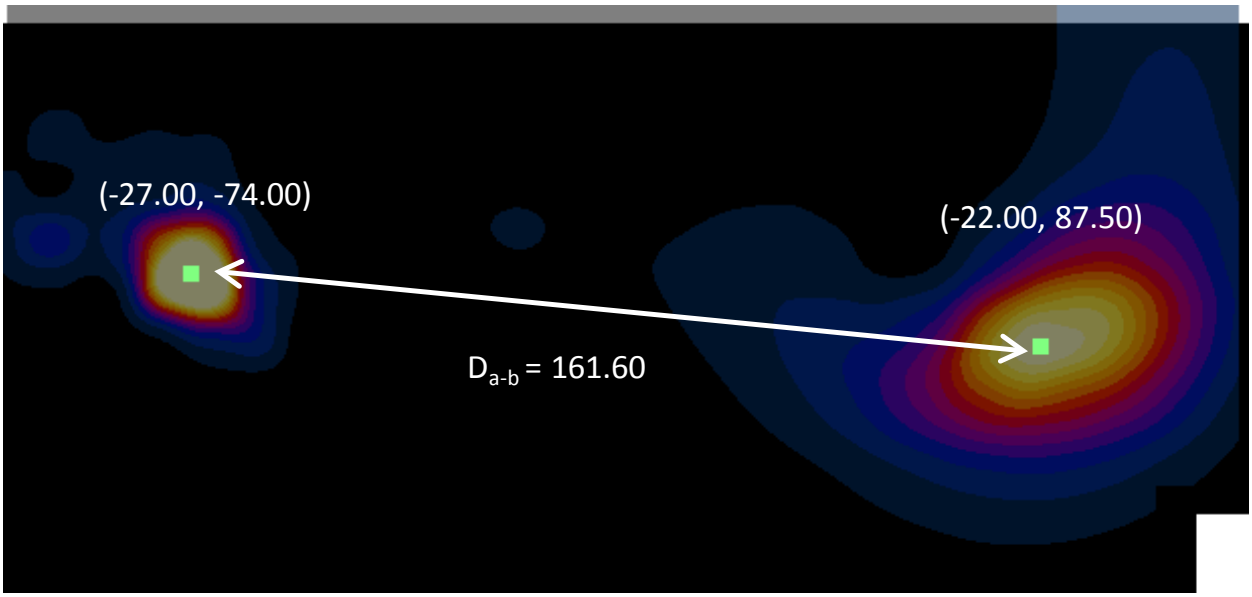

Figure 11-8
Peak SAR Locations of 5 GHz WLAN Antenna and GSM 1900 MHz

Table 11-26
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900	802.11a	0.897	<1.095	<1.992	161.60	<0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 15 mm with UMTS 1900MHz antenna operating at maximum output power with 5GHz.

Table 11-27
Peak SAR Locations for Body Back Side at 15 mm UMTS 1900 MHz and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
UMTS 1900	-2.00	78.00
802.11a	-27.00	-74.00

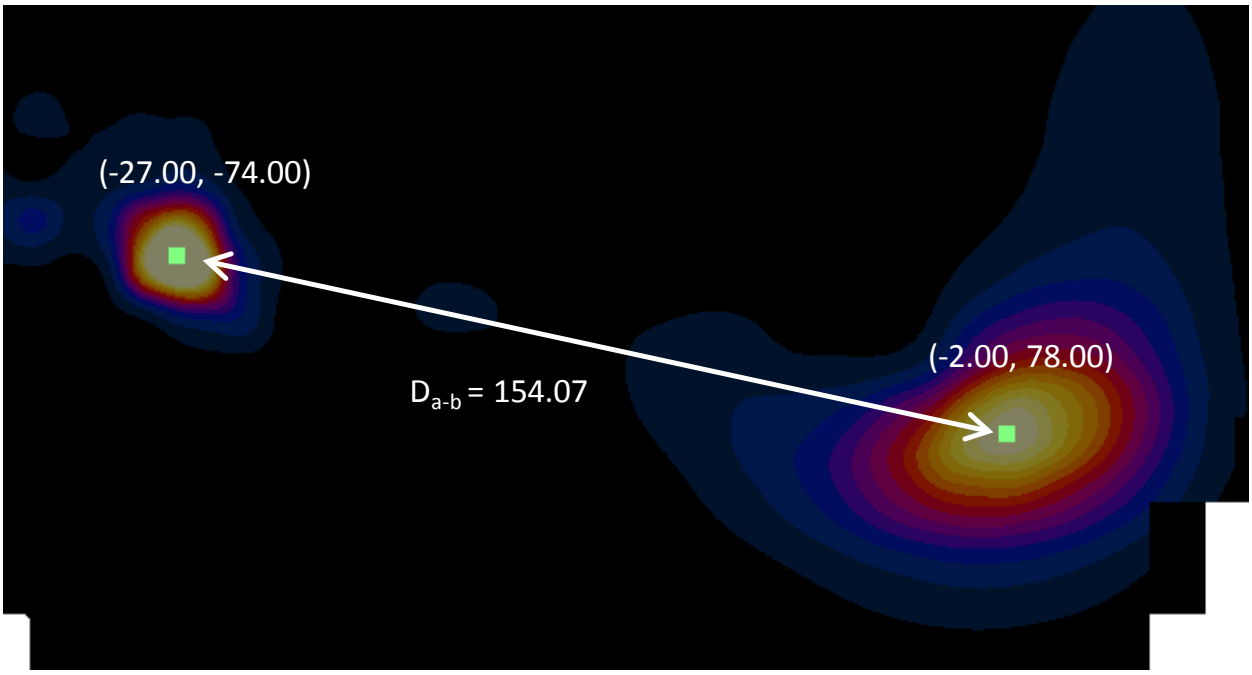

Figure 11-9
Peak SAR Locations of 5 GHz WLAN Antenna and UMTS 1900 MHz

Table 11-28
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 1900	802.11a	1.070	<1.095	<2.165	154.07	<0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with UMTS 1900MHz antenna operating at limited output power with 5GHz.

Table 11-29
Peak SAR Locations for Body Back Side at 0 mm UMTS 1900 MHz and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
UMTS 1900	-11.00	66.50
802.11a	-27.00	-74.00

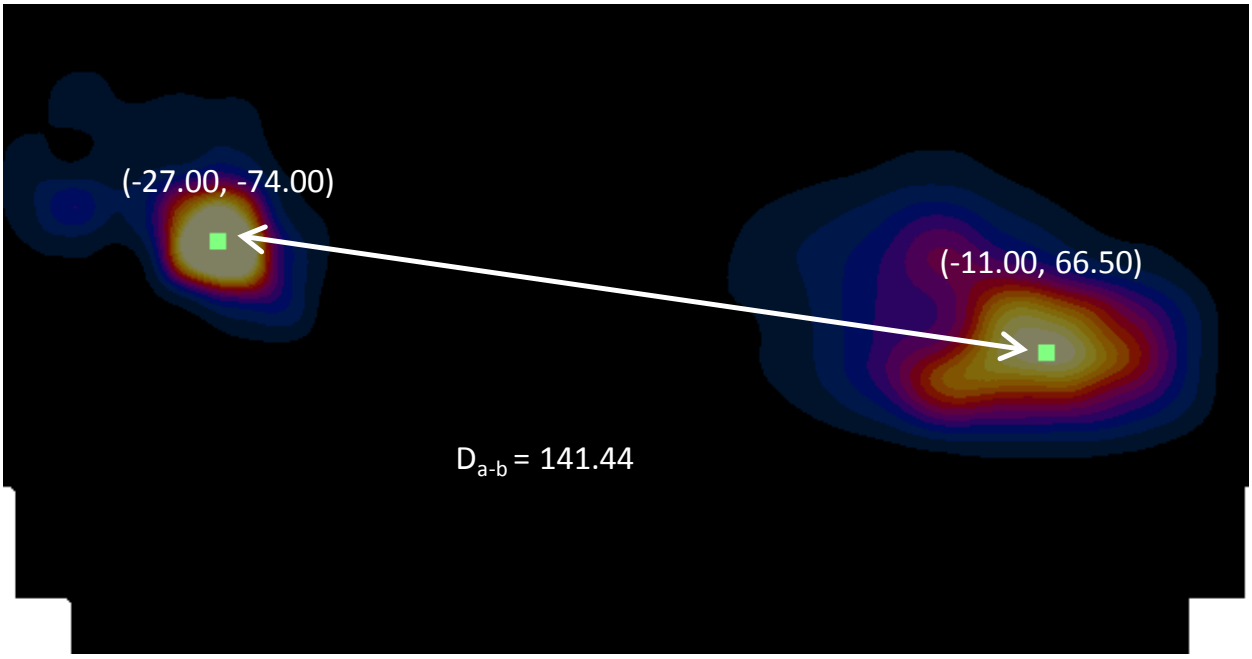

Figure 11-10
Peak SAR Locations of 5 GHz WLAN Antenna and UMTS 1900 MHz

Table 11-30
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 1900	802.11a	0.990	1.095	2.085	141.44	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with UMTS 850MHz antenna operating at limited output power with 5GHz.

Table 11-31
Peak SAR Locations for Body Back Side at 0 mm UMTS 850 MHz and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
UMTS 850	-1.50	76.50
802.11a	-27.00	-74.00

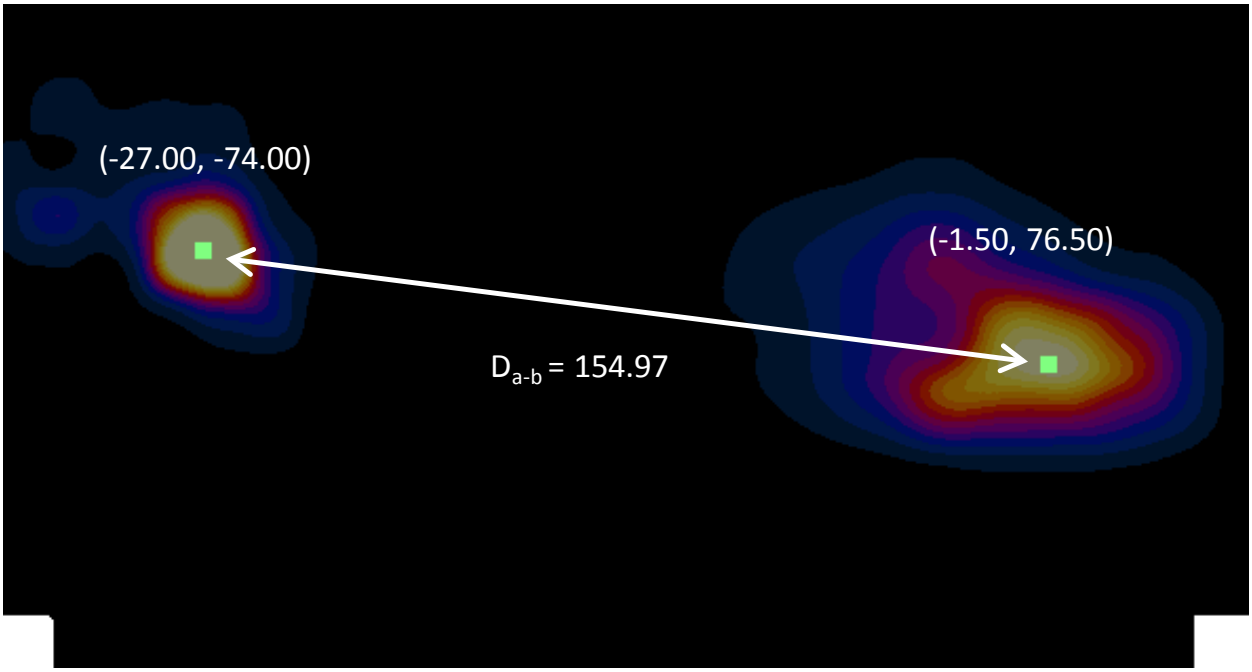

Figure 11-11
Peak SAR Locations of 5 GHz WLAN Antenna and UMTS 850 MHz

Table 11-32
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 850	802.11a	0.744	1.095	1.839	154.97	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with GSM 850MHz antenna operating at limited output power with 5GHz.

Table 11-33
Peak SAR Locations for Body Back Side at 0 mm GSM 850 MHz and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
GPRS 850	-15.00	75.00
802.11a	-27.00	-74.00

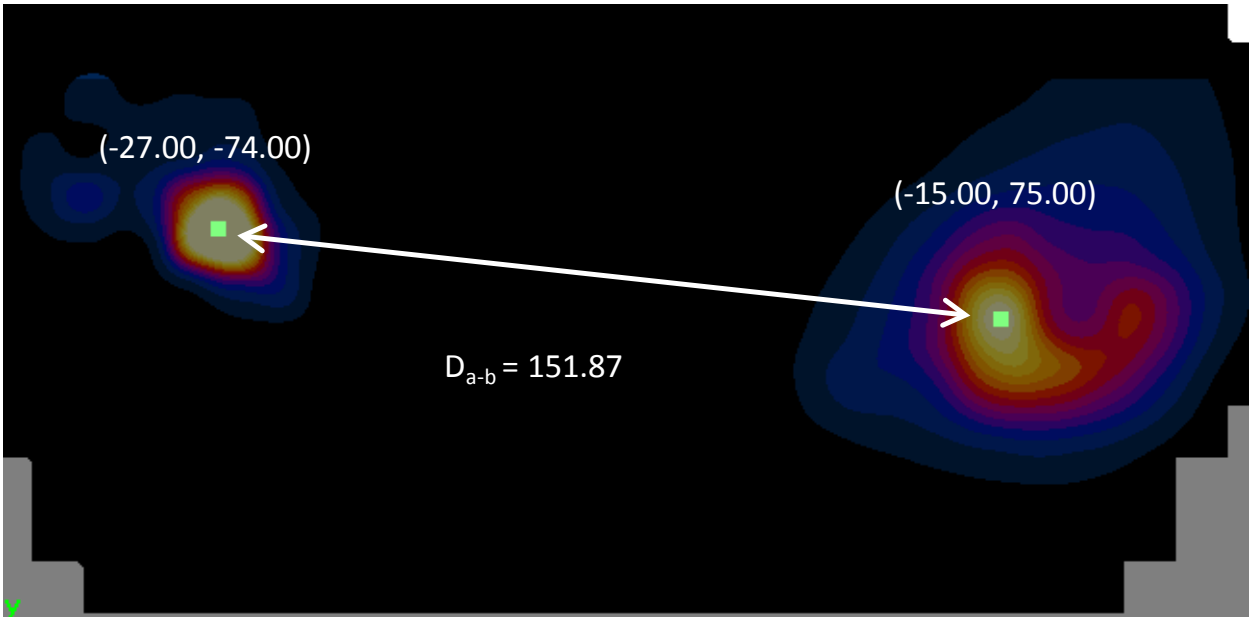

Figure 11-12
Peak SAR Locations of 5 GHz WLAN Antenna and GSM 850 MHz

Table 11-34
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 850	802.11a	1.096	1.095	2.191	151.87	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 0 mm with LTE Band 5 antenna operating at limited output power with 5GHz.

Table 11-35
Peak SAR Locations for Body Back Side at 0 mm LTE Band 5 and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B5	-3.00	76.50
802.11a	-27.00	-74.00

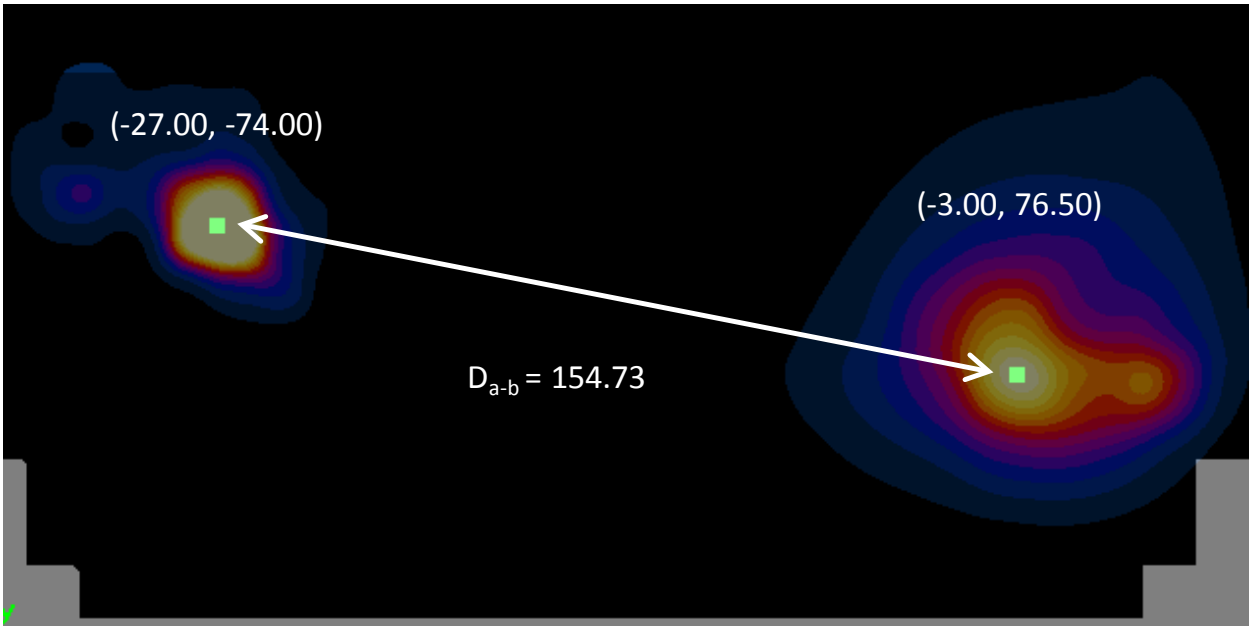

Figure 11-13
Peak SAR Locations of 5 GHz WLAN Antenna and LTE Band 5

Table 11-36
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE Band 5	802.11a	0.765	1.095	1.860	154.73	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body top edge configuration at a separation distance of 16 mm with GSM 1900MHz antenna operating at maximum output power with 2.4GHz.

Table 11-37
Peak SAR Locations for Body Top Edge at 16 mm GSM 1900 MHz and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
GPRS 1900	-16.50	92.00
802.11b	-4.50	-76.80

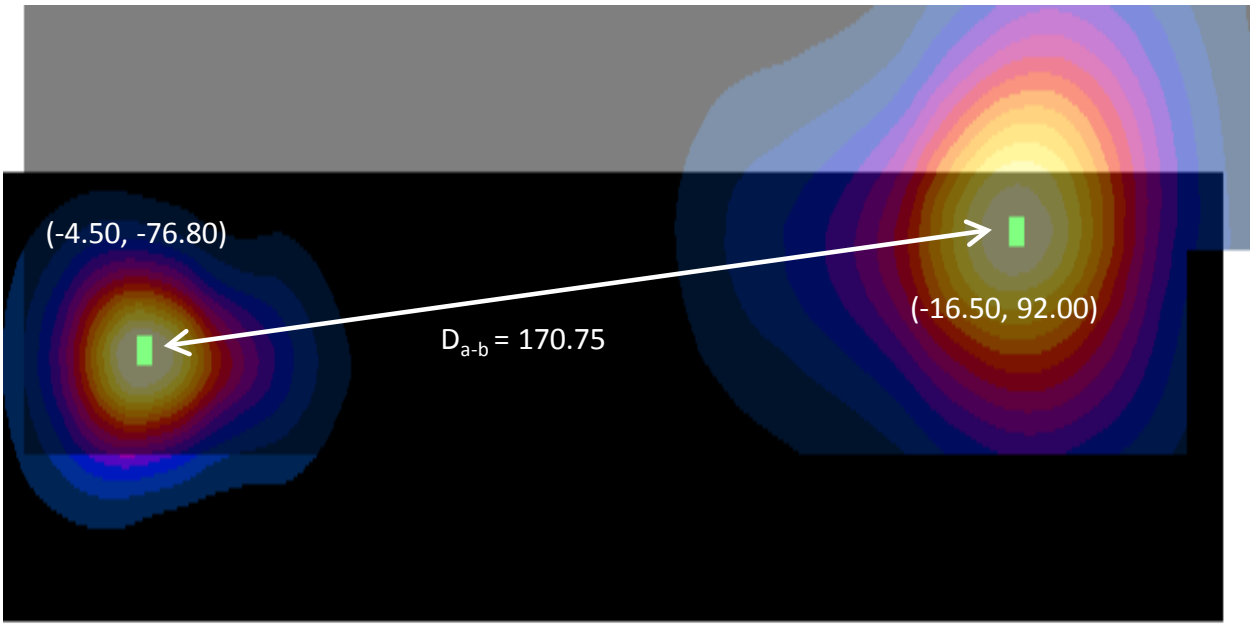

Figure 11-14
Peak SAR Locations of 2.4 GHz WLAN Antenna and GSM 1900 MHz

Table 11-38
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900	802.11b	0.973	<0.770	<1.743	170.75	<0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body top edge configuration at a separation distance of 16 mm with UMTS 1900MHz antenna operating at maximum output power with 2.4GHz.

Table 11-39
Peak SAR Locations for Body Top Edge at 16 mm UMTS 1900 MHz and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
UMTS 1900	-17.00	91.00
802.11b	-4.50	-76.80

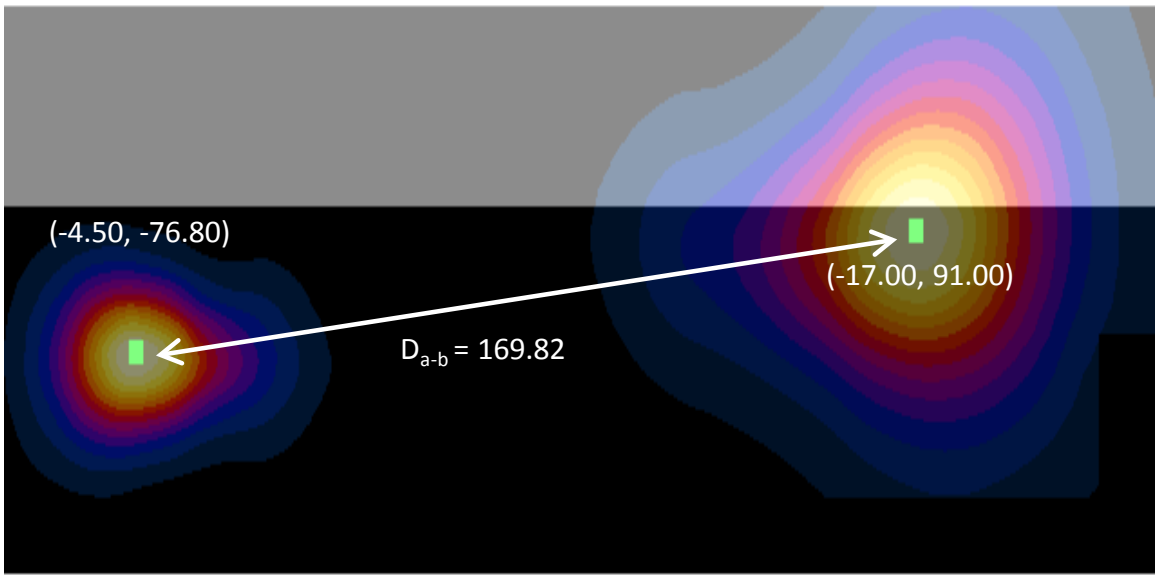

Figure 11-15
Peak SAR Locations of 2.4 GHz WLAN Antenna and UMTS 1900 MHz

Table 11-40
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 1900	802.11b	1.100	<0.770	<1.870	169.82	<0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body back side configuration at a separation distance of 15 mm with GPRS 850MHz antenna operating at maximum output power with 2.4GHz.

Table 11-41
Peak SAR Locations for Body Back Side at 15 mm GPRS 850 MHz and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
GPRS 850	-3.00	76.50
802.11b	-4.80	-78.00

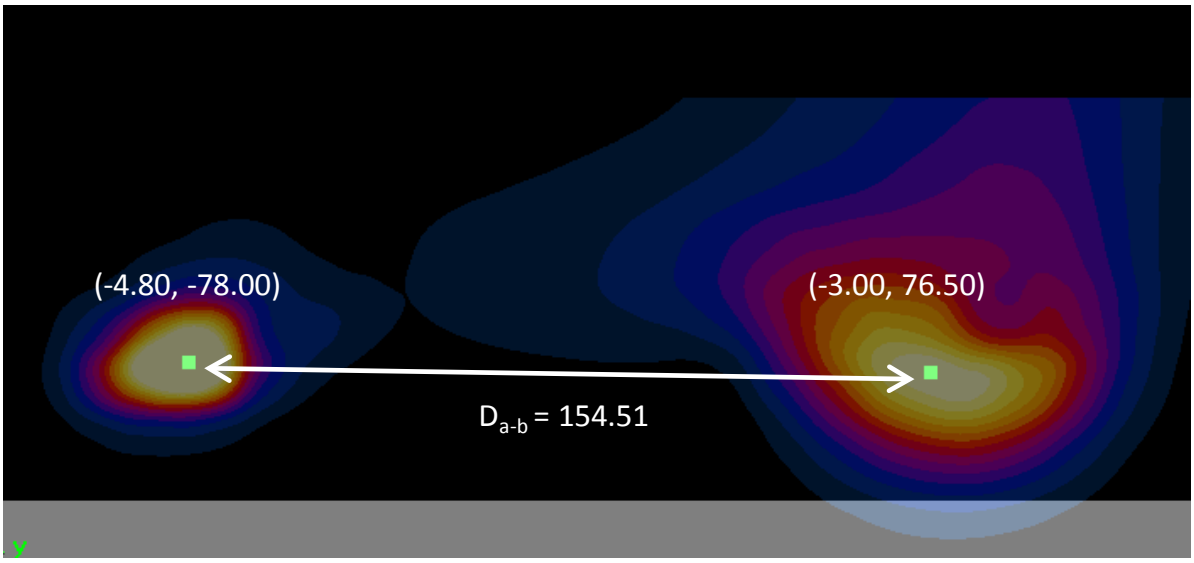

Figure 11-16
Peak SAR Locations of 2.4 GHz WLAN Antenna and GPRS 850 MHz

Table 11-42
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 850	802.11b	0.627	<0.975	<1.602	154.51	<0.01

11.5 Simultaneous Transmission Conclusion

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

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12 SAR MEASUREMENT VARIABILITY

12.1 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 12-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS															
Band	FREQUENCY		Mode	Service	# of Time Slots	Data Rate (Mbps)	Side	Spacing	Measured SAR(1g)	1st Repeated SAR(1g)	Ratio	2nd Repeated SAR(1g)	Ratio	3rd Repeated SAR(1g)	Ratio
	MHz	Ch.							(W/kg)	(W/kg)		(W/kg)		(W/kg)	
835	824.20	128	GSM 850	GPRS	3	N/A	back	0 mm	0.970	0.974	1.00	N/A	N/A	N/A	N/A
1900	1852.40	9262	UMTS 1900	RMC	N/A	N/A	top	16 mm	1.100	1.090	1.01	N/A	N/A	N/A	N/A
2450	2462.00	11	IEEE 802.11b	DSSS	N/A	1	back	0 mm	0.903	0.902	1.00	N/A	N/A	N/A	N/A
5800	5805.00	161	IEEE 802.11a	OFDM	N/A	6	back	0 mm	0.901	0.895	1.01	N/A	N/A	N/A	N/A
5300	5280.00	56	IEEE 802.11a	OFDM	N/A	6	back	0 mm	0.819	0.816	1.00	N/A	N/A	N/A	N/A
5500	5520.00	104	IEEE 802.11a	OFDM	N/A	6	back	0 mm	1.030	1.020	1.01	N/A	N/A	N/A	N/A
5600	5580.00	116	IEEE 802.11a	OFDM	N/A	6	back	0 mm	1.020	1.010	1.01	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						

Per KDB Publication 865664 D01v01r03, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements.

12.2 Measurement Uncertainty

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

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13 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	E5515C	Wireless Communications Test Set	10/18/2012	Biennial	10/18/2014	GB43193563
Agilent	85070C	Dielectric Probe Kit	2/14/2013	Annual	2/14/2014	MY44300633
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/16/2013	Annual	4/16/2014	MY45470194
Agilent	8753E	(30kHz-6GHz) Network Analyzer	4/16/2013	Annual	4/16/2014	JP38020182
Agilent	8648D	(9kHz-4GHz) Signal Generator	4/17/2013	Annual	4/17/2014	3629U00687
Agilent	8753E	(30kHz-6GHz) Network Analyzer	7/23/2013	Annual	7/23/2014	US37390350
Agilent	N5182A	MXG Vector Signal Generator	10/28/2013	Annual	10/28/2014	US46240505
Agilent	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Agilent	8753ES	S-Parameter Network Analyzer	10/29/2013	Annual	10/29/2014	US39170122
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00579
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Amplifier Research	5S1G4	5W, 800MHz-4.2GHz	CBT	N/A	CBT	21910
Anritsu	ML2438A	Power Meter	2/14/2013	Annual	2/14/2014	1190013
Anritsu	MA2481A	Power Sensor	2/14/2013	Annual	2/14/2014	5318
Anritsu	MT8820C	Radio Communication Analyzer	6/28/2013	Annual	6/28/2014	6201240328
Anritsu	ML2495A	Power Meter	10/31/2013	Annual	10/31/2014	1039008
Anritsu	MA2411B	Pulse Power Sensor	11/14/2013	Annual	11/14/2014	1126066
Anritsu	MA24106A	USB Power Sensor	1/3/2014	Annual	1/3/2015	1349501
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
Control Company	4353	Long Stem Thermometer	9/25/2012	Biennial	9/25/2014	122541143
Fisher Scientific	15-077-960	Thermometer	11/6/2012	Biennial	11/6/2014	122640025
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/30/2013	Annual	10/30/2014	1833460
Gigatronics	8651A	Universal Power Meter	10/30/2013	Annual	10/30/2014	8650319
L-Com	HG824-11LP	Log Periodic Antenna	CBT	N/A	CBT	N/A
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	NRVD	Dual Channel Power Meter	10/12/2012	Biennial	10/12/2014	101695
Rohde & Schwarz	NRV-Z32	Peak Power Sensor	10/12/2012	Biennial	10/12/2014	836019/013
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	2/8/2013	Annual	2/8/2014	101699
Rohde & Schwarz	SMIQ03B	Signal Generator	4/17/2013	Annual	4/17/2014	DE27259
Rohde & Schwarz	CMU200	Base Station Simulator	5/3/2013	Annual	5/3/2014	836371/0079
Rohde & Schwarz	SME06	Signal Generator	10/30/2013	Annual	10/30/2014	832026
Rohde & Schwarz	NRVS	Single Channel Power Meter	10/31/2013	Annual	10/31/2014	835360/0079
Seekonk	NC-100	Torque Wrench (8" lb)	11/29/2011	Triennial	11/29/2014	21053
SPEAG	D1900V2	1900 MHz SAR Dipole	2/6/2013	Annual	2/6/2014	5d148
SPEAG	D5GHzV2	5 GHz SAR Dipole	2/14/2013	Annual	2/14/2014	1120
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
SPEAG	D835V2	835 MHz SAR Dipole	4/25/2013	Annual	4/25/2014	4d119
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/18/2013	Annual	8/18/2014	1008
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/21/2013	Annual	8/21/2014	1322
SPEAG	ES3DV2	SAR Probe	8/22/2013	Annual	8/22/2014	3022
SPEAG	D2450V2	2450 MHz SAR Dipole	8/23/2013	Annual	8/23/2014	719
SPEAG	EX3DV4	SAR Probe	10/23/2013	Annual	10/23/2014	3914
SPEAG	DAK-3.5	Dielectric Assessment Kit	11/13/2013	Annual	11/13/2014	1091
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/19/2013	Annual	11/19/2014	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/19/2013	Annual	11/19/2014	1408
SPEAG	ES3DV3	SAR Probe	11/22/2013	Annual	11/22/2014	3333
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/17/2013	Annual	4/17/2014	B010177
VWR	36934-158	Wall-Mounted Thermometer	8/8/2013	Annual	8/8/2014	130477877

Note:

1. CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.
2. Each equipment item was used solely within its respective calibration period.
3. Agilent S-parameter Test Set (S/N 2904A00579) set does not require individual calibration since it is calibrated as part of the VNA system (Agilent 8753E Network Analyzer).
4. Agilent Wireless Connectivity Test Set (S/N GB46170464) was used to set up and maintain a connection only. All measurements were made with calibrated equipment.

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14 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

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Applicable for frequencies up to 6 GHz.

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	**IEEE 1528 Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i 1gm**	**c_i 10 gms**	**1gm u_i (± %)**	**10gms u_i (± %)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.55	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	1.0	1.0	1.3	1.3	∞
Boundary Effect	E.2.3	0.4	N	1	1.0	1.0	0.4	0.4	∞
Linearity	E.2.4	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	E.2.5	5.1	N	1	1.0	1.0	5.1	5.1	∞
Readout Electronics	E.2.6	1.0	N	1	1.0	1.0	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E.6.3	2.9	R	1.73	1.0	1.0	1.7	1.7	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	1.0	R	1.73	1.0	1.0	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	6.0	N	1	1.0	1.0	6.0	6.0	287
Device Holder Uncertainty	E.4.1	3.32	R	1.73	1.0	1.0	1.9	1.9	∞
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E.3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)			RSS				12.4	12.0	299
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				24.7	24.0	

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

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15 CONCLUSION

15.1 Measurement Conclusion

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

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

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

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

[30] 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.

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APPENDIX A: SAR TEST DATA

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PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT535; Type: Portable Tablet; Serial: 2014-7

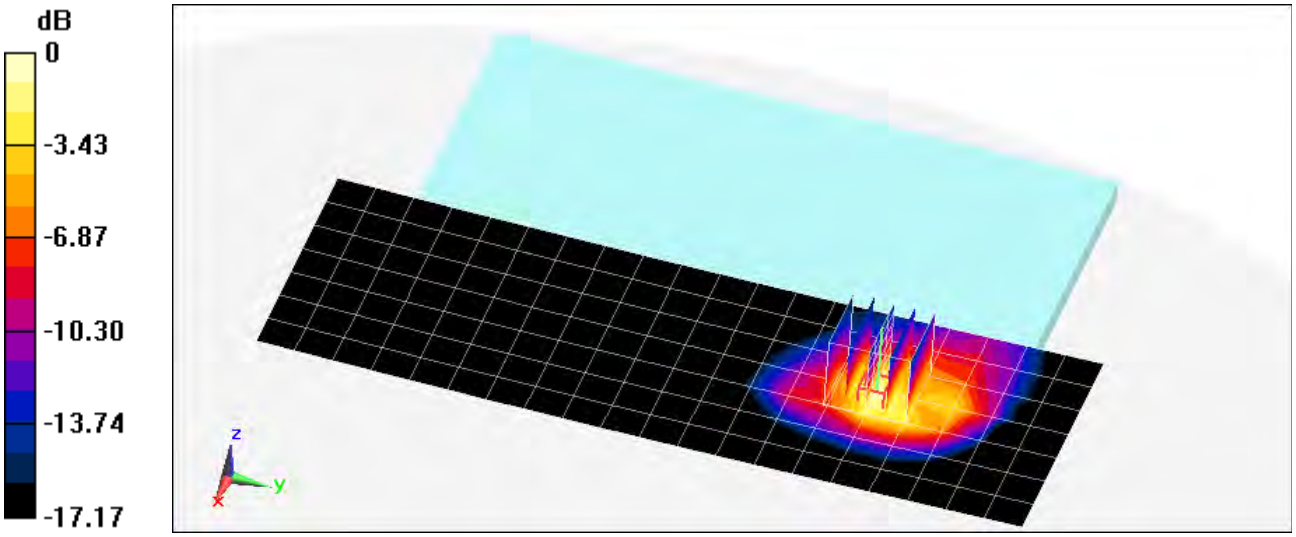
Communication System: UID 0, GSM GPRS; 3 Tx slots; Frequency: 824.2 MHz;Duty Cycle: 1:2.76
Medium: 835 Body Medium parameters used (interpolated):
f = 824.2 MHz; σ = 0.968 S/m; ε_r = 52.953; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 01-27-2014; Ambient Temp: 23.4°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3333; ConvF(6.07, 6.07, 6.07); Calibrated: 11/22/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 11/19/2013
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

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

Area Scan (8x21x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 33.828 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 2.18 W/kg
SAR(1 g) = 0.974 W/kg



0 dB = 1.09 W/kg = 0.37 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT535; Type: Portable Tablet; Serial: 2014-7

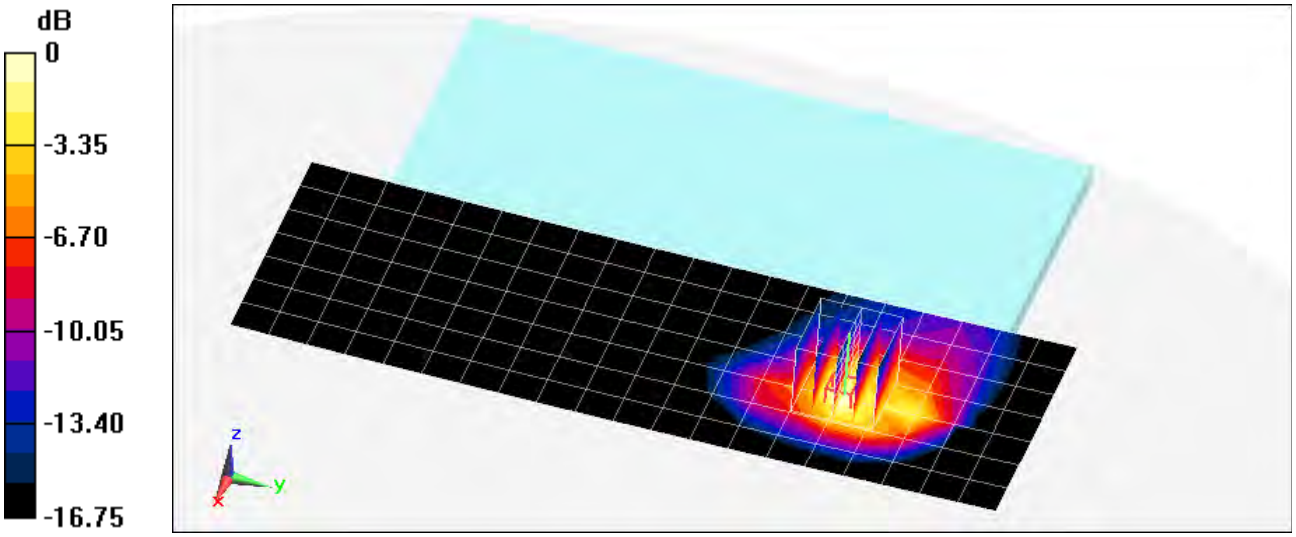
Communication System: UID 0, UMTS; Frequency: 836.6 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.979 S/m; ε_r = 52.814; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 01-27-2014; Ambient Temp: 23.4°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3333; ConvF(6.07, 6.07, 6.07); Calibrated: 11/22/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 11/19/2013
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

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

Area Scan (8x21x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 29.201 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 1.54 W/kg
SAR(1 g) = 0.719 W/kg



0 dB = 0.828 W/kg = -0.82 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT535; Type: Portable Tablet; Serial: 2014-2

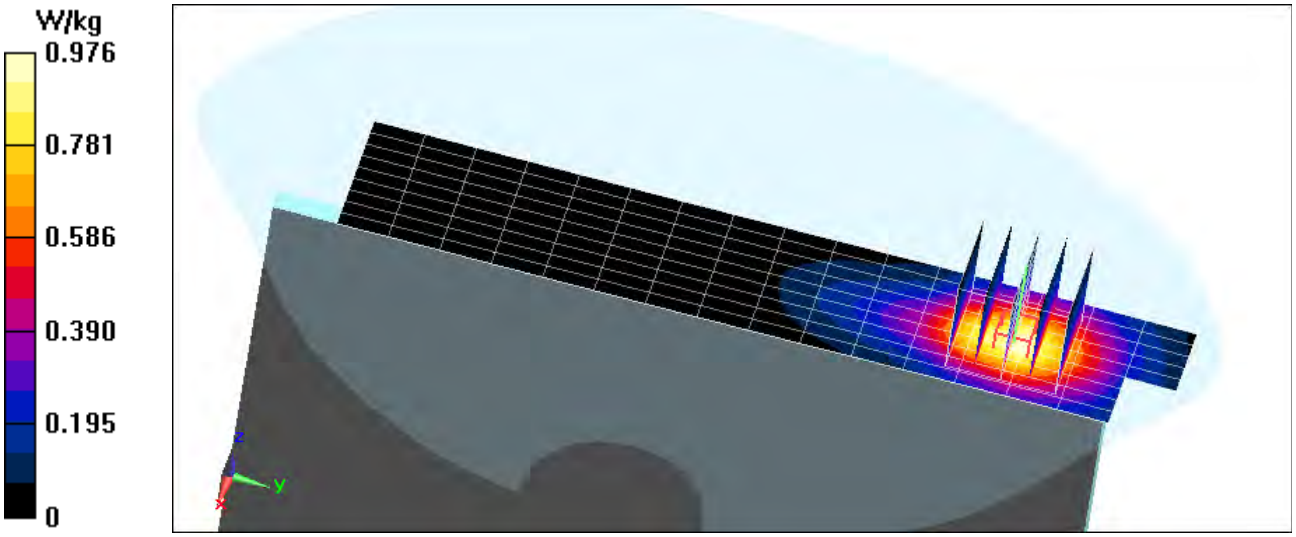
Communication System: UID 0, GSM GPRS; 4 Tx slots; Frequency: 1850.2 MHz;Duty Cycle: 1:2.076
Medium: 1900 Body Medium parameters used:
f = 1850.2 MHz; σ = 1.512 S/m; ε_r = 51.169; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.6 cm

Test Date: 01-27-2014; Ambient Temp: 23.0°C; Tissue Temp: 22.2°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/22/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/21/2013
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: GPRS 1900, Body SAR, Top Edge, Low.ch, 4 Tx Slots

Area Scan (9x17x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.311 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 1.50 W/kg
SAR(1 g) = 0.961 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT535; Type: Portable Tablet; Serial: 2014-3

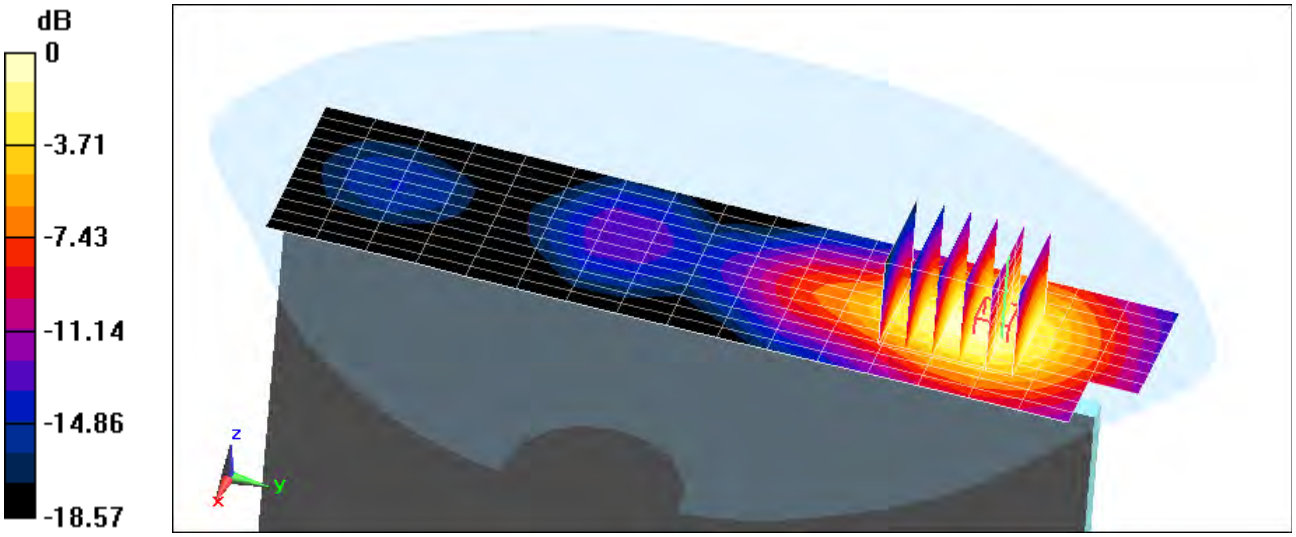
Communication System: UID 0, UMTS; Frequency: 1852.4 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used:
f = 1852.4 MHz; σ = 1.515 S/m; ε_r = 51.163; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.6 cm

Test Date: 01-27-2014; Ambient Temp: 23.0°C; Tissue Temp: 22.2°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/22/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/21/2013
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: UMTS 1900, Body SAR, Top Edge, Low.ch

Area Scan (13x18x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.157 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.74 W/kg
SAR(1 g) = 1.1 W/kg



0 dB = 1.13 W/kg = 0.53 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT535; Type: Portable Tablet; Serial: 2014-4

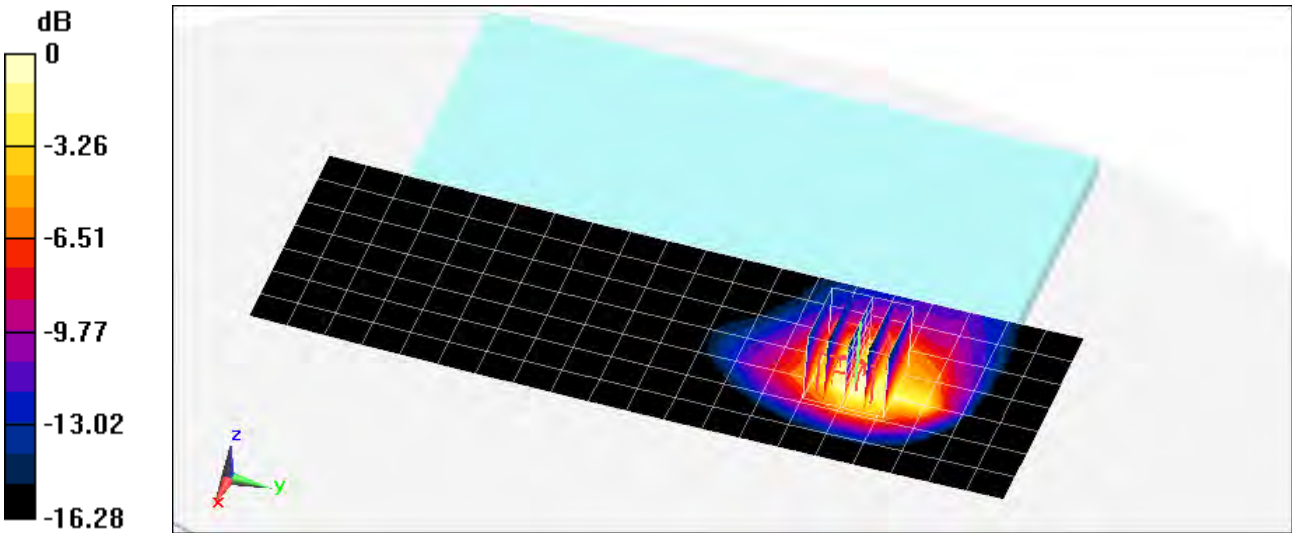
Communication System: UID 0, LTE Band 5 (Cell.); Frequency: 836.5 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.5 MHz; σ = 0.979 S/m; ε_r = 52.815; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 01-27-2014; Ambient Temp: 23.4°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3333; ConvF(6.07, 6.07, 6.07); Calibrated: 11/22/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 11/19/2013
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: LTE Band 5 (Cell.), Body SAR, Back side, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 49 RB Offset

Area Scan (8x21x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 28.732 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.58 W/kg
SAR(1 g) = 0.741 W/kg



0 dB = 0.790 W/kg = -1.02 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT535; Type: Portable Tablet; Serial: 2014-5

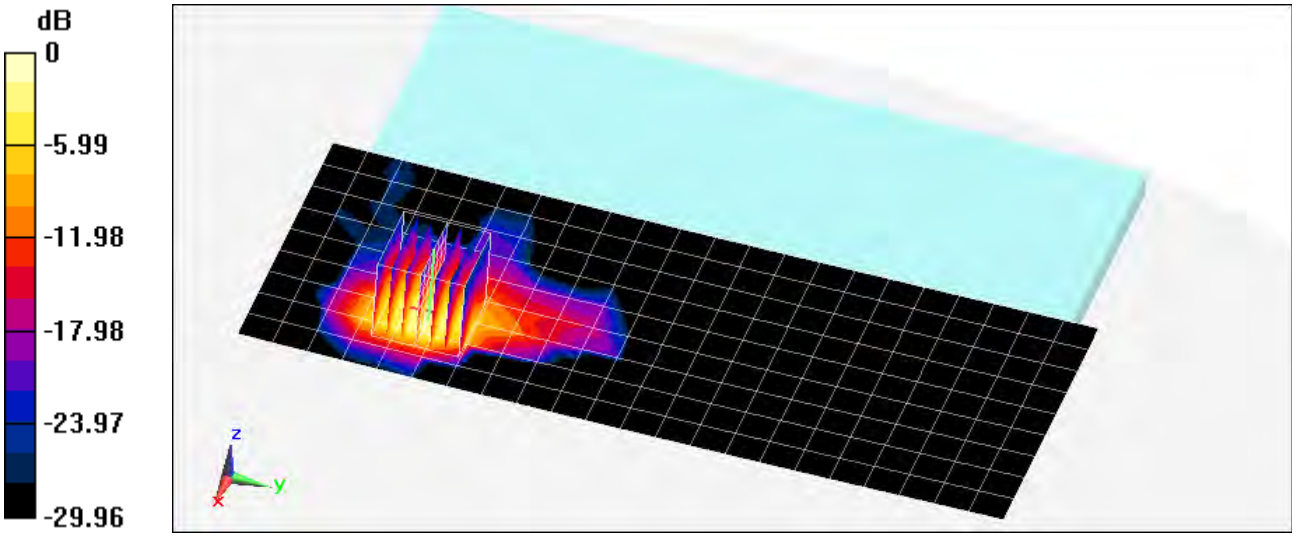
Communication System: UID 0, Bluetooth; Frequency: 2480 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2480 MHz; σ = 2.076 S/m; ε_r = 51.25; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 02-03-2014; Ambient Temp: 24.4°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3209; ConvF(4.34, 4.34, 4.34); Calibrated: 3/15/2013;
Sensor-Surface: 3mm (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: Bluetooth, Body SAR, Ch 78, 1 Mbps, Back Side

Area Scan (10x23x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.400 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.505 W/kg
SAR(1 g) = 0.199 W/kg



0 dB = 0.285 W/kg = -5.45 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT535; Type: Portable Tablet; Serial: 2014-5

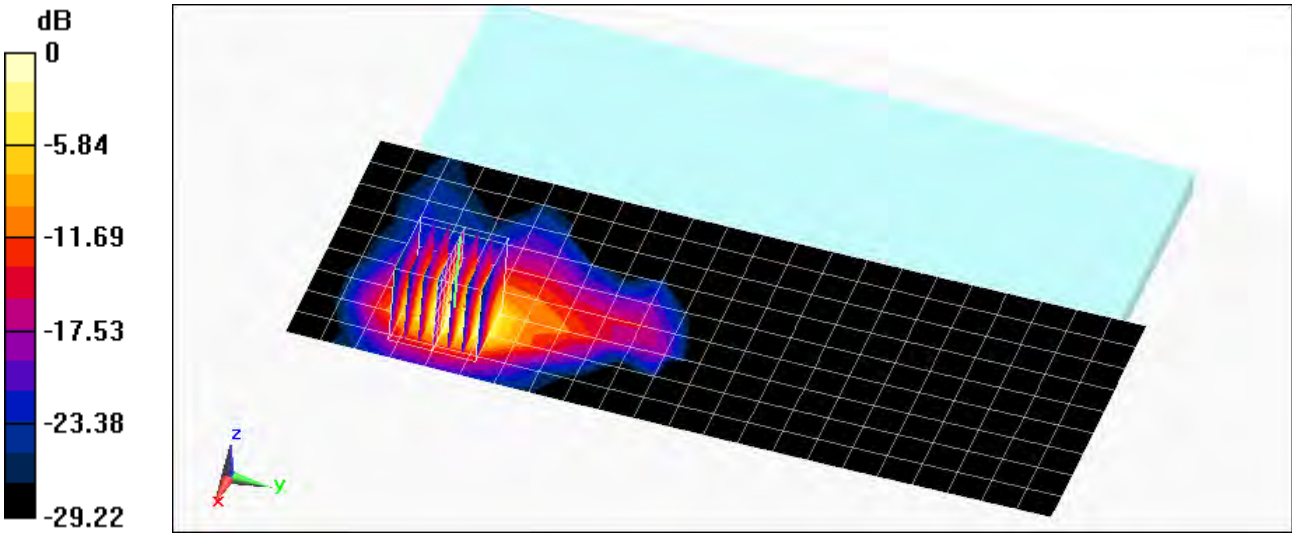
Communication System: UID 0, IEEE 802.11b; Frequency: 2462 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2462 MHz; σ = 2.002 S/m; ε_r = 51.155; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 01-28-2014; Ambient Temp: 21.5°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3209; ConvF(4.34, 4.34, 4.34); Calibrated: 3/15/2013;
Sensor-Surface: 3mm (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: IEEE 802.11b, Body SAR, Ch 06, 1 Mbps, Back Side

Area Scan (10x23x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 19.663 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 2.30 W/kg
SAR(1 g) = 0.903 W/kg



0 dB = 1.20 W/kg = 0.79 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT535; Type: Portable Tablet; Serial: 2014-3

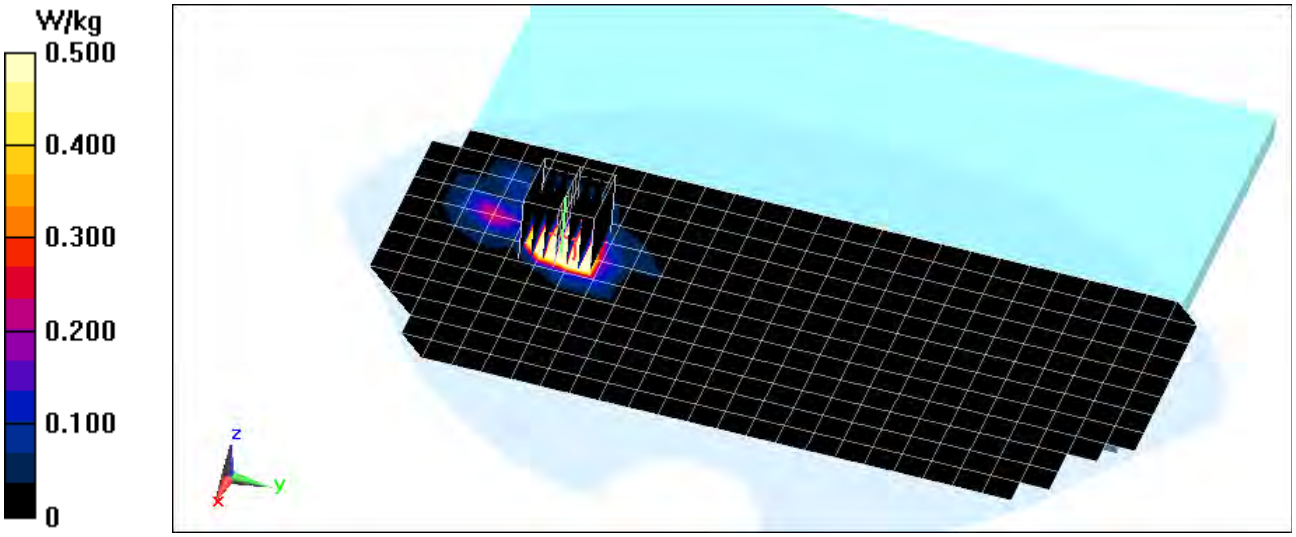
Communication System: UID 0, IEEE 802.11a; Frequency: 5805 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5805 MHz; σ = 6.264 S/m; ε_r = 46.01; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 01-30-2014; Ambient Temp: 24.4°C; Tissue Temp: 22.2°C

Probe: EX3DV4 - SN3914; ConvF(4.14, 4.14, 4.14); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 161, 6 Mbps, Back Side

Area Scan (13x27x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 10.933 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 5.94 W/kg
SAR(1 g) = 0.901 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT535; Type: Portable Tablet; Serial: 2014-3

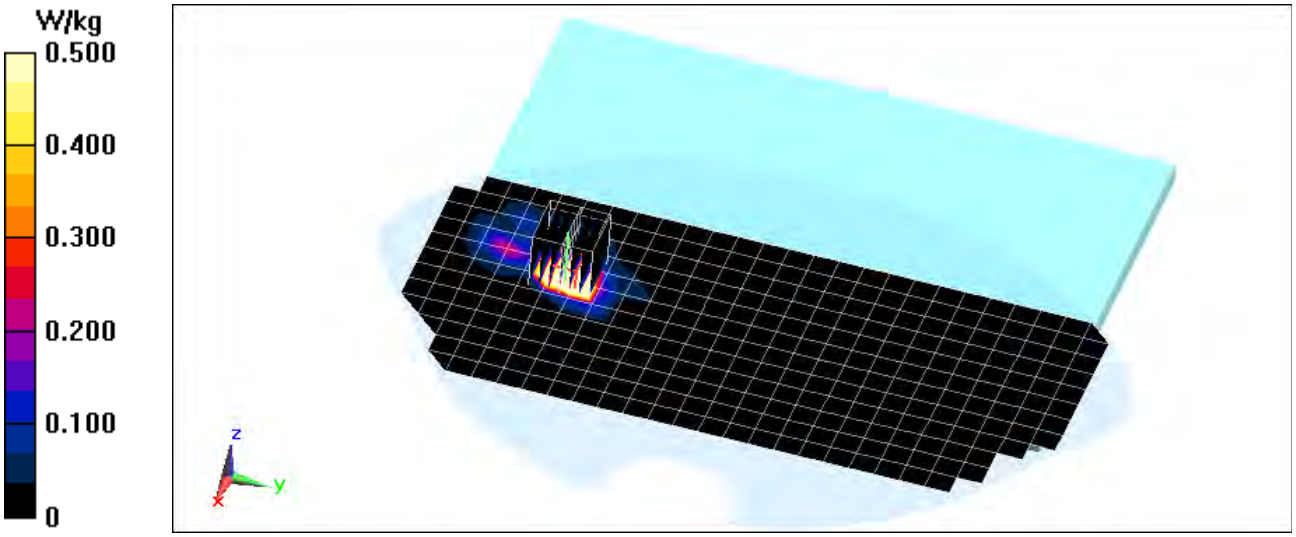
Communication System: UID 0, IEEE 802.11a; Frequency: 5520 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5520 MHz; σ = 5.827 S/m; ε_r = 46.739; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 0.0 cm

Test Date: 01-30-2014; Ambient Temp: 24.3°C; Tissue Temp: 22.1°C

Probe: EX3DV4 - SN3914; ConvF(4.07, 4.07, 4.07); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.5-5.7 GHz, Body SAR, Ch 104, 6 Mbps, Back Side

Area Scan (13x27x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 12.314 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 6.29 W/kg
SAR(1 g) = 1.03 W/kg



APPENDIX B: SYSTEM VERIFICATION

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PCTEST ENGINEERING LABORATORY, INC.

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

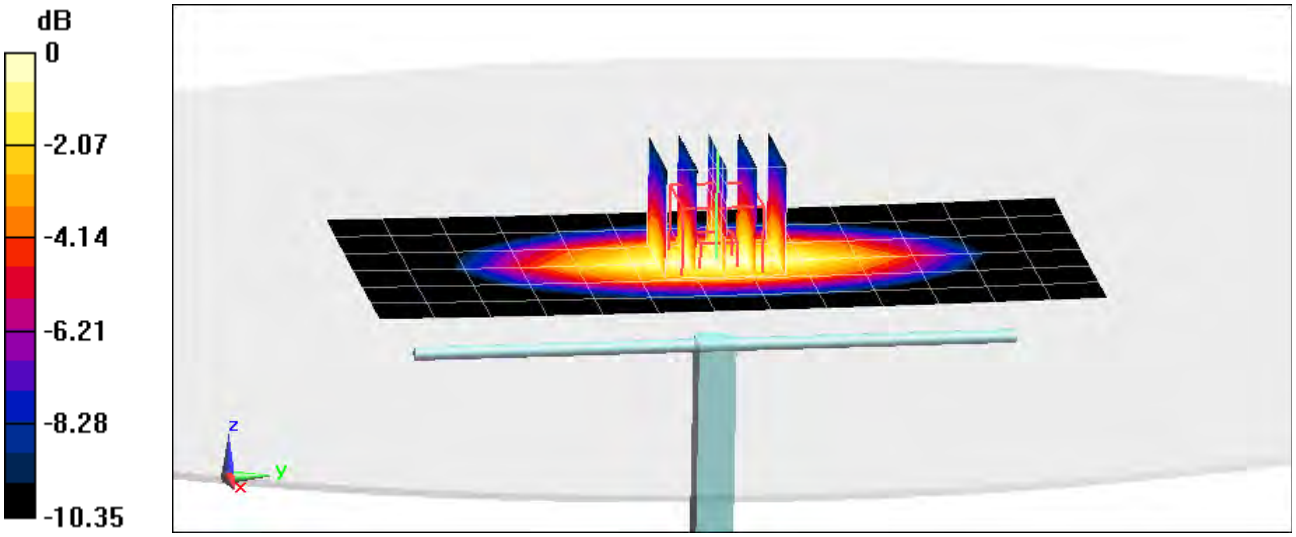
Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used:
f = 835 MHz; σ = 0.977 S/m; ε_r = 52.829; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.5 cm

Test Date: 01-27-2014; Ambient Temp: 23.4°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3333; ConvF(6.07, 6.07, 6.07); Calibrated: 11/22/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 11/19/2013
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

835 MHz System Verification

Area Scan (7x14x1): 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) = 1.41 W/kg
SAR(1 g) = 0.961 W/kg
Deviation: 0.73%



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

PCTEST ENGINEERING LABORATORY, INC.

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

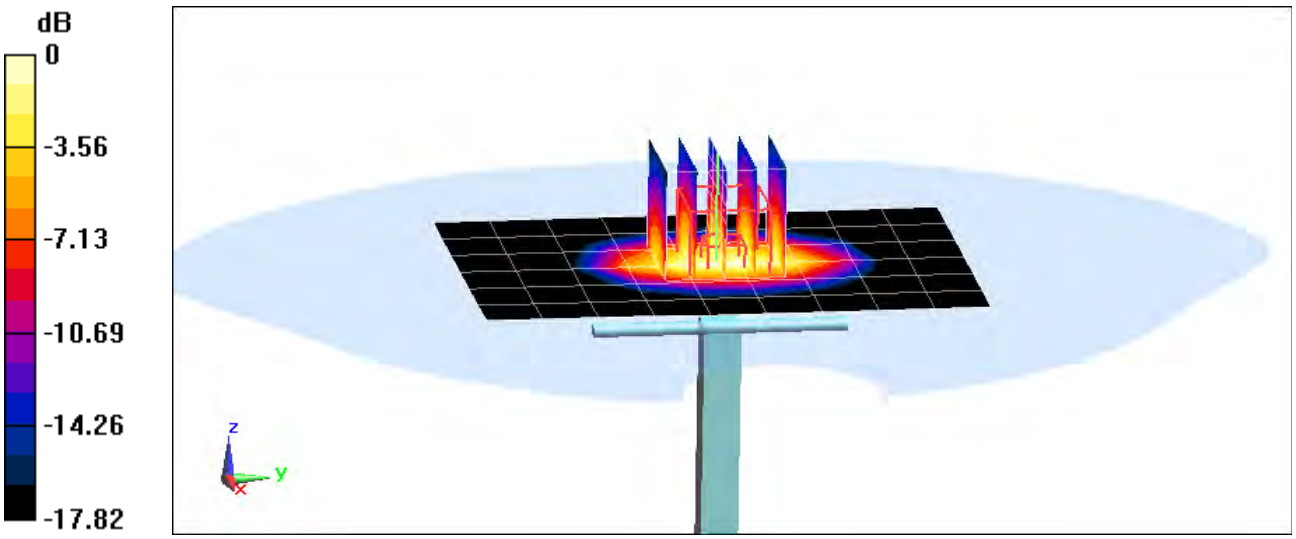
Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.567 S/m; ε_r = 50.987; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 01-27-2014; Ambient Temp: 23.0°C; Tissue Temp: 22.2°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/22/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/21/2013
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
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) = 7.04 W/kg
SAR(1 g) = 3.92 W/kg
Deviation: -3.92%



0 dB = 4.38 W/kg = 6.41 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

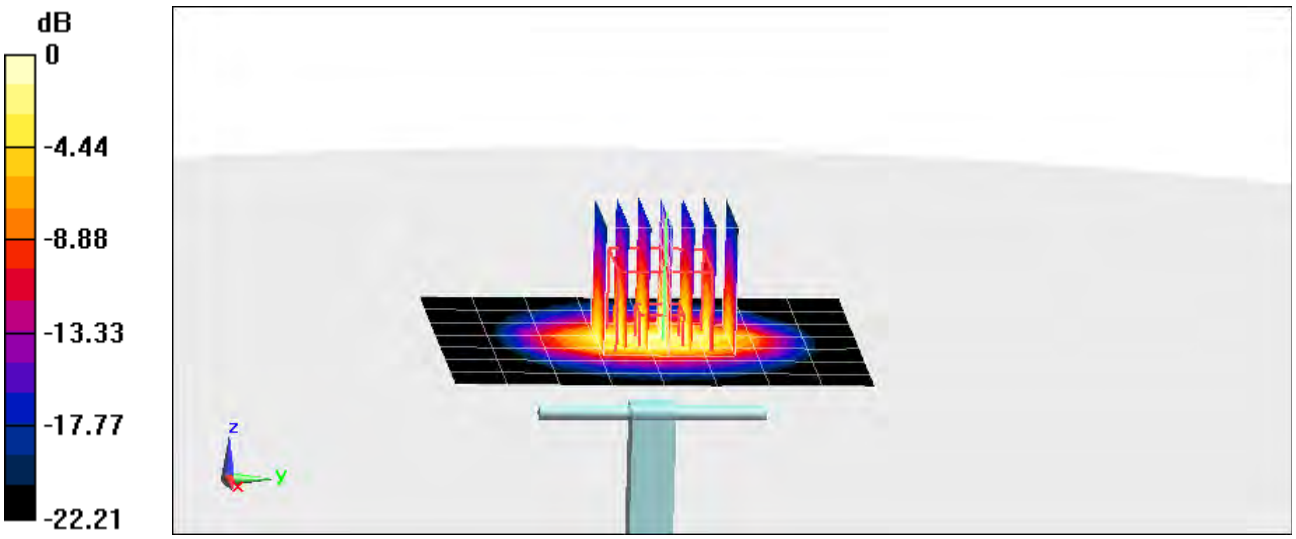
Communication System: UID 0, CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used:
f = 2450 MHz; σ = 2.039 S/m; ε_r = 51.366; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 02-03-2014; Ambient Temp: 24.4°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3209; ConvF(4.34, 4.34, 4.34); Calibrated: 3/15/2013;
Sensor-Surface: 3mm (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)

2450 MHz System Verification

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power: 20 dBm (100 mW)
Peak SAR (extrapolated) = 10.6 W/kg
SAR(1 g) = 5.05 W/kg
Deviation: -2.32%



0 dB = 6.63 W/kg = 8.22 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

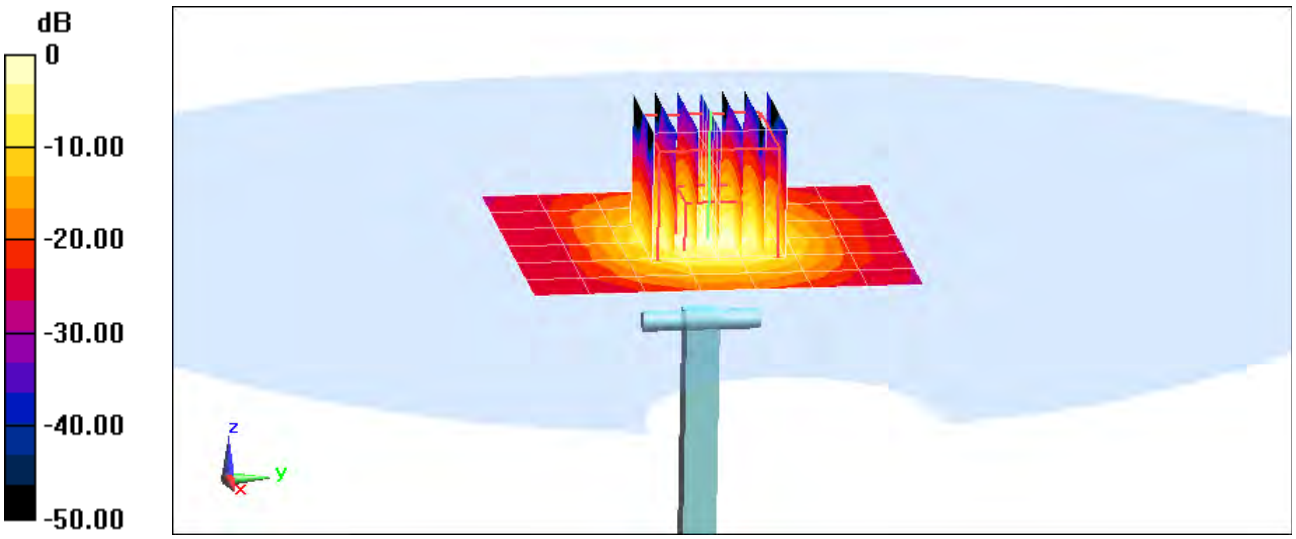
Communication System: UID 0, CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5200 MHz; σ = 5.345 S/m; ε_r = 47.515; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 01-30-2014; Ambient Temp: 24.2°C; Tissue Temp: 22.0°C

Probe: EX3DV4 - SN3914; ConvF(4.52, 4.52, 4.52); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

5200 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power: 20 dBm (100 mW)
Peak SAR (extrapolated) = 33.1 W/kg
SAR(1 g) = 7.84 W/kg
Deviation: 2.35%



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

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5300 MHz; σ = 5.494 S/m; ε_r = 47.274; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

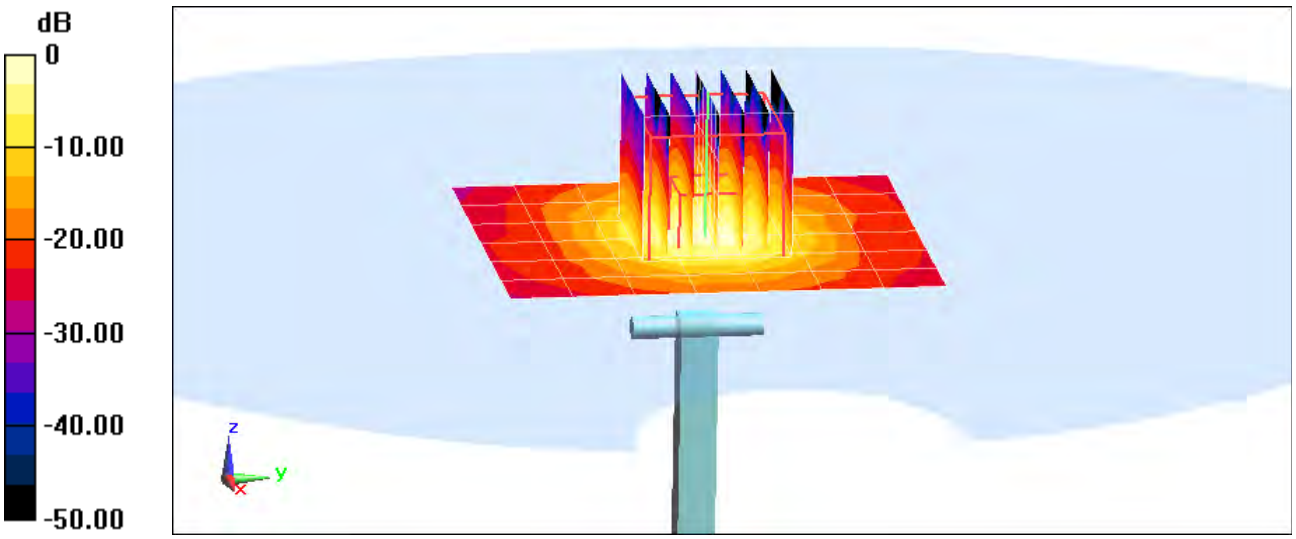
Test Date: 01-30-2014; Ambient Temp: 24.2°C; Tissue Temp: 22.1°C

Probe: EX3DV4 - SN3914; ConvF(4.32, 4.32, 4.32); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

5300 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power: 20 dBm (100 mW)
Peak SAR (extrapolated) = 34.6 W/kg

SAR(1 g) = 7.80 W/kg
Deviation: 1.56%



0 dB = 20.1 W/kg = 13.03 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

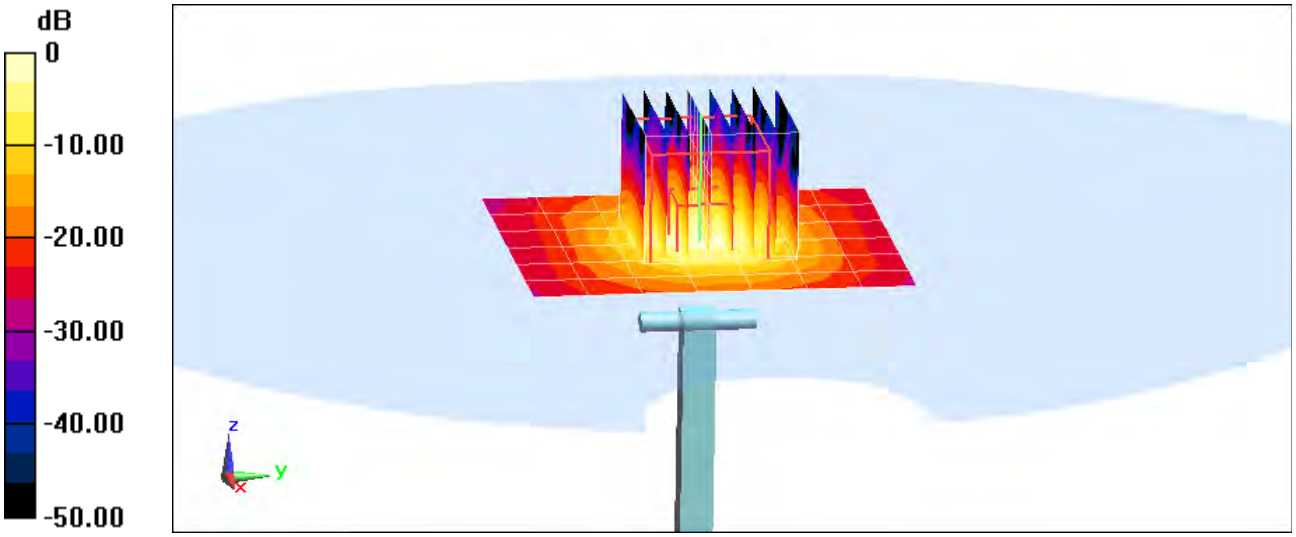
Communication System: UID 0, CW; Frequency: 5500 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5500 MHz; σ = 5.8 S/m; ε_r = 46.765; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 01-30-2014; Ambient Temp: 24.3°C; Tissue Temp: 22.1°C

Probe: EX3DV4 - SN3914; ConvF(4.07, 4.07, 4.07); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

5500 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power: 20 dBm (100 mW)
Peak SAR (extrapolated) = 35.9 W/kg
SAR(1 g) = 7.65 W/kg
Deviation: -4.14%



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

PCTEST ENGINEERING LABORATORY, INC.

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

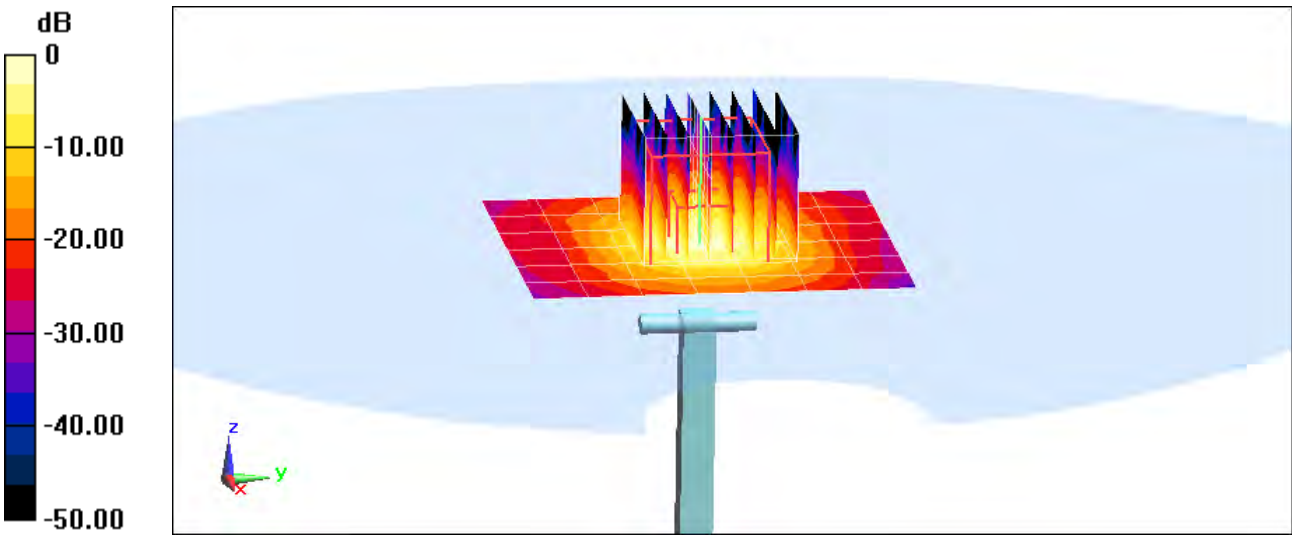
Communication System: UID 0, CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5600 MHz; σ = 5.949 S/m; ε_r = 46.532; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 01-30-2014; Ambient Temp: 24.4°C; Tissue Temp: 22.2°C

Probe: EX3DV4 - SN3914; ConvF(3.97, 3.97, 3.97); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

5600 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power: 20 dBm (100 mW)
Peak SAR (extrapolated) = 38.7 W/kg
SAR(1 g) = 8.04 W/kg
Deviation:-0.37%



0 dB = 21.4 W/kg = 13.30 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

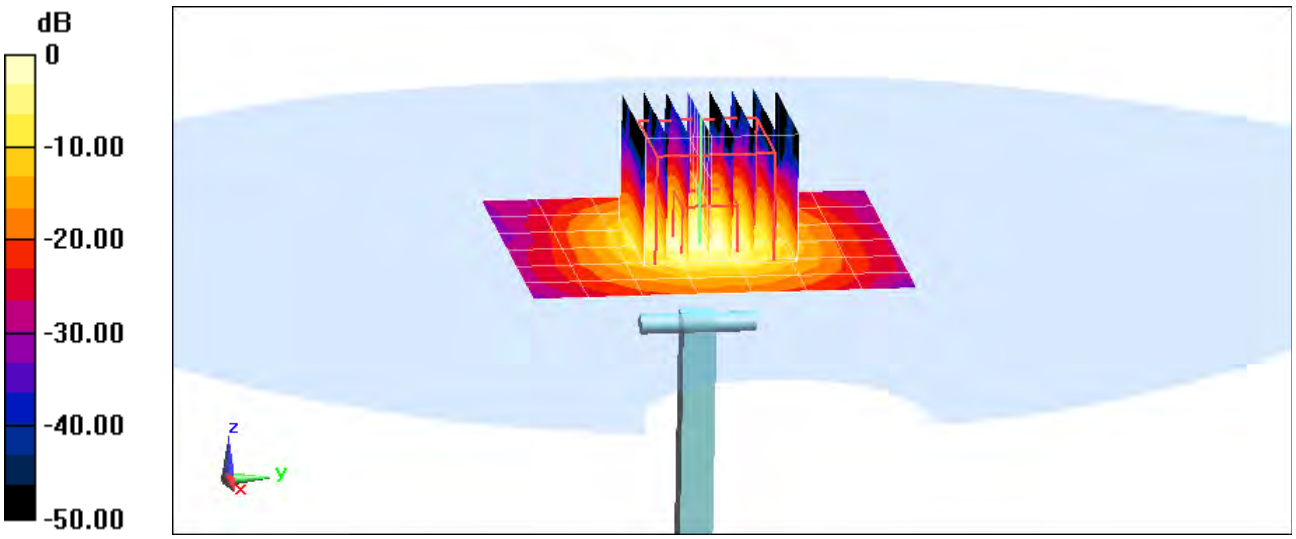
Communication System: UID 0, CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5800 MHz; σ = 6.256 S/m; ε_r = 46.055; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 01-30-2014; Ambient Temp: 24.4°C; Tissue Temp: 22.2°C

Probe: EX3DV4 - SN3914; ConvF(4.14, 4.14, 4.14); Calibrated: 10/23/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/19/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

5800 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Input Power: 20 dBm (100 mW)
Peak SAR (extrapolated) = 35.2 W/kg
SAR(1 g) = 7.17 W/kg
Deviation: -5.03%



0 dB = 19.1 W/kg = 12.81 dBW/kg

APPENDIX C: PROBE CALIBRATION

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

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

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

Accreditation No.: SCS 108

Client PC Test

Certificate No: ES3-3333_Nov13

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3333
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v5 Calibration procedure for dosimetric E-field probes
Calibration date:	November 22, 2013

KOK 1/7/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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	4-Sep-13 (No. DAE4-660_Sep13)	Sep-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-13)	In house check: Oct-14

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

Issued: November 25, 2013

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

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
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ES3DV3

SN:3333

Manufactured: January 24, 2012
Calibrated: November 22, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3333

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.08	0.90	0.88	± 10.1 %
DCP (mV)[B]	104.9	103.3	101.7	

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	140.9	±2.2 %
		Y	0.0	0.0	1.0		132.0	
		Z	0.0	0.0	1.0		170.3	

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

[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:3333

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	6.56	6.56	6.56	0.44	1.54	± 12.0 %
850	41.5	0.92	6.30	6.30	6.30	0.46	1.48	± 12.0 %
1750	40.1	1.37	5.23	5.23	5.23	0.77	1.17	± 12.0 %
1900	40.0	1.40	5.05	5.05	5.05	0.80	1.19	± 12.0 %
2450	39.2	1.80	4.42	4.42	4.42	0.74	1.31	± 12.0 %
2600	39.0	1.96	4.28	4.28	4.28	0.80	1.30	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3333

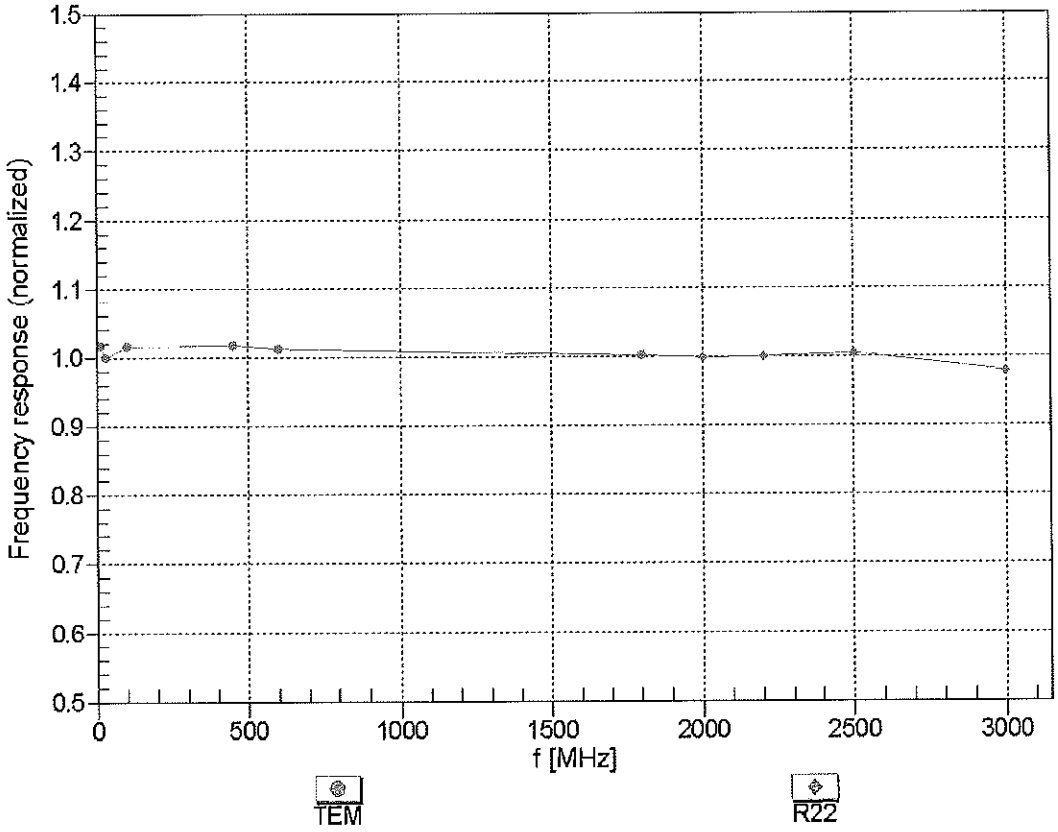
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	6.11	6.11	6.11	0.33	1.90	± 12.0 %
850	55.2	0.99	6.07	6.07	6.07	0.80	1.19	± 12.0 %
1750	53.4	1.49	4.95	4.95	4.95	0.80	1.26	± 12.0 %
1900	53.3	1.52	4.71	4.71	4.71	0.49	1.54	± 12.0 %
2450	52.7	1.95	4.22	4.22	4.22	0.80	0.95	± 12.0 %
2600	52.5	2.16	4.16	4.16	4.16	0.80	1.07	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

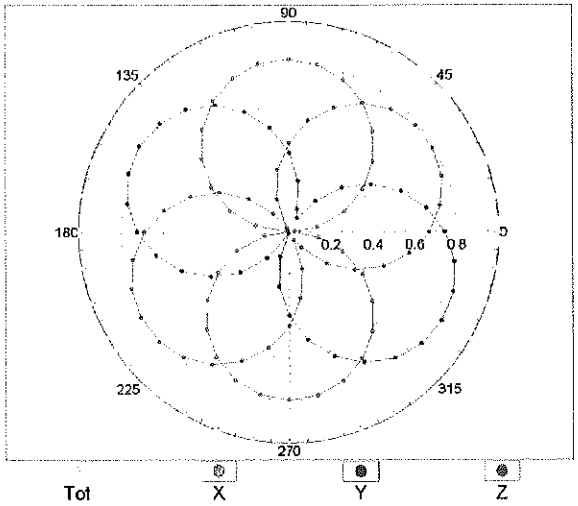
(TEM-Cell:ifi110 EXX, Waveguide: R22)



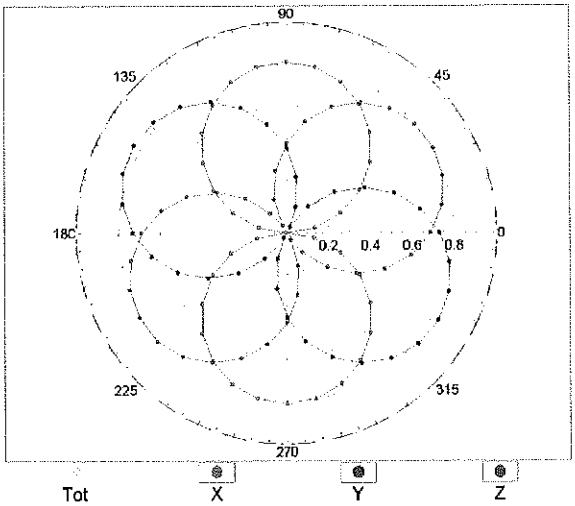
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

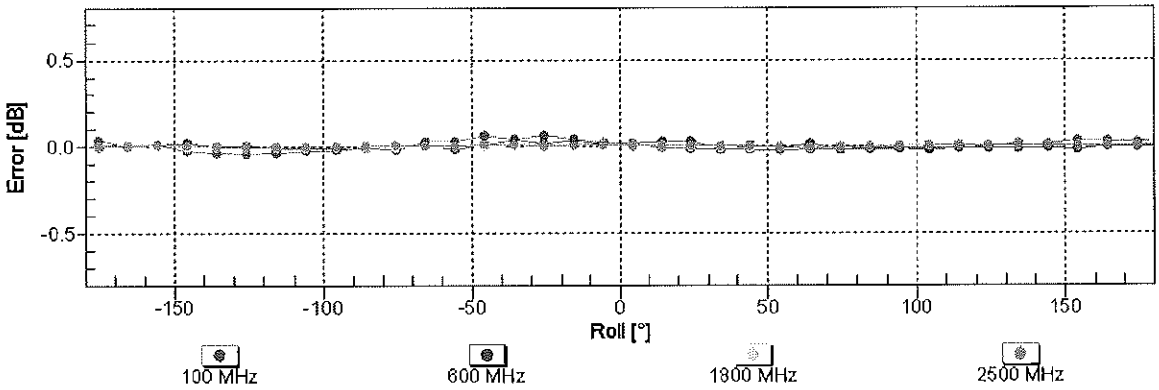
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



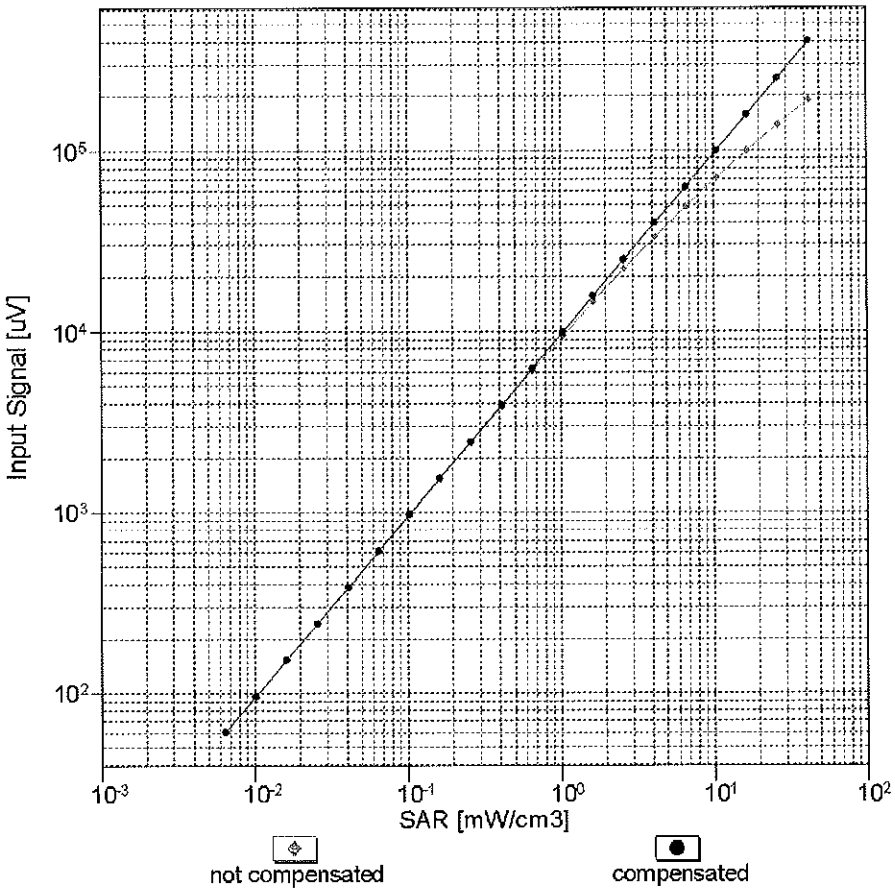
f=1800 MHz,R22

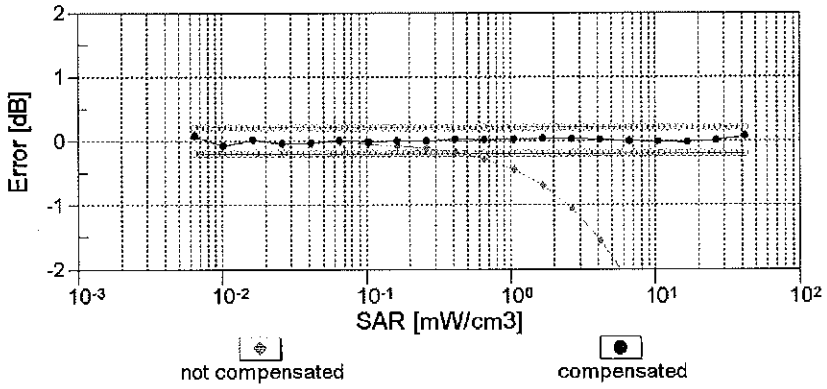




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

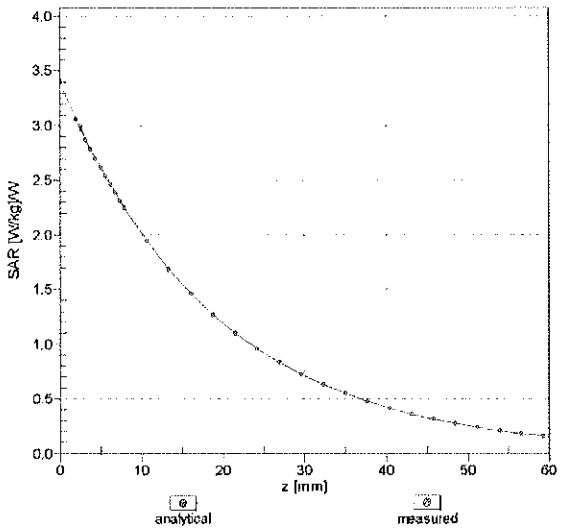




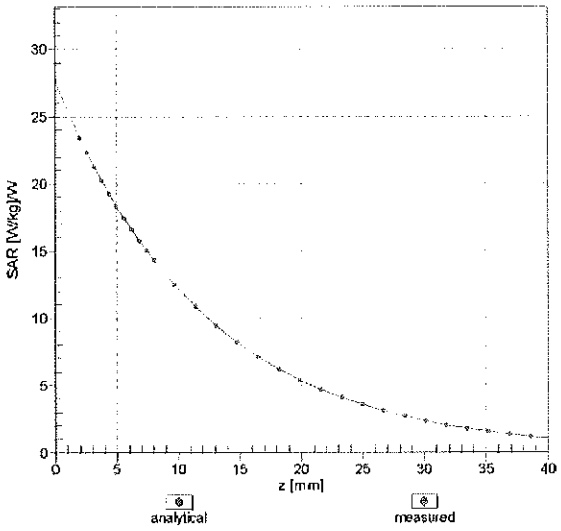
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 850 MHz,WGLS R9 (H_convF)

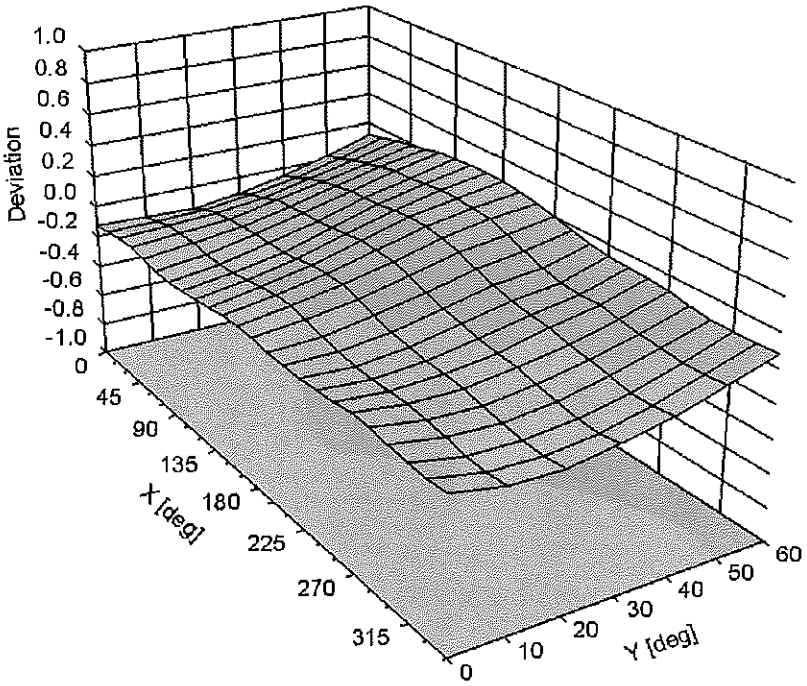


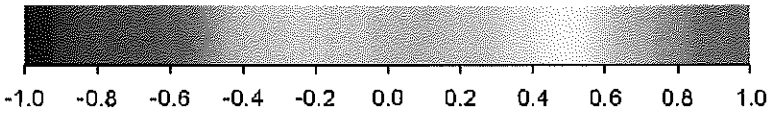
f = 1900 MHz,WGLS R22 (H_convF)



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:3333

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-35.7
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

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

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

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

Accreditation No.: SCS 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

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

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

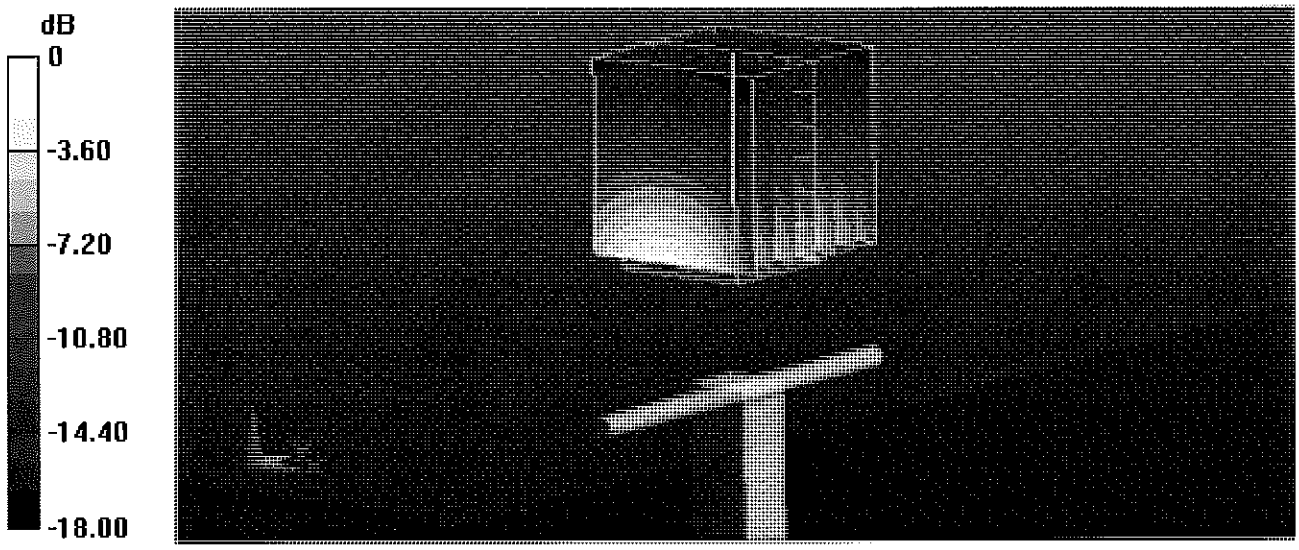
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 S/m; ε_r = 39.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

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)

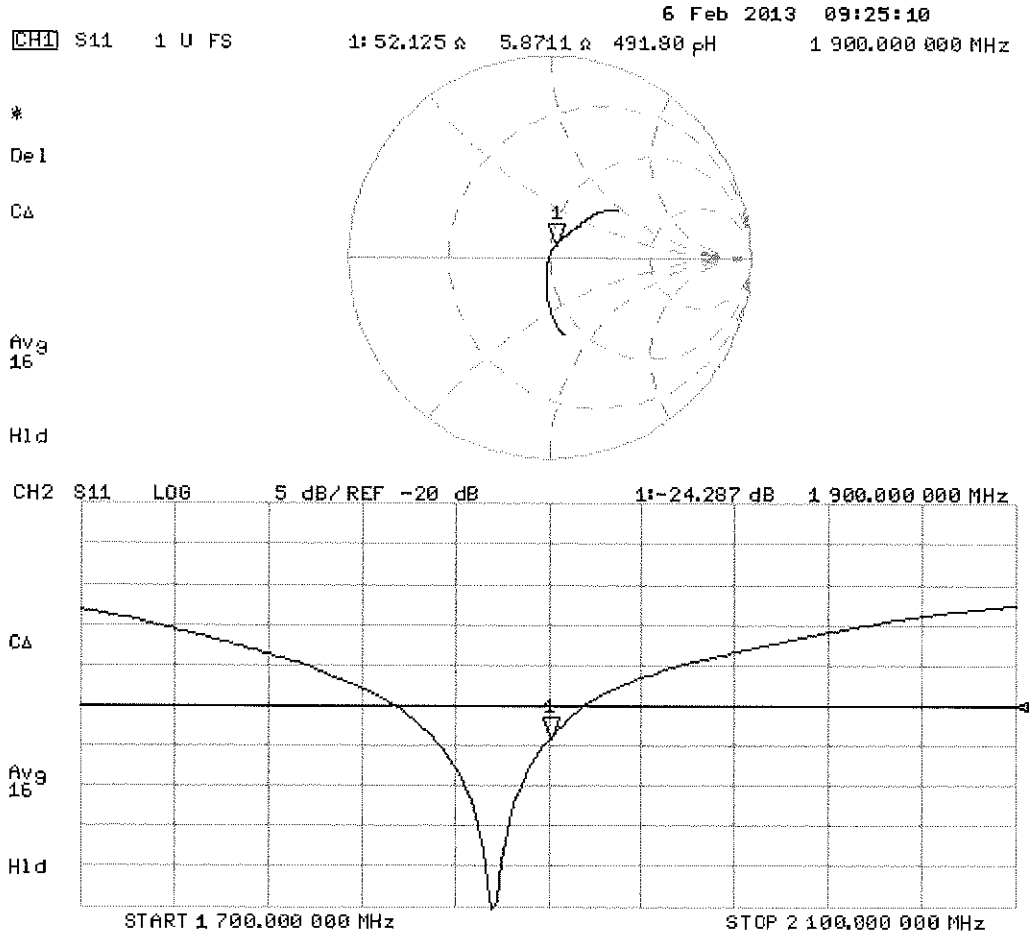
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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

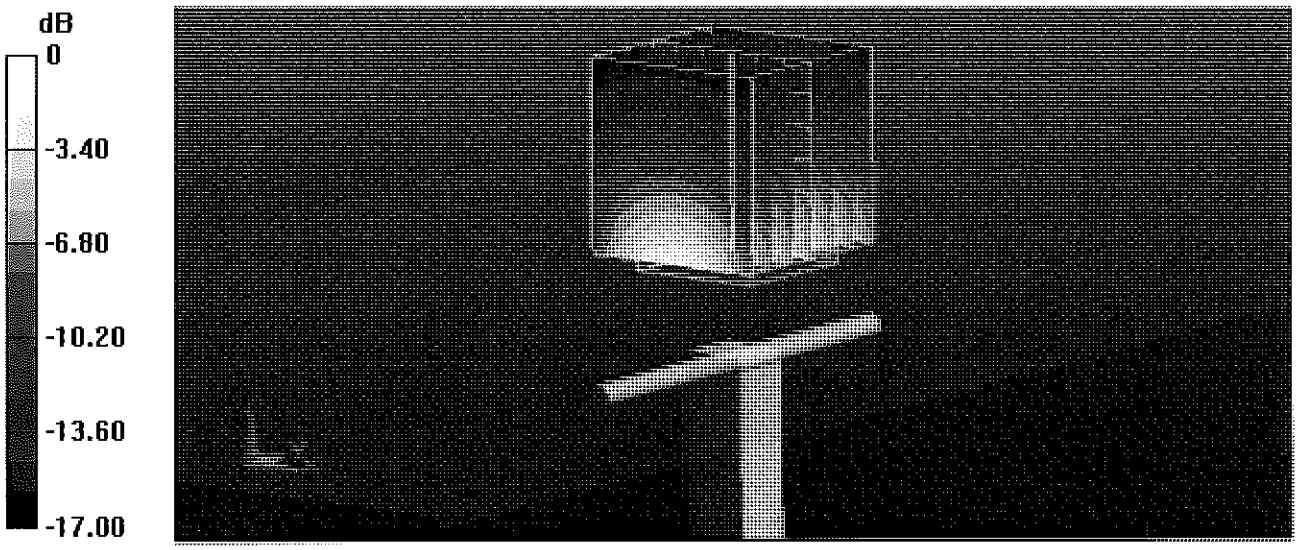
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.53 S/m; ε_r = 51.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

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)

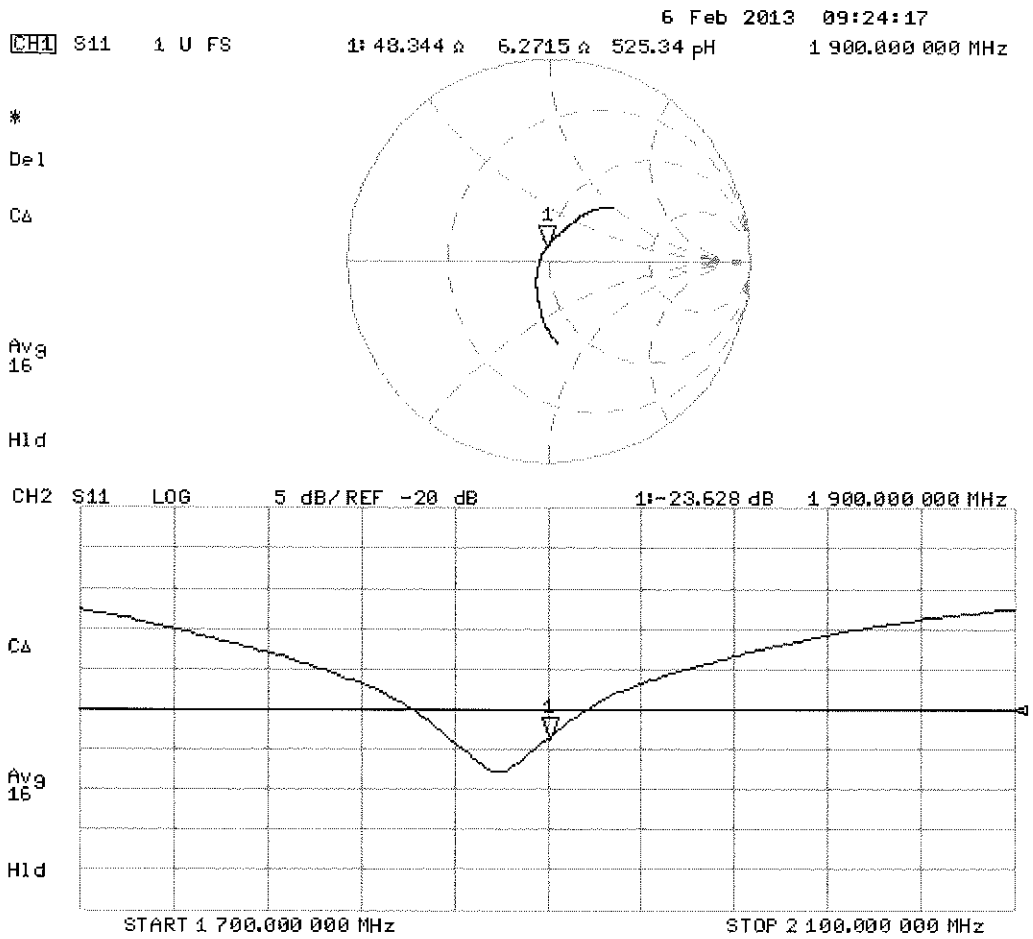
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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



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

S Schweizerischer Kalibrierdienst
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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D2450V2-719_Aug13

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 719
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	August 23, 2013

JCC 9/13/13

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)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 23, 2013

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

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.8 ± 6 %	1.80 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.8 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	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.6 ± 6 %	2.03 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.1 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.6 Ω + 3.5 jΩ
Return Loss	- 25.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.1 Ω + 5.4 jΩ
Return Loss	- 25.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 22.08.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

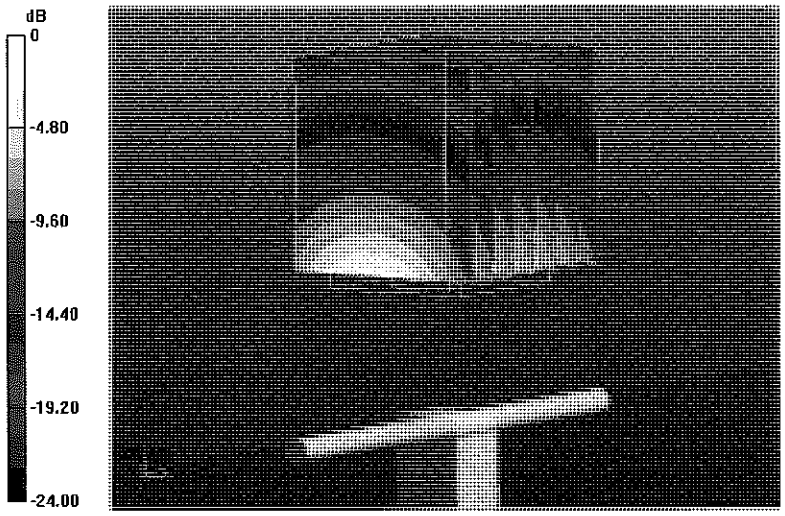
Communication System: UID 0 - CW ; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.8 S/m; ε_r = 37.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

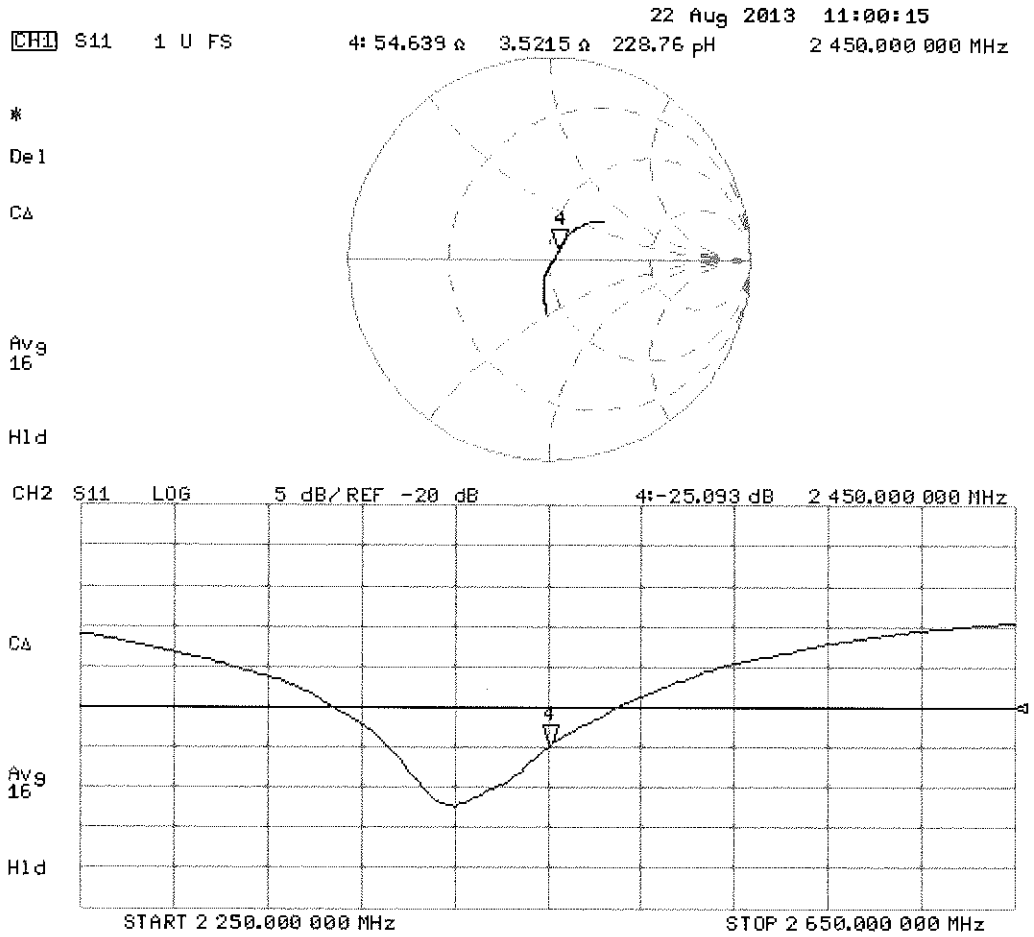
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.7 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.23 W/kg
Maximum value of SAR (measured) = 17.0 W/kg



0 dB = 17.0 W/kg = 12.30 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.08.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

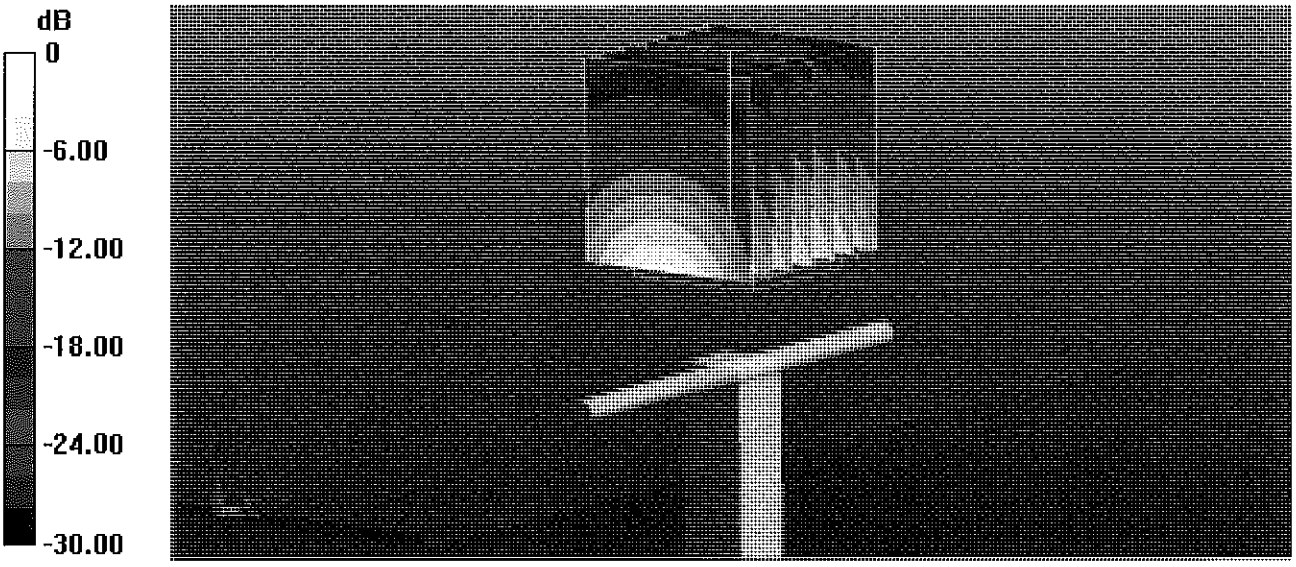
Communication System: UID 0 - CW ; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.03 S/m; ε_r = 50.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

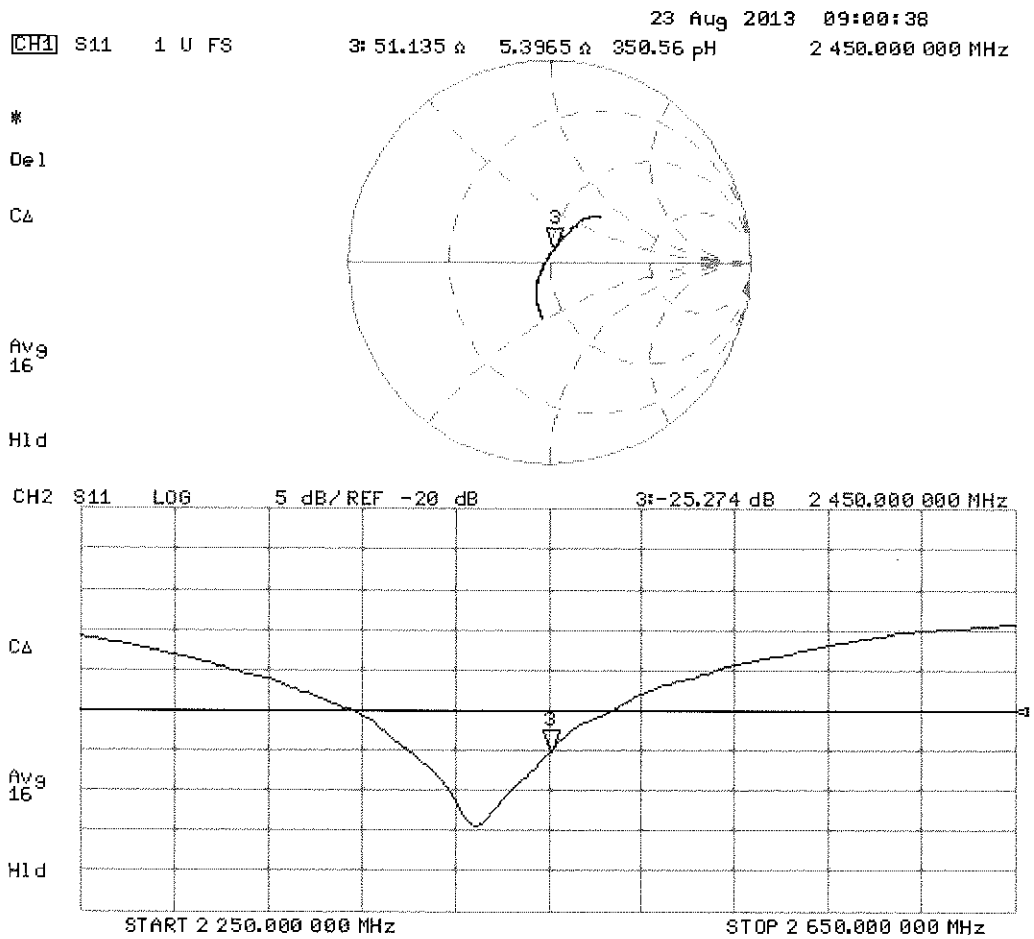
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.688 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.14 W/kg
Maximum value of SAR (measured) = 17.2 W/kg



0 dB = 17.2 W/kg = 12.36 dBW/kg

Impedance Measurement Plot for Body TSL



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

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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D5GHzV2-1120_Feb13

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1120
Calibration procedure(s)	QA CAL-22.v2 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	February 14, 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 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 EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_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:	Israe El-Naouq	Laboratory Technician	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 14, 2013

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

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) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010

b) 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:

c) 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 V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.47 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.67 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**76.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	4.57 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.94 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**78.7 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.27 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.4 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	4.74 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.6 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.1 ± 6 %	4.83 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.9 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**74.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.0 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.9 ± 6 %	5.36 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.73 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**76.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.7 ± 6 %	5.48 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.75 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**76.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	5.71 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**79.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.1 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.2 ± 6 %	5.83 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**80.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.3 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	45.9 ± 6 %	6.12 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.9 W/kg ± 19.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	53.8 Ω - 6.3 jΩ
Return Loss	- 23.0 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	50.1 Ω + 0.5 jΩ
Return Loss	- 45.3 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.0 Ω - 0.9 jΩ
Return Loss	- 37.9 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	55.3 Ω - 0.9 jΩ
Return Loss	- 25.8 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	53.5 Ω + 3.3 jΩ
Return Loss	- 26.7 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	53.7 Ω - 4.8 jΩ
Return Loss	- 24.8 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	50.2 Ω + 2.4 jΩ
Return Loss	- 32.5 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	51.6 Ω - 1.5 jΩ
Return Loss	- 33.3 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	57.4 Ω + 0.9 jΩ
Return Loss	- 23.2 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	53.5 Ω + 3.2 jΩ
Return Loss	- 26.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.206 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 08, 2011

DASY5 Validation Report for Head TSL

Date: 08.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1120

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.47 S/m; ε_r = 34.7; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 4.57 S/m; ε_r = 34.5; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.74 S/m; ε_r = 34.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.83 S/m; ε_r = 34.1; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.05 S/m; ε_r = 33.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 28.12.2012, ConvF(5.1, 5.1, 5.1); Calibrated: 28.12.2012, ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.76, 4.76, 4.76); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (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)

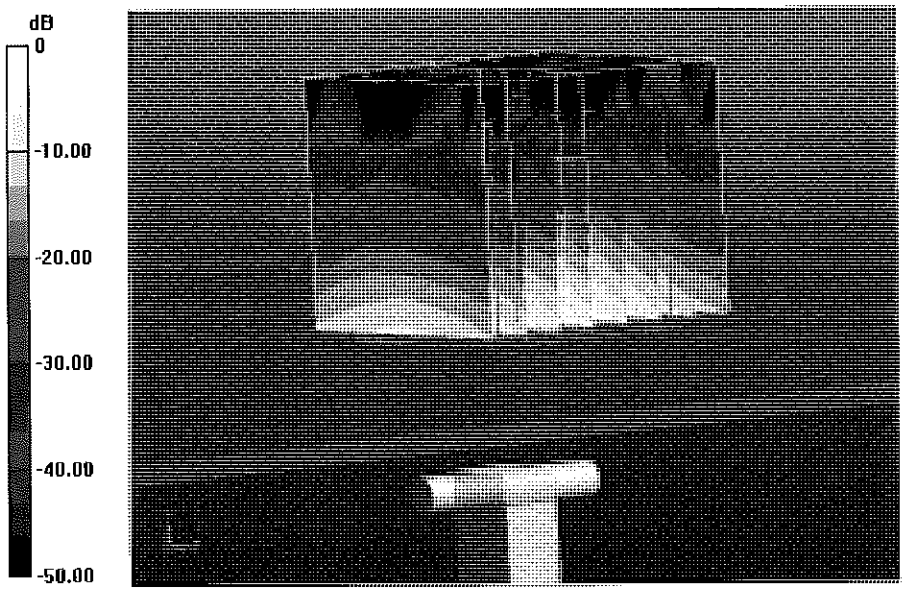
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.561 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 28.8 W/kg
SAR(1 g) = 7.67 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 17.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.429 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 30.3 W/kg
SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.27 W/kg
Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.998 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 32.7 W/kg
SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.29 W/kg
Maximum value of SAR (measured) = 19.3 W/kg

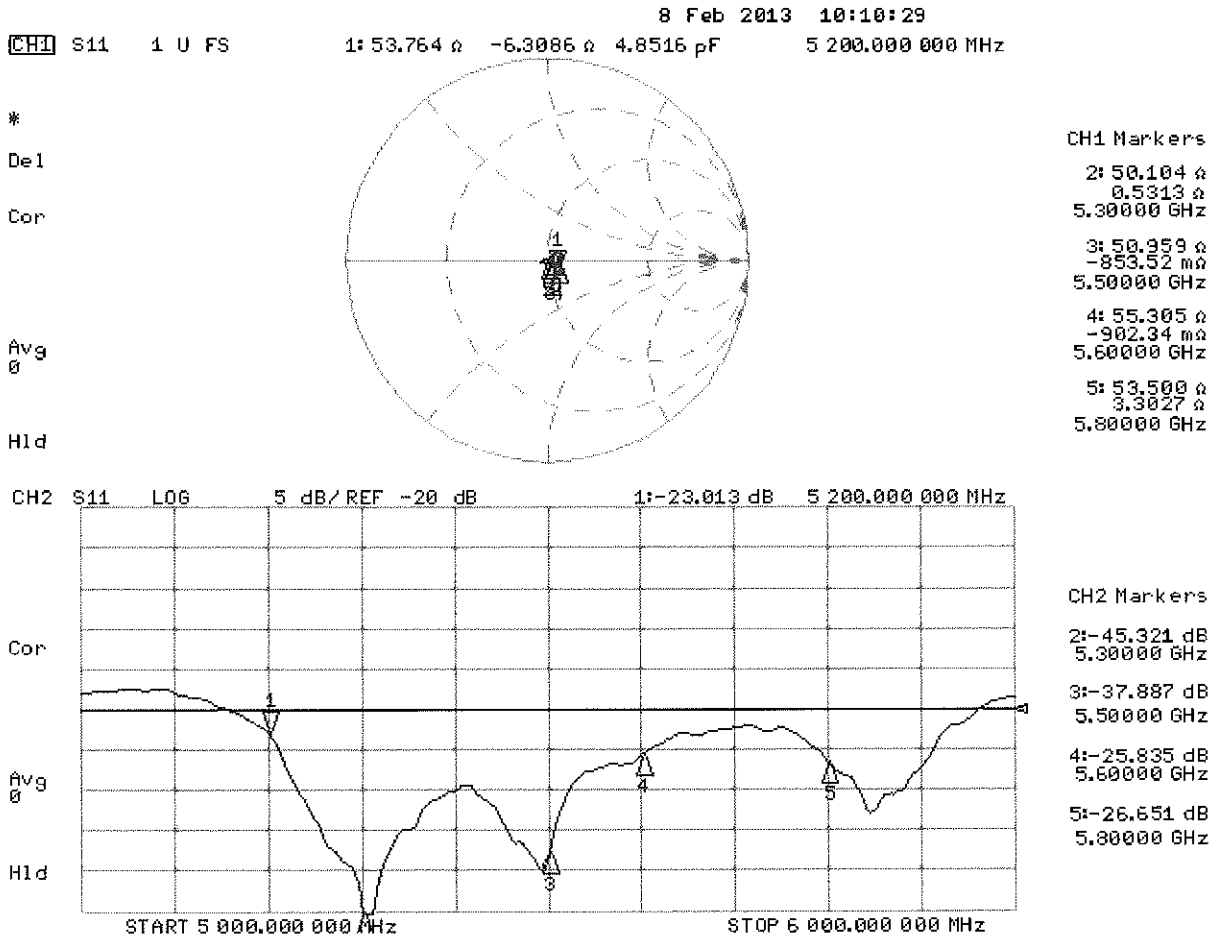
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.540 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 33.3 W/kg
SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.28 W/kg
Maximum value of SAR (measured) = 19.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.600 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 32.9 W/kg
SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.13 W/kg
Maximum value of SAR (measured) = 18.8 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 14.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1120

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.36 S/m; ε_r = 46.9; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 5.48 S/m; ε_r = 46.7; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 5.71 S/m; ε_r = 46.3; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 5.83 S/m; ε_r = 46.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.12 S/m; ε_r = 45.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.67, 4.67, 4.67); Calibrated: 28.12.2012, ConvF(4.43, 4.43, 4.43); Calibrated: 28.12.2012, ConvF(4.22, 4.22, 4.22); Calibrated: 28.12.2012, ConvF(4.38, 4.38, 4.38); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (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)

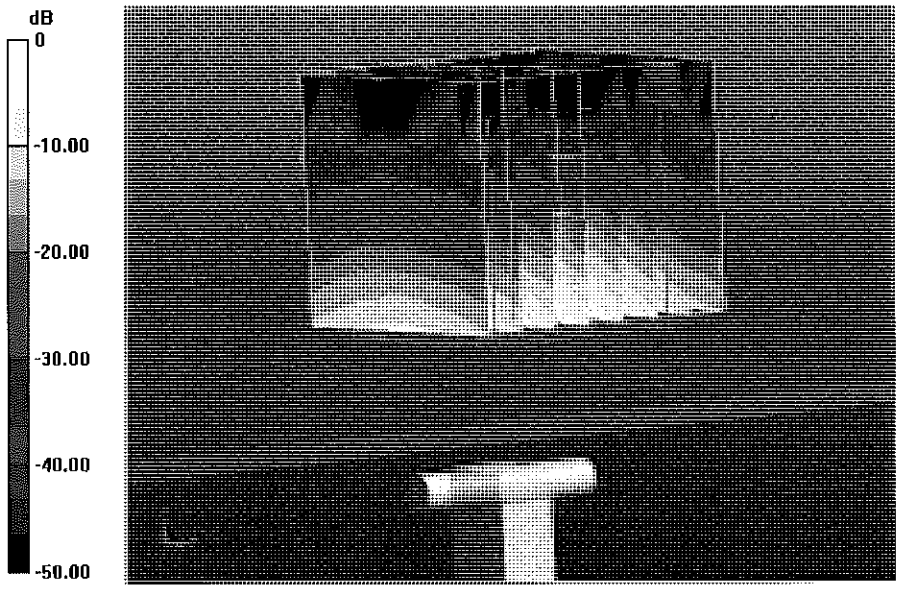
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.053 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 31.1 W/kg
SAR(1 g) = 7.73 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 18.2 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.021 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 32.1 W/kg
SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 59.894 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 35.3 W/kg
SAR(1 g) = 8.06 W/kg; SAR(10 g) = 2.24 W/kg
Maximum value of SAR (measured) = 19.4 W/kg

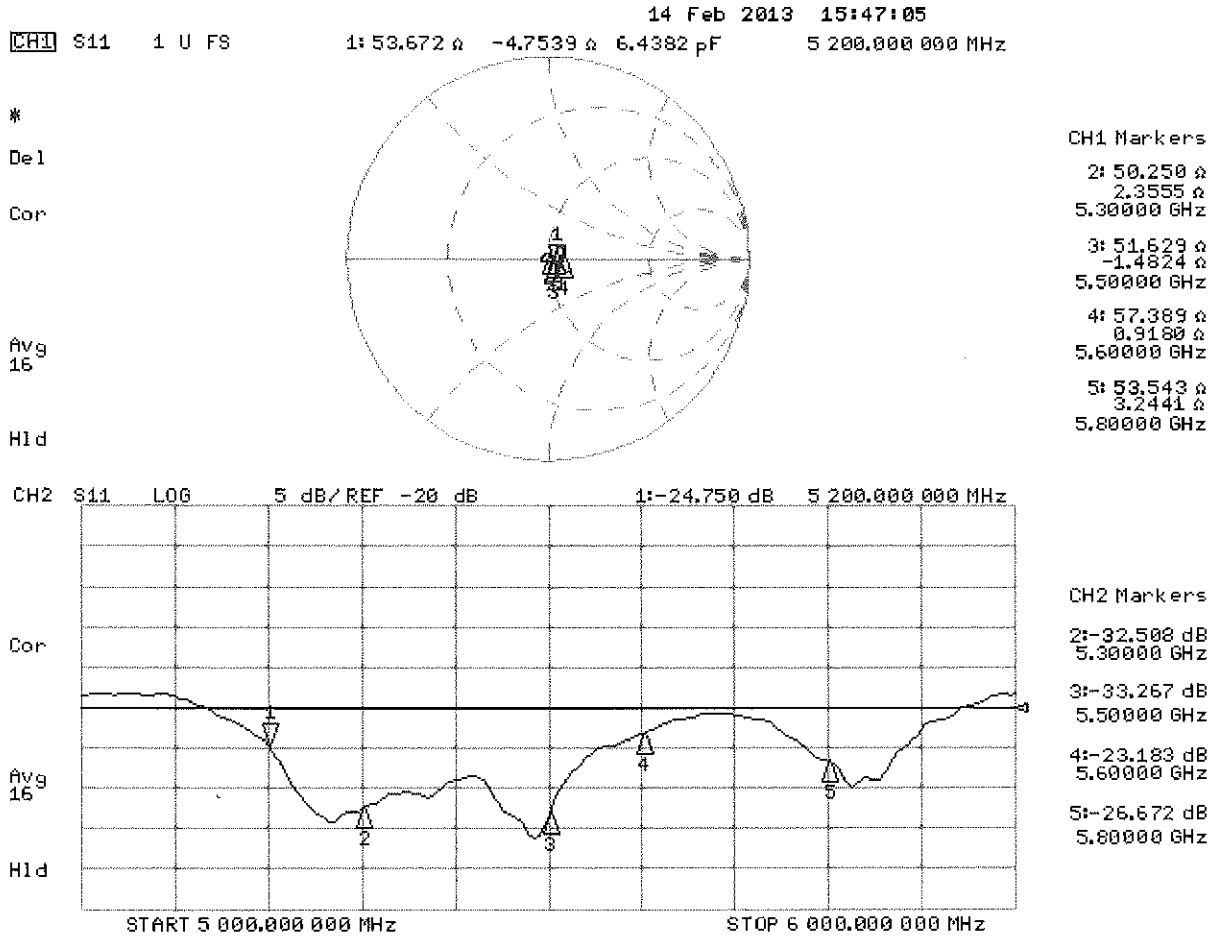
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 59.730 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 36.8 W/kg
SAR(1 g) = 8.15 W/kg; SAR(10 g) = 2.26 W/kg
Maximum value of SAR (measured) = 19.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 56.663 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 36.4 W/kg
SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.12 W/kg
Maximum value of SAR (measured) = 19.0 W/kg



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

Impedance Measurement Plot for Body TSL



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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D835V2-4d119_Apr13

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d119
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 25, 2013

✓ KOK 5/8/13

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)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 909	11-Sep-12 (No. DAE4-909_Sep12)	Sep-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:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 26, 2013

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

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	V52.8.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.8 ± 6 %	0.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.51 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.68 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.62 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.30 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.0 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.47 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.54 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.31 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.1 Ω - 4.7 jΩ
Return Loss	- 26.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8 Ω - 6.3 jΩ
Return Loss	- 22.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.385 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 29, 2010

DASY5 Validation Report for Head TSL

Date: 25.04.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

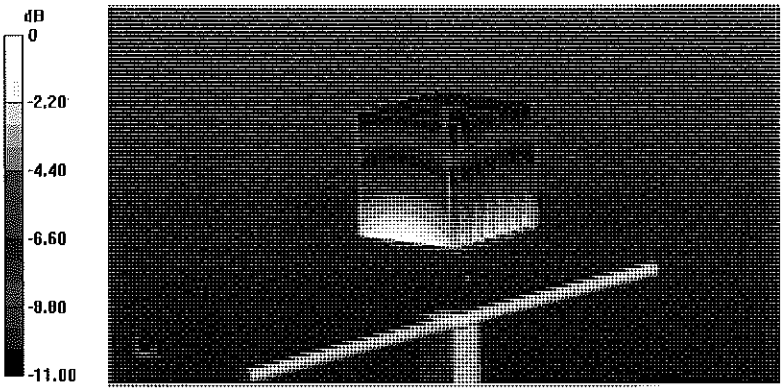
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 40.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn909; Calibrated: 11.09.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

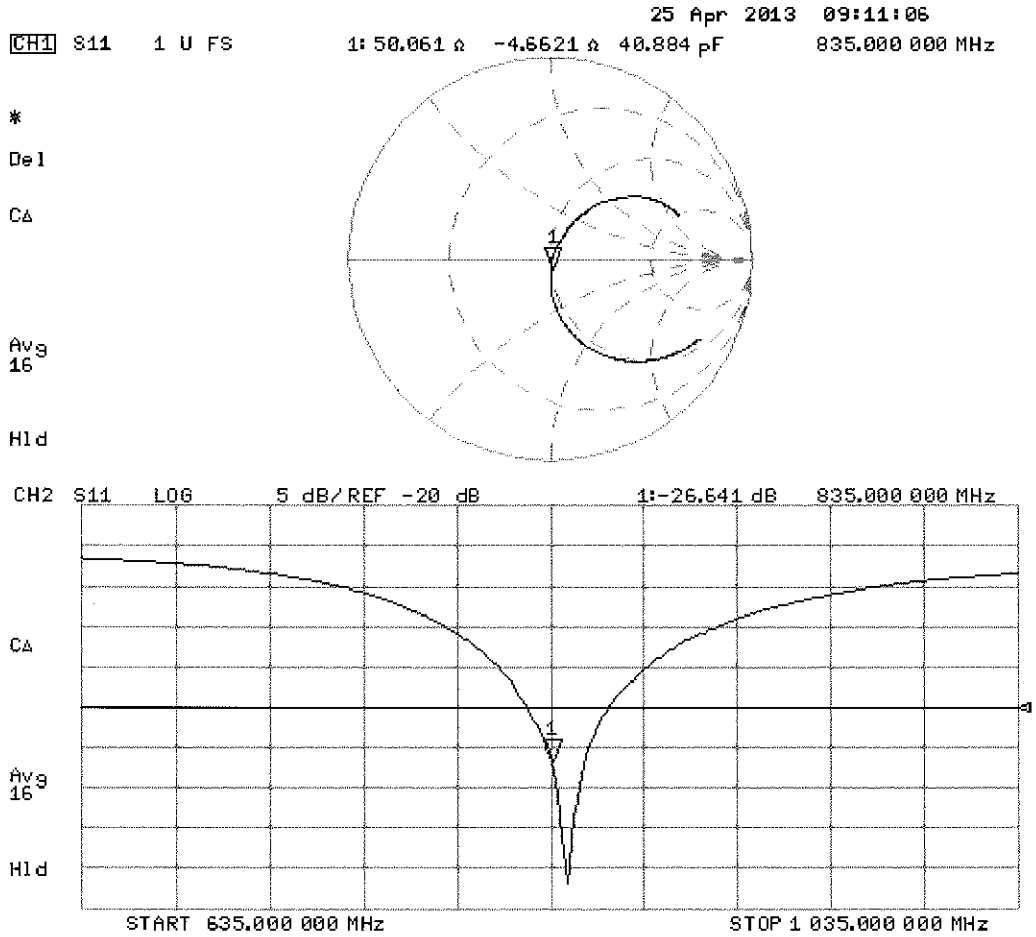
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.387 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 3.86 W/kg
SAR(1 g) = 2.51 W/kg; SAR(10 g) = 1.62 W/kg
Maximum value of SAR (measured) = 2.93 W/kg



0 dB = 2.93 W/kg = 4.67 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 24.04.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

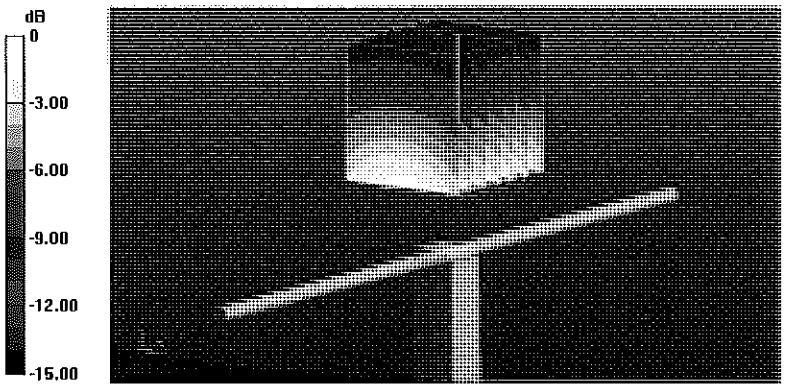
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.01 S/m; ε_r = 54; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn909; Calibrated: 11.09.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

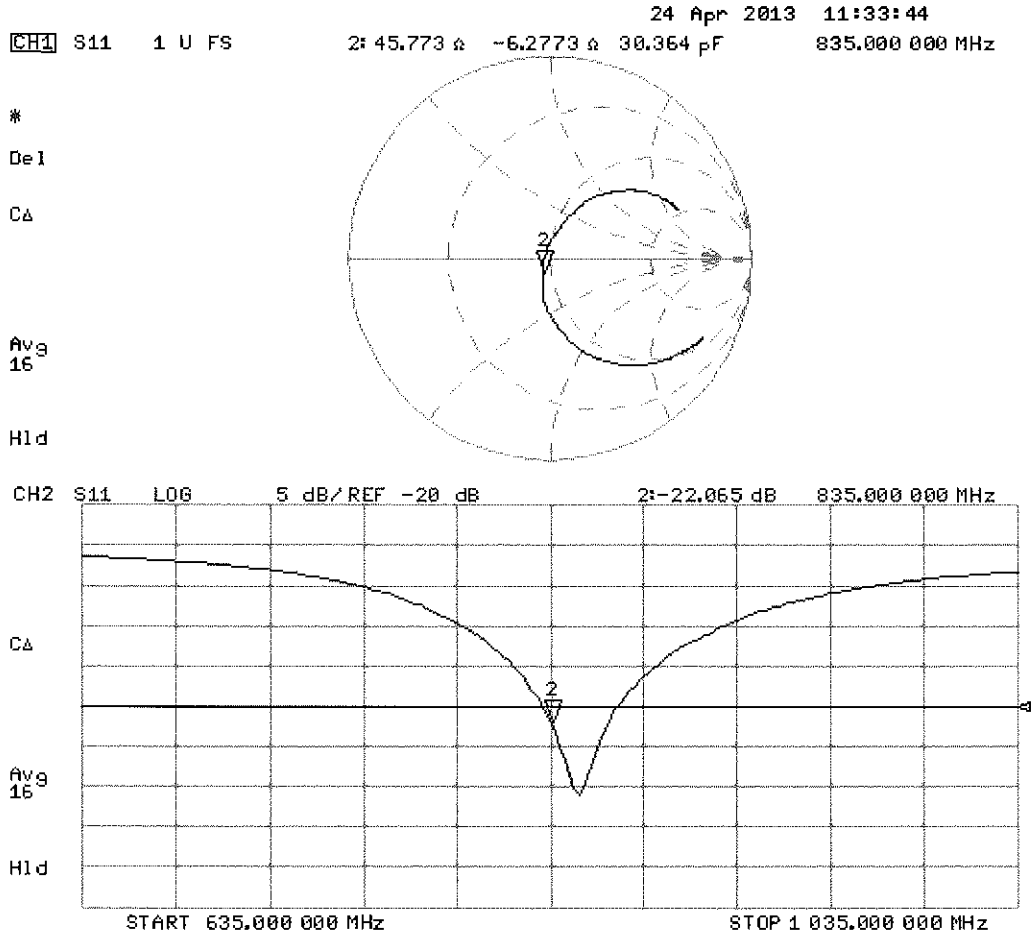
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.178 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 3.68 W/kg
SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.62 W/kg
Maximum value of SAR (measured) = 2.89 W/kg



0 dB = 2.89 W/kg = 4.61 dBW/kg

Impedance Measurement Plot for Body TSL



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

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

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: ES3-3022_Aug13

CALIBRATION CERTIFICATE

Object	ES3DV2 - SN:3022
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	August 22, 2013

UCC 9/13/13

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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 23, 2013

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

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 ES3DV2

SN:3022

Manufactured: April 15, 2003
Calibrated: August 22, 2013

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

DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.00	1.04	0.99	± 10.1 %
DCP (mV)[B]	100.7	97.4	99.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	178.6	±3.0 %
		Y	0.0	0.0	1.0		141.9	
		Z	0.0	0.0	1.0		134.7	

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: ES3DV2 - SN:3022

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.21	6.21	6.21	0.19	2.37	± 12.0 %
835	41.5	0.90	6.09	6.09	6.09	0.30	1.70	± 12.0 %
1750	40.1	1.37	5.19	5.19	5.19	0.65	1.23	± 12.0 %
1900	40.0	1.40	5.03	5.03	5.03	0.51	1.43	± 12.0 %
2450	39.2	1.80	4.36	4.36	4.36	0.51	1.51	± 12.0 %
2600	39.0	1.96	4.16	4.16	4.16	0.74	1.29	± 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: ES3DV2 - SN:3022

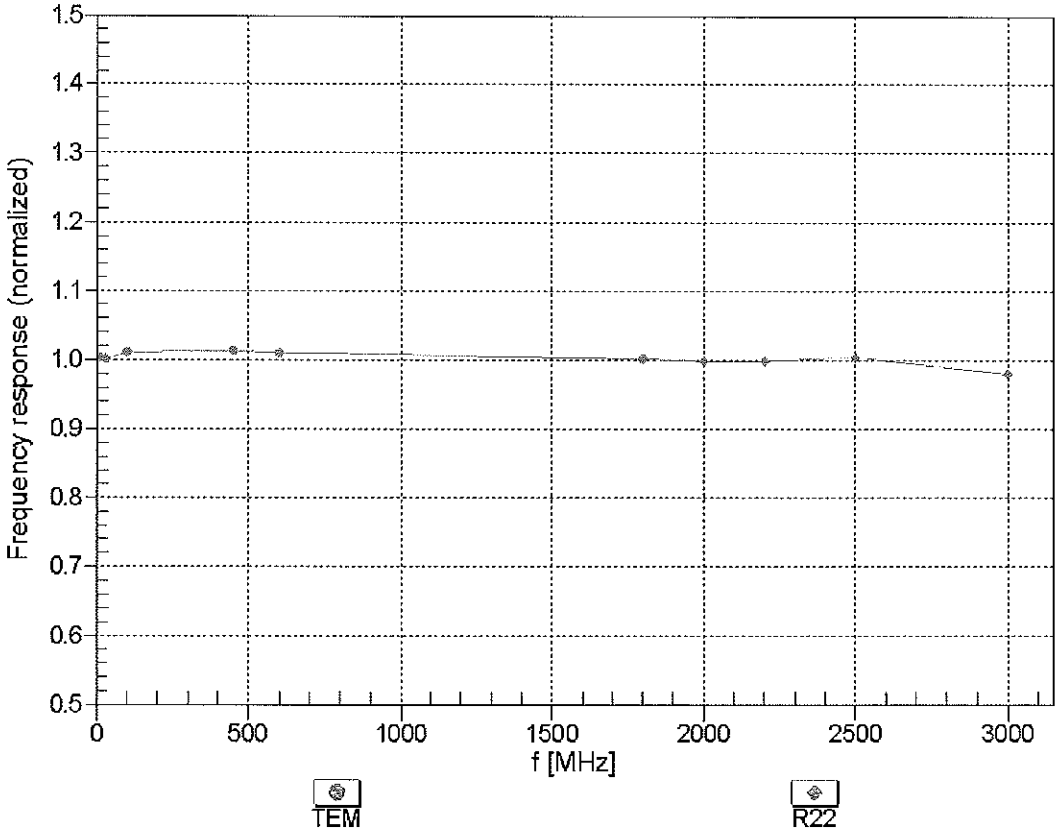
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	5.92	5.92	5.92	0.24	1.99	± 12.0 %
835	55.2	0.97	5.91	5.91	5.91	0.29	1.85	± 12.0 %
1750	53.4	1.49	4.75	4.75	4.75	0.52	1.52	± 12.0 %
1900	53.3	1.52	4.49	4.49	4.49	0.49	1.56	± 12.0 %
2450	52.7	1.95	4.01	4.01	4.01	0.70	1.02	± 12.0 %
2600	52.5	2.16	3.85	3.85	3.85	0.58	0.90	± 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

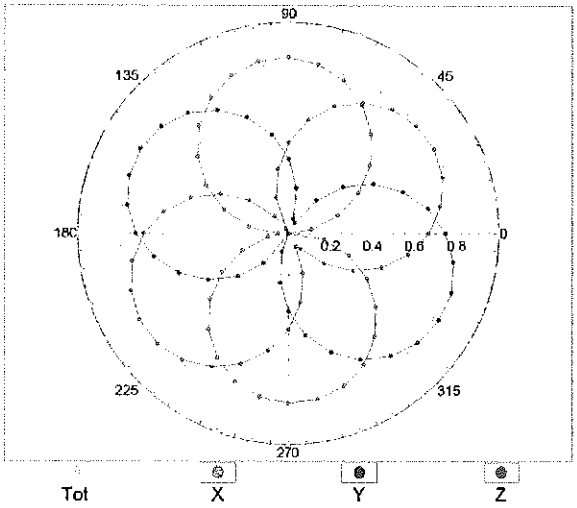
(TEM-Cell:ifi110 EXX, Waveguide: R22)



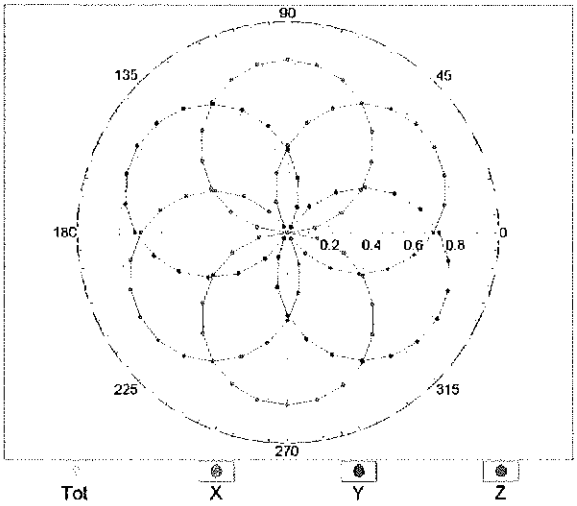
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

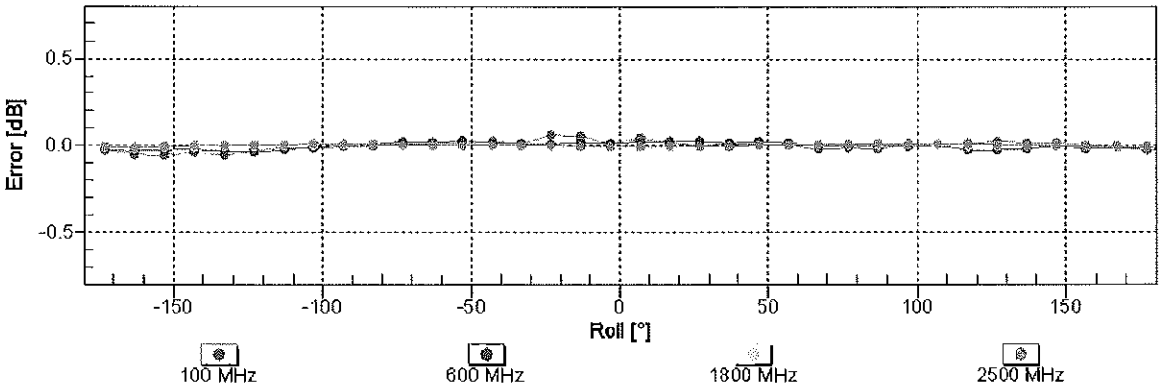
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



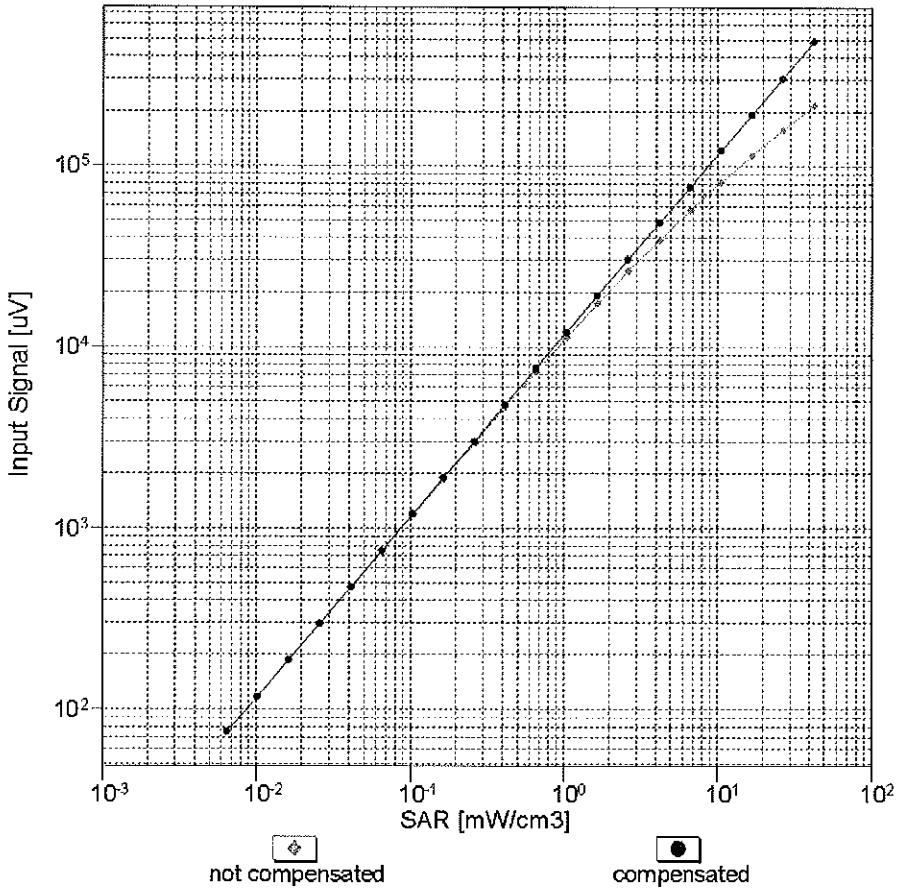
f=1800 MHz,R22

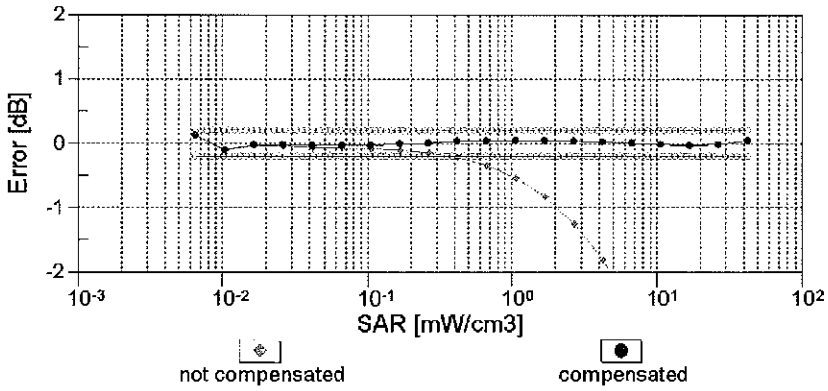




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

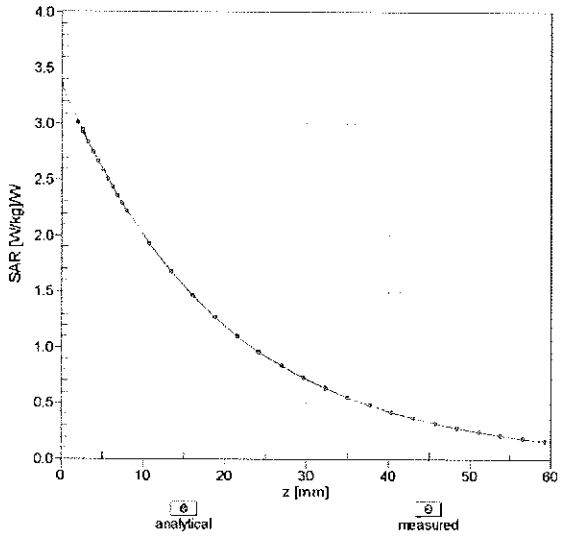




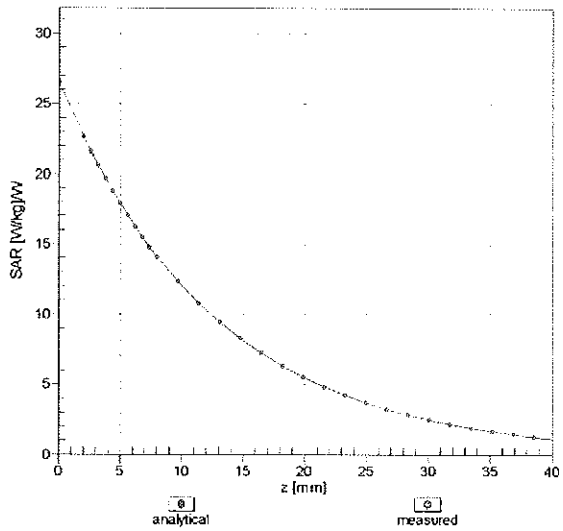
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

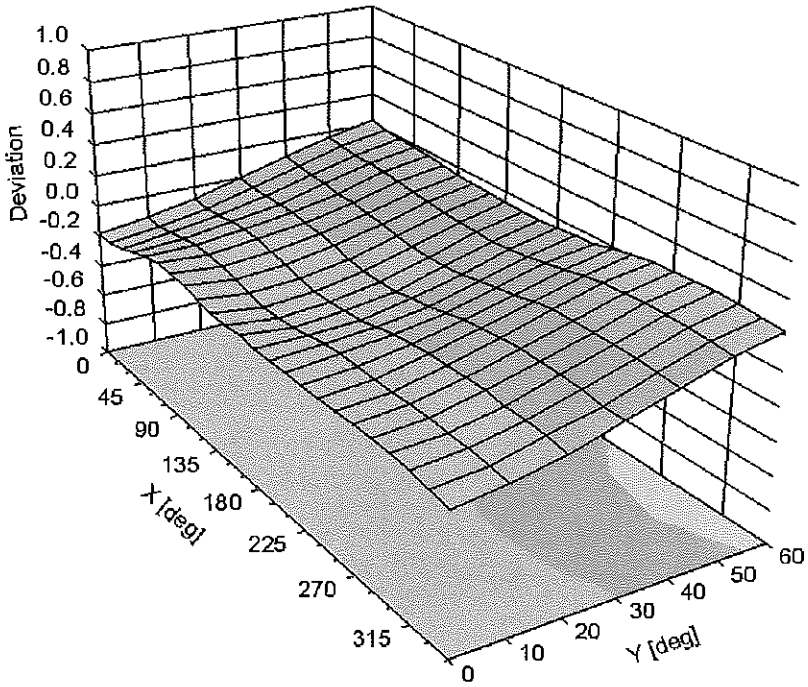


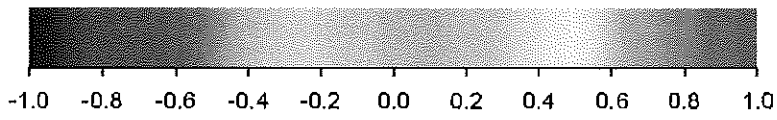
f = 1750 MHz,WGLS R22 (H_convF)



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: ES3DV2 - SN:3022

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-83.1
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

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

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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

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

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Glossary:

TSL	tissue simulating liquid
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

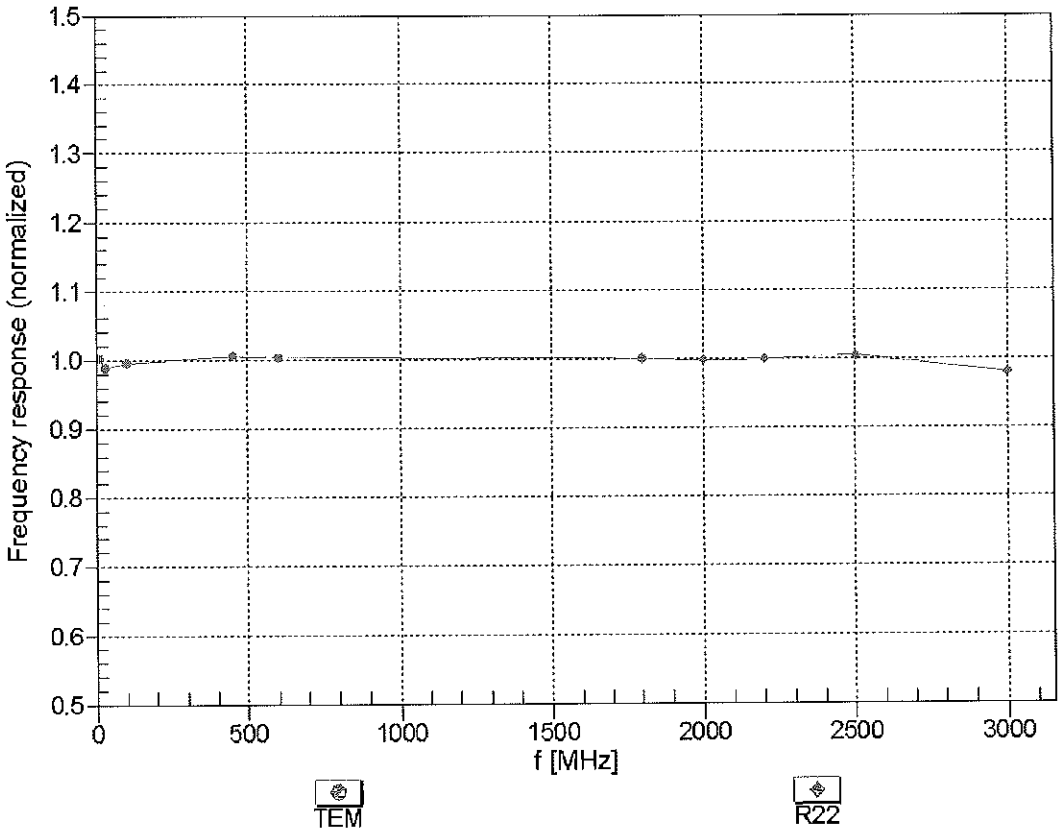
Calibration Parameter Determined in Body Tissue Simulating Media

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

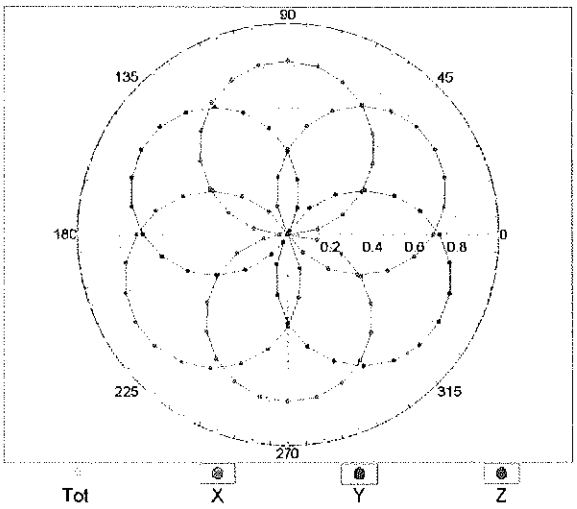
(TEM-Cell:ifi110 EXX, Waveguide: R22)



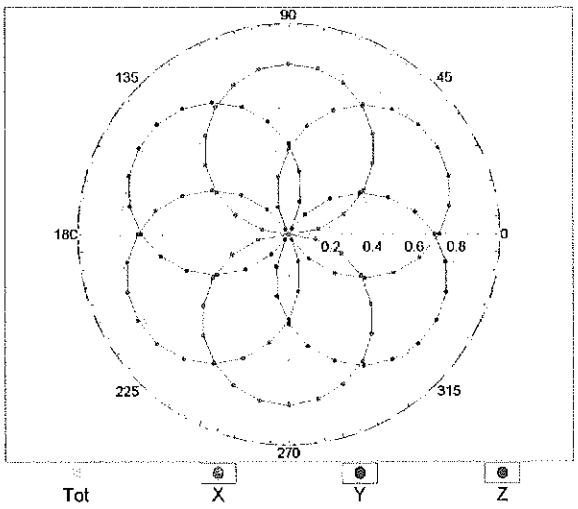
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

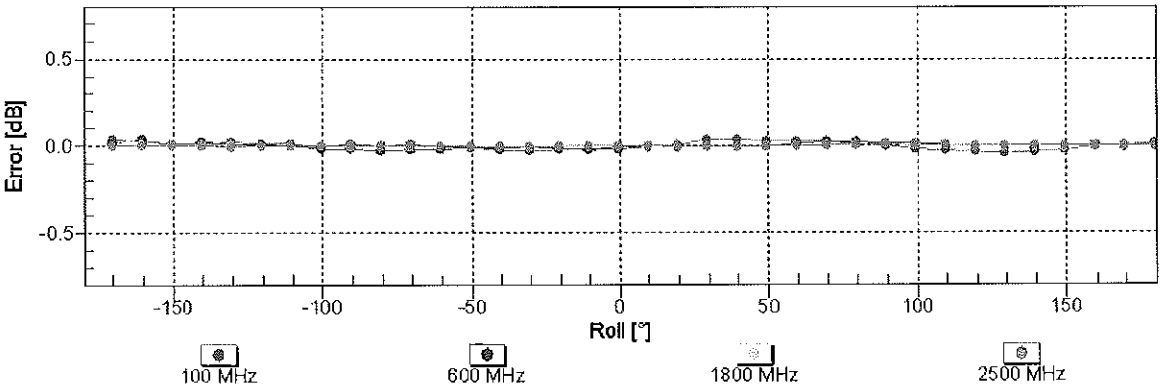
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



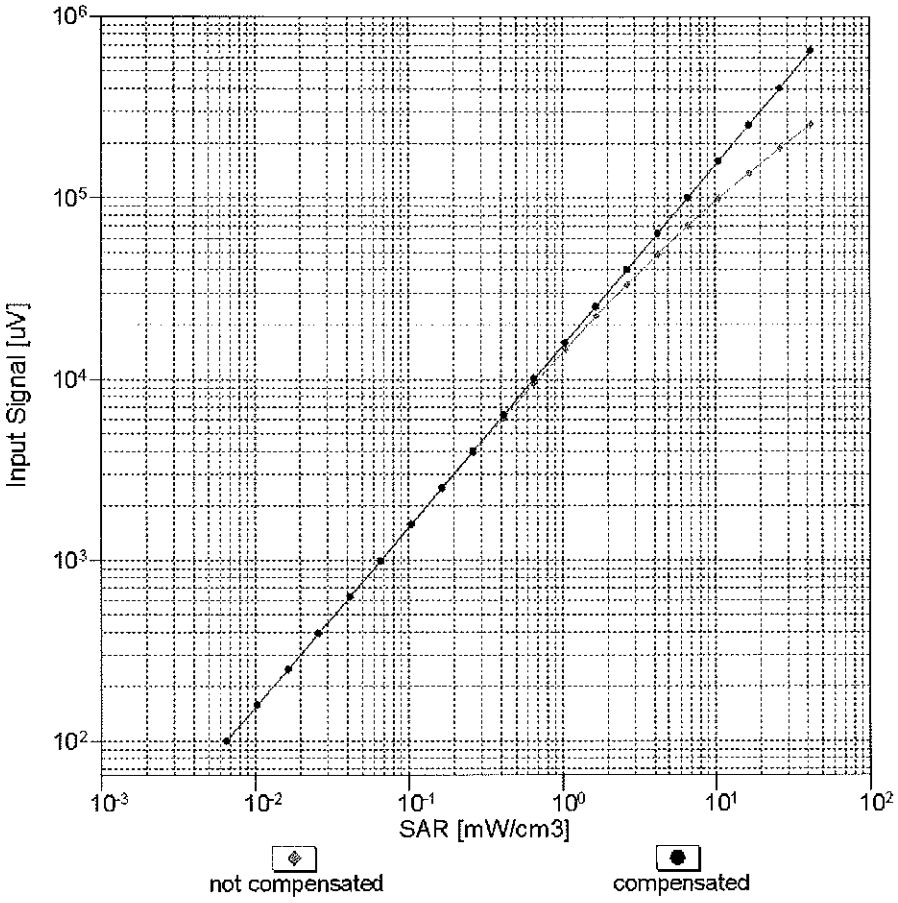
f=1800 MHz,R22

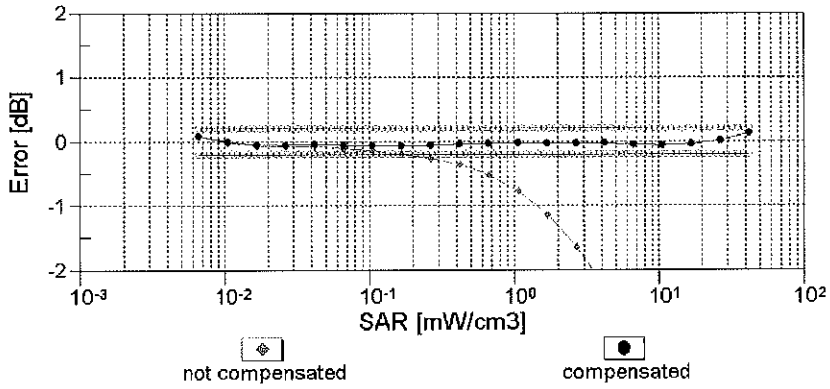




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

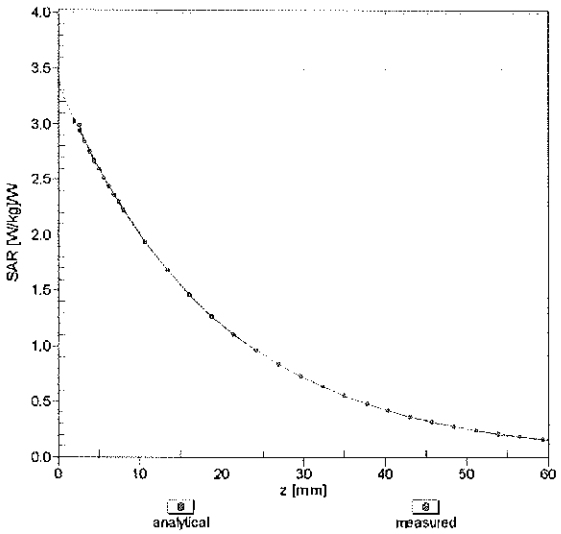




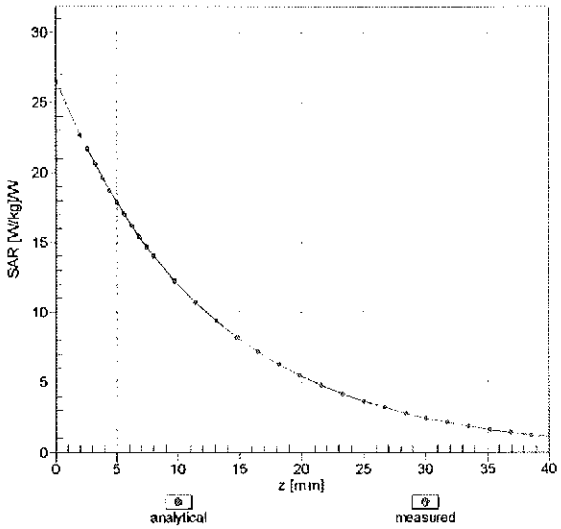
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

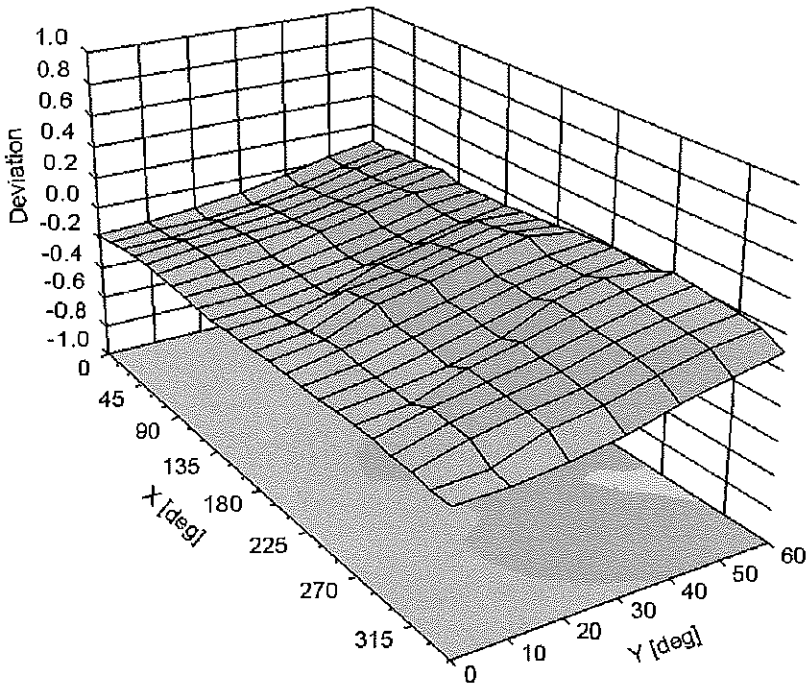


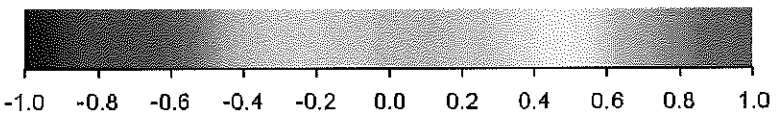
f = 1750 MHz,WGLS R22 (H_convF)



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

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

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

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

Accreditation No.: SCS 108

Client PC Test

Certificate No: EX3-3914_Oct13

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3914

Calibration procedure(s): QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: October 23, 2013

VCC
11/26/2013

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	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	4-Sep-13 (No. DAE4-660_Sep13)	Sep-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-13)	In house check: Oct-14

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

Issued: October 25, 2013

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

PCT # 81072

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
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3914

Manufactured: December 18, 2012
Calibrated: October 23, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3914

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.47	0.49	0.51	± 10.1 %
DCP (mV)[B]	99.2	98.9	98.2	

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	158.3	±3.0 %
		Y	0.0	0.0	1.0		154.6	
		Z	0.0	0.0	1.0		170.8	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	0.71	53.3	6.1	10.00	48.4	±2.5 %
		Y	2.43	67.0	13.8		39.9	
		Z	4.18	68.7	13.8		45.7	
10011-CAA	UMTS-FDD (WCDMA)	X	3.05	64.4	16.5	2.91	122.4	±0.5 %
		Y	3.31	66.5	18.2		123.5	
		Z	3.34	66.3	17.8		136.6	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.49	64.8	16.1	1.87	120.6	±0.5 %
		Y	2.94	68.6	18.7		123.6	
		Z	2.63	65.9	17.0		135.4	
10021-DAA	GSM-FDD (TDMA, GMSK)	X	1.52	61.5	10.9	9.39	83.6	±1.2 %
		Y	2.22	67.4	15.0		116.0	
		Z	2.47	66.8	14.7		95.9	
10023-DAA	GPRS-FDD (TDMA, GMSK, TN 0)	X	1.73	63.3	11.9	9.57	81.5	±1.7 %
		Y	2.11	66.2	14.2		111.8	
		Z	2.76	69.0	16.0		93.6	
10024-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	1.34	62.1	9.4	6.56	121.0	±1.2 %
		Y	4.24	78.6	17.9		130.0	
		Z	2.91	70.7	14.9		141.4	
10027-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	1.25	63.5	9.7	4.80	143.5	±1.4 %
		Y	1.59	66.9	12.2		149.7	
		Z	2.98	71.5	14.0		123.3	
10028-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	0.51	58.3	7.4	3.55	113.4	±1.2 %
		Y	25.43	100.0	22.6		121.3	
		Z	38.67	97.5	20.6		133.3	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	0.28	58.6	5.3	1.16	134.7	±0.9 %
		Y	65.75	99.6	18.6		141.3	
		Z	0.20	55.6	4.1		112.1	
10039-CAA	CDMA2000 (1xRTT, RC1)	X	4.33	64.6	17.4	4.57	113.8	±0.7 %
		Y	4.55	66.0	18.6		120.8	
		Z	4.85	66.2	18.4		135.9	
10062-CAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	9.83	67.6	20.7	8.68	109.0	±2.5 %
		Y	10.06	68.4	21.5		118.2	
		Z	10.66	69.2	21.7		134.0	

10081-CAA	CDMA2000 (1xRTT, RC3)	X	3.59	63.9	16.9	3.97	113.6	±0.7 %
		Y	3.84	65.6	18.2		119.6	
		Z	3.95	65.4	17.8		134.5	
10098-CAA	UMTS-FDD (HSUPA, Subtest 2)	X	4.41	65.2	17.3	3.98	126.0	±0.7 %
		Y	4.73	66.9	18.6		132.5	
		Z	4.51	65.5	17.7		105.6	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.26	66.2	18.6	5.67	130.5	±1.2 %
		Y	6.61	67.7	19.8		139.3	
		Z	6.21	66.0	18.7		107.7	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.13	65.8	18.6	5.80	126.3	±1.2 %
		Y	6.40	67.1	19.6		135.6	
		Z	6.10	65.5	18.5		107.4	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.78	65.3	18.3	5.75	123.1	±1.2 %
		Y	5.97	66.3	19.2		131.5	
		Z	5.86	65.3	18.4		104.9	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	9.92	67.7	20.3	8.10	115.7	±2.5 %
		Y	10.25	68.7	21.2		126.8	
		Z	10.71	69.4	21.3		146.0	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	9.95	67.8	20.3	8.07	116.6	±2.5 %
		Y	10.26	68.7	21.1		128.3	
		Z	10.70	69.4	21.3		146.9	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.19	67.3	21.5	9.28	145.0	±2.2 %
		Y	7.40	68.3	22.4		110.8	
		Z	7.79	68.4	22.0		128.0	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.79	65.3	18.3	5.75	124.2	±1.2 %
		Y	6.03	66.5	19.4		131.9	
		Z	6.29	66.9	19.3		149.7	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.23	65.9	18.6	5.82	128.3	±1.2 %
		Y	6.51	67.2	19.7		136.9	
		Z	6.24	65.7	18.6		107.3	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.83	66.0	18.9	5.73	147.5	±1.2 %
		Y	4.72	65.8	19.2		113.8	
		Z	5.03	66.1	19.1		129.7	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.83	69.2	22.8	9.21	149.9	±1.9 %
		Y	5.81	69.4	23.4		120.3	
		Z	6.38	70.0	23.2		137.2	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.86	66.1	18.9	5.72	149.8	±1.2 %
		Y	4.72	65.8	19.2		113.3	
		Z	5.09	66.4	19.1		126.0	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.83	66.0	18.9	5.72	146.3	±1.2 %
		Y	4.69	65.6	19.1		112.2	
		Z	5.02	66.1	19.0		125.1	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.51	67.4	20.2	8.09	108.6	±2.5 %
		Y	9.72	68.1	20.9		118.2	
		Z	10.30	68.9	21.1		135.0	

10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.52	67.4	20.2	8.10	111.6	±2.5 %
		Y	9.79	68.3	21.1		121.3	
		Z	10.30	68.9	21.2		139.2	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.47	67.4	20.2	8.03	111.8	±2.2 %
		Y	9.67	68.3	21.0		120.0	
		Z	10.20	68.9	21.1		138.0	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	9.96	67.9	20.4	8.06	118.4	±2.5 %
		Y	10.25	68.8	21.2		128.2	
		Z	10.65	69.3	21.3		144.5	
10225-CAA	UMTS-FDD (HSPA+)	X	6.96	66.7	18.9	5.97	140.0	±1.4 %
		Y	7.23	67.9	20.0		148.9	
		Z	7.03	66.4	18.9		115.6	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.51	67.5	21.8	9.21	114.2	±1.9 %
		Y	5.82	69.4	23.4		123.0	
		Z	6.49	70.6	23.6		140.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.83	67.1	21.4	9.24	136.6	±1.9 %
		Y	7.30	69.4	23.2		147.3	
		Z	7.36	68.1	22.0		117.5	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	7.26	67.5	21.6	9.30	142.7	±1.9 %
		Y	7.44	68.4	22.4		110.5	
		Z	7.84	68.7	22.2		122.6	
10274-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.86	66.2	18.2	4.87	135.4	±0.9 %
		Y	6.12	67.5	19.2		142.3	
		Z	5.91	65.9	18.2		107.6	
10275-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.17	64.8	17.3	3.96	115.6	±0.7 %
		Y	4.42	66.4	18.5		124.6	
		Z	4.47	66.0	18.0		132.6	
10291-AAA	CDMA2000, RC3, SO55, Full Rate	X	3.36	64.7	17.1	3.46	109.4	±0.5 %
		Y	3.55	66.2	18.3		118.2	
		Z	3.60	65.6	17.7		120.9	
10292-AAA	CDMA2000, RC3, SO32, Full Rate	X	3.34	64.9	17.2	3.39	110.1	±0.5 %
		Y	3.57	66.7	18.5		121.0	
		Z	3.54	65.6	17.7		123.9	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.14	65.8	18.6	5.81	125.1	±1.2 %
		Y	6.44	67.2	19.7		135.7	
		Z	6.52	67.0	19.3		142.2	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.76	66.6	19.1	6.06	131.8	±1.4 %
		Y	7.03	67.8	20.0		142.5	
		Z	7.15	67.7	19.7		148.6	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.42	64.6	16.1	1.71	116.8	±0.5 %
		Y	3.00	69.3	19.0		126.9	
		Z	2.61	66.3	17.2		128.2	
10317-AAA	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	9.71	67.6	20.5	8.36	111.7	±2.5 %
		Y	9.99	68.6	21.4		122.2	
		Z	10.38	68.9	21.3		129.5	

10400-AAA	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	9.83	67.8	20.6	8.37	112.9	±2.5 %
		Y	10.09	68.7	21.4		123.9	
		Z	10.48	68.9	21.3		130.5	
10402-AAA	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	10.61	68.3	20.7	8.53	121.1	±2.5 %
		Y	11.25	70.0	21.9		135.4	
		Z	11.15	69.4	21.4		137.4	
10403-AAA	CDMA2000 (1xEV-DO, Rev. 0)	X	4.51	67.4	17.8	3.76	119.2	±0.5 %
		Y	4.91	69.5	19.3		128.3	
		Z	4.84	67.5	18.1		135.4	
10404-AAA	CDMA2000 (1xEV-DO, Rev. A)	X	4.51	67.7	18.0	3.77	117.4	±0.5 %
		Y	4.92	69.8	19.5		125.4	
		Z	4.71	67.3	18.0		131.9	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 8 and 9).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3914

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	9.70	9.70	9.70	0.34	1.01	± 12.0 %
835	41.5	0.90	9.34	9.34	9.34	0.67	0.67	± 12.0 %
1750	40.1	1.37	7.99	7.99	7.99	0.79	0.56	± 12.0 %
1900	40.0	1.40	7.69	7.69	7.69	0.80	0.58	± 12.0 %
2450	39.2	1.80	6.95	6.95	6.95	0.41	0.77	± 12.0 %
2600	39.0	1.96	6.79	6.79	6.79	0.40	0.82	± 12.0 %
5200	36.0	4.66	4.99	4.99	4.99	0.30	1.80	± 13.1 %
5300	35.9	4.76	4.82	4.82	4.82	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.55	4.55	4.55	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.37	4.37	4.37	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.52	4.52	4.52	0.35	1.80	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3914

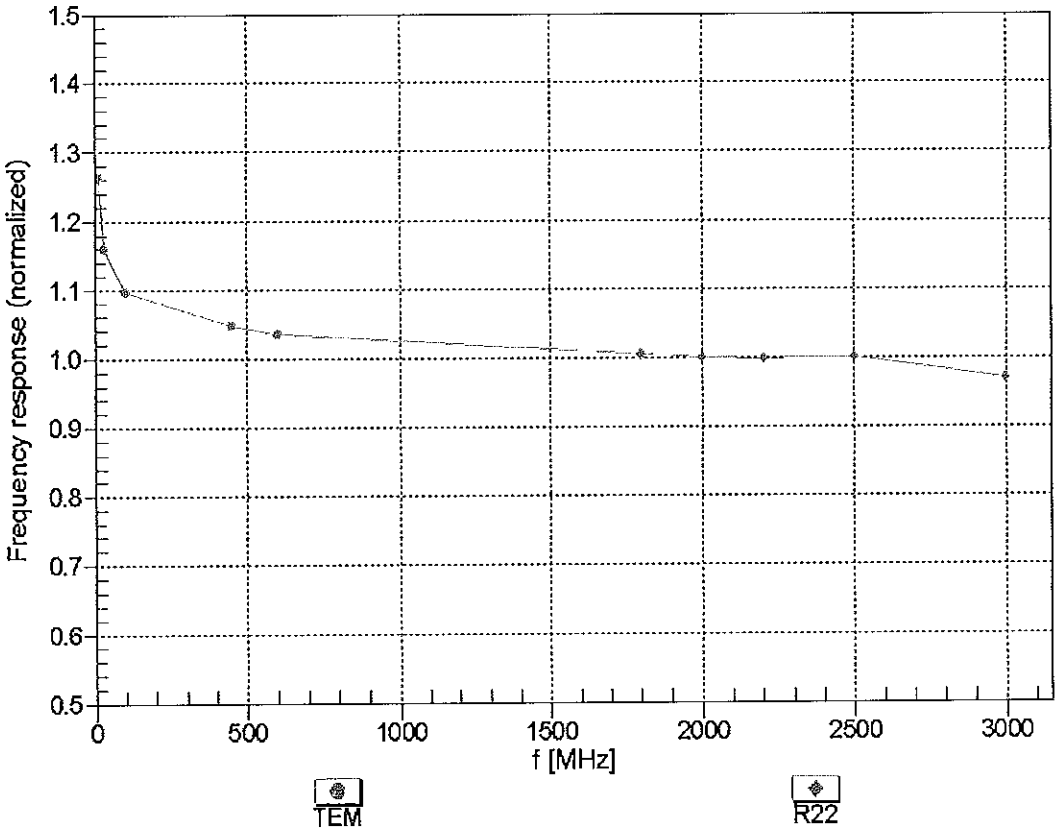
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	9.39	9.39	9.39	0.63	0.74	± 12.0 %
835	55.2	0.97	9.31	9.31	9.31	0.56	0.76	± 12.0 %
1750	53.4	1.49	7.89	7.89	7.89	0.32	1.03	± 12.0 %
1900	53.3	1.52	7.51	7.51	7.51	0.51	0.76	± 12.0 %
2450	52.7	1.95	7.02	7.02	7.02	0.80	0.50	± 12.0 %
2600	52.5	2.16	6.81	6.81	6.81	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.52	4.52	4.52	0.35	1.90	± 13.1 %
5300	48.9	5.42	4.32	4.32	4.32	0.35	1.90	± 13.1 %
5500	48.6	5.65	4.07	4.07	4.07	0.35	1.90	± 13.1 %
5600	48.5	5.77	3.97	3.97	3.97	0.35	1.90	± 13.1 %
5800	48.2	6.00	4.14	4.14	4.14	0.40	1.90	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

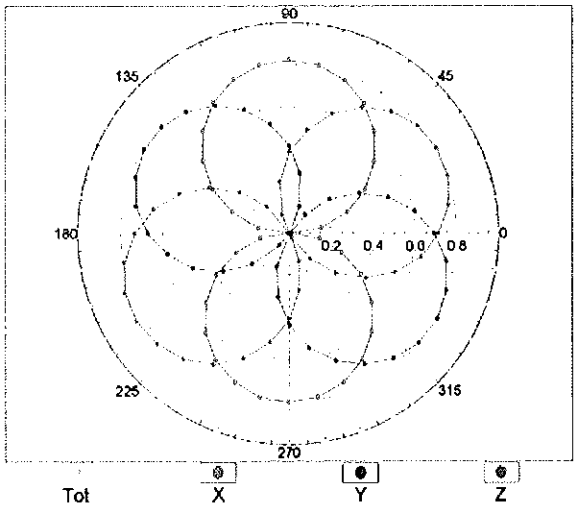
(TEM-Cell:ifi110 EXX, Waveguide: R22)



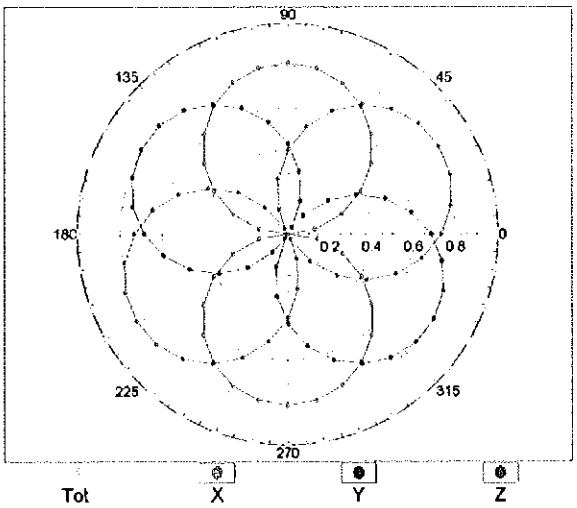
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

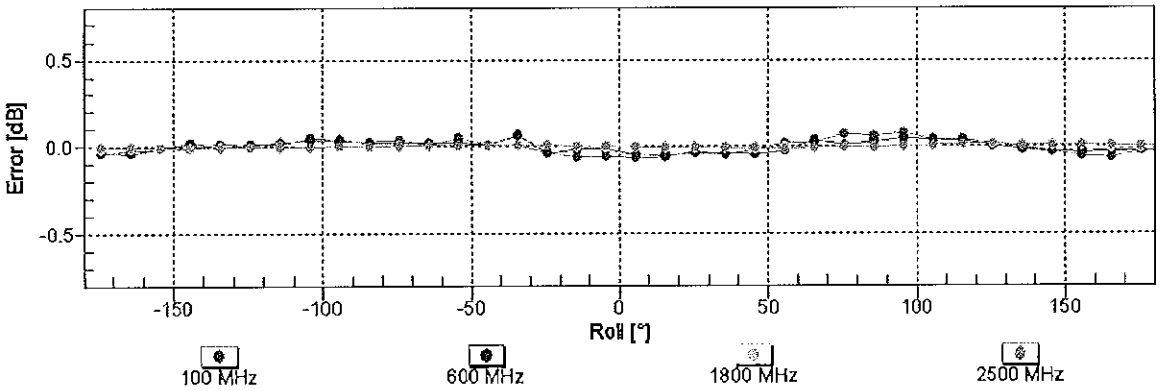
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



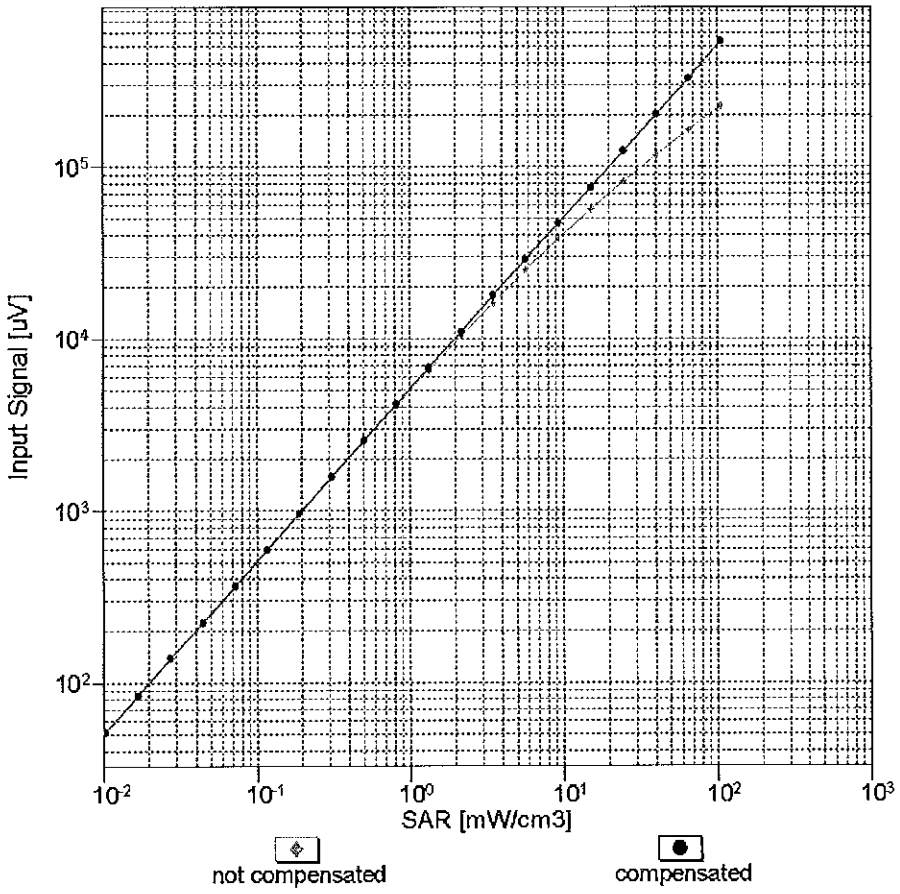
f=1800 MHz,R22

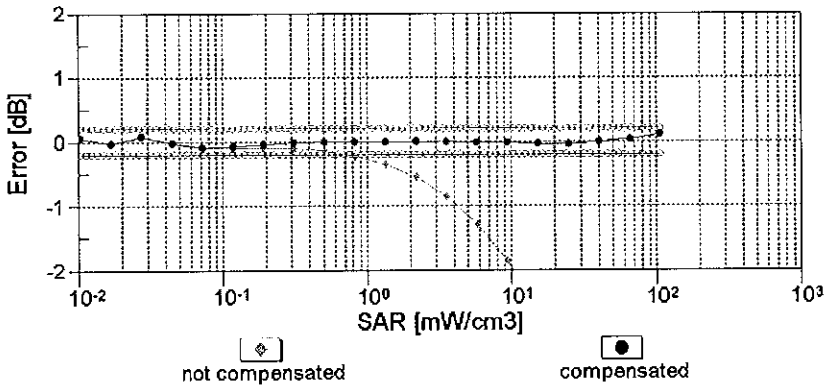




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

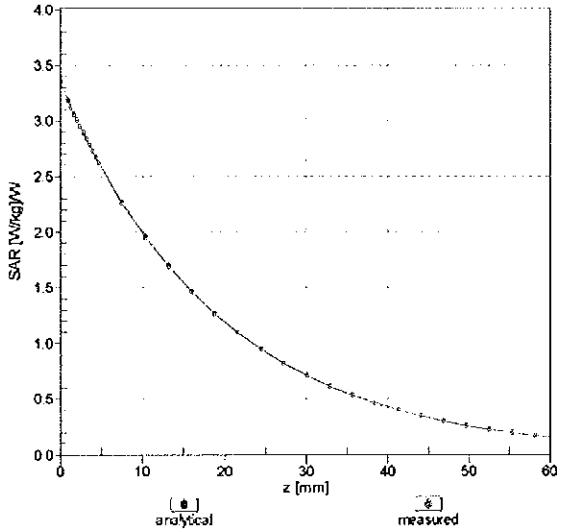




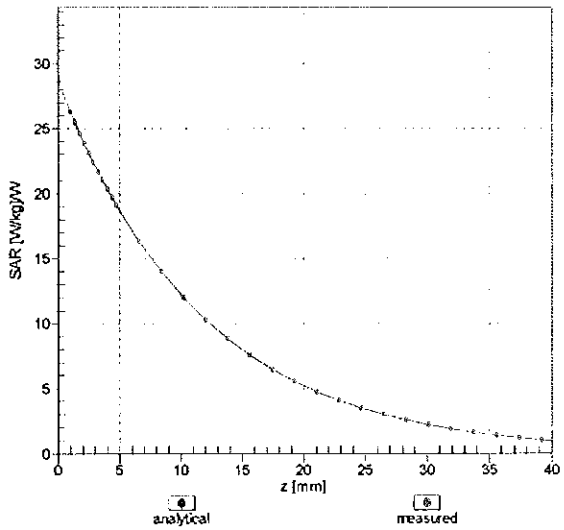
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

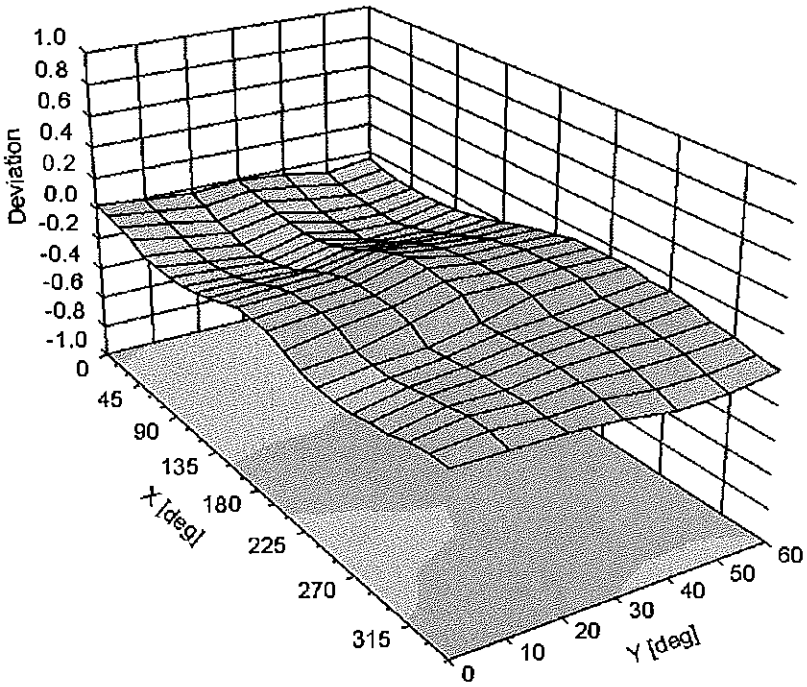


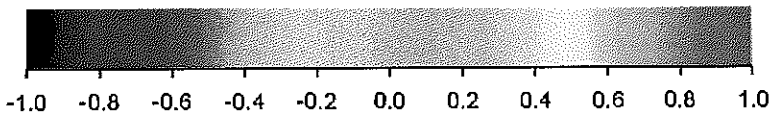
f = 1900 MHz,WGLS R22 (H_convF)



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: EX3DV4 - SN:3914

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-24.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 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 $\varepsilon_r^{'}$ can be calculated from the below equation (Pournaropoulos and Misra):

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

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)	835	1900	2450	5200-5800
Tissue	Body	Body	Body	Body
Ingredients (% by weight)				
Bactericide	0.1			
DGBE		29.44	26.7	
HEC	1			
NaCl	0.94	0.39	0.1	
Sucrose	44.9			
Polysorbate (Tween) 80				20
Water	53.06	70.17	73.2	80

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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 FCC KDB 865664 D01 v01 and IEEE 1528-2013. 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
K	835	12/19/2013	3333	ES3DV3	835	Body	1.006	53.18	PASS	PASS	PASS	GMSK	PASS	N/A
D	1900	9/10/2013	3022	ES3DV2	1900	Body	1.516	52.49	PASS	PASS	PASS	GMSK	PASS	N/A
G	2450	1/17/2014	3209	ES3DV3	2450	Body	2.041	50.74	PASS	PASS	PASS	OFDM	N/A	PASS
E	5200	12/7/2013	3914	EX3DV4	5200	Body	5.330	48.16	PASS	PASS	PASS	OFDM	N/A	PASS
E	5300	12/7/2013	3914	EX3DV4	5300	Body	5.481	47.91	PASS	PASS	PASS	OFDM	N/A	PASS
E	5500	12/7/2013	3914	EX3DV4	5500	Body	5.807	47.39	PASS	PASS	PASS	OFDM	N/A	PASS
E	5600	12/7/2013	3914	EX3DV4	5600	Body	5.933	47.15	PASS	PASS	PASS	OFDM	N/A	PASS
E	5800	12/7/2013	3914	EX3DV4	5800	Body	6.240	46.70	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both a CW and modulated signals, all measurements were performed using communication systems 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 for scenarios when CW probe calibrations are used with other signal types. 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

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APPENDIX G: SENSOR TRIGGERING DATA SUMMARY

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A3LSMT535 Sensor Triggering Data Summary

Per FCC KDB Publication 616217 D04v01, this device was tested by the manufacturer to determine the proximity sensor triggering distances for the back and left edge of the device. The measured output power within ± 5 mm of the triggering points (or until touching the phantom) is included for back side and each applicable edge.

To ensure all production units are compliant it is necessary to test SAR at a distance 1 mm less than the smallest distance from the device and SAR phantom (determined from these triggering tests according to the KDB 616217 D04v01) with the device at maximum output power without power reduction. These SAR Tests are included in addition to the SAR tests for the device touching the SAR phantom, with reduced power.

The operational description contains information explaining how this device remains complaint in the event of a sensor malfunction.

Back Side

Moving device toward the phantom:

KDB 616217 6.2.8 Measured Power [dBm]											
Distance[mm]	21	20	19	18	17	16	15	14	13	12	11
GSM850	32.41	32.39	32.38	32.42	32.4	27.52	27.51	27.54	27.55	27.53	27.55
GSM1900	29.76	29.73	29.75	29.76	29.74	19.45	19.46	19.43	19.44	19.46	19.47
GPRS850 1Tx	32.41	32.42	32.39	32.4	32.38	27.49	27.51	27.47	27.48	27.5	27.54
GPRS850 2Tx	30.51	30.5	30.49	30.46	30.44	25.43	25.45	25.4	25.41	25.44	25.45
GPRS850 3Tx	29.01	28.93	28.96	28.94	28.92	23.97	23.98	23.97	23.98	23.98	23.98
GPRS850 4Tx	27.51	27.49	27.5	27.53	27.51	22.45	22.41	22.41	22.42	22.46	22.48
GPRS1900 1Tx	29.76	29.75	29.74	29.78	29.76	19.5	19.48	19.48	19.49	19.51	19.52
GPRS1900 2Tx	28.73	28.71	28.74	28.7	28.68	18.4	18.38	18.38	18.39	18.41	18.41
GPRS1900 3Tx	26.76	26.72	26.74	26.78	26.76	16.31	16.28	16.33	16.34	16.32	16.32
GPRS1900 4Tx	25.71	25.73	25.72	25.69	25.67	15.36	15.34	15.38	15.39	15.37	15.39
WCDMA850	22.21	22.19	22.22	22.23	22.21	17.11	17.12	17.08	17.09	17.12	17.13
WCDMA1900	22.45	22.43	22.44	22.42	22.43	13.06	13.07	13.04	13.02	13.04	13.04
EDGE850 1Tx	26.93	26.91	26.92	26.95	26.96	21.93	21.91	21.9	21.88	21.91	21.93
EDGE850 2Tx	25.78	25.72	25.66	25.79	25.76	21.06	21.04	21.02	21	21.04	21.02
EDGE850 3Tx	25.01	24.97	25	25.03	25.02	19.87	19.84	19.85	19.83	19.85	19.85
EDGE850 4Tx	23.78	23.68	23.73	23.74	23.75	18.87	18.88	18.86	18.84	18.85	18.85
EDGE1900 1Tx	25.97	25.92	25.88	25.89	25.9	15.97	15.98	15.93	15.91	15.95	15.91
EDGE1900 2Tx	25.01	25.05	25.07	25.03	25.04	15.1	15.12	15.09	15.07	15.08	15.06
EDGE1900 3Tx	23.87	23.79	23.8	23.83	23.84	14.03	14.01	14	13.98	14.01	14.03
EDGE1900 4Tx	22.78	22.83	22.82	22.81	22.82	12.95	12.94	12.92	12.9	12.93	12.91
LTE B5	22.89	22.74	22.95	22.87	22.96	17.84	17.68	17.78	17.85	17.68	17.73

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Moving device away from the phantom:

KDB616217 6.2.4 Measured Power [dBm]																
Distance[mm]	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	9
GSM850	32.41	32.39	32.38	32.42	32.4	32.4	32.38	32.37	32.41	32.39	27.51	27.5	27.53	27.54	27.53	27.53
GSM1900	29.76	29.73	29.75	29.76	29.74	29.75	29.72	29.74	29.75	29.73	19.44	19.45	19.42	19.43	19.42	19.42
GPRS850 1Tx	32.41	32.42	32.39	32.4	32.38	32.4	32.41	32.38	32.39	32.37	27.48	27.5	27.46	27.47	27.45	27.45
GPRS850 2Tx	30.51	30.5	30.49	30.46	30.44	30.5	30.49	30.48	30.45	30.43	25.42	25.44	25.39	25.4	25.41	25.41
GPRS850 3Tx	29.01	28.93	28.96	28.94	28.92	29	28.92	28.95	28.93	28.91	23.96	23.97	23.96	23.97	23.93	23.93
GPRS850 4Tx	27.51	27.49	27.5	27.53	27.51	27.5	27.48	27.49	27.52	27.5	22.44	22.4	22.4	22.41	22.42	22.42
GPRS1900 1Tx	29.79	29.78	29.77	29.81	29.79	29.78	29.77	29.76	29.8	29.78	19.52	19.5	19.5	19.51	19.51	19.51
GPRS1900 2Tx	28.76	28.74	28.77	28.73	28.71	28.75	28.73	28.76	28.72	28.7	18.42	18.4	18.4	18.41	18.41	18.41
GPRS1900 3Tx	26.79	26.75	26.77	26.81	26.79	26.78	26.74	26.76	26.8	26.78	16.33	16.3	16.35	16.36	16.34	16.34
GPRS1900 4Tx	25.74	25.76	25.75	25.72	25.7	25.73	25.75	25.74	25.71	25.69	15.38	15.36	15.4	15.41	15.33	15.33
WCDMA850	22.24	22.22	22.25	22.26	22.24	22.23	22.21	22.24	22.25	22.23	17.13	17.14	17.1	17.11	17.12	17.12
WCDMA1900	22.48	22.46	22.47	22.45	22.46	22.47	22.45	22.46	22.44	22.45	13.08	13.09	13.06	13.04	13.01	13.01
EDGE850 1Tx	26.92	26.9	26.91	26.94	26.95	26.91	26.89	26.9	26.93	26.94	21.91	21.89	21.88	21.86	21.82	21.82
EDGE850 2Tx	25.76	25.68	25.72	25.77	25.71	25.74	25.7	25.63	25.72	25.78	21.04	21.02	21	20.98	21.01	21.01
EDGE850 3Tx	25.02	24.99	24.97	25.03	25.07	25	24.98	24.99	25.03	25.05	19.85	19.82	19.83	19.81	19.82	19.82
EDGE850 4Tx	23.77	23.67	23.72	23.73	23.74	23.76	23.66	23.71	23.72	23.73	18.85	18.86	18.84	18.82	18.81	18.81
EDGE1900 1Tx	25.96	25.91	25.87	25.88	25.89	25.95	25.9	25.86	25.87	25.88	15.95	15.96	15.91	15.89	15.91	15.91
EDGE1900 2Tx	25	25.04	25.06	25.02	25.03	24.99	25.03	25.05	25.01	25.02	15.08	15.1	15.07	15.05	15.02	15.02
EDGE1900 3Tx	23.86	23.78	23.79	23.82	23.83	23.85	23.77	23.78	23.81	23.82	14.01	13.99	13.98	13.96	13.95	13.95
EDGE1900 4Tx	22.77	22.82	22.81	22.8	22.81	22.76	22.81	22.8	22.79	22.8	12.93	12.92	12.9	12.88	12.92	12.92
LTE B5	22.88	22.76	22.84	22.75	22.90	22.74	22.76	22.84	22.76	22.86	17.84	17.74	17.59	17.78	17.69	17.66

Based on the most conservative measured triggering distance of 16 mm, additional SAR measurements were required at 15 mm from the back side.

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Top Edge

Moving device toward the phantom:

KDB 616217 6.2.8 Measured Power [dBm]											
Distance[mm]	22	21	20	19	18	17	16	15	14	13	12
GSM850	32.42	32.4	32.39	32.43	32.41	27.53	27.52	27.55	27.56	27.54	27.56
GSM1900	29.77	29.74	29.76	29.77	29.75	19.46	19.47	19.44	19.45	19.47	19.49
GPRS850 1Tx	32.42	32.43	32.4	32.41	32.39	27.5	27.52	27.48	27.49	27.51	27.52
GPRS850 2Tx	30.52	30.51	30.5	30.47	30.45	25.44	25.46	25.41	25.42	25.45	25.47
GPRS850 3Tx	29.02	28.94	28.97	28.95	28.93	23.98	23.99	23.98	23.99	23.99	23.97
GPRS850 4Tx	27.52	27.5	27.51	27.54	27.52	22.46	22.42	22.42	22.43	22.47	22.45
GPRS1900 1Tx	29.77	29.76	29.75	29.79	29.77	19.51	19.49	19.49	19.5	19.52	19.51
GPRS1900 2Tx	28.74	28.72	28.75	28.71	28.69	18.41	18.39	18.39	18.4	18.42	18.41
GPRS1900 3Tx	26.77	26.73	26.75	26.79	26.77	16.32	16.29	16.34	16.35	16.33	16.3
GPRS1900 4Tx	25.72	25.74	25.73	25.7	25.68	15.37	15.35	15.39	15.4	15.38	15.43
WCDMA850	22.22	22.2	22.23	22.24	22.22	17.12	17.13	17.09	17.1	17.13	17.17
WCDMA1900	22.46	22.44	22.45	22.43	22.44	13.07	13.08	13.05	13.03	13.05	13.08
EDGE850 1Tx	26.96	26.92	26.93	26.96	26.97	21.94	21.92	21.91	21.89	21.92	21.94
EDGE850 2Tx	25.72	25.78	25.76	25.71	25.68	21.07	21.05	21.03	21.01	21.05	21.08
EDGE850 3Tx	25.01	24.98	25.03	25.08	25.02	19.88	19.85	19.86	19.84	19.86	19.88
EDGE850 4Tx	23.79	23.69	23.74	23.75	23.76	18.88	18.89	18.87	18.85	18.86	18.89
EDGE1900 1Tx	25.98	25.93	25.89	25.9	25.91	15.98	15.99	15.94	15.92	15.96	15.97
EDGE1900 2Tx	25.02	25.06	25.08	25.04	25.05	15.11	15.13	15.1	15.08	15.09	15.1
EDGE1900 3Tx	23.88	23.8	23.81	23.84	23.85	14.04	14.02	14.01	13.99	14.02	14.04
EDGE1900 4Tx	22.79	22.84	22.83	22.82	22.83	12.96	12.95	12.93	12.91	12.94	12.94
LTE B5	22.87	22.89	22.78	22.74	22.84	17.85	17.79	17.84	17.87	17.95	17.58

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Moving device away from the phantom:

KDB616217 6.2.4 Measured Power [dBm]																		
Distance[mm]	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	10	7	4
GSM850	32.42	32.4	32.39	32.43	32.41	32.41	32.39	32.38	32.42	32.4	27.52	27.51	27.54	27.55	27.53	27.53	27.54	27.52
GSM1900	29.77	29.74	29.76	29.77	29.75	29.76	29.73	29.75	29.76	29.74	19.45	19.46	19.43	19.44	19.46	19.42	19.43	19.45
GPRS850 1Tx	32.42	32.43	32.4	32.41	32.39	32.41	32.42	32.39	32.4	32.38	27.49	27.51	27.47	27.48	27.5	27.46	27.47	27.49
GPRS850 2Tx	30.52	30.51	30.5	30.47	30.45	30.51	30.5	30.49	30.46	30.44	25.43	25.45	25.4	25.41	25.44	25.39	25.4	25.43
GPRS850 3Tx	29.02	28.94	28.97	28.95	28.93	29.01	28.93	28.96	28.94	28.92	23.97	23.98	23.97	23.98	23.98	23.96	23.97	23.97
GPRS850 4Tx	27.52	27.5	27.51	27.54	27.52	27.51	27.49	27.5	27.53	27.51	22.56	22.45	22.48	22.52	23.49	22.4	22.52	22.48
GPRS1900 1Tx	29.8	29.79	29.78	29.82	29.8	29.79	29.78	29.77	29.81	29.79	19.53	19.51	19.51	19.52	19.54	19.5	19.51	19.53
GPRS1900 2Tx	28.77	28.75	28.78	28.74	28.72	28.76	28.74	28.77	28.73	28.71	18.43	18.41	18.41	18.42	18.44	18.4	18.41	18.43
GPRS1900 3Tx	26.8	26.76	26.78	26.82	26.8	26.79	26.75	26.77	26.81	26.79	16.34	16.31	16.36	16.37	16.35	16.35	16.36	16.34
GPRS1900 4Tx	25.75	25.77	25.76	25.73	25.71	25.74	25.76	25.75	25.72	25.7	15.39	15.37	15.41	15.42	15.4	15.4	15.41	15.39
WCDMA850	22.25	22.23	22.26	22.27	22.25	22.24	22.22	22.25	22.26	22.24	17.14	17.15	17.11	17.12	17.15	17.1	17.11	17.14
WCDMA1900	22.49	22.47	22.48	22.46	22.47	22.48	22.46	22.47	22.45	22.46	13.09	13.1	13.07	13.05	13.07	13.06	13.04	13.06
EDGE850 1Tx	26.93	26.91	26.92	26.95	26.96	26.92	26.9	26.91	26.94	26.95	21.92	21.9	21.89	21.87	21.9	21.88	21.86	21.89
EDGE850 2Tx	25.81	25.74	25.79	25.75	25.76	25.79	25.71	25.68	25.74	25.75	21.05	21.03	21.01	20.99	21.03	21	20.98	21.02
EDGE850 3Tx	25.01	24.99	25.02	25.01	25.02	25.07	24.99	24.99	25.02	25.01	19.86	19.83	19.84	19.82	19.84	19.83	19.81	19.83
EDGE850 4Tx	23.78	23.68	23.73	23.74	23.75	23.77	23.67	23.72	23.73	23.74	18.86	18.87	18.85	18.83	18.84	18.84	18.82	18.83
EDGE1900 1Tx	25.97	25.92	25.88	25.89	25.9	25.96	25.91	25.87	25.88	25.89	15.96	15.97	15.92	15.9	15.94	15.91	15.89	15.93
EDGE1900 2Tx	25.01	25.05	25.07	25.03	25.04	25	25.04	25.06	25.02	25.03	15.09	15.11	15.08	15.06	15.07	15.07	15.05	15.06
EDGE1900 3Tx	23.87	23.79	23.8	23.83	23.84	23.86	23.78	23.79	23.82	23.83	14.02	14	13.99	13.97	14	13.98	13.96	13.99
EDGE1900 4Tx	22.78	22.83	22.82	22.81	22.82	22.77	22.82	22.81	22.8	22.81	12.94	12.93	12.91	12.89	12.92	12.9	12.88	12.91
LTE B5	22.91	22.89	22.79	22.84	22.86	22.87	22.78	22.83	22.81	22.73	17.84	17.75	17.81	17.88	17.73	17.92	17.64	17.59

Based on the most conservative measured triggering distance of 17 mm, additional SAR measurements were required at 16 mm from the top edge.

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